THE

BOTANICAL GAZETTE

EDITORS:

JOHN M. COULTER, Wabash College, Crawfordsville, Ind.
CHARLES R BARNES, Purdue University, Lafayette, Ind.
J. C. ARTHUR, N. Y. Agric. Exp. Sta., Geneva, N. Y.

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BOTANICAL GAZETTE.

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Asa Gray.

BY CHARLES R. BARNES.

(WITH PLATE A.)

It is neither suitable nor necessary that the GAZETTE should eulogize him. All the world knows that he is the most eminent American botanist, all botanists know why he is thus *facile princeps*, and all who have enjoyed personal intercourse with him know how unassumingly he bears his well-merited honors, and how gentle and genial is his whole life and character. Assuming that the incidents in the life of a great man are of interest to his disciples and co-workers, the GAZETTE accompanies the portrait of the man with this brief sketch of his life.

Asa Gray was born in Sauquoit, Paris township, Oneida Co., N. Y., on the 18th of November, 1810. His father had been apprenticed to a tanner and currier and must have been still working at the trade when this eldest child was born, for the little house which was his home stood on the tannery premises, and had formerly been used as a shoe shop. When the boy was a few years old his parents removed to Paris Furnace—a small settlement about a smelting furnace which long ago disappeared—where his father established a tannery. Here the monotonous occupation of feeding the bark-mill and driving the old horse that turned it was assigned to the child.

His schooling began at the age of *three* years, and at six or seven he was a champion speller in the numerous "matches" that enlivened the district school. Later, he attended, for a year or two, a "select" school taught at Sauquoit by the village pastor's son, and at twelve or thereabouts he was sent to the Clinton Grammar School. Here he stayed two years. His summer vacations were spent in the hay or corn-fields, for his father had begun to buy up the land cleared by the Furnace Co. for charcoal, and to turn his attention to farming. After leaving the Clinton school he went, in October, 1825, to the academy at Fairfield, Herkimer Co., seven miles north of Little Falls, where he remained a year. His father, who thought an investment in land better than one in a collegiate education for his son, persuaded him to begin at once the study of medicine. He therefore entered the "Medical College of the Western District" (located at Fairfield) in the autumn of 1826, whose courses of lectures in chemistry he had attended the year before while at the academy. The annual sessions were very short.

In the spring and summer of 1827 he studied with Dr. Priest, of Sauquoit, returning to the medical school in autumn. In that winter, 1827–8, he chanced to read the article *Botany* in Brewster's Edinburgh Encyclopædia. He was greatly interested, bought Eaton's Manual and read its pages eagerly, longing for spring. He sallied forth early, discovered a plant in bloom, brought it home and found its name in the Manual to be *Claytonia Virginica*, the species *Caroliniana* to which the plant really belonged, not being distinguished then. In the same spring he became a pupil of Dr. John F. Trowbridge, of Bridgewater, with whom he stayed three years, except during the annual sessions of the medical college. In the frequent rides about the country to visit patients he had abundant facilities for observing and collecting plants, and, besides studying out their names, he began a herbarium. In the autumn, when he returned to the medical school, he took with him a bundle of specimens which had puzzled him, hoping to get assistance from Professor Hadley. He studied Prof. Hadley's small herbarium during the winter, and by his advice opened correspondence with Dr. Lewis C. Beck, of Albany.

These botanical studies continued to occupy his leisure. In the summer of 1829 he collected largely, and in the summer of 1830 went to New York to buy medical books for Dr. Trowbridge. He took with him a package of undetermined plants and a letter of introduction to Dr. Torrey, but was disappointed by not seeing him. He left the plants, however, and in the winter received a letter from Dr. Torrey naming them, the first letter of a correspondence which lasted until Dr. Torrey's death, in 1873. Young Gray's medical course was closing. He had attended four annual courses of lectures, besides the work with his preceptors, had passed the examinations, and in the spring of 1831, six or seven months before he passed his 21st birthday, he received the degree of M. D.

In the latter part of May and June he delivered his first course of lectures on botany, Dr. Beck, who had been lecturing previously, having given up the engagement. With the money thus earned, he made a collecting tour through western New York, going as far as Buffalo and Niagara Falls. About this time he received an appointment as teacher of chemistry, botany, geology and mineralogy in a private school for boys in Utica, controlled by a Mr. Bartlett. His first summer vacation was spent in a trip through southern New York, Pennsylvania and New Jersey, collecting plants, fossils and minerals. At Bethlehem he spent a day with Bishop Schweinitz. Arriving in New York City, in September, he met Dr. Torrey for the first time, and went with him on a collecting trip to Tom's River, N. J.

During the next summer he was employed by Dr. Torrey to collect in the "pine barrens" of New Jersey, and the regions about Little Egg Harbor, Wading River and Quaker Bridge were scoured by him. On one of his excursions he fell in with an entomologist who proved to be Major Le Conte. Many of the plants which he collected in this locality came into possession o B. D. Greene, and are to be met with in various herbaria labeled "Coll. Greene." The winter was spent at the Bartlett school, but the spring saw him on another collecting tour along the Black river. During the summer he gave a course of lectures on mineralogy and botany at Hamilton College, Clinton, N. Y., for Professor Hadley.

In the autumn he got a furlough from the Bartlett school in order that he might be Dr. Torrey's assistant in chemistry in the medical school at New York. During this winter, 1834–5 (?), he lived with Dr. Torrey, and worked all the spare time in his herbarium. At this time he issued the first century of "Gramineæ and Cyperaceæ of North America." In December, 1834, he read his first paper before the New York Lyceum of Natural History, entitled: "A Monograph of N. Am. Rhynchosporæ," and a second one, "A notice of some new, rare or otherwise interesting plants from the northern and western portions of the State of N. Y." In February or March he returned to his school work at Utica, but the summer again found him collecting plants and minerals in northeastern New York. An account of the minerals then collected forms his first contribution to the American Journal of Science.

He expected to return to New York in the fall, as Dr. Torrey's assistant, and to this end had resigned his position in the Bartlett school. But the autumn brought a letter from Dr. Torrey saying that the prospects of the school were so poor that he could not afford to employ him. Nevertheless he went to New York, assisted Torrey as he had opportunity, and issued the second century of "Gramineæ."

In the summer of 1835 he returned to his father's home with some books received from Dr. Lehmann, of Hamburg, in exchange for plants. In this summer he planned and partly wrote his "Elements of Botany," and when he returned to New York in the autumn, arranged for its publication. It appeared in May, 1836. In the fall of this year he was appointed curator of the collections of the New York Lyceum of Natural History, and in its new building he made his home. There he wrote two papers: "Remarks on the structure and affinities of the Ceratophyllaceæ" and "Melanthacearum Am. Sept. Revisio," both of which were published in 1837. As the duties of his curatorship were light, and he had time on his hands, Gray took hold of the work of making a preliminary revision of some of the orders for the Flora of North America, which had been planned by Torrey. He was at this time awaiting the sailing of the exploring expedition to the South Pacific, to which he had been appointed botanist in the summer of 1836. The departure was long delayed. When the "Wilkes Expedition" finally sailed it was with a smaller fleet and a reduced staff. In the meantime (1838) Dr. Gray was elected professor of Natural History in the just-organized University of Michigan, and when the staff of the Wilkes expedition was to be diminished he resigned in favor of the assistant botanist, Wm. Rich.

As in the year or more in which he had been working at it, Dr. Gray had accomplished so much work, Dr. Torrey invited him to become joint author of the Flora of North America. In July, 1838, the first part, and in October, 1838, the second part of this work was issued. Having gotten so far, it was necessary to consult the American collections in European herbaria. Dr. Gray therefore asked a year's leave of absence from the University of Michigan, that he might go to Europe. This was granted, and a considerable sum of money was placed in his hands by the trustees to be expended in purchasing books for the infant University.

He sailed in November, 1838, and went at once to Glasgow, where he was the guest of Dr. W. J. Hooker. In England he consulted various public and private herbaria, and met Arnott, Greville, Graham, Balfour, Boott, Bentham, Robert Brown, Bennett, Lambert, Lindley, Bauer, Ward, Menzies and others. In March, 1839, he crossed to the continent and made an extensive tour of the principal points of interest, keeping in mind always the chief object of his visit. In Paris he met Mirbel, Adrien Jussieu, Brongniart, Decaisne, Spach, A. Richard, Montague, Gaudichaud, Delessert, Jacques Gay and Boissier; at Lyons, Seringe; at Montpelier, Delile and Dunal; at Vienna, Endlicher and Fenzl; at Munich, Martius and Zuccarini; at Geneva, the De Candolles and Reuter; at Halle, Schlechtendal; at Berlin, Klotzsch, Kunth, Link and Ehrenberg; and at Hamburg, his early correspondent, Lehmann. His letters to Dr. Torrey, which contain a complete account of his journey and doings, are still in existence.

When he returned, late in 1839, he found matters at Michigan University still in a somewhat chaotic condition, and the trustees were willing to extend his furlough. Accordingly he began earnest work on the Flora, and parts 3 and 4 were issued in June, 1840, and in the following spring the first 184 pages of vol. ii appeared.[1] In the summer of 1841 he collected in the valley of Virginia, going as far south as Grandfather and Roan Mts. in North Carolina. In January, 1842, he made his first visit to Boston, as the guest of B. D. Greene. While there he made the acquaintance of President Quincy of Harvard College, and in April the Fisher Professorship of Natural History was tendered him. This he accepted, and went to Cambridge in July. This position he holds to the present time.

At Cambridge he devoted his time to the reorganization of the botanic garden and the necessary instruction of students, giving whatever time he could command to continued study of the voluminous and important collections which poured in from all sides, especially from the government surveys of new territory and the assiduous work of individual collectors. The results of this study, of the highest importance, are embodied in various memoirs in different publications. This embarrassment of riches caused the suspension of the Flora of North America.

About the time he went to Cambridge appeared the first edition of the Botanical Text-book, of which the second volume of the *sixth* edition has just been issued. In 1848 he began the publication of the "Genera Illustrata", of which the second volume was published in 1849. In 1848 the first edition of the "Manual" appeared. When the Wilkes Expedition returned, all its material was put into his hands. The report on these collections forms a large quarto volume with an atlas of one hundred royal folio plates. It is not possible, however, to enumerate even the most important of his writings since 1842. They are scattered through the American Journal of Science (of which he

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[1] Pages 185–400 were issued in the spring of 1842, and the remainder of vol. ii in February, 1843.

became associate editor in 1853), the Annals of the N. Y. Lyceum of Natural History, the Memoirs and Proceedings of the American Academy, Hooker's Journal of Botany, the Journal of the Linnæan Society, the Smithsonian Contributions to Knowledge, the North American Review, the Bulletin of the Torrey Botanical Club, the American Naturalist, and the BOTANICAL GAZETTE.

Every one is familiar with the text-books, passing through many editions, which have made his name a household word, and which fully demonstrate that scientific truths can be popularized without being distorted or transformed into errors. Many learned societies of this country and Europe have honored themselves and him by electing him to membership and to offices of honor. For over *fifty years* he has been a member of the oldest natural history society in Europe, Academia Cæs. Leopoldino-Carolinæ Naturæ Curiosorum, from which he received, on the fiftieth anniversary of his election, a letter of congratulation.

In 1864, his offer to Harvard University of the immense and priceless herbarium which he had accumulated, on condition that a fire-proof building be erected to contain it, was accepted and the herbarium building put up. The special library attached to the herbarium, consisting of nearly 5,000 volumes, and over 3,000 pamphlets, is very largely due to his generosity.

Since 1873, at which time he retired from the work of instruction, he has devoted himself assiduously to the preparation of the Synoptical Flora of North America, a work which will represent, when complete, the greater part of the labor of a lifetime. No more earnest wish can be uttered by the American botanists whom he has served so long than that his unabated vigor may continue until he has finished this masterpiece of scholarly learning and critical acumen.

Birthday Congratulations.

UNIVERSITY OF MICHIGAN,
SECRETARY'S OFFICE, ANN ARBOR, November 16, 1885.

Professor Asa Gray, M. D., LL. D., Cambridge, Mass.:

MY DEAR SIR:

The Senate of the University of Michigan wish, as a body, to be represented among the many friends who will join in paying their respects to you on your approaching seventy-fifth birthday, and to that end has adopted a congratulatory address, of which I have the honor, as Secretary of the University Senate, herewith to transmit to you a copy.

At the same time, allow me to recall the privilege I had, more than a quarter of a century ago, of sitting under your instruction, and personally to extend to you my most cordial greetings and congratulations. Very respectfully yours,

W. H. PETTEE.

[Congratulatory Address, adopted by the Senate of the University of Michigan, November 9, 1885.]

To Professor Asa Gray, M. D., LL. D.:

The Senate of the University of Michigan, mindful of the approach of the seventy-fifth anniversary of your birth, take great pleasure in sending you their greetings on the occasion. We congratulate you that life and health and usefulness have been prolonged till three-quarters of a century have passed over your head. We entertain the hope that many years of activity yet remain.

With our congratulations we beg to give expression to a lively sentiment of gratitude for services rendered to your chosen science during a long and devoted life. You found the science of botany barred by a hedge of technicalities against the approach of the common student. You have made it the delight and inspiration of the youth of the land. You have subjected the science of botany in its *higher* departments to lucid and masterly exposition. Many of the comprehensive and critical reviews of the American flora have proceeded from your pen. The botanical pages of the *American Journal of Science* reveal labors sufficient in volume and value to fill and honor a lifetime. And those labors are yours. We hail you as the Nestor of American botany. Few of us there are who do not feel gratefully proud to testify our personal obligations to you for aid and inspiration in our earlier studies; and none of us fail to appreciate the services and honor which you have rendered to education and cultivated scholarship. We recall the catholic spirit and breadth of view with which you have treated questions of the interpretation and philosophy of science. We thank you for your acute but just and conservative criticisms and estimates of the doctrine of evolution through natural selection, at a time when the doctrine was new and rising into overshadowing importance which filled many honest minds with apprehension. We thank you again for stepping to the defense of fundamental religious truth through the power of the very philosophy which so many thought sent into the world to destroy religion. But for all that you have done we do not release you from service. We expect you to serve yet many years the cause of education and sacred truth; and we expect to concede you the highest honors of all for the labors which, we trust, are to adorn the last quarter of your century.

With us the pleasure of these congratulations is quite peculiar, since we can hail you as an ex-professor in our University. Your memory readily reverts to the crude infancy of this institution, when your name was chosen to stand first in its list of professors. You recall your actual participation in the labors of our early organizers; and we trust that while your recognized gifts of mind and heart found early employment in a broader field than was offered in Michigan, you have never ceased to entertain an interest in the University which you aided to inaugurate, and have some personal satisfaction in seeing the slender shoot of 1838 grown to the dimensions of the sturdy oak of 1885.

Accept, Respected Sir,
Our Kind Remembrance
And Our Cordial Greeting.

DR. GRAY'S REPLY.

CAMBRIDGE, MASS., November 20, 1885.

Prof. W. H. Pettee, Secretary of the Senate of the University of Michigan:

DEAR SIR:

I can not well say how deeply I was touched and gratified by the Congratulatory Address from the Senate of your University, which I found on my table on the morning of my seventy-fifth birthday, accompanied by your official and friendly note. I was particularly impressed with the breadth of its survey of the labors of my life, and with the discriminating reference to some of them which would escape ordinary notice. I beg you to convey to the Senate my grateful acknowledgement of the very kind notice thus taken of my endeavors. I recognize, moreover, the fitness of its intimation that I should make the most of the few years that may perhaps remain. I am happy to be able to declare that my appetite for work is as yet unabated; also that labor is still attended with joy rather than with the *sorrow* which the Psalmist contemplates.

I am much pleased that, although a deserter from the ranks before the war began, I am generously recognized as an ex-professor of the University of Michigan. I suppose that the only direct service I ever rendered it was that of getting together, when in Europe in 1838–9, the books which were the small foundation of its library. I well remember the gratified feeling with which, long afterwards, I incidentally heard that the first President of the University, on viewing this slender collection, expressed the opinion that the books had been well selected for the purpose.

I have never ceased to be particularly interested in the University in which I expected to pass my life. I regret that circumstances have hitherto almost wholly prevented me from personally verifying the impressions which I have received of the amplitude of its appliances for the higher education and of the worthy and efficient use that is made of them. I am, indeed, glad that I have lived to see the acorn which was planted in my youth develop into "the long-surviving oak," vigorous and beneficent in its youth, and rich in the promise of future years. May its leaf never wither nor its fruitage fail.

Please convey to the Senate my heartiest thanks for such "kind remembrance and cordial greetings," and believe me to be

Very truly yours, ASA GRAY.

LINES

On Dr. Asa Gray's Seventy-fifth Birthday, November 18, 1885.

Oft times it haps the singer's voice is dumb
When most is needed eloquence of song;
And oft the heart, though stirred by passions strong,
Can make no sign, nor will fit language come
The depth of its affection to make known:
So is it with myself. I fain would pay
Some tribute worthy one whose wealth is shown
In kindnesses to others—ASA GRAY!
But my full heart refuses to express
Its affluence of love. I can but raise
A feeble voice and wish him happiness
On this birthday, when friends have come to praise
His virtues and his works. To such as he
There cometh certain immortality!

GEORGE E. DAVENPORT.

TO A. G.

On his Seventy-fifth Birthday.

Just Fate, prolong his life well-spent
Whose indefatigable hours
Have been as gaily innocent
And fragrant as his flowers!

November 18, 1885. JAMES RUSSELL LOWELL.

TO DR. ASA GRAY.

November 18th, 1810–1885.

Over the earth is reachless, living light
In flaming marvels that defy the sight;
Under the earth are brilliant things, but dead;
Who toil among them are disquieted.
The world of green
That moves between—
With sweets and colors, flowering turf and height—
Comes close with health and beauty as with bread,
Touches us fondly, foot and hand and head,
Till we are glad and healed as well as fed.
The child, the feeble, and the lusty man,
Each finds a mother in the green earth's plan.

Thou who art wise with searching all her looks,
And givest ages wisdom through thy books;
The secrets of her breath are in thy hold—
In years and science only art thou old.
The flowers' faces
Have sent such graces
Into thine own, as bless their native nooks.
Ferns, grasses, ancient trees of mighty mould
Whose mazy roots run deep, whose aim is bold,
Their varied forces in thy life have told;
For, while intent on flower or tree or sod,
Thy soul's full eye hath been upturned to God.

CHARLOTTE FISKE BATES.

The Pollen-spore of Tradescantia Virginica L.

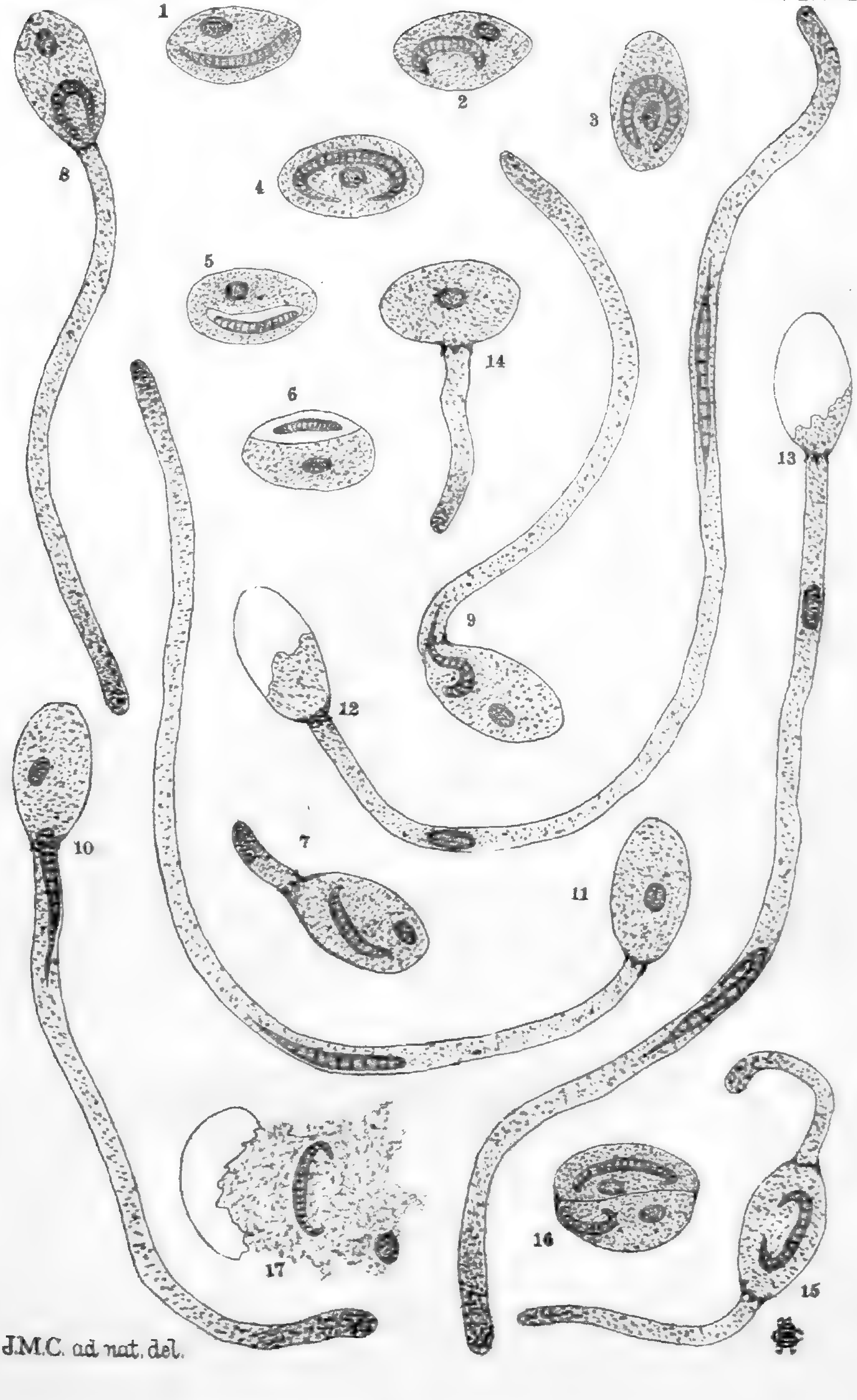
BY JOHN M. COULTER AND J. N. ROSE.

(WITH PLATE I.)

The pollen-spores of Tradescantia Virginica are exceptionally favorable for study. With the simplest appliances, and with few staining reagents, both nuclei can be demonstrated, the development of the pollen-tube can be watched, and the descent of the nuclei plainly followed. We have not been able to consult Hartig's paper,[1] in which is recorded the original discovery of two nuclei in pollen-spores, among which he includes those of Tradescantia, but the general facts pertaining to the subject are well presented in the works of Strasburger and Sachs, and recently summarized in this country by Goodale. In fact, to Strasburger is due most of our knowledge of this interesting subject, his latest views being presented in the first part of his *Neue Un-*

[1] Karsten's Botan. Untersuch. iii. 1866.

PLATE I.



COULTER & ROSE ON TRADESCANTIA.

tersuchungen,[2] published in 1884. The only original paper upon the subject published in this country is that of Barnes on Campanula Americana.[3]

All these authors agree in their testimony as to the difficulty of performing this work, and so the demonstration of these recondite, but very important, facts has been left entirely to trained investigators. Knowing that the pollen-spores of monocotyledons were much more favorable for study than those of dicotyledons, which are certainly too difficult for ordinary observers, and desiring to discover some plant in which these almost inaccessible facts could be seen with comparative ease, the pollen-spores of Tradescantia were selected. The result was so signally successful, and the methods were so repeatedly tested, that we present them in this paper.

The simplest kind of moist chamber was prepared, such as is described by Bower and Vines,[4] and Goodale.[5] Two pieces of heavy blotting paper were cut the size of a glass slide, and a hole cut through the middle of them just large enough to allow a cover-slip to rest upon the edge all around. The slips of blotting paper were then saturated with water and placed upon a glass slide. A saturated solution of cane sugar was prepared, and a drop placed upon a cover-slip upon which pollen-spores had been sown. The cover-slip was then inverted, and placed over the hole cut in the blotters, and the pollen-spores were thus ready to germinate in a hanging drop of sugar solution, in a chamber in which evaporation was impossible. The blotters being kept moistened, the culture was continued as long as desirable. It is always preferable to place the pollen-spores upon the cover-slip before the drop of sugar solution, as otherwise they are apt either to remain out of reach of the objective, or to send their tubes directly towards it, thus giving end views instead of profiles. The best results were obtained with pollen-spores from flowers that had been open for some time, such seeming to respond more readily. A power of 250 diameters was constantly used in the work, though the figures of the plate are drawn larger (460 diameters) for the purpose of securing clearness of detail. The spores are elliptical in optical section, and the extine is so thin and so free from the customary markings of pollen-spores that the details of the interior can be easily seen. In a few min-

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[2] For review see Bot. Gazette, x. 328.

[3] Bot. Gazette, x. 349.

[4] Practical Botany, p. 16.

[5] Physiological Botany, p. 430.

utes, at most five or ten, the spores swelled up sufficiently to show their contents, and usually the two nuclei became plainly visible. Figures 1–4 show some of their most common positions. In the nomenclature of these nuclei we use that of Strasburger in his *Neue Untersuchungen*, followed by Barnes in the paper already referred to, and exactly the opposite of that of Strasburger in his *Botanisches Practicum*, and Sachs in his Text-book.[6] The generative nucleus is a thick, worm-like filament, tapering at both ends, and always more or less coiled. Its appearance is exactly that figured by Bernimoulin in his studies[7] in the division of the nucleus in the pollen-spore mother-cells of the same species. The vegetative nucleus is round or oval, of much smaller size, and some of its positions with reference to the generative nucleus are shown in figures 1–4. In some cases, as in figure 4, the generative nucleus is seen almost to encircle the contents of the pollen-spore. In figures 5 and 6 is seen the small cell cut off from the larger one, containing the generative nucleus, and forming the generative cell. The generative nucleus always lies against the intine wall, and its apparent central position in some cases, as in figures 1 and 3, is explained by the fact that it is lying against the upper or lower wall in the figure. The wall which cuts off the generative cell seems to be simply an ectoplasmic layer of protoplasm,[8] and not in any case cellulose. That this layer is often difficult to demonstrate seems to be due both to the fact that the generative nucleus almost entirely fills its cell, and that it is so transparent that only an exceptional position will bring it into view.

Usually within fifteen minutes, or at most half an hour, the pollen-tube can be seen developing from the larger or vegetative cell. It breaks through the extine at one end of the spore, and the broken edges of the extine can be seen turning back from the emerging tube, figure 7. The generative nucleus retains its position until the pollen-tube is of considerable length, when it can be seen shifting its position towards the side of the pollen-spore from which the tube is developing (figure 8). The streaming movement of the protoplasm, which carries the nuclei into the tube, was not demonstrated other than by the changes of position in the nuclei themselves. The fact that the nucleus of the vegetative (large) cell invariably remains towards the further end of the spore until the generative nucleus passes into the tube, seems

[6] Second English edit., p. 554.

[7] Note sur la Division des Noyaux dans le Tradescantia Virginica. Bull. Soc. Roy. bot. Belgique, t. xxiii.

[8] Sachs' Text-book, 2d English ed., p. 583.

to be contrary to the usual order.[9] In entering the tube the curved generative nucleus usually straightens, or may remain curved at the posterior end. Its course, as seen, can be traced in figures 9, 10, 11, etc., the coiled posterior end being brought into view in figure 13. Owing to the size of the generative nucleus it was hoped that its division could be demonstrated, but such was not the case. Although in some instances it was suspected, it was not clear enough to be certain.

After the generative nucleus had entered the tube, the nucleus of the vegetative cell seemed to be carried forwards, and when the former had proceeded some distance down the tube, the latter was swept into it, and followed along at considerable interval (figures 10, 11, 12, 13). The vegetative nucleus retained its structure perfectly as far as we were able to trace it in the cultures.

The nuclei in the spores could always be demonstrated after a short immersion in the sugar solution, without the use of a staining fluid, but of course were brought out much more distinctly by it. The nuclei in the pollen-tubes, however, were never seen, with certainty, without staining. The method employed was as follows: A drop each of magenta solution and ordinary acetic acid was placed upon a slide, the cover-slip with hanging drop of sugar solution containing the developing pollen-tubes was let down into it, and then, after a moment or two, glycerine was run under.[10] In this way the nuclei in the tubes receive a dark stain, while the intine is left colorless. Of course there are other and better methods and stains, but our object was to use only such reagents as could be obtained at any drug store. Crushing a stained pollen-spore resulted as shown in figure 17, by which method the shape and structure of the nuclei can easily be studied. It should be said that in many cases both nuclei were not visible, as is represented in figures 14 and 15, although this fact should not be connected with the spores that are exceptional in other respects. In many instances a tube began to develop from each end of the pollen-spore, as shown in figure 15, but one was usually stronger than the other. Quite frequently a pollen-tube developed from one side instead of the end, as represented in figure 14. These two cases would seem to indicate more than one point of emergence, contrary to the general rule among monocotyledons.[11]

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[9] Sachs, Text-book, 2d English ed., p. 583; also Strasburger, Neue Untersuchungen, p. 15.

[10] Or the magenta and acetic acid were added directly to the culture drop, allowed to stand a moment, and then inverted and mounted in a drop of glycerine.

[11] Sachs, Text-book, 2d English ed., p. 555.

In rare cases pairs of spores that had not completely separated were seen, but evidently mature, as in each one the two nuclei were demonstrable (figure 16). Sometimes, in strong and rapidly developing tubes which had attained considerable length, the intine of the pollen-spore seemed to be pulled away from the extine, or as though it had fallen in or was pushed in by external pressure which the more rigid extine resisted, as shown in figures 12 and 13, and finally became knotted up at the tube end of the spore.

In conclusion, then, the results intended to be presented in this paper are:

1. That in Tradescantia Virginica, by using the simplest appliances, and in a very brief time, the two nuclei of the pollen-spore, and their descent into the pollen-tube, can be demonstrated.

2. That in this species the generative nucleus is a large worm-like spindle, and precedes the vegetative nucleus into the pollen-tube.

A New Larval Entomophthora.

BY J. C. ARTHUR.

(WITH PLATE II.)

The clover-leaf weevil, *Phytonomus punctatus* Fabr., is a comparatively new insect in this country. It was first brought to public notice in 1881[1] as very destructive to clover in Yates county, N. Y. It has now extended considerably, being abundant at Buffalo, and in the adjacent part of Canada, and is also reported from Indiana. It is supposed to have been introduced from Europe, where it is common, but looked upon as innoxious.

In last of May and first of June of this year, the larvæ were found in a clover field at Geneva, N. Y., dying in vast numbers of some parasitic fungus. Again, in October and November, they appeared in the same manner over a large lawn. At the latter date as full a study of the fungus was made as limited time would permit. It proves to be an undescribed species of Entomophthora, and may be characterized as follows:

Entomophthora Phytonomi (n. sp.)—Mycelium abundant, branched, non-septate, colorless, 9–12μ in diameter, on the ventral surface of the insect growing out in form of rhizoids to act as holdfasts; hymenium over the whole surface except the head, 35–45μ deep; conidiophores branched at the base, as thick as the mycelium; spores oblong, colorless, 24–28μ long by 7–10μ thick. Resting spores not seen.

In the larvæ of *Phytonomus punctatus* Fabr. Geneva, N. Y., May—June and October—November, 1885.

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[1] Riley, Amer. Nat., xv, p. 751; Rep. U. S. Dep't Agric., 1881-2, p. 172; Lintner, First Ann. Rep. Insects of N. Y., p. 252.

The habit of the larvæ is to feed during the night and remain concealed during the daytime, but when attacked by the fungus they crawl as high as possible before daylight, coil around the edge of the object, usually horizontally (figure 1), and do not again descend. Until ten o'clock in the morning most of them are still able to crawl about when disturbed, but are sluggish. By noon the insect dies, and the rhizoids fasten it firmly to the support. Some hours afterwards the normal yellowish or pea-green color is changed to a dull gray by the appearance of the hymenium. The spores are produced late in the afternoon, and during the night they are discharged; by morning only a small shriveled and blackened mass remains, while the objects beneath are powdered with the colorless and evanescent spores. If the dead insect be placed on a pane of glass over night, the body will be surrounded in the morning by a halo of spores nearly two centimeters in diameter. When the atmosphere is damp enough during the night, the mycelium grows out over the whole body as a white pubescence. This is the usual course of development.

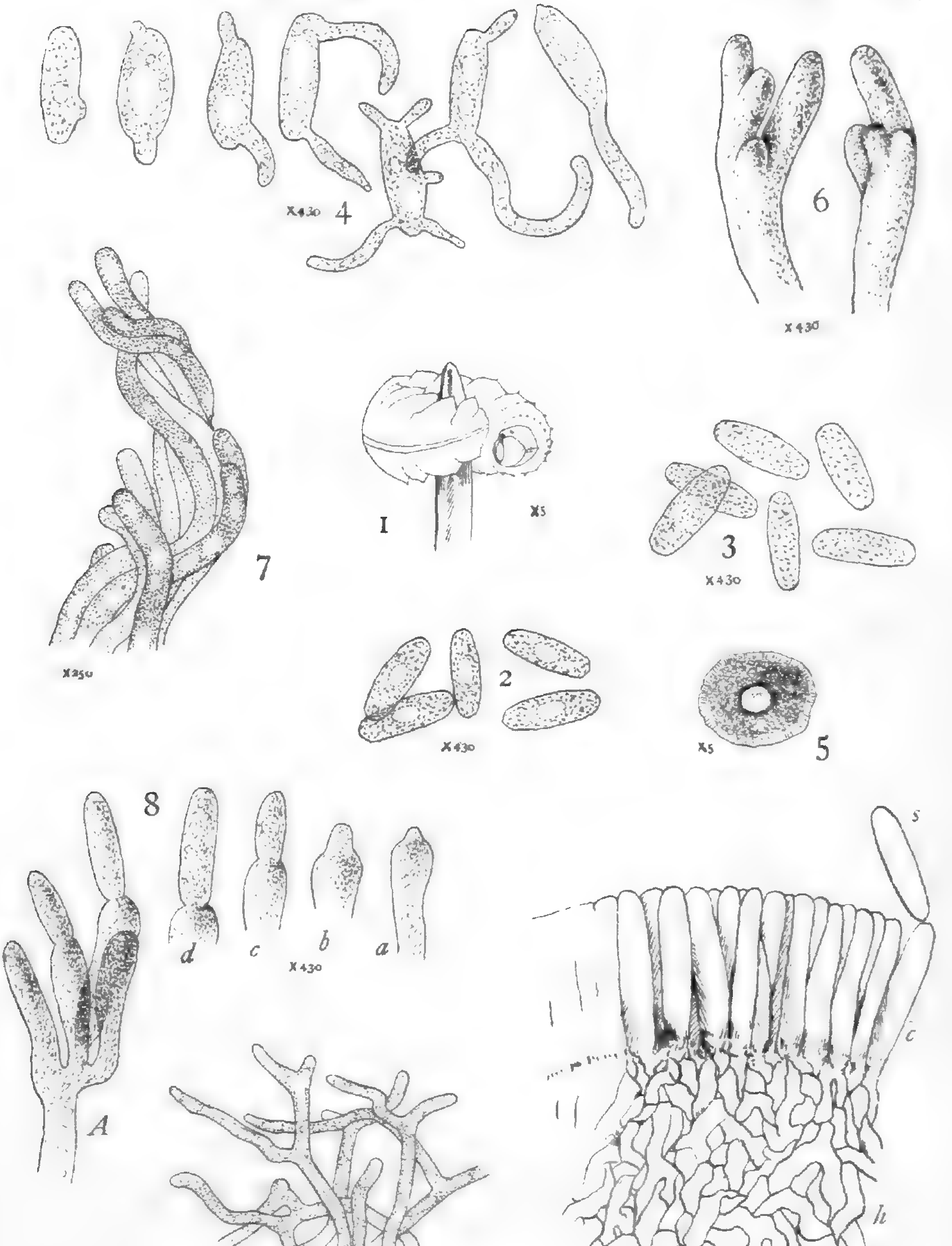
A larva dissected an hour or two before its death shows a mass of interlacing hyphæ (figure 9) among the muscles which line the outer wall of the body; the viscera are still unaffected. The hyphæ are quite uniform in size, with finely granular contents and vacuoles of various sizes, and are extensively branched. As the mycelium grows it encroaches upon the internal organs, and eventually fills up the whole cavity of the body, except that it does not enter the alimentary tract or the tracheæ. The internal organs, except the two just named, together with the fluids of the body are entirely consumed by the fungus. The larva when now cut across presents a firm interior traversed by the cavity of the alimentary tract (figure 5). In some cases, however, certain bacteria, and occasionally yeast, have become so abundant before this stage is reached that the tissues are converted into a slate-colored liquid, and the growth of the fungus is checked.

The rhizoids appear before the hymenium is formed, but whether before the insect is dead or not was not determined; nor was it ascertained on just what portions of the ventral surface they occur. They will extend a full millimeter in length when the insect is removed from the supporting object and placed in a damp atmosphere. They consist of straight colorless hyphæ, with walls much distorted and ends somewhat flattened.

The hymenium, which surrounds the whole body, presents a uniform thickness when not grown in a very moist atmosphere (figure 11). The conidiophores branch at their base (figures 6 and 8), and each bears a spore, formed by abstriction (figure 8). I was unable to see, either in fresh or alcoholic preparations, any partition wall between the conidiophores and the hyphæ from which they arise, but do not feel entirely convinced in regard to the matter, as I found it difficult to separate them well, owing to the compact interlocking of the branches. Swollen hyphæ with granular contents (figure 10) were a few times seen among the conidiophores, but they could hardly have been paraphyses. No sterile hyphæ projected beyond the hymenium under ordinary circumstances. When the dead larvæ are placed in a damp atmosphere over night, the mycelium grows out a millimeter or so beyond the surface of the body in straight or somewhat coiled hyphæ (figure 7); these do not appear to be elongated conidiophores, or true paraphyses, but a luxuriant growth of the mycelium.

The spores are very regular and uniform in size (figure 3). When mature they are projected from the body of the larva, as in the common house-fly fungus, and like those adhere to whatever they touch. Spores gathered in May and kept dry till November measured, when examined in water, a little less than fresh ones, 21–27μ by 6–8μ, had one end slightly pointed, and exhibited a central non-granular spot (figure 2). Fresh spores are uniformly granular, and both ends are the same shape. They germinate in water in two to six hours by pushing out one to several tubes which grow irregularly and to indefinite length (figure 4). The protoplasm is filled with vacuoles, but does not all collect at the advancing ends of the hyphæ nor are there septa formed as in the closely related *E. sphærosperma* Fres. Their behavior when germinated in moist air was not observed. Spores kept upon glass in the laboratory gave but a small per cent. of germinations after five days.

This fungus is intimately related to *E. sphærosperma* Fres. (*E. radicans* Brefeld), the habit of growth being the same so far as investigated, but differs in ultimate shape of spores, septation of hyphæ, the various measurements, etc. Although observed as late as Nov. 20, when cold weather set in, no mummified larvæ containing resting spores were found. This could hardly have been because they were overlooked, for the sick larvæ are conspicuous by their position, and up to the date mentioned were dying by thousands. The disease appears to extend readily into an epidemic of economic importance; whether it could be propagated at will is yet to be determined by experiment.



ARTHUR ON ENTOMOPHTHORA, N. SP.

Explanation of Plate II.—Structure and development of Entomophthora Phytonomi: Fig. 1, the position of larva of Phytonomus punctatus at tip of a blade of grass when sick with Entomophthora. × 5. Fig. 2, spores examined in water from a dry specimen gathered nearly six months before. × 430. Fig. 3, spores a few hours after maturity. × 430. Fig. 4, successive stages of germination of spores sown in water on a glass slide. × 430. Fig. 5, thin transverse section of larva showing the body cavity uniformly filled with mycelium, a peripheral border of hymenium and the alimentary tract at center empty except a little undigested food. × 5. Fig. 6, two hyphæ at an early stage in the development of the conidiophores. × 430. Fig. 7, a coil of hyphæ from the pubescence on larvæ in damp atmosphere. × 250. Fig. 8, *A*, hyphæ bearing four conidiophores, *a b c d*, successive stages in the formation of a spore. × 430. Fig. 9, mycelium from among the muscles at an early stage of the disease. × 150. Fig. 10, swollen ends of hyphæ, filled with granular protoplasm and without vacuoles. × 430. Fig. 11, hymenium *c*, and subjacent mycelium *h*; the spores have all been detached, *s* single mature spore; drawn from an alcohol specimen. × 430.

BRIEFER ARTICLES.

Anemone nudicaulis, n. sp.—I wish to direct the attention of any of our botanists, who may next summer be visiting Lake Superior, to a singular Anemone which grows in bogs and on banks near the water at Sand Bay, Minnesota, very near lat. 48°, and in or near the Canadian boundary. All I know of it is from a specimen sent to me in a letter, dated August 8, 1870, from Mr. Joseph C. Jones, then of the U. S. Steamer *Search*. He wrote that the plant was found growing in mossy ground, close to the water's edge, and also in the bogs, and that it grows in the manner of Coptis trifolia. I believe it has filiform root stocks, like those of Anemone Richardsoni, and the radical leaves are so like those of that species that I inadvertently mistook the plant for that species. But the involucre consists of a single petiolate leaf, very like the radical, or else is wholly wanting. And the akenes are tipped with rather short and hooked styles, very unlike the long ones of the aforesaid Arctic species. A flowering specimen is a desideratum.—Asa Gray.

Dispersion of some tree seeds.—About twenty-five rods to the northwest of my foot-path on the lawn, there are two large white birch trees, still holding fruit of the last summer. Along the depressions of foot-steps and the mark of an occasional sleigh in the snow may be seen large numbers of birch seeds, looking as though some one had scattered bran on the snow. Most likely many other seeds went further, as there was fair sailing beyond.

For some years past I have often observed the distribution of the winged fruits of the tulip-tree, of which there are several on our lawns. In autumn part of the fruits drop off, falling near the tree, but even in the grass and weeds every wind tosses them a little further on. Before snow came this year there were certainly many of them ten rods from the nearest bearing tree. When the snow comes others are torn from the trees and may often be seen for a quarter of a mile going before the wind on the snow, which may be only very slightly packed. I have known persons who stoutly maintained, from experiments made, that the wings of the fruit of the tulip-tree amounted to little, because they did not carry the fruit through the air like a miniature balloon.

The nuts of the basswood have also frequently been seen drifting on the snow before the wind, aided by the decurrent bract which is attached in such a way that the fruit cluster is not likely to remain flat on the snow or on the ground.

Numerous other examples could be cited, but we shall leave the rest of them for some of the sharp students who are studying botany in winter.—W. J. BEAL, *Agricultural College, Mich.*

EDITORIAL.

WITH THIS INITIAL NUMBER of a new decade before us, it is impossible not to think of the change since a single naked sheet made its appearance a little more than ten years ago and announced its desire to become the organ of botanists. It was projected by one whose determination to make it succeed was unfailing, and so through troubles of all kinds the GAZETTE made its way. Desirable articles came in slowly, subscriptions still more slowly, and advertisements not at all, the constant financial loss being set over against a constantly increasing experience. At last botanists thought the struggle had been long enough to show vitality, and articles and subscriptions began to come in more rapidly, until the GAZETTE has entered upon its second decade with the hearty good will and substantial support of American botanists. The numerous letters of warm congratulation attest the fact of the very strong place the GAZETTE has made for itself, and it hardly needs to be said that its editors will spare no labor in trying to make it still more indispensable. In these days of numerous ephemeral periodicals it is both a strange and a creditable thing that the GAZETTE has survived, and it helps to emphasize the fact of the growing interest and vigor in botanical studies. The history of this journal can be taken as an index of botanical activity, and this country is to be congratulated that its botanists are so thoroughly aroused and energetic that the GAZETTE can enter upon its second decade with such enlarged space and aspirations. There can be no doubt but that the coming decade will witness unusual botanical activity in this country, many young men, strong, well-trained, and well-equipped, having entered the field. The GAZETTE proposes to stimulate, to assist, to record this activity, and no honest worker need fear that his work will be lost. And so this journal, strengthened by the struggles and successes of ten years, faces its second decade with the marks of undoubted success, and as it deserves, so will it expect the hearty support of every American botanist.

A LITTLE REFLECTION will show that the recent sale in New York city of orchids belonging to the Morgan estate, at which single plants brought from one to nine hundred dollars each, has some relation to the progress of botanical science. In this age any science is stimulated into increased activity by its objects becoming of commercial value. In the domain of electrical and mechanical sciences the importance of their applications has had a reciprocal influence upon the further development of them as pure sciences; plenty of illustrations to the same end might be taken from chemistry, mineralogy, zoology and other departments of learning. A case, analogous in some respects to that under consideration, is the wholesome growth of veterinary science in this country during the last few years, a progress to be traced in some degree to the great increase of thorough-bred and valuable stock whose owners demand the services of skillful and learned practitioners. The increased cultivation of rare and costly plants must in a similar way lead to a demand for additional knowledge in regard to various physiological, pathological and even structural matters which have a bearing upon their growth and well-being. The important question of timber in this country has led to the admirable botanical work of Professor Sargent in connection with the tenth census; in Germany, where the necessity of forestry knowledge has been still more keenly felt, much attention has been devoted to the diseases of trees, involving a careful investigation of the life histories of a number of species of fungi. Thus in many ways which the reader will have no difficulty in calling to mind does the market value of a class of objects have an indirect influence upon the recondite investigations which underlie the applications of science. One element in making this influence real and effective, however, is a readiness on the part of those holding commercial interests to accept scientific facts and to encourage their discovery. In agriculture, horticulture, floriculture, etc., it is unfortunately true that there is great backwardness in seizing and applying scientific results and methods, which hinders the advancement of those professions and at the same time fails to afford a needed stimulus to new investigations regarding plants and kindred subjects. Still there is hope of better things for the future; the fashion for orchids, roses, chrysanthemums, or other flowers, may not now mean much to the botanist, and yet in so far as any influence is really exerted upon botanical science it is beneficial.

It so happens that one of the editors has been using for reference both the dispensatories alluded to by "*R.*" in an "open letter." The opinion expressed by him is amply borne out by our experience. The descriptive terms of botany are carelessly used and distinctions which are important are entirely overlooked. Of course it is to be remembered that the dispensatories are not written for botanists, but for pharmacists and physicians, and this fact necessitates the use of somewhat less technical language. It is, however, a point to be insisted upon, that the absence of technicality ought not to mean inaccuracy. One of the volumes referred to is especially negligent in the matter of quoting authorities for the scientific names of plants. This frequently renders the identification of the plant named quite impossible. So many changes are constantly being made in the nomenclature that it is not to be expected that such works as these should keep up with them, though an attempt should be made to use the best established names. But in the midst of such changes and for the reason that the names are changeable, the least that can be done is to quote the authority for whatever name is used. When the next revision of these two very useful books is made, by all means let the editors use every endeavor to have the botanical portions as complete, exact and reliable as possible. At present they are neither exact nor reliable, though the latest editions are markedly better than former ones.

The cutting up of published exsiccatæ and distribution of the specimens in the general herbarium is advocated by Professor Bessey in the *American Naturalist* for December, and the method has much to commend it. This brings all the specimens of a group together and makes their examination simple and easy. The saving of time and patience may be well illustrated by an attempt to find a particular specimen in the unindexed and voluminous collections of von Thümen for example, which, unless much time is taken, may lead to no other result than doubt whether it occurs there or not. Uniform treatment of this kind has been generally adopted in the large phanerogamic herbaria of the country, and it seems to us could well be extended to the cryptogamic collections—in fact that there should be, when possible, but a single series in each herbarium, ranging from the protophyte to the highest angiosperm.

The day is not far distant, we believe, when phanerogamic botanists will do as zoologists, bryologists and mycologists are now doing in quoting authorities for plant names, *i. e.*, cite not only the name of him who combines the generic and specific names, but also the one who first distinguished the plant and assigned to it a specific name. The burden of synonymy is growing greater day by day.

The General Index to the first ten volumes has been somewhat delayed in its preparation, but will soon be ready.

OPEN LETTERS.

Seeds wanted.

Professor Schübeler, of Christiania, Norway, whose works upon the history of cultivated plants and the changes that have occurred in the distribution of indigenous vegetation are so well known, greatly desires fresh seeds of our Indian rice, Hydropyrum esculentum, or Zizania aquatica. If any of our western botanists can supply them they will much oblige him, and also the subscriber,

Asa Gray.

The Dispensatories.

I have had occasion to consult extensively the latest editions of the National and U. S. Dispensatories, and am much surprised at the looseness there found in the use of botanical terms and the frequent inaccuracy of the botanical information (?) there given. Surely, in works of such prominence and importance the very best botanical talent ought to be employed to contribute this portion, as has apparently been done in the chemical, pharmaceutical, and therapeutic parts. Perhaps a word from the Gazette would be of influence upon the next editions of these books. R.

A Phallus.

If the reply be within the scope of the Gazette, I should be very glad to know if there be any means of extirpating from the soil the spores of a most offensive Phallus. I do not know the species, but for a day or two before they appear above the ground the odor of carrion prevails, and as soon as visible, they are covered with large flies. They grow on a shady (but not damp) bank, in a poor loamy soil, and follow one another in most annoying succession. If any application to the ground can destroy them I should be greatly obliged for information. MARTHA BOCKÉE FLINT.

The Agricultural Department.

I was very much interested at Ann Arbor, last August, in two things connected with this department, viz: the action of the botanists with reference to making the national herbarium what it ought to be, and the hearty encouragement given to the new work under the charge of Prof. Scribner. I take this means of asking, either the editors of the GAZETTE, or the officers of the Agricultural Department, what has been the result of the action in these two cases? I know of many botanists ready to assist in both these directions if they can obtain the necessary information. S. N. T.

CURRENT LITERATURE.

Manipulation of the Microscope. By Edward Bausch. Bausch & Lomb Optical Co. Rochester, 1885. 12°. 96 pp. Illust.

The author has attempted, in this little work, to describe the parts of a microscope and their uses in such a clear and concise manner that the beginner, confronted for the first time with a new microscope, may have no difficulty in becoming acquainted with his instrument. We have no hesitancy in saying the object has been admirably accomplished; the language is lucid and simple, the treatment is brief, and yet all essential points have been covered, and the typography, form and cheapness of the work (50 cts.) are commendable.

As the author is a manufacturing microscopist, it is natural to anticipate a strong personal bias, and the reader will therefore be pleased to note that the firm's name occurs but twice in the work, and that it is as free from any advertising dodge as could well be. On the other hand, there is a decided advantage in the author being a well known manufacturer, as one is never at a loss for a concrete conception of the kind of instrument to which the remarks are specially applicable. The chapters of the work are devoted to the simple microscope, compound microscope, objectives and eye-pieces, requisites for work, how to work, advanced manipulation, sub-stage illumination, care of a microscope and considerations in testing objectives.

We commend the work to all who use a microscope, especially those who do not feel themselves full masters of the instrument, and it would also be excellent to put into the hands of the laboratory student at the beginning of his course.

Thirty-eighth Annual Report of the N. Y. State Museum of Natural History: Report of the Botanist. By Charles H. Peck. Albany, 1885. 8 vo. pp. 77–138. 3 plates.

This report is for 1884. It is gratifying to note that hereafter the reports of the Museum staff are to be printed under their immediate supervision, and as soon as ready. The work of the botanist which has been partially interrupted for two years through political interference, has been fully resumed, and the result is seen in the description of sixty-six new species in the present report, including a curious fungus on flies, assigned to a new genus, Appendicularia. A monograph of the New York species of Lactarius and Pluteus is also given, containing forty and nine species respectively. Mr. Peck says very truly that "a descriptive manual of our hymenomycetous fungi is greatly needed," and we think he is just the person to write it. But if this is too great an undertaking at present, why not bring out a monograph of the New York species with colored plates, to be printed in the Museum series of quarto volumes; it would be of great scientific value, and of lasting credit to its author.

For the information of those who may not be aware of the fact we will state that the 32d report of the botanist, which was never distributed, may be found in Assembly Document 89 for 1879, vol. 6.

A Synopsis of the Bacteria and Yeast Fungi and allied species. By W. B. Grove, B. A. Chatto and Windus. London, 1884. 12°. 112 pp. 87 illustrations.

The account of these two classes of plants given by Winter in the last edition of Rabenhorst's *Kryptogamen Flora von Deutschland*, etc., has furnished the basis for several English works, and none more serviceable than the one in hand. Somewhat over half the book is practically a translation from that work, with notes by the translator, and some additional species, principally from Van Tieghem, Burrill, Kock and Hausen. Additional cuts are also introduced from various sources, of which the most interesting are those from Dallinger showing flagella. A chapter is given to forms which are inadequately known, or whose true bacterial nature is undecided, with such as could not be placed in the previous classification. These embrace over forty names from Zopf, Lankester, Lister, Thin, Engelmann, Warming, Van Tieghem, Klein, Ehrenberg and many others.

This, in the present unsatisfactory state of knowledge regarding these minute organisms, provides a very useful manual, giving good descriptions and illustrations, and indicating to some extent the synonymy and literature. The cuts are numerous and clear, but in many instances have lost in the reproduction much of the nicety of outline that gives individuality to the organism.

An interesting feature of the work is the chapter on classification in which the progress of classification is traced and the systems given that have been proposed at various times. The views that are more or less opposed to the classification of bacteria by Cohn are stated briefly but clearly and impartially. They are by Lister, Lankester, Cienkowski, Nägeli, Haberkorn, Neelsen and others, but especially by Zopf. The views of the latter on pleomorphism and its dangers are discussed, closing with a statement of the true nature of species among the schizophytes. In regard to the rank of the yeast plants considerable space is given to the hypothesis of Brefeld, who considers them to be a conidial stage of other fungi, probably of the smuts.

Appendices give information regarding the unit of micro-measurement, staining of Bacillus tuberculosis, and diseases produced by schizophytes. A full index completes the work.

The excellent appearance of the work and no less excellent contents should bring it into the hands of many workers.

NOTES AND NEWS.

DR. FRANZ, Baron Ungern-Sternberg, known as monographer of the Salicorniæ, died in Turin, Italy, August 12, 1885.

AN APPARATUS to demonstrate before classes or large audiences the manner in which the cambium gives rise to wood and bast, has been devised by Dr. F. Noll, of Heidelberg, and is highly spoken of by Professor Sachs.

DR. WINTER, of Leipsig, and C. H. Demetrio, of St. Louis, publish, in *Hedwigia* a list of 350 species of various kinds of fungi collected in Missouri. Twenty-five new species are described, including six of Septoria and eight of Cercospora.

SIR JOSEPH D. HOOKER, after twenty years' service, resigned the Directorship of the

Kew Gardens on November 30. Being relieved of administrative duties he will have more time for the more important systematic work which he has on hands.

THE JOURNAL OF MYCOLOGY closes its first year with an expression of satisfaction at its reception and success, and promise of more varied contents, articles for beginners, and biological sketches of eminent mycologists for the coming year.

VERY CONSIDERABLE ATTENTION is devoted to hybrid forms of common wild plants in Sweden, judging from the frequent descriptions of named sorts in the *Botaniska Notiser.* They are species, some well known in this country as weeds, of such genera as Epilobium, Rosa, Primula, Rumex, etc.

COOKE'S PROVISIONAL LIST of the British sphæropsideæ, publishing in *Grevillea,* reaches in the December issue to No. 478, having just entered the genus Septoria. The *Synopsis Pyrenomycetum,* begun in June, 1884, now reaches No. 2134. Only a few of these numbers are accompanied by descriptions.

THE DRUGS AND MEDICINES of North America, published in Cincinnati, is a far more important serial to non-medical botanists than its name would indicate. Its matter is original and fresh, and to a considerable degree strictly botanical; it includes synonymy, literature, description, distribution presented by maps, and minute anatomy, after which comes the medical portion. Even the latter need not be left entirely to the physician. It is printed on excellent paper and the illustrations are copious and admirably executed.

A PRIZE of 500 francs ($100) is offered for the best unpublished monograph on a class or amily of plants, the award to be made in October, 1889. It may be written in English, and is to be sent to the *Société de Physique et d'Histoire Naturelle,* Geneva, Switzerland. The prize was founded by A. P. De Candolle. It would be a matter of just pride if some really valuable memoirs were presented by American botanists for this, and also for the Walker prize in plant embryology, which is announced in our advertising columns.

F. EMICH has made extended researches upon the self-purification of natural waters, (detailed in *Biedermann's Centralblatt für Agrikultur Chemie*) and finds that direct oxidation from the air does not occur and that ozone and peroxide of hydrogen play but a feeble part, if any. When exposed to air or agitated with it, purification does not take place if the water has been sterilized by boiling or germs are in any way excluded. The entire question of purification of rivers and other open channels is obviously removed from the sphere of chemistry and becomes purely biological.

THE AUCTION sale of the Morgan collection of orchids in New York City some months since developed the fact that considerable attention is given to orchid cultivation in this country. The sale included over 1,450 plants, very few of them in flower at the time, for which Mrs. Morgan is said to have paid $200,000. A specimen of Vanda Sanderiana, bought by Veitch & Sons of London, brought $900, the highest price paid for a single plant; it is said to have cost $2,000. It is a rare and lovely species from Mindanao, one of the southern Phillipine islands, and first flowered in cultivation about two years ago. Another equally good plant of this species is owned by Mr. F. L. Ames of North Easton, Mass. Nine plants of Cypripedium brought from $100 to $750 each, all but one going to England.

THE ANNUAL FUNGUS FORAYS of England are an interesting feature of mycologic study in that country. They are excursions arranged by the societies to some collecting ground, where the party tramps through the fields, collecting fungi especially, and in the evening dines with a liberal *cuisine de champignon,* if the day has been successful. After the day's collecting the finds are displayed, named and commented upon. In the evening are papers and discussions. The meetings last from one to four days, and usually take place in October. The year 1885 proved a poor season for the larger fungi, and the gatherings have therefore lacked somewhat in interest. The Essex Field Club gave two days, the Tunbridge Wells Nat. Hist. Society, the Hertfordshire Nat. Hist. Society, the Hackney Nat. Hist. Society and the Leicester Nat. Hist. Society one day each, and the Woolhope Club four days.

STRASBURGER, at a meeting of the German Botanical Society on the 17th of September last, presented the results of some recent experiments (not yet completed) to ascertain the limits within which plants specifically distinct will permit effective grafting or budding, and the reciprocal influence of the stock and graft. He grafted a large number of various species of Solanaceæ on Solanum tuberosum and *vice versa*. Almost all of the grafts "took" and union was complete. The best results were obtained with Datura Stramonium on Solanum, the specimens of which formed good-sized tubers containing a small quantity of *atropine!* He also succeeded in grafting the Scrophularineous Schizanthus Grahami on Solanum, a most interesting result, and probably the first authentic instance of the union of two plants of different orders. He was led to attempt this because the potato-rot fungus develops on Schizanthus. The further results of these experiments and the promised histological investigation will be looked for with interest. The present paper is published in *Berichte d. deut. bot. Gesell. iii, XXXIV.* (Nov. 19, 1885).

ANOTHER PAPER is to be added to the already voluminous literature of the apparently interminable discussion of the morphology of the female flower of the Coniferæ. Kramer, in a recent paper[1], espouses the idea that in the Cupressineæ the scales of the cone are carpels which bear the ovules in their axils, and that the peculiar contour of these scales is not due to the coalescence of two organs, the bract and carpellary scale (*Deckschuppe* and *Fruchtschuppe*) as claimed by some, but is produced by mere swellings of no morphological significance. In the Abietineæ he considers the *Deckschuppe* of Strasburger and others as the carpel and their *Fruchtschuppe* as the placenta formed in its axil. This placenta, instead of remaining small, increases greatly in size, the more rapid growth of the under side reverses the position of the ovules, and it finally encloses them completely. According to this view of course the cone of these tribes would be considered a single flower and not as an inflorescence. Much has been said on both sides—and still it is doubtful where the truth is. An account of the development of the cones of fourteen species of Cupressineæ and Abietineæ forms the bulk of the paper.

WHAT IS CALLED a case of symbiosis between a fungus and the roots of certain trees has been described by Frank in the *Berichte der deutschen botanischen Gesellschaft.*[2] The fungus completely invests the absorbing rootlets of the trees, so that the nutritive solutions pass through the mycelium before entering them. To this symbiotic condition he applies the term Mycorhiza, and in a more recent contribution[3] to the same subject he makes *en resumé* these statements: 1. Mycorhiza is a symbiotic relation of which perhaps all trees are capable under certain conditions. This has been observed in almost all Cupuliferæ, in Coniferæ and Salicaceæ, in the Betulaceæ nearly allied to Cupuliferæ, in the linden and Prunus spinosa. 2. Mycorhiza is formed only in a soil which contains humus or undecomposed vegetable matter. The development of mycorhiza diminishes with the poverty and increases with the richness of the soil in these constituents. It has been observed to vary even on the same root as it passes through different layers of soil containing different amounts of organic matter. 3. The fungus of mycorhiza supplies to the tree, in addition to the necessary water and organic and mineral nutritive matters, substances derived directly from the humus and decaying vegetable matter. The tree is capable of this immediate reconversion of organic vegetable *débris* for nourishment only through the intervention of the mycorhiza fungus. 4. The old theory of the direct nutrition of green plants by humus will be revived though with a modified meaning. 5. The importance of humus and fallen leaves for the nutrition of forests acquires a new theoretical support. 6. While the symbiotic nutrition is chiefly of importance where, as in trees, it assists in the production of vast quantities of vegetable matter and where the immediate reconversion of vegetable *débris* is highly helpful, yet mycorhiza can render service when nutrition from humus becomes a necessity on account of the absence of chlorophyll, as in Monotropa Hypopitys.

It is to be noticed, however, that in neither of his papers on the subject has Frank demonstrated that this is a genuine symbiotic relation. The mycelium is sterile and no cultures or infection experiments have been carried on. The observed facts are interesting and probably important, but it will be well to hold aloof from his hypothesis of symbiosis until more exact knowledge is obtained.

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[1]Beiträge zur Kenntniss der Entwickelungsgeschichte und des anatomischen Baues der Fruchtblätter der Cupressineen und der Placenten der Abietineen.—Flora, Nos. 29, 30, 31, 1885.

[2]Band iii, heft 4, p. 128.

[3]Berichte d. deut. bot. Gesell., iii, XXVII; Nov. 19, 1885. In this paper he shows the existence of the same symbiosis between the fungus and roots of Monotropa Hypopitys.

SCRIBNER ON ARCTIC GRASSES.

Some Arctic Grasses.

F. LAMSON SCRIBNER.

(WITH PLATE III.)

DESCHAMPSIA BREVIFOLIA R. Br. in Parr. 1st Voy. Suppl. p. 291. (1823).—The finding of what we believe to be the typical form of Robert Brown's D. brevifolia, by Lieut. A. W. Greely in 1882, near Ft. Conger, Grinnell Land, latitude 81° 44′, leads us to restore to its specific rank this truly Arctic grass that has been classed by many recent authors as only a variety or form of D. cæspitosa. We do not find it represented in any of the numerous Rocky Mountain collections which we have examined, and the only approach to it among our Arctic collections is a specimen from Schumagin Island, Alaska, collected by M. W. Harrington in 1871–2. The Alaskan plant is about three times the size of the one from Grinnell Land, but in other respects there is no essential difference. The figure we have made is drawn from one of Lieut. Greely's specimens and shows the habit of the plant, natural size, with enlarged illustrations of one of the spikelets.

The following is copied from Brown's description:

Gramen 3–5-unciale, glabrum. Culmi simplicis, erecti, foliati. Folia inferiora involuto-subulata, stricta, uncialis—sesquiuncialis; vaginis strictis, folio brevioribus, ipsa basi integra; ligula lanceolata; supremum brevissimum, vagina elongata, laxiuscula, ligula breviore. Panicula coarctata, lanceolata vel oblonga, fusco-purpurascens, scariosa, ramis semiverticillatis. Locustæ bifloræ raro trifloræ, semper cum rudimento pedicelliformi flosculi alterius. Gluma subæquivalvis, mutica, acuta, valvulis lanceolatis, concavis acutissimis, scariosis disco purpurascenti, limbo pallido, uninerviis, locusta paulo brevioribus. Perianthia subuniformia scarioso-membranacea separatim solubilia, inferius sessile: valvula inferior ipsa basi barbata pilis brevibus strictis, albis, cæterum glabra, concava subquinquinervis, nervis omnibus lævibus, lateralibus obsoletis, apice eroso multidentato, dorso sæpius infra medium aristata; arista setacea, recta, denticulata, valvulam ipsam vix vel paulo superanti; superiore longitudine inferioris, angustior, dinervis, apice bidentato, quandoque semifido.

PHIPPSIA ALGIDA R. Br.—Mr. H. N. Patterson, who is well-known both as a collector and a compiler of useful and neatly printed check-lists of plants, has been spending the season in the Rocky Mountains, gathering in botanical treasures, and among his interesting finds is Phippsia algida, a curious little grass, allied to Coleanthus and Sporobolus, that has not before been discovered south of Alaska. Mr. Patterson collected it in wet, gravelly places about Chicago Lake, Georgetown, Colorado. It may not be so rare within our limits as now appears for its low, moss-like growth and aquatic habits render it very likely to escape notice. Our figure is taken from Trinius, *Icones*, and shows very well both the habit of the plant, excepting that it is densely cespitose, and the minute characters of the spikelets. The outer or empty glumes are very small and the lower one is sometimes wholly wanting.

AGROPYRUM VIOLACEUM, Hornem.—This grass was collected at Ft. Conger, Grinnell Land, by Lieut. Greely and Dr. D. L. Brainard. The specimens are fine, 8–15 cm. high, with short spikes and densely pubescent glumes, a character observed in Greenland specimens collected by Thomas M. Fries. The figure illustrates one of the specimens nearly natural size.

In 1883 Mr. Wm. M Canby collected at the Upper Marias Pass, Montana, alt. 8,000 ft., specimens of this Agropyrum in which the leaves are much narrower than in the Scandinavian plant and pubescent, as are also the floral glumes. The outer glumes are smooth. All the glumes are remarkably broad with very short awns.

EXPLANATION OF PLATE III.—A, *Deschampsia brevifolia* R. Br.; entire plant, nat. size and spikelet enlarged. B, *Phippsia algida* R. Br.; entire plants and details of flowers. C, *Agropyrum violaceum*, Hornem.; entire plant, nat. size and spikelets enlarged.

The Life and Labors of Linnæus.

A. P. MORGAN.

Previous to the time of Linnæus, the science of botany was in a chaotic state. Discoveries there had been, it is true, and the science had made much progress; each discoverer seemed disposed to attach most importance to what he found out himself and proceeded to establish a system of classification upon the particular feature which he had investigated. The method of Cæsalpinus was founded on the fruit, that of Rivinus on the number of petals of the flower, that of Tournefort on the figure of the same. All were artificial because they took into consideration only one or a few features of the plants.

The problem of the great botanists of all times has been to find a natural system, one in which every plant will be shown in its perfect relation to all other plants. With this problem all the distinguished botanists of Linnæus' time were busily engaged. Haller at Göttingen labored doubtfully, sometimes despairingly, over his Prodromus of a German Flora and Enumeration of the Plants of Switzerland. Dillenius at Oxford improved Ray's Synopsis and labored faithfully upon mosses and other plants.

Bernard de Jussieu, while arranging the great Jardin des Plantes at Paris, pondered deeply the problem of a natural system. Botanists of lesser note were all occupied with the same question.

While at the university in Upsala, in 1829, Linnæus was prompted by reading a discourse by Vaillant, on the structure of flowers, to examine very closely the stamens and pistils of plants. These appendages he discovered to be essential to the vegetable and to assume as much variety as the petals; hence he conceived that they might be made the basis of a new system of classification. He thus early laid the foundation of that sexual system which he afterwards wrought up to such perfection. According to this system were arranged all his succeeding botanical observations.

The Linnæan or sexual system is briefly as follows: All known plants are divided into 24 classes, the characters of which are established upon the number or upon the difference of situation or arrangement of the stamens; the orders as far as possible on a similar number, situation or arrangement of the pistils. For example the classes are Monandria, Diandria, Triandria, etc.; stamens and pistils are present in all of the classes to the 23d. The 24th class is the Cryptogamia containing even to this day many plants the mode and organs of whose fructification are not yet ascertained. Linnæus did not publish his system till he went to Holland, in 1735. Having paid a visit to Dr. Gronovius, of Leyden, the latter returned it and saw his Systema Naturæ in manuscript, which astonished him, and he requested Linnæus' permission to get it printed at his own expense. The Dutch botanists received Linnæus with the utmost cordiality and all immediately embraced and adopted his system. He rearranged the gardens of Clifford and Van Royen and assisted his friend Gronovius in the publication of his Flora Virginica, all of which was done upon Linnæan names and principles.

As soon as the sexual system was given to the world Linnæus strove to secure for his method the good will of distinguished botanists elsewhere. He went over to England and visited the learned botanist Dillenius, who at first received him very haughtily; but he afterward detained him a month, and at last took leave of him with tears in his eyes, wishing him to remain with him till his death. He maintained a friendly correspondence with him, though the grim old professor always adhered to the method of Ray, and made labored quotations from John Bauhin and Dr. Plukenet. He had no doubt, he said, that Linnæus would one day overthrow his own system. He gruffly called in question the genus Dillenia, named by Linnæus in his honor, but which still holds good with nine species of Asiatic plants, and which furthermore has given name to the natural order Dilleniaceæ.

Linnæus received word that the celebrated Prof. Haller, at Göttingen, contemplated writing against his new method. Deprecating this he wrote to Haller the noblest protest that ever man made; from it we may make many valuable extracts. He said:

I must declare that I am anxious to avoid, if possible, all anger or controversy with you; my wish is rather to act in conjunction with you; I should detest being your adversary, and as far as possible I will avoid it. May there be peace in our days.

I dread all controversies, as, whether conqueror or conquered, I can never escape disgrace. Who ever fought without some wound or some injurious consequence? Time is too precious, and can be far better employed by me, as well as by you. I am too young to take up arms; which, if once taken, can not be laid aside till the war is concluded, which may last our lives.

If my harmless sexual system be the only cause of offense, I can not but protest against so much injustice. I have never spoken of that as a natural method; on the contrary, in my Systema, I have said: "No natural botanical system has yet been constructed, though one or two may be more so than others; nor do I contend that this system is by any means natural. I do not deny that a natural method is preferable, not only to my system but to all that have been invented. Probably I may, on a future occasion, propose some fragments of such a one. Meanwhile, till that is discovered, artificial systems are indispensable."

Haller's reply was cordial and removed all cause for anxiety He pronounced the report to be false; it had not entered his mind to disturb a young man of so much merit in the science of botany, in the commencement of his fame and fortune.

Linnæus was delighted and very grateful. "I rejoice with all my heart," he wrote, "that the rumor was unfounded, for indeed you and Dillenius are the only people I would not wish to have for adversaries." The life-long correspondence between these two great men is exceedingly interesting.

Before returning to his native country Linnæus went to Paris and visited the Jussieus. Although "they would not stir a step from the method of Tournefort," yet they received him most hospitably and made him very welcome. They showed him their herbaria and that of Tournefort, and the large collection of books belonging to Dr. Isnard. They made excursions to Fontainbleau and Burgundy solely for the purpose of showing Linnæus the finest plants that were to be met with in the neighborhood of Paris. He was elected corresponding member of the Academy of Sciences, and Du Fay proposed to Linnæus to become a Frenchman, in which case the Academy would appoint him one of its members with an annual salary. His correspondence continued with Bernard de Jussieu, who, though continually planning the natural system, afterward published by his nephew, recommended the works of Linnæus to his pupils and caused them to be published and sold at Paris.

Although the Oxfordian professor held aloof from the Linnæan system, nevertheless it was speedily adopted and put in practice in England and America. His faithful disciples, John Ellis and Peter Collinson, were unwearied in their efforts to promulgate his doctrine. They were rich merchants, actively engaged in trade, and with a love for natural history pursuits. Through their shipmasters they gathered plants from every country in the world and sent them to Linnæus. Their correspondence was extensive, especially with America, and through them Linnæus obtained most of his American plants.

After a while the mighty Solander, one of Linnæus' pupils, was sent to London. He sailed round the world with Captain Cook, and returning to London, laid the foundation of the Hortus Kewensis of his friend Aiton. By his elegant and engaging manners he gained the favor of those high in authority, and overthrew at court the old regime in the person of the great Dr. Hill. When a king's botanist was to be appointed for the provinces Ellis and Collinson secured the place for their friend John Bartram.

Linnæus had several occasional correspondents in America, though most of the plants seem to have been sent through Ellis and Collinson.

His Excellency Cadwallader Colden, Governor of New York, addressed him stately and learned letters from his residence at Coldenham. He favored and assisted the enterprises of his student Peter Kalm, and facilitated his journeys through that part of North America. Linnæus named a genus for him, Coldenia. His daughter was an excellent botanist and had mastered the method of Linnæus. John Ellis writes: "This young lady merits your esteem and does honor to your system; she has drawn and described 400 plants in your method only." She figured and described the Gold-thread. Ellis sent her characters to Linnæus and begged him to call this plant Coldenella.

John Bartram was unwearied in his labors and gathered everything into his garden at Philadelphia that he could lay his hands on. He was much beloved by Dr. Garden, of Charleston, and they visited each other often. When Bartram was appointed king's botanist in America, Dr. Garden appeared to be greatly astonished. He wrote to Ellis: "Is it really so? Surely John is a worthy man; but yet to give the title of 'king's botanist' to a man who can scarcely spell, much less make out the characters of any one genus of plants, appears to me rather hyperbolical. Pray how is this matter?"

Dr. Garden was a very scholarly man; he was educated at Edinburgh; his letters to Linnæus were addressed in elegant Latin. He practiced medicine at Charleston, S. C., till after the revolution, when, with many other royalists, he felt compelled to return to Great Britain. He attempted twice to penetrate through the wilderness to the Mississippi river, but was compelled to return by the danger arising from the disturbed state of the country. He sent many plants as well as animals to Linnæus through Ellis and directly. He was very anxious to have a plant named for his friend and valued correspondent, Ellisia; he sent specimens and figures of the plant and persisted in his choice a long time. But Linnæus decided that his plant belonged to a genus already established; this was a great disappointment to him. Ellis named the elegant genus Gardenia after him.

The difficulties of shipping plants and sending letters in that day are well illustrated in many of his letters. His letters and packages were captured by the French time and again, and his lamentations are pitiful. He writes to Ellis after one such disaster:

> My grief at my own and your disappointment is inexpressible. A few days ago I heard that both Captain Coats and Cheeseman were taken and with them the two most valuable collections of seeds that ever I could promise or even hope to procure for you. There was every kind that you mentioned in your letter to me and many new and curious shrubs besides. They were all carefully packed exactly as you directed. My patience is gone. I would have given twenty guineas if you had only got one box. I never shall have anything like them again.

The Linnæan system of classes and orders held sway for a hundred years and many people in this country, not yet very old, studied Mrs. Lincoln's Botany. Even after the recognition of the natural system of Jussieu, it was customary to prefix to floras the Linnæan system as a key to the genera. No other such convenient artifical classification of plants was ever invented, and the impetus it gave to the study of plants throughout the civilized world was never equaled. The facility with which the plants of a limited region could be marshaled into regular order was wonderful and young men and women, and old, too, took to the study of botany; it became the craze of the time. Linnæus sent his students abroad and busied himself with arranging under their proper classes and orders the plants from the uttermost parts of the earth. The latest edition of his Systema Naturæ contained more than 1,200 genera and nearly 8,000 species.

It is a singular fact that Linnæus did not at first perceive the great value of the binomial nomenclature. He established the classes and orders of the sexual system and bent his energies to describing and defining genera with greater precision. He continued to distinguish species by the explanatory phrases of the older botanists. Some examples from the Flora Lapponica will illustrate this. Three species of Violet are named thus:

276. VIOLA foliis cordato-obtusis, pedunculis caulinis.
277. VIOLA foliis cordatis oblongis, pedunculis fere radicatis.
278. VIOLA foliis subrotundis cordatis pedunculis radicatis.

These species he afterward called Viola biflora, Viola canina and Viola palustris.

The labor of handling these long names is apparent from the following extract from a letter from Dillenius to Linnæus:

> In your last letter of all, I find a plant gathered in Charles Island, on the coast of Gothland, which you judge to be *Polygonum erectum augustifolium, floribus candidis* of Mentzelius and *Caryophyllum saxatilis, foliis gramineis, umbellatis corymbis,* C. Bauhin; nor do I object. But it is by no means Tournefort's *Lychnis alpina linifotia multiflora, perampla radice,* whose flowers are more scattered and leaves broader in the middle, though narrower at the end.

The plant, the object of all these maledictions, seems to have been *Gypsophila fastigiata* L.

In 1753 appeared what Haller emphatically termed Linnæus' "maximum opus et æternum," the *Species Plantarum.* To give this work its utmost perfection had been the author's object for many years, and to this all his other botanical productions were in some measure only preparatory, as the rightly ascertaining of species is the great end of all method. It is in this work that Linnæus first employs *trivial* names, as he termed them, which are single epithets, expressive as far as possible of the essential specific differences among the species of a genus, or, in default of these, of some striking and obvious character; not seldom they are local terms or the names of the first discoverers.

Although the Linnæan classes and orders for plants have passed away yet it is wonderful how well the Linnæan genera and species have stood the test of time; this is owing to the remarkable exactness of his descriptions as well as his keen perception of the relationships of plants. Linnæus was accustomed from his earliest youth to put a high value on verbal accuracy and logical precision. He improved the distinctions of genera and species and introduced a better nomenclature on the binomial method. His verbal accuracy and the remarkable terseness of his language reduced the crude matter that was stored up in the folios of his predecessors to a form that was accessible to all men. The knowledge which he displayed, and the value and simplicity of the improvements which he proposed, secured the universal adoption of his suggestions and crowned him with a success altogether unparalleled in the annals of science.

Notes on the Flora of Eastern Virginia.

LESTER F. WARD.

While engaged in making a geological reconnoissance through the State of Virginia, and as far south as the Roanoake river in North Carolina, during the month of August of the present year, I made a few botanical notes, usually without collecting specimens, except where the plant was doubtful or specially desirable. The terrain to be studied forms a narrow belt, rarely over fifteen miles in width, and extends in a direction slightly west of south from Washington, following the Potomac river as far as Aquia Creek, passing through Fredericksburg, Richmond and Petersburg, from which point it was barely traceable to Weldon, North Carolina. It is the newer or younger Mesozoic of Rogers and Fontaine, or Potomac formation of Mr. W. J. McGee, of the United States Geological Survey, and contains several beds of fossil plants which were the special object of my investigations.

My familiarity with the flora of Washington and vicinity rendered it both easy and interesting to note the more conspicuous changes which the flora undergoes in passing southward, and my notes were almost wholly confined to this aspect of the question. They were usually taken from the carriage, without stopping to make special researches, and it is therefore very evident that the species enumerated below can form only a small part of the whole number, which a thorough investigation of the localities named would show to exist as marking the differences between the flora of those localities and that of Washington. It was, moreover, impossible to note the absence of Washington species, although in a few cases this was quite conspicuous. Where species rare at Washington became common, the fact was noted as well as that of the appearance of entirely new forms. The arboreous vegetation, as being the most striking as well as the most important, naturally claimed special attention, but the more humble forms were not overlooked. Meager as my notes are, however, I find it necessary to omit many minor points, in order to restrict this article to such limits as I presume to be suitable to the pages of the GAZETTE.

I was much interested in the specimens seen of *Quercus Michauxii* Nutt., which, indeed, occurs near Washington, but very sparingly and in such doubtful forms that I had almost felt obliged to apologize for its introduction in the Flora of Washington. The most northerly point at which typical specimens were seen was on Powell Run, the first stream north of the Quantico. Here a fine tree was found, and fruiting specimens collected. Some of the lower leaves are scarcely distinguishable from those of Q. Prinus, while the upper ones show considerable analogy to those of Q. bicolor, to which species the tree is, of course, most closely allied. In the valley of the Pamunkey, near Hanover Court House, this species is very abundant, and the trees attain a great size. The resemblance to Q. bicolor is less close, the leaves not being at all lyrate or whitened underneath. After a thorough examination of it from this point southward, I conclude that while Dr. Engelmann certainly had some grounds for uniting it with Q. bicolor as a variety, there are still better ones for keeping it distinct.

The behavior of the pines furnished a constant subject of observation. Besides the rare Pinus pungens, not seen further south, the only pines thus far met with in the Washington flora are P. mitis, P. rigida and P. inops. These are about equally abundant, except that where any considerable forests of pine occur, they are always composed almost exclusively of P. mitis. A very large part of eastern Virginia and North Carolina, probably one half of the territory, is grown over with pines. The land has been once under cultivation, but long abandoned, and the forests often consist of large trees, between which in many cases the furrows are distinctly visible. In the vicinity of Washington, and especially in Maryland, P. rigida plays the *role*, to a considerable extent, of an "old field pine," but P. inops, the scrub pine, grows in similar situations. As one proceeds southward both these species grow more rare, P. rigida almost completely disappearing before the Rappahannock is reached. It was in the vicinity of Fredericksburg that I saw the first traces of the long-leaved pine, P. Tæda. These appeared in the form of occasional young growths around the margins of groves of P. mitis. It is a singular fact that the leaves of these small bushes or trees were much shorter than the normal length for the species, while, as I have always observed. the leaves of young trees of P. mitis are generally longer, often considerably longer, than the normal length. The effect was to obscure the fact of the gradual appearance of the former species. One might almost think that a partial hybridization was going on. Nowhere on the Rappahannock did I see a cone-bearing tree of the long-leaved pine, but there can be little doubt that sufficient research would reveal a few from which the seeds had come that produced the seedlings observed. A little further south, however, after crossing the Massaponax river, such trees began to be seen. They first occurred around the edges of yellow pine forests, as if struggling for admission, next as encircling borders to such forests, a few trees penetrating some distance inward. Still further southward the obvious struggle between the two species becomes more fierce, but to the evident disadvantage of P. mitis. The Tædas close in and share the ground equally, the margins of woods consisting entirely of them. Finally, as we approached the James and Appomattox rivers the yellow pines had generally disappeared, and the timber consisted almost exclusively of P. Tæda. It was only where this was the case that this species assumed the character of a distinctively "old field pine." I had expected to see it come in as such, but this was not the case. In these more southern districts, however, where vast forests of it exist, loblollies, having the typical form of top, stand out in the old fields with all the characteristics that are so often described. But it is proper to say that within the forests this tree presents none of these characteristics. It is tall, straight and symmetrical, having none of the small horizontal limbs, so characteristic of P. mitis, growing from the lower part of the trunk of the smaller trees. The trees when large stand well apart, the interspaces being devoid of shrubby undergrowth, and the appearance of one of these older forests is highly imposing. It is almost the only pine of this part of southern Virginia and northern North Carolina, no specimens of P. australis having been met with. It is also the only species of pine I have ever seen in the Dismal Swamp where it penetrates to Drummond Lake.

Ulmus alata, the winged elm, was first seen on the South Anna river, but it soon became common and remained so to the Roanoake. On the Chickahominy, James and Appomattox it is a small tree, but the specimens planted in the state capitol grounds at Richmond have attained a large size, and form graceful shade trees. The largest trees seen were in the valley of Fontaine's creek, near the state line, some of which had a diameter of nearly two feet.

Quercus aquatica was very closely associated with the last, being first seen near Ashland, 17 miles north of Richmond, and becoming more abundant southward. The foliage is quite constant, being even less variable than that of most oaks. It is entirely different from any of the forms of Q. heterophylla that I have ever seen, and I can not admit for a moment that the latter is a form of it.

The above are the principal trees in the range of which I was specially interested. The following herbs and shrubs either rare in or absent from the Washington flora were noted and may convey some idea of the unceasing interest and pleasure which a botanist must derive from a journey through that part of the south.

Rubus cuneatus, rare near Washington, steadily increases in abundance from the Accotink to the most southerly point reached, gradually supplanting R. villosus, and becomes very rare in southern Virginia. The berry, which is scarcely edible further north, becomes plump and very sweet, and on several occasions our party halted to enjoy a feast of them from the bushes. In the valley of the Nottaway river this species has the habit of the northern blackberry and forms dense brambles along the fences, some of the bushes growing to the height of six or eight feet.

Nelumbium luteum has never been found in a wild state near Washington, but does well in artificial ponds. I was surprised, therefore, rather by its abundance than by its presence in the Quantico creek. This estuary, as well as that of Aquia creek, is filled with it, and as we happened to be there at the right season to see it in flower, we enjoyed a grand sight. It is perfectly well known to the inhabitants of this part of the state by the name of *Wankapin* (if this is the correct spelling), the first vowel having the same sound as in *want*. As it is the Water Chinquapin of other localities one might surmise that this name was a contraction of the latter, but no one knows it by this more accepted name and it is more probable that Wankapin is an original Indian name. This plant, so abundant in the tidal estuaries of the Potomac, was not seen in those of the James or Appomattox, nor did we meet with it at any inland point on our route.

Liatris squarrosa was found at Brooke Station below Aquia creek and numerous points further south.

Helianthus atrorubens occurs some distance north of the Rappahannock and from this point to the Roanoake it was common, often abundant.

Phragmites communis was seen on the Tapony, six miles above Bowling Green, also near Chester, twelve miles south of Richmond, and again on the Meherrin

Eupatorium fœniculaceum first appeared in the vicinity of Stafford Court House and became a constant companion throughout southern Virginia.

Vitis vulpina, of which a single vine was seen near Mount

Carmel Church, was rare at Fredericksburg, but soon became common and is the principal grapevine of the South.

Chrysopsis graminea, first seen on the Tapony, above Bowling Green, side by side with the more northern species, C. Mariana, gradually takes the place of the latter as you go southward, until from Richmond on it becomes very abundant and almost omnipresent.

Clethra alnifolia, although it extends much further north and has lately been found north of Washington, near Bladensburg, Md., was not encountered until we reached the tributaries of the Mattapony. From here it rapidly grows abundant and in southern Virginia often lines the roadside for miles. As we happened to strike it in its best flowering state we had an opportunity to enjoy the fragrance as well as the beauty of its flowers.

Clitoris Mariana, which is a rarity here and is much sought by lovers of wild flowers, was found at Milford Station blooming in wild profusion along the railroad and in the fields and meadows, where it climbs up the tall weeds and stalks of corn. It was found in the same abundance at nearly all points along our route to Weldon, North Carolina.

Sabbatia lanceolata was collected near Ashland, about seventeen miles north of Richmond. It was seen at one or two more southerly points.

Rhynchospora corniculata was found literally filling small, partially dried ponds at two points south of Richmond, one only five miles from that place, the other near the Rowanty creek, twenty miles south of Petersburg.

Bignonia capreolata was first seen on the James near the Dutch Gap canal. It was common enough there to be known to the inhabitants, who call it the Quarter-vine, from the fact that by a little twisting the stems will cleave longitudinally along the planes whose cross-section gives the well-known "cross" which has caused it to be called the "Cross-vine." I found by experiment that this was the case, and if it has not already been done, the peculiar character of these specialized medullary rays would undoubtedly well repay a careful investigation. The plant was still more common further south.

A small patch of the northern Myrica asplenifolia was found at Ware Bottom Mills, on Trent's Reach, the great bend of the James that was cut off by the Dutch Gap canal, and I thought this southerly position remote from mountains somewhat remarkable and worthy of record.

Diodia Virginica was first seen at the point last mentioned, below which it grows more abundantly.

Silphium compositum was observed near Swift creek, about six miles north of Petersburg, and became abundant on Stony creek and between the Nottaway and the Meherrin. As this species has not been previously reported north of the southern boundary of Virginia this constitutes a considerable addition to its northward range. It is so abundant all through the southern half of Virginia that it is strange that this fact should have remained so long unknown, and this and many other things indicate that very little botanical work has been done in this region.

Polygala Curtisii, var. pycnostachya was found at various points; near Swift creek, at Jarrat's, below the Nottaway (where good albinos were collected), on Three creek, etc. It proves to be a very common form and to range far southward. I have a specimen from Capt. John Donnell Smith, collected at Buck Forest, Transylvania county, North Carolina, and another from Dr. Chas. Mohr, collected by E. A. Smith, at Mobile, which, though labeled "P. fastigiata??," can be none other than our plant. Dr. Mohr suspected as much and wrote on the label "caruncle sparsely hairy, as long as the stalk, but different in the *persistent* bracts. Is it Curtisii?"

Aster gracilis was seen five miles north of Petersburg, and at several points between the Appomattox and the Roanoake. It grows in sandy, open ground in small dense patches, its habit being much that of a Sericocarpus, closely resembling S. solidagineus, except in its blue flowers. It agrees perfectly with Martindale's specimen from the New Jersey pine barrens, which is the only one I had seen.

Passiflora incarnata was not observed north of Petersburg, but at that place it is quite common, and in the valley of the Nottaway it becomes a weed of the cornfields injurious to the crops. It was still flowering abundantly towards the end of August, and was also in full fruit. The inhabitants know it by its fruit as "maypops," and do not understand the term "passion flower."

Paspalum Floridanum was found at points a few miles both above and below the Appomatox, and also on the Nottaway growing very tall (five to six feet) and stout. It seems to follow the cotton and pea-nut ("goober") belt of low sandy country.

Spiræa tomentosa was collected near Jarrat's below the Nottaway, and not elsewhere seen.

Parthenium integrifolium was common from above Rowanty creek to the Roanoake.

Sarracenia flava was found and pitchers brought to me by

Mr. W. J. McGee, of the party, from a swamp in a pine wood, two miles north of Rowanty creek.

Jatropha urens, var. stimulosa, becomes a common plant from the Rowanty creek southward.

Tephrosia spicata was found at Bolling's Bridge, over the Nottaway, as a kind of vetch in the fields.

Desmodium strictum, one or two young flowering plants, was also collected in the vicinity of Bolling's Bridge.

Breweria humistrata was found on the Nottaway, in a dense pine wood, trailing and climbing over the smaller undergrowths and blooming profusely, a delicate and handsome vine.

Elephantopus tomentosus, which replaces E. Carolinianus of the northern districts, was first seen in the Nottaway valley, and became quite frequent as we traveled southward.

Cyrilla racemiflora was first seen on Falling Run, about three miles south of Hicksford, and once more near the state line in North Carolina. It was unfortunately then (August 18) out of flower.

Pluchea camphorata was seen between the Meherrin and Fontaine's creek.

Arundinaria macrosperma, which occurs sparingly on the Nottaway, forms a constant feature of the low ground along Fontaine's creek, near the state line, and is abundant from that point southward.

The principal new forms noted in North Carolina, which were not seen in Virginia, were Senecio tomentosa, Baptisia villosa (in fruit), Carex glaucescens (I once collected this at Norfolk, Va.), and Amorpha fruticosa.

After our return to Washington, the reconnoissance was extended to Maryland.

Eupatorium serotinum, which has never been found in the District of Columbia, is one of the most abundant plants along the Patuxent, above and below Marlboro, a distance of less than twenty miles.

Centrosema Virginianum was also found growing in the deep sands that now cover the wide tract east of the Patuxent, across which the bed of that stream has been shifting since the tertiary epoch.

BRIEFER ARTICLES.

Anemonella thalictroides Spach, Hist. Nat. Veg. vii. 239.—We adopt this genus and Spach's name for it. The little plant has given much trouble, having the leaves of a Thalictrum, except that the cauline are whorled-involucrate, the only point in which it really accords with Anemone, while the terminal depressed-sessile stigma is foreign to both these genera Spach is the first to characterize the genus, though even he did not rightly describe the stigmas; and his name is excellent. Much earlier than this, F. Hofmeister, in the Regensburg Flora, gives the names *Syndesmon thalictroides* and *Syndesmon tuberosum* as imposed by Count Hofmannsegg, but no character is indicated, and the two plants are not of the same genus. The latter species is one of a group of Asiatic and European species of Thalictrum (§ COROLLINA of Boissier), which, indeed, have large and petaloid sepals and short erect stamens, but all have the unilateral stigma of Thalictrum. This is as true of *T. orientale* Boiss., as of the rest, which this author well describes as with "*stigmate oblongo recto*," but Lecoyer incorrectly as with "*stigmate minutissimo*," probably from the fruit. We await the concluding part of Lecoyer's monograph of Thalictrum, which should give some needed explanations. The first part is in Bull. Soc. Roy. Bot. Belg. xxiv, 1885. On page 223 it describes T. anemonoides as with "*stigmate minutissimo punctiformi*," which applies only to the remains of this organ upon the fruit; but the next page comes nearer to the mark with "*stigmate ordinairement sessile, disciforme, disposè presque horizontalement au sommet de l'ovaire.*" Then it is large and broad.

We may note that the specimen which M. Lecoyer describes at the close of his account of the above species, "*dont les charactères distinctifs ne concordant pas*," no doubt belongs to Isopyrum biternatum.—A. GRAY.

Edmond Boissier.—M. de Candolle has just published a biographical sketch of this distinguished botanist, who died the 25th of last September, at his country residence in Switzerland. Dr. Gray has also given a brief outline of his life and work in the *Am. Journal of Science* for January. Both of these gentlemen knew Boissier personally, and none could be more competent to speak of him. He was born in Geneva the 10th of May, 1810, of a family from whom he inherited an independent fortune. Instead of devoting his life to luxurious idleness, he determined to enter upon some profession, and being in Geneva, with the De Candolles, it was but natural that his choice should fall upon botany. His attention was directed entirely to systematic work, chiefly in the region of the Mediterranean and the East. In 1837 he collected in Spain, and between 1839 and 1845 he published his *Voyage Botanique dans le midi de l'Espagne*, two quarto volumes, containing 180 plates. In 1842 he traveled with his wife in Greece, Syria and Egypt. In 1849, while traveling in Spain, he lost his wife from typhoid fever, and the rest of his life was spent in the shadow of this sorrow and afflicted by his own bodily ailments. Between 1842 and 1855 appeared his *Diagnoses Plantarum Orientalium Novarum*. In 1845 was completed his monograph of *Plumbaginaceæ*, while in 1862 appeared his great monograph of the genus *Euphorbia*, published in De Candolle's Prodromus. In 1866 he published his *Icones Euphorbiarum*, containing 120 folio plates. His great work was the *Flora Orientalis* (1867 to 1884), in five octavo volumes, embracing a region extending from Greece and Turkey to the first cataracts in Egypt, and eastward to the borders of India. The work was entirely completed, and at the time of his death he was preparing a supplementary volume containing recent discoveries.

He was a great traveler, visiting Europe from Norway to Spain and the Crimea, and also much of the East. His last trip was to Spain in 1881, his eighth visit, his first botanical trip having been to the same region more than forty years before. And so the older botanists, the pioneers, are gradually departing, but their names will always be familiar to us as we endeavor to build a superstructure worthy of the foundation they have laid so well.—J. M. C.

Sections of native woods.—Probably the most perfect collection of our native woods is the magnificent series in the American Museum in Central Park, New York City, known as the "Jesup collection." The amount of money expended in gathering this collection was not less than $150,000. Truncheons from this collection, which was carefully named by Dr. Charles S. Sargent, have been placed in the hands of Mr. Charles W. Spurr, of Boston, a well-known manufacturer of veneers, who has cut from them a few sets of thin sections which are now offered for sale.

These sets are certainly unique. Each represents about 200 species of native trees. Where the nature of the wood has permitted, transverse, tangential and radial sections have been cut of each. These sections vary in thickness according to the grain and character of the block from one one-hundredth to one two hundred and fiftieth of an inch. Each section is placed between thin sheets of mica, and mounted in flexible wood frames. Each frame consists of two layers of curled maple veneer backed by strong paper, and varnished with shellac. On the frame is printed the name of the individual or institution purchasing the set, a number corresponding to the specific name in Sargent's *Woods of the Jesup Collection*, the scientific name in full, the common name, the direction of the section and the name of the preparer.

One can hardly realize the time and patience represented by this work. The sections were cut with a 3-ton veneer-machine, which had to be adjusted for the cutting of each block and sometimes for the different parts of even the same piece. In all nearly 18,000 separate sections had to be handled and laid carefully between blotting paper. Add to this the preparation of the woods for cutting, the care necessary to prevent confusing the sections from the numbered truncheons, the making, finishing and printing of the frames, and the mounting of the sections, and we have a truly appalling amount of work. No such series has ever before been made and probably no one else will ever have opportunity or patience to prepare another. The sections prepared and mounted as they are, are exceedingly valuable for the study of the nature and character of the various native woods. These sets, by reason of their completeness, accurate naming, elegant and durable mounting, are unequaled, and a rare opportunity is thus offered to educational institutions which they ought not to be slow to avail themselves of. The price is certainly very reasonable.

The tumble-weed of the West.—In this plant we have an excellent illustration of the effect of climate upon the physical development of the plant body. In the east it is the familiar Amarantus albus, and so far as I have observed never shows any tendency to take upon itself the "tumbling" habit, but grows into an irregularly branching plant which remains fixed to the ground long after it dies at the close of the season. Upon the plains and prairies of the west, however, it grows into a compact plant, with stout curving branches, of such length and curvature as to give to the whole an approximately spherical form. The autumn and early winter winds break off the main stem near the root, and away the whole goes rolling, tumbling and bounding over the ground, often for miles. In Coulter's *Rocky Mountain Botany*, by an accidental transposition of type, the related A. blitoides is called the "tumble-weed." This latter species is, however, a prostrate plant, reminding one of the familiar purslane, and does not take the spherical form necessary to the "tumble-weed."

It may be interesting to note in this connection that upon the steppes of Russia, north of the Black Sea, an entirely different plant becomes a veritable "tumble-weed." Henfrey, in *The Vegetation of Europe*, thus describes it: "One curious plant of the thistle tribe has attracted the notice of most travellers, the 'wind witch,' as it is is called by the German colonists, or 'leap-the-field,' as the Russian name may be translated. It forms a large globular mass of light wiry branches interlaced together, and in autumn decays off at the root, the upper part drying up. It is then at the mercy of the autumn blasts, and it is said that thousands of them may sometimes be seen coursing over the plain, rolling, dancing and leaping over the slight inequalities, often looking at a distance like a troop of wild horses."

On the island of Martha's Vineyard, Mass., the wild Indigo (Baptisia tinctoria) grows into a globular form, breaks off at the root in the autumn, and tumbles about much like the genuine "tumble-weed" of the west.

C. E. Bessey.

EDITORIAL.

Much has been said in the Gazette about teaching botany, and it may be thought that the chief end of botanical study is teaching, but much as we would exalt the teacher's profession there is another work for the professional botanist. If teaching botany is all, what is to become of the science? Are we to teach the same things over and over again, with an occasional new inspiration wafted across from the German laboratories, and simply raise up teachers to follow in our footsteps? Unfortunately, in this country the professional botanist is almost of necessity a teacher only, with his time fully occupied in the drudgery of the laboratory and lecturing upon the very rudiments of his science. If our endowments for botanical teaching have not now secured us a perennial succession of teachers, then has all our teaching been in vain. What we now need is endowment for botanical research, that our country and our botanists may do themselves credit. This does not necessarily mean a great outlay of money, but simply a supply of trustworthy assistants for teaching, that the professor may have ample time for research. Time is what is needed vastly more than money, and when our boards of control begin to appreciate the reflex influence of original investigators upon our whole system of education, they may see the wisdom of the necessary assistants. It is not to be expected that we can soon emulate foreign countries in the matter of opportunities for original research, but it is a thing that our well-equipped universities should begin seriously to consider, and the first and most practicable step is to give professors more time for special work. Furnishing cheap or temporary assistants will not answer the purpose, but they should be of such proficiency that if desirable the entire work of instruction can be left to their care. In several universities we could mention, an abundance of material is stored up, with all needed accessories of library and apparatus, only waiting for time to become productive. The amount of dead capital laid up in such equipment in this country is astonishing. In such cases, an endowment for botanical research would mean simply a sufficient outlay to pay a reasonable salary to a competent assistant.

Of course many professors have neither ability nor inclination to pursue original investigations, and for such we make no plea. But there are some who have already shown their ability and desire in this direction, in spite of many other time-consuming duties, and it is for such that we urge a more liberal allotment of time. It has been said that our boards of trustees can not be made to understand that anything is needed in a university except teachers and equipment for teaching, but we have just that faith in the growing intelligence of our people, which leads us to believe that we will not long be without some such provision as we have suggested.

THE NEED OF giving careful heed to the work of German botanists, both of to-day and of earlier times, is illustrated anew by the experience of Dr. Bessey, who informs us that he finds in a German work just at hand that the adventitious character of the inflorescence of Cuscuta glomerata, discovered by him, and brought to the attention of the American Association a year and a half ago, and thought to be a new fact by all American botanists, has been known across the water for some time. He will have something further to say in regard to the matter in the March number of the *American Naturalist.* This case, which happens to an eminent investigator whose extensive knowledge of German botanical literature is well attested by his writings, gives us the opportunity of saying that we have been long inclined to think that not enough attention, as a rule, is paid by our less advanced workers to the historical study of the subjects they may have in hand. We do not overlook the fact that few have the ample library facilities afforded the German student. Much can be done to remedy this disadvantage, however, by purchasing the separate papers which most authors now have printed, and which can be obtained by mail through foreign dealers.

THE STRIKING similarity between parts of the biographical sketch of Dr. Gray, published in the January GAZETTE, and the account of his life, from the pen of Dr. C. S. Sargent, published in the New York *Sun* of January third and reprinted by the author in pamphlet form, makes it necessary for us to say, in simple justice to the GAZETTE, that our article was sent to the printers on December 23 and the proof of it corrected and returned before we had seen Dr. Sargent's paper. The reader of the two will notice that the GAZETTE's sketch is much fuller in its account of Gray's early life, while Dr. Sargent's contains a much more extended history of his botanical labors. Having both had access to the same source for our facts the two papers naturally agree closely in some points while at the same time they supplement each other.

THE EDITORS OF THE GAZETTE intend to make their June number one for collectors. This will include not only directions for collecting and preserving all forms of plant life, but all the details of herbarium work. Many specialists will furnish notes pertaining to their own departments, but this early notice is given, with the request that all collectors in every department and all herbarium workers send us notes concerning the collection, transportation, preservation, and final arrangement of plants. The coöperation of botanists will make this number a valuable collector's hand-book.

THE PORTRAIT of Dr. Gray, which we published in our last issue, was made from a photograph taken in 1880. It was selected by Mrs. Gray from the numerous ones in her possession as being the best likeness of the Doctor.

OPEN LETTERS.

Some Variations.

In July, 1885, I collected, in Somerset county, Maine, several specimens of Botrychium matricariæfolium, in which the fertile segments were more compound than in the usual forms, and the sterile segments were smaller, especially narrower, and had sporangia around the edges. Curious looking specimens when compared with the ordinary forms beside which they grew.

In August, at Wenscott Reservoir, R. I., I collected a handful of Monotropa uniflora, one specimen of which had seven petals, twelve stamens, and a six-celled ovary; another had six petals, thirteen stamens, and a six-celled ovary. Several other specimens had some of the parts slightly multiplied, but not so much as these two.

Providence, R. I. — J. FRANKLIN COLLINS.

Botany at Harvard.

With your permission I should like to explain the statement made on page 397 of the GAZETTE for December, as I understand that some readers have been puzzled to understand why the cryptogamic laboratory of Harvard University is separated from the phænogamic laboratory and united with the zoological department, as appears to be the case from the statement in the GAZETTE. One of the elective courses in the college is called elementary biology, and in that course the rudiments of both botany and zoology are taught by the study of a few types, a plan pursued in several colleges of the country. This course is given in a large-sized laboratory at the Agassiz Museum, and the zoological portion is taught by Prof. Faxon, while it is my duty to teach the botany, which includes not only types of cryptogams, but also of phænogams. This is properly the biological laboratory so-called, and the cryptogamic laboratory is in an adjoining room, in which the large collection of thallophytes, together with an illustrative herbarium of higher cryptogams and phænogams, is deposited. In this room all the special cryptogamic work is done with collections and books at hand. During half of the college year general work on cryptogamic botany is taught at the laboratory in Harvard Hall. I am led to make this explanation lest some of your readers may otherwise infer that the botanists of Harvard believe in keeping cryptogamic botany distinct from phænogamic botany. The contrary is true, and no one would be allowed to take the courses in cryptogamic botany proper who had not previously passed a satisfactory examination in phænogams.

Cambridge, Mass. W. G. FARLOW.

CURRENT LITERATURE.

Revision of the Canadian Ranunculaceæ. By Geo. Lawson, Ph. D., LL.D. From Trans. Roy. Soc. Canada, ii, pp. 15–90. 4°. 1884.

In this extended paper on plants of a single order the author has treated very fully of the synonymy, description, geographical distribution and local occurrence of each species known to have been found in Canada. In instances where doubt exists respecting the validity of a species' claim to recognition, he has entered into a discussion of historical data in regard to it. This paper was preceded by a similar one published in 1870, and embodies the results of riper study, and the additional information secured through private collectors and the Canadian Survey. The extent of the labor involved in its preparation may be inferred from the fact that the index contains 418 different names of the plants embraced in the paper, of course including synonyms. The work will prove valuable to all students of the North American flora, and particularly so to those of Canada, for whom it is specially designed.

Dr. Lawson is author of a number of other botanical papers on the Canadian flora, especially in reforence to several rare plants, including Calluna vulgaris, Sedum Rhodiola and others.

Manual of Rocky Mountain Botany. By John M. Coulter, Ph. D., Professor of Botany in Wabash College. Ivison, Blakeman, Taylor & Co. New York and Chicago, 1885. 8vo. pp. 452, and a glossary.

This volume is one of a botanical series published by the above-named firm. Of course we expected to find the press-work, paper, and binding satisfactory, and the expectation is fully met. It is, however, in some respects unfortunate that so close a conformity to a style adopted years ago was adhered to.

It is to be hoped that we shall have a complete flora of North America from the master, who has so long had this great task before him. The continued influx of new species must make his labor appear like the hopes of Tantalus. A volume containing all our known species requires to be supplemented almost as soon as the printer's ink is dry.

To-day, no single book, or series of books, can be designated as the Flora of North America. It must be years before any such can be produced. It was a graceful thing on the part of Professor Gray to suggest the preparation of this Rocky Mountain Manual to Professor Coulter. *Truly it meets a want*; and will leave the dwellers in the region between the 100th meridian and the western slope of the Rocky Mountains, on one hand, and between the latitudes of Southern Colorado and British Possessions, on the other, without excuse for remaining ignorant of their own flora.

The contents of the book might be outlined in tabular form, thus—

	Genera.	Indigenous species.	Varieties.	Introduced species.	Species likely to be found.
Polypetalæ..................38 Orders	184	613	59	11	4
Gamopetalæ ....23 "	181	662	149	9	?
Apetalæ.......................14 "	49	166	26	3	1
Total Dicotyledons.....75 Orders	414	1441	234	23	5
Monocotyledons ....13 "	104	344	49	7	7
Gymnosperms............ 2 "	6	16	6	0	?
Vascular Cryptogams.. 7 "	19	44	3	0	2
Total.........................97 "	543	1845	292	30	14

The 30 introduced species are divided among 11 genera. These added to the 543, would bring the entire number of genera up to 554.

Approximately, we may estimate the area covered by this manual at 460,000 square miles. When we remember that Chester county, in Pennsylvania, with but 738 square miles, has an indigenous flora of nearly 1,200 species, it serves to bring out strongly how little, even in favored regions, mere area has to do with the number of specific forms a flora may contain. Another interesting fact as bearing upon introduction of plants is, that while Chester county has probably not less than 200 introduced species which have obtained a hold, Professor Coulter's region, vast as it is, has has thus far but 30. These figures may be useful in future as showing relation of increase to time and commercial avenues, though being mostly more or less vile weeds, the west can certainly desire no increase of the number thus brought in.

Leaving the state of Michigan from the area embraced by Gray's Manual, it will then be found that Coulter's Manual covers nearly an equal surface. Considering how widely different, in the main, these floras are, it is interesting to note, that Gray describes 85 genera and 345 species of Compositæ, while Coulter has 87 genera and 354 species. Of Orchids there are nearly four times as many species in the eastern as in the western region. Including his solitary "addendum," Coulter gives 88 species of Carex, while Gray's Manual has 151. Our region is richer both in genera and in species of Coniferæ than that of the Rocky Mountains. Touching the south-western hot belt, it is not surprising to find Professor Coulter's region so well represented in Cactaceæ. We have more genera and fewer species of Leguminosæ than the western area now considered. Of course Oxytropis and Astragalus explain this.

In area, Nevada and Utah, whose flora Mr. Watson has described, is to that of Professor Coulter's range *about* as 2 is to 5. At the date of his publication (1871), Mr. Watson enumerated in his field, west of, but adjoining the Rocky Mountain region, 1,235 species, representing 439 genera and 84 orders.

The Rocky Mountain Manual merits a much more extended notice than the space permits. It must be said, however, that it is destined to mark an educational era for that portion of our country. Two months ago there was not a single volume to be had which enabled practical botany to be taught there in the schools. Now there is one of the very best character—concise, but full enough and thoroughly reliable.

It is true that here and there one detects an oversight. Thus we find Leucampyx in the text and Leucocampyx in the index. The use of a single paragraph for genus and species both, when there is but one of the latter, mars the appearance of the page. Hence we do not like it. It is a deviation from plan, and slight as it is, will prove an annoyance to the teacher, who is always troubled to keep these distinctions before his pupil. It is all the worse, too, that this want of uniformity does not run throughout the volume after it was started. Compare Anaphalis with Melampodium.

Gymnospermæ are placed where they should be—after the Monocotyledons. Abolition of the Spadiceous, Petaloideous and Glumaceous Divisions in the key is good; as one is no longer called upon to apologize, before pupils, for the appearance of Juncus in the second and its absence from the third of these groups.

There is, we think, a serious oversight in failing to give an artificial key to the Tubulifloræ in Compositæ. The order is, in general, considered by students difficult, if not unapproachable, but with such a key as is found in Gray's Manual these difficulties vanish after a few lessons. True such keys do not teach affinities, but they are very likely to lead to a desire to know more about them.

Prof. Coulter deserves not only the gratitude of his botanical brethren, but also that more substantial recognition from educators which results in prompt and large sales of needed and meritorious books. The call for a new edition can only be a matter of a short time.

J. T. ROTHROCK.

Zur Morphologie und Biologie der Niederen Pilzthiere (*Monadinen*), zugleich ein Beitrag zur Phytopathologie. Von Dr. W. Zopf. Veit & Co. Leipzig, 1885. 4°. pp. 45. 5 col. plates.

This is an important contribution to or rather against the monera theory. It consists of a careful and keen study of the biological changes in the life of ten species belonging to the genera Vampyrella, Protomonas, Diplophysalis, Pseudospora, Aphelidium and Gymnococcus. These are representatives of the lowest forms of the protozoa, and lie upon the debatable ground between animals and plants. Most English biologists place them in the animal kingdom, just below the amœba. Zopf has classed them with the Myxomycetes in his work on *Pilzthiere oder Schleimpilze* (see this journal, vol. x, p. 332). Hæckel set them apart in a group he called the "monera" (see his History of Creation, Studien über Monera, or Leidy's Rhizopods of N. A.). The characters and relations of the monera are very well stated by Packard in his *Zoology* (p. 18). The work before us, however, touches only incidentally upon their general relationship, dealing more especially with their morphology and biology.

The monera, according to Hæckel and subsequent writers, are characterized by the simplest organization, consisting of undifferentiated protoplasm without nuclei or vacuoles. It was Zopf's good fortune to come across a fine quantity of Vampyrella among some fresh-water algæ, and he took the occasion to test the correctness of the diagnostic characters by a critical study of their structure and changes. He first treats of *V. vorax* Cienk. A very large specimen of this readily shows a border of weakly refractive protoplasm, free of the minute granules which are abundant throughout the remainder of the individual, thus demonstrating the presence of a true ectoplasm and endoplasm, as in amœba.

The most careful examination with the best immersion lenses failed to reveal a nucleus until staining was resorted to. Brandt's method of staining living organisms was first tried, which consists in using a dilute watery solution of hæmatoxylin containing a very little alum. This brought into view a number of small round bodies, first colored pale, then a deep blue. By using other staining fluids, such as borax-carmine, alum-carmine and strong hæmatoxylin, after killing with some fixing reagent like chromic or picric acid, it was readily determined that individuals contained from one to several dozen of these bodies.

according to size. The proof that these were not pyrenoids or any protoplasmic bodies other than nuclei was demonstrated by their amœboid properties.

Close scrutiny further showed a reticulated arrangement of the protoplasm, which had also been observed by Cienkowski, Hertwig and Lesser. These investigators were unanimous in considering that it was due to numerous non-contractile vacuoles. Zopf was struck with their uniformity in size, and the fact that under the highest magnification they did not appear to change their form or size in the least, as vacuoles would be likely to do. He therefore surmised that they might be solid bodies instead of empty spaces, and upon crushing an individual found it to be so. By micro-chemical tests these were shown not to be starch, cellulin or cellulose, but paramylum.

We can only glance at the remainder of this very instructive and interesting investigation. Vampyrella vorax was found to possess several nuclei and numerous paramylum bodies; V. Spirogyræ, V. variabilis, V. pendula and Protomonas amyli each contain a nucleus and contractile vacuole, or sometimes two or three. It is therefore evident that Hæckel's monera group must either be characterized anew or these species excluded; it is even possible that what is true of these may be true of all other members of the group.

Studies upon five new closely related species are given in addition to the above, and the whole is summed up under the headings morphological, biological and systematic.

Aside from the important facts which this memoir contains it is worthy of careful examination for its explicit and suggestive methods.

NOTES AND NEWS.

DR. CHARLES E. BESSEY, Lincoln, Neb., desires to obtain dried or alcoholic specimens of various species of Cuscuta, either by purchase or exchange.

SZYSZYLOWICZ has published in Engler's *Jahrbuch* the first two parts of a paper on the systematic arrangement of the Tiliaceæ. It has not yet reached the genus Tilia which most concerns American botanists.

BENEDICT RÖZL died at Smichor, Prague, on Oct. 14 last, 61 years of age. He was an extensive collector, especially of orchids, and had traveled through the southern United States and other parts of North and South America.

THE DECEMBER NUMBER of *Queen's Microscopical Bulletin* appeared with a cover, a permanent acquisition which gives it more of a magazine appearance. Although a small journal, it contains valuable items for workers with the microscope.

THE POTATO ROT (Phytophthora) destroyed last year one-third of the crop in the State of Michigan, and a still larger proportion in New York. Michigan raises in prosperous seasons 9,000,000 bushels of potatoes. The importance of the thorough economic study of such a disease is sufficiently evident.

AT THE ANNUAL ELECTION of January 12, 1886, Mrs. E. Britton and F. J. H. Merrill were elected editors of the *Torrey Bulletin* for the coming year, to succeed Mr. W. R. Gerard. All exchanges or donations of papers or books for the club's library, are to be hereafter addressed "Torrey Botanical Club, Columbia College, New York City." Papers and notes for publication should be sent to the same address.

THE ITALIAN GOVERNMENT will open on March 2 an International Exhibition of apparatus for the application of remedies in solution, powder or mixture against animal and vegetable parasites of plants, especially the grape mildew. Prizes will be given as follows: One gold medal with $100, three silver medals with $30 each, and five bronze medals. A similar exhibition for southern France will be given February 15 to 17, under the auspices of the Central Agricultural Society of the Herault.

Dr. W. T. Thiselton Dyer, who has acted for some years as assistant director at the Kew Gardens, has been promoted to the directorate, to fill the place left vacant by the resignation of Sir Joseph D. Hooker. Dr. Dyer's name is familiar to botanical students in this country as one of the translators of Sachs' Text-book, and also in other ways. The position of assistant, which has become of almost as great importance as that of director, has been offered to and accepted by Mr. D. Morris, F. G. S., heretofore Director of Public Gardens, Jamaica.

Protoplasmic continuity in the Fucaceæ continues to be a subject of investigation by Thomas Hick. In the *Journal of Botany* for December he gives his results with Himanthalia lorea and Laminaria digitata, at the same time apologizing for including the latter with Fucaceæ. The most effective agents for swelling, clearing, and even dissolving were necessary. In both these cases continuity of protoplasm was clearly made out for the cortical and central tissues, but not at all for the epidermal. In Himanthalia continuity is maintained by means of comparatively stout cords of protoplasm and also by sieve-plates, while in Laminaria it is chiefly through the intervention of sieve-plates.

The existence of Salvinia natans in this country has always been doubted. The only evidence that it grows in the United States is the statement of Pursh that he saw it in Western New York, but his collections which went to Lambert's herbarium contain no specimens of it. Recently, however, Mr. C. H. Demetrio has forwarded to Dr. Asa Gray specimens of genuine Salvinia natans collected in a bayou of Bois Brulé creek in Perry Co., Mo. Whether the specimens are native or accidental introductions remains to be determined. It is hard to believe them native, as the plant could hardly be confined to so limited a locality and is conspicuous enough not to be easily overlooked where it does grow; and it is equally difficult to understand how they could possibly be introduced.

The Geographico-botanical Exposition held in Copenhagen last April under the supervision of M. Carl Hansen met with excellent success, according to a lithographed account just received. It was held in the halls of the Royal Danish Society of Geography, and aimed to give an idea of the vegetation of different regions of the earth by grouping living plants from conservatories and the open ground in as natural relations as possible. These were fully labeled, and additional information given by means of charts, pictures, etc. Although no prizes were given, both amateur and professional cultivators gave all possible aid, and the public showed its appreciation by a good attendance. This is one of the first exhibitions of the kind yet attempted, and its success ought to stimulate similar exhibitions elsewhere.

Red snow was the subject of a paper by Romyn Hitchcock, before the Biological Society of Washington, which is printed in the December number of the *Amer. Micro. Journal*. Such snow was observed by De Saussure in Switzerland as early as 1760. The observations made by Captain Ross and the material brought by him from the Arctic regions in 1818 attracted special attention. It stained the snow deep crimson on the sides of cliffs eight miles in extent, and penetrated in places to twelve feet below the surface. It was then deemed of vegetable origin, but the affinities were not more closely determined. It has often been seen in recent years, and has been classed by different writers as a fungus, alga and lichen, and has at various times been placed in the genera Uredo, Palmella, Protococcus, Lepraria and Chlamydococcus, and its true position seems yet in doubt. Its growth and development has not yet been traced.

CAMPBELL ON BOTRYCHIUM

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The Development of the Root in Botrychium ternatum.

DOUGLAS H. CAMPBELL.

(WITH PLATE IV.)

Among the peculiarities of the Ophioglossaceæ distinguishing them from the true ferns are the roots. These are much less numerous, but of correspondingly greater size, only one root being developed at the base of each leaf, and consequently, in such forms as produce but one leaf annually, but one principal root is formed each year, though probably several leaves are developed the first year, and a corresponding number of roots. On account of the extreme shortening of the internodes of the stem, which in large specimens of the species under consideration seldom reaches a length of more than two or three centimeters, the roots are much crowded.

The roots are thick and fleshy, and almost completely destitute of root-hairs, thus differing very much from most other pteridophytes, the older ones being sometimes 3mm. in diameter. They have a thin brown epidermis in the younger parts, becoming in the older portions thicker and wrinkled, forming with the underlying tissue a tough and ridged cortex.

Arising from the larger roots are smaller ones, formed in acropetal succession, but in smaller numbers than in the true ferns, and not as distinctly two-ranked. Nothing was observed to indicate that they arose dichotomously, or in any way differently from the ordinary methods in other pteridophytes. In some cases it was evident that a lateral root had taken the place of the main one, whose apex had apparently been in some way injured, and in one case this had been repeated, two roots branching out the second time nearly at the same point, diverging widely, and at first sight having the appearance of dichotomous branching, but their lateral origin was plainly evident on closer examination. Possibly the supposed dichotomous branching of the roots was inferred from some such cases. Occasionally where secondary roots were developed very early, they also gave rise to lateral rootlets, but this was not very common.

Longitudinal sections through the conical end of the root show a very early division of the young tissues, which a short distance below the apex becomes very conspicuous. The growth is due to the division of an apical cell of the usual form, whose derivative cells become differentiated into the permanent tissues of the root. The root-cap differs in appearance from that of the true ferns in the indistinctness of the layers of cells representing the successive segments of the apical cell, all traces of the stratification so conspicuous in true ferns being very early lost. Occupying the center of the root is a cylinder of procambium cells, and surrounding this, several rows of broader cells, with intercellular spaces between their lateral walls. On account of the air occupying the spaces, this zone of cells is very conspicuous when the section is mounted in water. Lying outside of these cells is a second zone of smaller cells destitute of intercellular spaces, and surrounding the whole is the epidermis whose cell-walls, very early, become brown in color, and form a continuous thin brown covering over the end of the root. Some of the cortical cells lying immediately underneath later have their walls similarly changed.

The apical cell (figure 1. *a*) is a nearly equilateral tetrahedron in form, and the succession of segments seems to be perfectly regular. Each segment is formed by a wall parallel to one of the faces of the apical cell, the cell thus formed being tabular, with the broader faces triangular. The cap-cell is the last formed of each cycle of segments, and differs in its subsequent divisions from the three lateral segments. Each of the latter is first divided into two nearly equal cells by a radial wall (figure 2. *a*). In each of the cells thus formed a tangetial wall arises, dividing it into an inner and an outer cell, the former being the larger; and very soon after, the inner cell becomes further divided by a second tangential wall into two nearly equal cells. Of the three cells into which each half of the original segment is now divided, the inner one gives rise to the central procambium cylinder of the root; the middle one to the ground tissue lying next the procambium, and probably to the whole, or at any rate to a large part of the cortical parenchyma; from the outer cell, the epidermis and possibly part of the cortical tissue. I was unable to determine positively whether or not the outer cell underwent any further division by walls parallel to the first wall, that is, whether the cells derived from this outer cell formed more than one layer, or whether all the subsequent division walls were perpendicular to that first formed.

In the segments from which the root-cap is formed, the first wall, as seen from above (figure 3. I), is parallel to one of the sides of the triangular cell, dividing it into two unequal cells, an elongated four-sided, and a triangular one. The former is divided into two by a wall perpendicular to the first (figure 3. II), before the other is divided. For a short time walls are formed only at right angles to the broad faces of the segment, as in true ferns. In the latter this remains permanent, so that the root-cap consists of a series of distinct strata or lamellæ, each composed of a single layer of cells, and representing a single segment of the apical cell; but in Botrychium walls are soon formed in all directions, and thus the original strata become so merged as to obliterate completely the boundaries between them.

In the lateral segments there are formed for some time walls perpendicular to the broad faces only of the segments, so that the latter remain for some time single layers of cells, the growth of the segments being almost entirely lateral, and the vegetative cone is thus rendered very obtuse. The first transverse walls are formed in the outer cells, where they continue to form rapidly, alternating with longitudinal walls and forming a small-celled tissue whose cells are nearly cubical in form. Divisiốn does not occur so rapidly in the cells lying nearer the central part of the root, and these are consequently of larger size; they also very early show intercellular spaces. Those lying immediately in contact with the procambium cells of the central cylinder are narrower than the others and form the bundle-sheath, which, however, never becomes very sharply differentiated.

The tissue derived from the innermost cells of the segments is composed of cells whose transverse divisions are very few as compared with the longitudinal ones, and are therefore long and narrow, this becoming very early marked and sharply separating the central plerome cylinder from the surrounding tissues. The transverse partitions are usually oblique so that the cells have more or less pointed ends, forming the procambium (figure 1. *pr*). All of the young cells possess a large central nucleus from which radiate protoplasmic threads, which with the peripheral protoplasm of the cells contain numerous granules.

The root soon reaches nearly its full diameter, any further growth being due to increase in the size of the cells, and longitudinal divisions cease, although for some time transverse walls form rapidly except in the procambium cells. These finally cease and the subsequent lengthening of the root is due to the elongation of its cells.

The epidermal cells become thicker walled, the walls at the same time becoming brown, and the cells losing the greater part or all of their contents.

The ground-tissue cells remain distinguishable into two portions, although this is not so evident as in the younger parts of the root. They develop great quantities of starch in small, roundish or oval granules, these being especially numerous in the larger celled inner parenchyma.

The development of the different parts of the fibro-vascular bundle is most readily followed by means of a series of transverse sections. Such a section, made before any of the permanent tissue is formed, shows that the young bundle is composed of a mass of thin-walled cells whose diameter is very much less than that of the surrounding ground-tissue cells, so that the young bundle is clearly defined (figure 4).

The first indication of the formation of permanent tissue is a change in the walls of certain cells arranged in groups at the periphery of the cylinder and at equal distances from each other (figure 5, *ph*). Their walls become noticeably thicker and strongly refractive, so that they are easily recognized. These cells form the beginning of the phloem masses of the complete bundle. Shortly after the first phloem cells have become differentiated, there are formed at equal distances from them, also at the outside of the bundle, an equal number of groups, consisting at first of two or three cells, whose walls become strongly thickened, but appear opaque, so that they differ markedly from the phloem cells. These are the primary tracheids and form the beginning of the xylem (figure 5, *xy*).

A longitudinal section of a bundle at this stage shows that the primary tracheids are narrow pointed cells, with spirally thickened walls, the spirals more or less confluent so as to form reticulate markings (figure 7, *tr*).

The further development of the bundle proceeds very slowly, the formation of permanent tissue continuing from the points at the circumference toward the center. The secondary tracheids, for there are no true vessels, are frequently marked with bordered pits, resembling more those of gymnosperms than the scalariform markings of the vessels of ferns. Their formation can be readily followed by making thin longitudinal sections at points where the bundle is not fully formed.

These markings begin by the thickening of the wall leaving spaces of considerable size where the wall remains of its original thickness. At this stage (figure 9), the wall appears marked with large but shallow pits. As the thickening progresses, while the bottom of the pit retains its original diameter, the parts of the wall surrounding it grow over it so as to make the pit assume more and more the form of an inverted cone. The upper opening does not close up, but after it has reached a certain size its walls cease to approach each other and the upper part of the pit has the form of a short tube, so that the whole pit is like an ordinary inverted funnel. On account of the uniform diameter of the neck of the funnel, its outline, when seen from above, is very sharply defined; whereas the outline of the base is much fainter, and the whole pit seen from above appears as a very definite pit whose transverse diameter is the greater, surrounded by a much less distinct, but usually quite evident circle marking the original outline of the pit (figures 8 to 10). In proportion as the pits are more or less elongated and crowded, the tracheid approaches more those of the ferns or gymnosperms. I could not certainly determine whether or not the bottom of the pit was finally absorbed. There is a general correspondence in the place of formation of pits on the adjacent walls of neighboring tracheids, but not so marked as is often the case. Sometimes the thickening of the wall is uniform between the pits, so that they retain the form of unbordered pits.

The bundles differ in form in the main and lateral roots. In the former the mature bundle has a nearly triangular section, the xylem consisting of three radially placed oval masses of tracheary tissue, with three masses of rather thick-walled, imperfectly developed sieve tissue, constituting the phloems lying between. The limits of the phloem masses are not very clear, merging more or less into the thin-walled parenchyma, constituting the rest of the fibro-vascular cylinder. In the lateral roots the bundle is oval in outline and the xylem and phloem in two masses instead of three (figure 6). In neither case do the separate masses coalesce. In one case a very strong main root showed four instead of three xylem and phloem masses.

The phloem consists of elongated cells of varying diameter, some of the larger ones with the transverse walls only slightly oblique, probably being undeveloped sieve-tubes. The rest of the cells are narrower, with much more oblique walls, so that their ends are often decidedly pointed; otherwise they differ but little from the surrounding parenchyma.

EXPLANATION OF PLATE IV.—Fig. 1. Longitudinal section through the apex of a main root of *Botrychium ternatum*. × 150. *a*, apical cell. *pr*, procambium cylinder. *c*, root-cap.

Fig. 2. Transverse section through the region of the apical cell. × 150. The first six lateral segments are numbered.

Fig. 3. Young segment of root cap, showing the first division walls, I and II. × 245.

Figs. 4–6. Transverse sections through the young bundle of a lateral root. 6 is practically complete. *ph*, phloem. *xy*, xylem. × 245.

Fig. 7. Longitudinal section of the bundle of a main root, of about the age of Fig. 6, showing the primary tracheids, *tr*. × 245.

Fig. 8. Longitudinal section through mature bundle of main root, showing parts of two complete tracheids. × 500.

Fig. 9. Surface of the wall of a young tracheid, showing the early stages of the bordered pits. × 500.

Fig. 10. Section through the wall separating two tracheids with bordered pits. × 500.

On Some Recent Notes and Descriptions of Eriogoneæ in the Proceedings of the California Academy of Sciences.

C. C. PARRY.

The present energetic and successful botanical collector of the California Academy of Sciences, Mrs. M. K. Curran, having lately undertaken the very different work of systematic description in the published Proceedings of the Academy, the views there presented naturally call for some notice in the current pages of botanical literature.

Having lately given some attention to the study of Eriogoneæ the writer was naturally much interested in seeing whatever new light might be thrown by recent discoveries on the difficult problems of systematic classification, and having been kindly favored with authentic specimens and published notes from the above source, the following suggestions are respectfully offered. The old difficulty of strictly defining genera and species, that in the now prevalent Darwinian view are genetically related, is only equally true of Eriogoneæ as of other more or less closely associated genera, and the only satisfactory solution is in a careful exercise of judgment based on extensive observation and experience. As Mr. Bentham, the most profound of modern botanical systematists, has wisely remarked, "Any tyro with a little practice can draw up long descriptions of *specimens*, fairly detailing every organ, but the selecting the characters necessary to give a good idea of a *species* in a short description requires a thorough knowledge of the subject and a methodical mind." In the brief pages 1–4 of the Calif. Acad. Proc. for 1885–86 Mrs. Curran claims to have data, mainly derived from her own recent discoveries, to invalidate some of the long established genera of Eriogoneæ, even at the risk of merging all into the single polymorphous genus Eriogonum. To properly substantiate such a claim we would naturally look for very important discoveries, but, as far as the pages referred to show, only two are brought to light. The first of these is a very well marked Eriogonum, closely related to the well-known *E. angulosum* Benth., showing in fact no essential difference either in involucral characters, or internal bracteoles, only indeed remarkable for the excessive wooliness encompassing the flowers, on which the very appropriate specific name, *E. gossipinum*, is based. On the strength of this normal species, however, Mrs. Curran proceeds at once to demolish the Nuttallian genus Nemacaulis, and hastily constructs a section of Eriogonum, "*Bracteolata*," in which it is snugly ensconced, being somewhat strangely followed by a species (E. Greggii) which she knows only from description.

Having on a previous study of this genus carefully examined its character, and at one time even ventured to anticipate Mrs. Curran's conclusions in merging it into Eriogonum, as E. Nemacaulis, on the advice of other experienced botanists, a second sober thought induced me to withhold my rash hand, and while still seeing how a further development of involucral characters, by uniting the lower series of spiral bracts into a true whorl, would break down the generic distinction, till this is accomplished the genus may well stand as Prof. Gray suggested, one of the very best of the Eriogoneæ genera. Therefore I doubt not the botanical verdict will be in the case under consideration "not proven," and *Nemacaulis Nuttallii* Benth. will still escape an italicised reduction.

Coming next to Chorizanthe, the above writer, after designating two unimportant varieties, comes out with a detailed description of a minute, inconspicuous plant (barely three inches high), under the name of *Chorizanthe insignis*. Why so designated does not appear, either from the specimen or description. At the same time not a single character is given to keep it out of the genus Oxytheca, as at present defined, the entire absence of basal spurs, as well as an increased number of flowers, with obscure bracteoles at the base, clearly separating it from C. leptoceras, which it outwardly resembles, and, therefore, unmistakably a genuine Oxytheca, only approximating, as one would naturally expect, the allied but very distinct genus Chorizanthe. Having thus glanced at the descriptive work, we may go back to the preliminary views with which the descriptions are prefaced.

While realizing fully the difficulties that seem to crowd upon the path of discovery in the clear definition of the Eriogoneous genera, we fail to get any light here in the confused statements made. Instead of which there are crude views of relationship, such as comparing the involucroid perianth (?) of Lastarriæa, with the entirely normal one of Hollisteria, to which it has not the most remote resemblance, and which the author of the genus failed to recognize in his clear description.

The "theory" of a reduced perianth in Chorizanthe Lastarriæa is demolished in a single paragraph by the inability of the writer to recognize under her microscope a character which the original describer clearly laid down, which is (perhaps in rather an exaggerated way) shown in the published plate, and which all subsequent descriptions have plainly stated, viz: a series of lobed appendages alternating with the stamens, reasonably representing a reduced perianth. Only one other point in this connection, on which the writer feels competent to express an opinion. What Prof. Gray once suggested, but with an important reservation, might be the equivalent of an involucre in Lastarriaea in the subtending whorl of cauline bracts, is utterly inadmissible from the fact that besides the so-called perianth, they encircle invariably the extending axis, thus showing that it is a true cauline and not a floral appendage. This is also clearly not the case in Oxytheca luteola (or any other Eriogonous species), where as in the former case the irregular whorl of spines enclose only the cluster of bracted perianths.

In conclusion, may we not express the earnest hope, in the true interest of systematic botany, that before botanical science is loaded down with useless synonyms, or made obscure by crude speculations and rash innovations, those who venture to leap will first take a long and careful look.

Botanizing in Texas. I.

J. REVERCHON.

By "botanizing" I do not mean taking a railroad and stopping at such and such a station, taking a ramble or two in the neighboring hills, or sometimes jumping from the cars at a coal station, tempted by some tantalizing plant, and running back with only the top of said plant, at the call of the imperious whistle, and after that running may be a hundred miles before stopping again. That is not my way, as the railroads do not pass exactly where many nice things are found, and I don't care to be in a hurry.

So we started, my wife and I, and Robert Freeman, April 8, 1885, from our home in Dallas county. Freeman was a fine fellow, exactly fit for driving, hunting, fishing, and other duties invaluable on such a trip. Had we met some strayed Apaches or unruly Mexicans, he would have been equal to the emergency. Our covered wagon, drawn by a good team, was packed with provisions, drying papers, arms, etc. It would seem as if we were fixed to travel any length of time, and over any extent of country. I will not venture to describe our appearance, and must not forget that I am writing for botanists, anxious that I begin to botanize.

The evening sees us in the "Lower Cross-timbers," a vast belt of sandy post-oak land that extends a long distance north and south, and separates two regions of extensive prairies. As the season was very backward few plants were in bloom, and I will only mention the Astragalus distortus. After that we reached some cretaceous hills bordering a vast prairie, and here for the first time a botanist traveling from the east will find Actinella scaposa, Scutellaria Wrightii, and Quercus virens, all three very common through the west. Along the streams he would notice Vitis rupestris.

After crossing some extensive prairies we come in sight of the valley of the Brazos. There are limestone bluffs intermixed with sandy patches of post-oaks, some fine prairies, and beautiful clear streams. There we collected Psoralea esculenta, Townsendia sericea, Vesicaria recurvata and densiflora, and Berberis trifoliata. The mountain cedar (Juniperus occidentalis, var. conjungens) also appears for the first time.

We crossed the Brazos near Comanche's peak, and reached the Paluey's valley the next day, through a sandy forest interspersed with rocky prairies. Along streams we collected Ranunculus macranthus. We find nothing new in this valley, nor in the regions south of it for about twenty miles, consisting of woods, prairies, and hillocks.

On the 17th we crossed the Bosque river, and found ourselves in an extensive prairie, where was discovered a rare plant, Amsonia longiflora. We also admired the numerous shades of Castilleia purpurea, whose flowers vary from dark red to white, and from orange to light straw color.

About Cowhouse creek and Lamposas river we were detained over a week by nearly continual showers. On the prairies we noticed Gaura coccinea, Œnothera Greggii, and Melampodium cinereum; along the streams, Clematis coccinea and Nemophila phacelioides; while the characteristic species of the limestone bluffs are Astragalus Reverchoni, Psoralea hypogaea, Erodium Texanum, Vesicaria Engelmanni, and a Sisyrinchium that I expect has no name yet. I also found a little patch of Dodecatheon Meadia. On some rocky hills were the following: Morus parvifolia, Mimosa fragrans, Arenaria Benthami, Galium Texense, Acalypha Lindheimeri, Erysimum asperum, and Hedeoma acinoides; in clefts of the rocks the two ferns Notholæna dealbata and Cheilanthes lanuginosa.

April 25th we reached Lamposas, a town celebrated for its beautiful sulphur springs, which attract many people. Near this place I noticed for the first time Thamnosma Texanum, Astragalus Wrightii, and Menodora heterophylla.

At Lamposas we took the San Saba road, due west through a prairie country dotted here and there by high rounded hills. On the next day, after crossing through a deep gap between two picturesque bluffs, crowned with shrubbery, we left the cretaceous formation for the red carboniferous sandstone. Instead of good grazing prairies there was poor, gravelly, rocky or sandy soils, all hoary with *chapperals* or thickets. These thickets are mostly formed by the following shrubs: Prosopis juliflora, Diospyros Texana, Colubrina Texensis, Lippia lycioides, and Opuntia leptocaulis. Among other plants I note Astragalus Lindheimeri, Cooperia pedunculata, Cereus paucispinus, Cassia pumilis, and Argythamnia ophioides. In nearing the Colorado the country is more regularly sandy, and we found Senecio ampullaceus and Festuca sciurea in abundance.

We crossed the Colorado the 27th. It is a deep stream, bordered on both sides by precipitous bluffs, on which I found Cheilanthes tomentosa and Alabamensis, and also for the first time the beautiful Pellæa flexuosa.

After traveling two or three miles west of the Colorado, over a red sandstone country, we found ourselves again in a hard limestone region. Here the rains overtook us again, and we were compelled to pay a little more attention to the botany of that place. Here the little prairies were dotted with the very beautiful Phlox Rœmeriana; the streams were bordered with Mimulus Jamesii, var. Texensis; while on the rocky bluffs I noticed Selaginella rupestris and Rhus virens.

On the 30th, the journey was resumed in spite of threatening weather. We descended the San Saba valley, full of mesquit (Prosopis juliflora), where I found a plant most abundant on the plains of western Texas. It is an Apium proper, but not the same plant that was collected by me and distributed by Mr. Curtiss. This one must have another name, as the plant found on the plains is certainly the one collected by Capt. Pope.

In a branch of San Saba river, I noticed some Schollera graminea in bloom. At San Saba we took the Llano road south, and soon afterward pitched our tent in a small valley that would have been a fine place for any one to stop, but to me it looked like a botanist's paradise. There was a long hill all capped with perpendicular rocks, where were found Tinantia anomala, Specularia Lindheimeri, Bouchetia erecta, Abutilon Wrightii, Gonolobus reticulatus, and a good many more that I have already mentioned. Beyond this valley lay a country all intermixed with sands or rocky hills, and very disagreeable to travel over. In the valleys the principal trees are mesquit and post oaks; on the hills, mountain cedars and Quercus Durandi. We finally camped on Cherokee creek, in a better looking country. The creek was full of Nuphar advena, and the banks were lined with Carex comosa, and a remarkable variety of Carex acuta.

The 2d of May we reached the granite region of Llano. It first appears as a few granite boulders cropping out among the post oaks, and along with them we noticed the following plants: Tephrosia Lindheimeri, Sida Lindheimeri, and a small plum tree (Prunus glandulosa) covered with fuzzy, unripe fruits, looking very much like small peaches. The people said they were "awful" good when ripe.

The Babyhead mountains were soon in view, a dark mass of nearly naked granites. I was disappointed in finding but two plants I had not seen before, Pellaea Wrightiana and a Selaginella that our best authorities have considered only a form of rupestris. In spite of that honorable opinion I am very much inclined to think it a different species. Beyond those hills, in a sandy valley, we collected Vesicaria grandiflora, Hymenatherum Wrightii, and an Indigofera considered by some to be leptosepala, but quite different in appearance.

At the town of Llano, after we had crossed the river of that name, we turned our faces toward the setting sun, going up the Llano valley. There in the sandy forests were found Dalea nana and lasiathera, Paronychia setacea, Eritrichium Texanum, Vesicaria argyrea, and Houstonia humifusa.

On the 4th, being along the Llano, we stopped on account of numerous species calling my attention. In the scanty soil among the rocks that border the tumultuous Llano were discovered Boerhaavia tenuifolia, Nicotiana repanda, Gilia incisa and acerosa, Bouteloua Burkei, and a shrubby Croton not yet named. In the river Herpestis chamædryoides was found.

The next day, after crossing a very poor country, a perfect desert, where Plantago Patagonica was about the only thing growing, with here and there a tuft of Hermania Texana not yet in bloom, we pitched our tent at the very foot of House mountains, a mass of bold, denuded rocks, quite high for Texas, where there are no true mountains this side of the Pecos. This proved to be a very interesting locality for a botanist, and for a tourist it is certainly so. And now I am sorry we did not stay there a week instead of three days. During that time I had my hands more than full. The ferns were Woodsia obtusa, Notholæna Hookeri, Pellæa flexuosa (with immense fronds) and Wrightiana, Cheilanthes Lindheimeri, and a variety of tomentosa near Eatoni.

Mildews of Indiana.

J. N. ROSE.

The following mildews were collected in the vicinity of Wabash College during the past season. It is not presumed to be a complete list, but merely a beginning, which it is hoped may lead to the cataloguing of all the species of the state. I have also listed the hosts upon which they were found, mentioning those plants which, as far as could be learned, had not before been reported as hosts. This is the first attempt made in this state to determine the various species of this group. The list comprises 11 species and 29 hosts, which have been preserved in the herbarium of the college.

I have followed in the specific descriptions Cooke's "Handbook of British Fungi," Bessey's "Erysiphei of the United States," and "Earle's Podosphæra,"[1] and have used to good advantage in collecting hosts Trelease's "Parasitic Fungi of Wisconsin." Such notes have been added as have come under my own observation, and when the description has not been complete I have added other characters and pointed out differences. These, it is hoped, may be of use in an early revision of some of the ill-defined species.

1. *Uncinula circinata* C. & P.

On leaves of Red Maple. While the perithecia are quite large, .14mm. in diameter, they do not equal those found by Bessey on the Silver Maple. Asci only from 8 to 10.

2. *Microsphæra Friesii* Lév.

Very abundant on the leaves of the Lilac. Common everywhere.

3. *Microsphæra Russellii* Clinton.

Found abundant on leaves and stems of Oxalis stricta, especially on plants growing in moist, shady places.

4. *Microsphæra Platanii* Howe.

On leaves of Sycamore. Common.

5. *Microsphæra Grossulariæ* Lév.

On Sambucus Canadensis. As far as I can learn, this is the first time this species has been found on the Elder in this country. Cooke gives it as a host in his Hand Book. Farlow mentions the Elder as the host of M. Hedwigii; while Trelease gives it for M. VanBruntiana. While our specimen does not corre-

[1]Botanical Gazette, IX. 24.

spond very well with the description given by Bessey for M. Grossulariæ, yet it is more like this than either of the two species just mentioned. The following characters more nearly describe our specimens: Perithecia scattered on both sides of the leaf, globose, minute, .07–.09mm. in diameter. Reticulations prominent. Appendages 10 to 15, prominently dichotomous, 4 to 6 times branched and spreading, clear throughout their length; spread of branches equal, exceeding the diameter of the perithecia; ultimate branches often quite long, tips blunt. Asci 3–7, ovate, containing from 3 to 4 spores.

6. *Podosphæra oxyacantha* DC. (P Kunzei Lév. P tridactyla Wall.)

On the Persimmon and Quince. Bessey gives P. Kunzei, while Trelease adheres to tridactyla. In this species we follow Earle, who has carefully worked out the literature of the subject and has made a special study of this genus. See BOTANICAL GAZETTE, Vol. IX, p. 24. Neither of the above hosts are mentioned in any of the reports which I have at hand. The Persimmon is the first host outside of Rosaceæ upon which this species has been found. The perithecia, however, are few and scattered. All the asci which I examined contained 9 spores, differing in this respect from any of the species of Podosphæra. The description of this species by Cooke is not at all adequate. The description of Earle more nearly includes it. The specimen from the Quince gives the following characters: Amphigenous, fruiting on both sides of the leaf, abundant especially on the upper side. Perithecia dark brown, .08mm. in diameter. Appendages about as long as the diameter of the perithecia, 5 to 16, colored for more than half their length, 3 to 4 times branched.

7. *Phyllactinia suffulta* Reb. (P. guttata Lév.)

On leaves of Dogwood and Hazel; very abundant on the latter.

8. *Sphærotheca Castagnei* Lév.

On Taraxacum Dens-leonis, Bidens frondosa, B. chrysanthemoides, Hieracium, Lactuca, Erigeron. All of these, excepting the first two, are new hosts. Cooke's description is not sufficient to include all these forms. I make the following notes from our specimens: Mycelium often abundant, web like, and commonly persistent. Perithecia globose, very minute, but varying in size, .07 to .10mm. in diameter, on both sides of the leaves and often on the branches and stems, abundant in patches. Appendages equalling or exceeding the diameter of the perithecia. Ascus with few spores, generally 8.

9. *Erysiphe tortilis* (Wall.) Lk.

On Clematis Virginiana. Our specimens are amphigenous, as given also in Bessey's notes. Spores generally 4, often 5 and 6. With these two exceptions the description of Cooke corresponds with our specimens. The plants on which this mildew were growing were in a very sickly condition.

10. *Erysiphe lamprocarpa* (Wall.) Lév.

On Cnicus altissimus, var. discolor, Verbena urticifolia, Ambrosia artemisiæfolia, Helianthus doronicoides, H. annuus, Actinomeris squarrosa, Vernonia fasciculata, Eupatorium perfoliatum, Solidago Canadensis. This is one of our most common and best known mildews. The conidial stage occurs in the early part of summer and lasts until fall. The mycelium is generally very abundant, covering the foliage with a whitish web-like mass. The last six hosts are not given in any of the lists to which I have had access.

11. *Erysiphe communis* (Wall.) Schl.

On some Anemone and Ranunculus abortivus. Our Anemone specimens give the following points: Perithecia abundant on petiole and blade above and below, very dark brown. Appendages 10 to 15, sometimes very long, lower half slightly colored, tips clear. Asci 3 to 4: spores 3 to 5, mostly 4. Perithecia quite variable in size, reaching .11 mm. in diameter. This host plant was found growing in a patch of Ranunculus abortivus which had this mildew upon it, and from which it had probably spread to the Anemone. In the Ranunculus specimen I noted asci from 2 to 6, with spores ranging from 4 to 6.

Three other species were reported in the laboratory last year, but as the specimens were not preserved I could not verify the work, and so dispose of them as nearly as possible from the meager descriptions in the laboratory notes at hand.

Uncinula Americana Howe.

On the leaves of the grape.

A species found on the Elm, and doubtless belonging to the genus Uncinula, is given, but does not come under any of the three species assigned to this host as given by Bessey. The notes give number of asci 10 to 12; spores 5. C. H. Peck is the only one in this country who has reported finding this mildew on the Elm, and hence I judge it must not be a very common form. After a most searching examination of many leaves I was compelled to give up without finding a single perithecium.

The species reported from the Beech is probably *Phyllactinia suffulta* Reb., as Cooke says it is commonly to be found here.

A species was found by me growing abundantly on Poa pratensis in November and again late in December. This Bessey calls *Erysiphe communis* Schl., while Trelease assigns it to *E. graminis* DC. As yet only the conidial phase has been studied and finding of perithecia will be necessary to positively decide the species.

BRIEFER ARTICLES.

Aspidium Oreopteris Swz.—The only American station hitherto recorded for this species has been the Island of Unalaska, where it was discovered by Mr. L. M. Turner in 1878, but by the past season's searches of that indefatigable worker, Professor Macoun, Naturalist of the Geological Survey of Canada, it is now located on the North American continent proper, and no less than about 1,600 miles east of the former station. It was found August 22, 1885, on Mount Dawson, at the summit of the Canada Pacific Railway pass through the Selkirk Range, British Columbia, a little south of lat. 51°. The patches, which were fairly abundant, grew on a comparatively dry slope of the mountain, at an altitude of 6,500 feet, or a little less, and also in wetter soil and at a greater altitude, on a neighboring mountain, the upper slopes of which were covered by a glacier.

The fronds of the Canadian plants are narrower and more graceful looking, both as a whole and in all their parts, than those of the Unalaskan and most European forms, but Professor Eaton, to whom a specimen was sent, writes me that he has one from Mettenius which is as narrow and slender as these. The largest of the specimens received from Mr. Macoun has fronds 1½ feet high, of which 3½ inches forms the stalk, while the middle pinnæ are only 2¼ inches long. The segments, the basal ones of which are often large in proportion to those next them, are but little more than a line in width, and the under surface is but very slightly glandular.—T. J. W. Burgess, M. D., *London, Ontario, Canada.*

A Cheap Camera.—A good substitute for a more expensive camera-lucida for the microscope can be made as follows:

Cut a piece of thin metal, brass or copper, or even tin will do, in the form of a letter L. After smoothing the edges, bend one limb into an unclosed band, to clasp the end of the eye-piece after the cap is removed. Clasp the other limb near its juncture with the ring, with a pair of pliers, and twist it on its own axis through an angle of 90°. On the outer end bend a cock-eye to hold a piece of wood, in the end of which make a slight split and insert the edge of a cover-glass to serve as a mirror. Of course both the image and the pencil-point are seen by looking through the glass, the former by reflected and the latter by transmitted light. The light reflected is sufficient to give good definition when ordinary powers are used. In this way each member of a class can easily make a camera for himself.

J. R. Lowrie.—On December 10, 1885, the death of J. Roberts Lowrie Esq., in the 63d year of his age, occurred at his residence in Huntingdon county, Pa. A son of the Hon. Walter Lowrie, at one time U. S. Senator from the state, he was born in the town of Butler. From Jefferson College he received his first academic degree, with honor, in 1842, and devoted himself to the study of law with his uncle, Judge Lowrie, of Pittsburg, afterward Chief Justice of the Supreme Court. As a field for the practice of his profession he chose Hollidaysburg, in Blair county, but a year or two later removed to Warriorsmark, a village at the base of the Bald Eagle Ridge, near the Alleghanies, where he spent the remainder of his life. Having married Mary, the daughter of Mr. John Lyon, the senior member of a firm which owned one of the largest estates in Central Pennsylvania, including farms, furnaces, forges, ore-banks, and many thousand acres of mountain lands covered with forests, he became its legal adviser and the general manager of the domain.

Thus situated he had ample means and opportunity for the study of the natural sciences, to which he was strongly inclined. Of these, botany was his favorite, as a visitor would soon discover from the full and choice array of botanical works on the shelves of his library and the herbarium which occupied a place in the same room. His love of trees and shrubs amounted to a passion, and he was well acquainted not only with all the wild arborescent vegetation in his neighborhood, but, soon after coming to Warriorsmark, converted the extensive grounds attached to his mansion into an arboretum, where now may be seen, after the lapse of more than thirty years, splendid specimens of many beautiful and remarkable species, native and exotic. In the creation of this park he was guided by thorough scientific knowledge and excellent taste. May it long flourish as a monument to his memory.

But his attention was not confined to the cultivation of trees and shrubs. To him the entire flora for many miles around his home was an object of special interest. He made large collections of the rarer plants, and by his efforts one species new to science was brought to light (*Prunus Alleghaniensis* Porter), and a number new to the state, of which may be named *Ilex mollis* Gray, *Lathyrus ochroleucus* Hook., *Symphoricarpos racemosus* Mx., var. *pauciflorus* Robbins, *Phlox ovata* L., *Pinus pungens* Mx. (since found elsewhere), *Listera convallarioides* Hook. The circumstances under which the last was obtained will furnish a good illustration of his energy and zeal as an explorer. On a botanical trip to the Bear Meadows, an elevated mountain-bog in Center county, he made his way very slowly, and with great toil for a considerable distance, through a dense wall of rhododendrons to an open space where he gathered the plant, its only known station south of N. New York, and then, with his treasure in hand, by the aid of a compass, struggled back through the jungle to the point where he had entered—a difficult and dangerous feat which occupied several hours.

In person Mr. L. was tall and rather slender. His eye was keen and his movements quick. In temperament he was grave but cheerful, and to his intimate friends a most agreeable companion, decided in his opinions but tolerant, a man of sterling integrity and great influence, courteous in his manners, hospitable, and above all an earnest Christian. *Requiescat in pace.*

THOMAS C. PORTER.

EDITORIAL.

THE SUCCESS which has heretofore attended the issue of special numbers leads us to hope that the one announced for June, to cover the work of the field and herbarium, will meet with a hearty response from collectors (and what botanist is not a collector?). The object in view is not to bring together all that might be said in reference to the collection and preservation of plants, our space would not permit that, but to present new and less known methods and observations. Almost every one who gathers plants has some special method or some ingenious device, which has grown out of his experience or necessity; such items are particularly desired. There are also things to be said about finding, gathering and final disposition of certain classes of plants calling for independent treatment, which, although well understood by specialists of each class, are unknown or imperfectly known to others. In order to combine entertainment with instruction some short narratives connected with herborizing will be acceptable. The material for this number will be partly presented as separate articles over the signatures of the contributors, and partly grouped under general headings, in which case due credit will be given for all assistance. There need be no hesitancy, therefore, in forwarding items because they are short, for these will be equally as acceptable and useful as the long ones. A half-dozen well considered lines from each one of several collectors, which may be sent on a postal card, might together form a valuable article. The term 'plants' in this connection is used to cover all vegetable growths which are gathered into herbaria or exsiccatæ, including the various sorts of flowering plants and ferns, the mosses and liverworts, fresh and salt water algæ, lichens, fleshy, parasitic and other fungi, and even the bacteria. There are smaller groups in each of these classes to which general methods are not applicable, and which call for special mention. Material for this number should be sent in as early in April as convenient.

BOTANY IN AMERICA was never in a more flourishing condition than at the present time. American systematic work, especially that emanating from Harvard, has long stood in the front rank, but other departments of the science have not until recently been so assiduously or successfully cultivated. The study of the anatomy, development and habits of plants received a great impulse by the advent of Sachs' Text-book in 1875, and was especially promoted by Bessey's Botany in 1880. The latest addition to this line of text-books, Goodale's Physiological Botany, attests its excellence by receiving commendation, not only at home where it was expected, but abroad. A critical review in the *Botanisches Centralblatt* speaks of it as marking an important event for American science, and ranks it in some respects above the text-books of German writers. The *Gardeners' Chronicle* of England calls it "one of the most useful summaries yet issued." This may be taken as an index to our advancement in the teacher's sphere. It would not be hard to trace a connection between good didactic works and the increase of original research. In the latter we are surely making notable progress. *Nature*, in noticing the Association number of this journal, took occasion to say of the botanical papers presented at Ann Arbor, that "these furnish satisfactory evidence of the good work doing in this branch of science on the American continent, and will not suffer from comparison with a similar record at any of the recent meetings of our own [British] Association." Some of the papers are mentioned as "giving especially good evidence of a capacity for original work." American botanists may well feel encouraged at these signs of intellectual prosperity.

THERE ARE TWO things that we would like to see our systematic botanists do. The first has reference to the citation of authorities. It is the most evident injustice to ignore and lose sight of the author who originally defined a species. This becomes painfully evident when by some change in our notions of generic limitations whole groups of species are set adrift, to be caught up and named in a wholesale way by some one who had nothing whatever to do with defining the species. In such a case it would be very simple to cite two authorities, one in parenthesis referring to the author who originally published the species, under whatever name, the other the authority as now quoted. This would not only be justice, but would also facilitate reference to the literature of the species. The first author holds a peculiar relation to the species that should be acknowledged constantly. It is his by right of discovery, and whatever name it may afterwards be called does not affect this fact, and should not prevent his name being forever connected with it.

The other thing is in reference to generic names. It is our belief that a name once used for a genus should never be so used again even if the genus has been reduced to a synonym. This should be especially avoided within the limits of a single order. There is no telling when the old genus may appear again, and then the new one must be renamed and synonymy becomes confused.

THE NEW EDITORS of the *Torrey Bulletin* have made a change in the dress of that journal and have increased the number of pages to sixteen, using larger type and dividing the articles more prominently. The January number opens with a synopsis of North American species of Myosurus by Dr. Gray. The "Index to American botanical literature," to which eight pages are given in this issue, is an excellent resumé, somewhat after the style of the *Literaturbericht* of German journals. We hope that there will be enough sound American literature to keep this department always full, but we doubt it. We are glad to note the increasing vigor of the *Bulletin*, and wish its new editors abundant success.

A WORD of explanation seems to be necessary regarding the place of publication of the first ten volumes of the GAZETTE. Cataloguers and indexers have fallen into natural mistakes in regard to this matter by assuming, in the absence of any direct statement to the contrary, that the *printers* were also the publishers. One prominent index goes so far as to style it "a migratory publication." As a matter of fact the GAZETTE in the ten years of its existence has had but two offices of publication. From November, 1875, to August, 1879, it was published from Hanover, Indiana, and since that time from Crawfordsville, Indiana.

THE EDITORS were more disappointed than subscribers could have been when the February number of the GAZETTE appeared with the cover of the last decade. It was one of those things which happen, no one knows exactly how. It is proper to say that the same mistake will not be repeated.

THE NUMBERS of the GAZETTE for 1885 were mailed on the following dates: 1, Jan. 8; 2, Feb. 14; 3, Mar. 14; 4, April 24; 5, May 19; 6, June 4; 7, July 11; 8, Aug. 11; 9 and 10, Oct. 7; 11, Nov. 11; 12, Dec. 20.

OPEN LETTERS.

Reverchon's Texan Ferns.

I have received from Mr. Reverchon a set of the ferns recently collected by him in South-Western Texas, and find, among other desirable species, such rare ferns as Pellæa aspera, Pellæa flexuosa, Pellæa Wrightiana (typical form), Notholæna candida and Aneimia Mexicana, well represented.

The specimens are well selected, and in every respect excellent.

As some of these species have long been a desideratum to botanists, they will be glad to know that there is now an opportunity to secure specimens from a collector whose reputation is so well known.

With the ferns came specimens of Selaginella apus, two forms of S. rupestris and Marsilia macropoda A. Br. The specimens of the last being more villous than those which I had formerly received from Mrs. Young, I was led to look upon them as a possible large form of M. vestita, and I am indebted to the kindness of Prof. Eaton for a more accurate determination.

Medford, Mass. GEO. E. DAVENPORT.

A Glue for the Herbarium.

It may interest certain old-fashioned botanists, who in these progressive days still find an interest in herbaria, to know that carriage-glue is an excellent medium for mounting. It is always ready, and one dispenses with the intolerable nuisance of a water-bath. Work which accumulated on my hands to a formidable amount I have been able to quickly and surely discharge by its employment. The glue, which is a semi-fluid, easily thinned by water, comes in tin cans of various sizes, and prices from 30 cents upwards. Given the glue, the curator has then only to provide the small boy to apply it.

Brown University, Providence, R. I. W. W. BAILEY.

De profundis.

A curator of a museum is often placed in a predicament. I am convinced from considerable experience, that connected with every *young* herbarium, at least, there should be an underground railway for the transportation of trash to some Botany Bay. I can not always afford to smilingly bow off a benefactor that offers me a daisy from the grave of Burns, or a sprig of ivy from Kenilworth. In his way he means well, and it might be hard to convince him that scientific interests and those of sentiment may not always coincide. He may, too, be one of the persons back of the academic throne, and hence, as hinted above, the curator must be receptive and bland. But, then, must he not, of necessity, shelve some of these odds and ends?

Again, why are givers, especially botanists, so blind to the best interests of science, as to insist on special cases for their own collections? A herbarium should be continuous and connected. It is exasperating when one wishes to consult things in sequence, to be compelled to hunt through three or four separate collections. Still again, and my cry is from a personal pain, why may not our botanical books be always placed in connection with the herbarium? When, for instance, one desires a volume of the Prodromus, is it quite fair to expect him to walk a quarter of a mile, or even to leave his special building for it? May this "growl" be not wholly ineffectual!

Brown University, Providence, R. I. W. W. BAILEY.

Hypnum Barberi.

In a letter lately received from Mr. J. Cardob of Slenay, France, he says that Mr. Renauld has concluded that *Hypnum Barberi* Renauld, of which a description was published in the American Naturalist, vol. XVIII, should be referred to *Hypnum compactum* Muell. Therefore number 886 of my Catalogue of Musci and Hepaticæ should be struck out.

Wellesley College. CLARA E. CUMMINGS.

Dispersion of tree-seeds.

My own observations are confirmatory of Professor Beal's note in the January GAZETTE. I have long held the opinion that the seeds of the birches and larches, that here spring up so freely in an open field, are distributed chiefly by means of the drifting snow, or rather by blowing along on the surface of the frozen crust. J. VROOM.

St. Stephen, New Brunswick.

Tumble-weeds.

While speaking of "tumble-weeds" other than those of our own country, Dr. Bessey might have mentioned the curious Crucifer, Anastatica Hierochuntina, popularly known as the "Rose of Jericho," though this name is also applied to the hygrometric Selaginellas. It is a native of the sandy deserts of the Levant. At maturity, the leaves fall, the branches (which arise near the base) curl inwards and form a globular mass which the winds uproot and roll about at their will. On being moistened the branches straighten and the pods open. Undoubtedly this habit of "tumbling" has been acquired by these different species to secure wider dissemination. QUISQUIS.

Cambridge, Mass.

CURRENT LITERATURE.

Synoptical Flora of North America. Supplement and Indexes to Gamopetalæ. Asa Gray, LL.D.

The first part of this work was published in 1878, containing the Gamopetalæ after Compositæ. The part embracing the Compositæ appeared in 1884. As some years must elapse before the whole work can be completed it became necessary to publish a supplement to contain additions and corrections. This was especially needed for the older part, and as the first issue of it has been exhausted, the whole of Gamopetalæ have been bound into a single volume, with such changes as can be made upon electrotype plates, containing also this supplement and new indexes.

It is impossible to note with any fullness the changes proposed, when the whole supplement of 80 pages is devoted to nothing else. The point of chief interest to botanists is that they can now obtain a single authoritative book which brings up to date all our knowledge of the Gamopetalæ of North America, and that they can obtain it at a price so reasonable that no botanist can afford to be without it.

The principal changes naturally occur in the orders after Compositæ. An interesting addition to our flora is Littorella lacustris, discovered at several northern stations by our Canadian botanists and others. The recasting of

Gilia, to include Collomia, is a very necessary change, and naturally some changes in nomenclature follow. The revision of the section of Phacelia, which contains P. glandulosa, Neo-Mexicana, etc., has brought relief to some of us whose specimens paid no attention to the old group characters.

The Eritrichium group of Borraginaceæ takes on now its modern appearance, as already noted in these pages, and the genus Krynitzkia contains most of its species.

The genus Mimulus is also revised in view of Mr. E. L. Greene's new arrangement in *Bull. Calif. Acad.*

The most important changes have already appeared in periodical publications, and chiefly in the Proceedings of the American Academy. It is the earnest wish of botanists that the author who has so fully presented this important group of Dicotyledons may be given the time and strength to finish the great work of which this forms so important a part.

English Worthies: Charles Darwin. By Grant Allen. 16°. pp. vi, 201. New York: D. Appleton & Co. 1885.

According to his announcement in the preface, Mr. Grant Allen makes no attempt to enter into the details of the philosopher's life in its domestic and social relations, except so far as these touch his scientific work. He deals with his position as a thinker and worker, bringing out especially his relation to the doctrine of evolution and to those who had preceded him in its development and advocacy. Prominent among those who were preparing the way for Darwin and his work are mentioned Buffon, St. Hiliare, Goethe, Erasmus Darwin, and Lamarck. To the latter, in connection with Malthers, is given the first place in suggesting the solution of difficulties and confirming the opinions of this eminent biologist. The author brings out with great clearness the circumstances that bore most forcibly upon the life work of the man whom nature had so grandly fitted to fill no small niche in the temple of science—himself a good illustration of his own theory of "natural selection." Schooled, not at Oxford, but at Cambridge, where scientific rather than classical studies held the prominent place, it was through the recommendation of his Professor there that he received the appointment as naturalist of the Beagle—an inestimable privilege to one well prepared to begin the study of nature on so grand a scale. No part of the book makes a more pleasing impression upon the reader than the chapter entitled "The Period of Incubation," in which the author dwells on the patience and painstaking of the author of the *Origin of Species.* Darwin's was a genius of the type so well described by some one as being "a faculty for work." To retain and work upon a tentative theory for fifteen years needed almost superhuman patience. But how richly has he been repaid in the stability of his work, to which its strongest enemies can only oppose an unsupported denial. Mr. Allen takes no pains to conceal the fact that his acceptance of the theory goes beyond that of its great expounder. The undercurrent of extreme materialistic views throughout the book in no way advances the cause of science and we can not but regret that the author has seen fit to use his brilliant style to cast a slur upon those who are not yet ready to say with Sir Charles Lyell, "we must go the whole orang." There are many biologists whose powers of reasoning and opportunities of knowing are perhaps quite equal to Mr. Allen's, who are unwilling to accept materialism as the outcome of the Darwinian theory. More respect for such opinions would have well become the writer of this attractive volume.

Ueber intramolekulare Athmung; von W. Pfeffer. Extracted from ——? pp. 636–685.

This extract comes without the least intimation of its source, an unfortunate omission. In it Dr. Pfeffer continues the discussion on intramolecular respiration, the present experiments being based on the work of our countryman, D. W. P. Wilson, to whom full acknowledgement is made. A full discussion of the method of experimentation used, together with a figure of the apparatus, is followed by the details of experiments with seventeen different plants, phanerogams and cryptogams, in various stages, seedlings, leafy twigs, inflorescences or entire plants, at various degrees of temperature and illumination. In the different experiments the ratio of the intramolecular to the normal respiration (*i. e.* I÷N) varies from 0.077 in young leafy twigs of Abies excelsa, to 1.197 in seedlings of Vicia faba at 23° C. The greater part of the paper is occupied by a discussion of these results and critical remarks upon the theoretical explanation of the phenomena of normal and intramolecular respiration.

NOTES AND NEWS.

DR. HENRY G. BULL, of Hereford, England, a mycologist, died October 31, 1885, at the age of 67.

DR. J. E. DUBY, the well-known mycologist, died at Geneva, Switzerland, November 24, 1885, 88 years old.

MILLSPAUGH'S third fascicle of American medicinal plants has appeared, containing 30 colored plates, with descriptive texts.

THE REPORT of the Forestry Commission of New Hampshire, 1885, is a hundred-page pamphlet containing much information regarding the forests of that state.

DR. J. H. OYSTER, of Paola, Kansas, has published a catalogue of North American plants, which seems to be well done, and is surely very useful as a check-list.

STATE AND PROVINCIAL LEGISLATION in the interests of horticulture and forestry is the title of a pamphlet of twenty-eight pages, by Charles W. Garfield, containing valuable information.

AN EXTENDED ACCOUNT of the American pear blight, written by Dr. J. H. Wakker, has been published in *Het Nederlandsche Tuinbouwblad*, a gardening journal of Holland, with a view to ascertaining if the disease is found in that country.

PROF. EDOUARD MORREN has distributed his address entitled "La sensibilité et la motilité des végétaux." It was delivered at a public meeting of the science class of the Royal Academy of Belgium, and is a delightful presentation of a very interesting subject.

AN ATLAS DES CHAMPIGNONS is being published by Octave Doin, of Paris, which gives the principal edible and poisonous mushrooms of France. The authors are MM. Richon and Roze. It is a large quarto with admirable colored plates, and is issued in fascicles at a reasonable price.

THE HERBARIUM of Columbia College, New York City, is being removed to the third floor of the library building. This will give many advantages, not the least of which will be a thorough protection against fire, the building being fire-proof. It will be several months before the work of removal is completed.

PROF. CHAS. E. BESSEY has been appointed State Botanist of Nebraska, and "the sum of twenty-five dollars, or so much thereof as may be necessary," was appropriated to pay the incidental expenses connected with the appointment. With such munificent appropriations it can not be long before the botany of this country is well worked up.

IN THE JOURNAL OF BOTANY for February, James Britten gives proofs to show that the genus *Brodiæa* of Smith should bear an older name, *Hookera* of Salisbury. It is a tardy act of justice to Salisbury, and the case is so well presented that there seems to be no reason for not accepting the change. In that event our species may retain their specific names.

IN THE BULLETIN of the Royal Society of Belgium, Vol. xxiv, J. C. Lecoyer has published a monograph of the genus Thalictrum, with five plates representing the types of akenes. The genus numbers 79 species, of which we have about 10. The name *T. Cornuti* L. is suppressed, which brings up *T. corynellum* DC., but Dr. Gray claims that *T. polyganum* Muhl. is earliest and well enough defined to be distinguished from any other species. By Muhlenberg's name, therefore, this species will probably hereafter be known, at leas among American botanists.

THE FITCHBURG (Mass.) High School, under direction of its science teacher, E. Adams Hartwell, has prepared a catalogue of the plants of Fitchburg and vicinity. It is published by the Agassiz Association of that place, and is well done. As is natural, the old names and order of sequence are used, but as the result of seven seasons' botanizing it is an excellent showing.

WE CLIP the following lines regarding Dr. Asa Gray from the Gardeners' Chronicle of February 6. They were called out by Professor Sargent's biographical sketch in the *New York Sun*: "English botanists claim Asa Gray as one of themselves, despite the accident of his birth on the other side of the Atlantic, and he is held in as great esteem here as in the land of his birth."

WINTER WEEDS is the subject of an illustrated article in *Vick's Monthly* for February, by Warren H. Manning. Capsella Bursa-pastoris, Veronica peregrina, Linaria Canadensis, Lobelia inflata, Hypericum mutilum, Spergularia rubra, Malva rotundifolia and Stellaria media are mentioned. Although most of them are usually classed as annuals, the power of young plants to endure the winter, and often to open the flowers whenever the weather is mild, makes them in effect biennials. They have sometimes been called winter annuals.

EDMOND LOUIS RENE TULASNE died at Hyères on the twenty-second of December last, at the age of seventy. Though he has done no scientific work for the past twenty years, his name is famous by reason of his classical researches upon various groups of fungi, especially the Tuberaceæ, Tremellineæ, Nidularieæ, and Ustilagineæ. His work upon the reproductive apparatus of lichens is likewise well known. He also published papers on various groups of Phanerogams, the most important of which is a Synopsis of Podostemaceæ. Much of his laborious research was shared by his brother, Ch. Tulasne, who died some years ago, their most celebrated joint work being *Selecta Fungorum Carpologia*.

PROF. J. C. ARTHUR has just distributed his annual report for 1885, as botanist of the New York Agricultural Experiment Station. The report shows great activity and, better than all, a desire to grapple with what are really living problems. The average reports from agricultural stations, containing the usual tables of very unimportant results from still more unimportant experiments, has brought considerable discredit upon this kind of work. This report deals chiefly with plant diseases, the topics presented being as follows: pear blight, spotting of quince fruit, rotting of tomatoes, rust and mildew of lettuce, rotting of cherries and plums, disease of clover-leaf weevil, weeds and their fungous parasites.

THE JOURNAL of the Elisha Mitchell Scientific Society for 1884-5 contains one hundred well printed pages of excellent scientific matter. This society draws its inspiration in part from the University of North Carolina, and its work does credit both to the society and to the university. The chief botanical articles are a sketch of the life of the Rev. M. A. Curtis by Dr. Thomas F. Wood, and a list of additions to Curtis' catalogue of plants of North Carolina by M. E. Hyams. The latter is a list of about 150 species, without localities, and not including sedges or cryptogams. The sketch of Dr. Curtis is a scholarly presentation of the botanical labors of this eminent botanist, accompanied with a portrait. There are also notes on transpiration of plants, analysis of Ilex leaves, citric and malic acid in peanuts, cypress in North Carolina quaternary, twisting of the trunks and abnormal leaves of Blephilia, by Messrs. Venable, Schweinitz, Holmes and Hyams.

THE ANDEAN FLORA is the subject of a recent communication to the Linnean Society by John Ball. Dealing with the origin of the Andean flora, the author remarks that a quarter of the phanerogams of the region are Compositæ, probably the highest proportion known in any region, and that of these the most characteristic group is the Mutisiaceæ. Mr. Ball combats the idea of the recent origin of Compositæ, arguing their great antiquity from the variety of forms, the localization of some great groups, and the cosmopolitan dispersion of others. Allowing for all these a community of origin, or even several lines of descent, the results as seen to-day must have required an amount of time for their working out which could hardly be called even geologically recent. The relation of the Andean flora to the Rocky Mountains of North America, brought about by the mountainous connection through Central America and Mexico, is discussed. Polemoniaceæ and Hydrophyllaceæ are both noted as orders whose original home may be considered western North America, having feebly spread southward along the Andes. The order Loasaceæ, on the contrary, shows a South American origin.

AMANITINE and its antidote is the title of an article by C. Macilvaine in the *Journal of Mycology* for January and February, reprinted from the *Medical and Surgical Reporter*. This deadly alkaloid is confined to several species belonging to the Amanita group of mushrooms, as first pointed out by Julius A. Palmer, of Boston, in a communication to the *Moniteur Scientifique* in 1879. The alkaloid was isolated as early as 1868. This poison, when taken into the system, does not manifest itself till a lapse of eight to fifteen hours; one of the characteristic symptoms is a leaden or ash-colored hue of the skin. The one successful antidote is atropine. It had been tested upon the lower animals previous to the season of 1885, at which time it was first tried upon the human system in a case occurring in Pennsylvania from eating the poisonous Amanita vernus. It must be given under the direction of a physician. Polyporei, Boleti, Hydnei, Clavaria and Lycoperdons do not contain a poison, but may sometimes occasion disturbance of digestion by being too old, partly decayed, possessing an acrid or bitter principle, or from over-eating. In such cases the use of sweet oil and whisky, in equal proportions, is considered a sufficient remedy.

THE LITERATURE of 1885 is full of work on the respiration of plants. Two notable papers by MM. Bonnier and Mangin are added to their previous contributions in various French journals. The first of these, *Recherches sur les variations de la respiration avec le développement des plantes*,[1] is summarized by the authors as follows: 1. The ratio of the gaseous exchanges of respiration has not the same value at different stages of development. In general, it passes a minimum during the period of germination, and a maximum about the middle of the development, in an annual plant. For the long-lived plants, the ratio of O to CO_2 passes through the maxima (spring) and the minima (autumn) during the seasons of successive years. 2, The intensity of respiration varies with the development. Annual plants show one maximum during the germinating period and another at the time of flowering. Perennial plants also have two maxima, one at the time of unfolding of the buds and a second at the time of flowering. As a general thing, the species with persistent leaves have a respiratory intensity inferior to that of those with caducous leaves.

The second paper, *La fonction respiratoire chez les végétaux*,[2] is based upon all the previous work of the writers. From it the following general statements may be taken: 1, Within wide limits, for the same plant, at a given moment, the ratio of gaseous exchanges in respiration is independent of the partial pressures of the gases, the temperature and the illumination. 2, The ratio of gaseous exchanges varies with the development of the plant. 3, In a given time the intensity of respiration increases, more and more rapidly, with the temperature, and this increase is continuous and unlimited, even to the death of the plant. It also increases with the humidity of the air, and decreases with the illumination.

AN IMPORTANT and lengthy memoir, by J. Herail,[3] on the comparative anatomy of the stem of dicotyledons sets forth the present knowledge of the subject and adds materially to it. The length of the paper (over 100 pages) forbids a presentation here of more than the general conclusions of the author, which are as follows: 1. The unity of plan of the stem structure persists throughout all the modifications or variations to which this organ is subject. 2. The anomalies of structure are independent of the mode of life of the plant, and nothing is at present known of their causes. 3. Considering the modifications to which the histological structure of the elements of the various tissues are subject, it may be said: (a) that the composition of the wood is independent of the mode of life, but that, as a general fact, the diameter of the vessels is relatively greater in climbing and twining plants than in plants of ordinary habit; (b) that the liber escapes in great measure from this dependence, for, though certain twining and climbing plants have very large latticed vessels, others, growing under analogous conditions, have these vessels very small; (c) that the cortical portion (appareil tégumentaire) certainly varies least under the influence of the conditions of growth (provided it is considered from the same medium): the structure of this portion of the stem is generally identical in a given family and does not vary whether the plant is twining or erect.

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[1]Ann. Sci. Nat., Bot., sér. vii, ii, p. 315-364.

[2]Ann. Sci. Nat., Bot., sér. vii, ii, 365-380.

[3]Recherches sur l'anatomie comparée de la tige des dicotylédones: Ann. Sci. Nat., Bot., sér. vii. ii. p. 201-314. 6 plates.

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EDWARD TUCKERMAN.

I. Biographical Sketch.

[The following sketch is condensed from the notice of Dr. Tuckerman in the Amherst *Record* of March 17, which we understand is from the pen of Prof. Tyler.—Eds.]

Edward Tuckerman, professor of botany in Amherst College, died on Monday the 15th instant, at his residence in Amherst, of which town he was a citizen for more than thirty years.

Edward Tuckerman was the eldest child of Edward and Sophia (May) Tuckerman, and was born in Boston December 7, 1817; prepared for college at Ingraham's school and the Boston Latin school; entered the Sophomore class at Union College 1834, being graduated B. A. in 1837. Thence he proceeded to Cambridge and entered the Harvard Law School, taking the degree LL. B. in 1839. He remained at the Law School till 1841, during which time he took a special course at the Divinity School, and then went abroad and studied several years in Germany, devoting himself particularly to the study of history, philosophy and botany.

Returning to this country, he joined the Senior class of Harvard College, being led to that step by friendship for several of its members, and graduated with them the following year. He subsequently received the degree of M. A. from both Harvard and Union, and LL. D. from Amherst. A taste for the natural sciences very early manifested itself, and during his course at Union College he was appointed curator of the museums. His connection with Amherst College dates from 1854, the years previous being spent in the pursuit of his favorite studies at Cambridge. In Amherst he held the position of lecturer in history from 1854–55, and again from 1858–1873, and professor of Oriental history from 1855–58. It was not till 1858 that he was appointed to the chair of botany, which he held thereafter till the day of his death.

He was married May 17, 1854, at Boston, to Sarah Eliza Sigourney, daughter of Thomas P. Cushing, and leaves no children.

Professor Tuckerman was a student all his life, and studies once begun were never relinquished till feebleness and the inroads of disease compelled him to lay them aside. He was a specialist, and yet he was not one, for he was a scholar in the truest sense of the word, and his attainments were as wide and varied as his reading. His linguistic acquirements were remarkable, and his literary correspondence with foreign scientists was carried on in other languages than his own. In his use of words he was especially nice and discriminating, selecting those which best interpreted the meaning he wished to convey, and frequently anticipating their use, giving them a force which has since been recognized and accepted.

His literary work commenced at the age of fifteen, and between 1834 and 1841 we find him contributing to the *Churchman* a series of fifty-four articles entitled "Notitia Literaria" and "Adversaria," embracing a wide range in criticism, biography and theology. As we read their pages we scarcely know which to wonder at most, the extent and thoroughness of his reading, or the ripeness and maturity of his expression. The boy of seventeen was a full grown man in the stature of his thought, and we can well understand the astonishment with which he was regarded when he first presented himself before the scholars with whom he had long been in correspondence. This same interest in general literature followed him through his life. In 1865 he edited a reprint of "New England Rarities" by John Joselyn, Gent. [A few pages of this quaint volume are devoted to descriptions of plants, most of the species intended being identified by the editor.] Scattered through the publications of the Antiquarian and Genealogical Societies will be found many of his contributions, and recently he has written several articles, chiefly criticisms, in the *Church Eclectic.*

Notwithstanding his close and unwearied application to the chosen study of his life, he still found time to keep abreast of the literature of the day in theology, history and travel. He was a pioneer in the study of the flora of the White mountains, and the ravine which bears his name and the contributions to Starr King's "White Hills" will be a lasting monument to the enthusiastic student who so thoroughly explored them. His scholarly ability was recognized at home and abroad by election to membership in many literary and scientific societies.

II. Bibliographical Sketch.

HENRY WILLEY.

[No attempt is made in the following sketch to enumerate anything but the scientific writings of Dr. Tuckerman.]

Prof. Tuckerman commenced the study of lichens in 1838, and made explorations in the vicinity of Boston and in the White mountains. The results of these studies appeared in the *Journal* of the Boston Society of Natural History under the following titles: "An enumeration of some lichens of New England," read Dec. 5, 1838, vol. ii. pp. 245–261; "A further enumeration," etc., read in March, 1840, vol. iii. pp. 281–305; "Further notice of some N. E. Lichens," read in March, 1841, vol. iii. pp. 438–464; "A further notice of some alpine and other lichens of New England," vol. v. pp. 93–103, January, 1845. These papers give the first notices of the alpine lichen flora of the White mountains, and contain an account of the systematic classification of lichens up to that time, as developed in the writings of Linnæus, Acharius, Fries and others. In "Observations on some interesting plants of New England," in *Am. Jour. Science,* xlv (1843), 27–49, he mentions two lichens, one of which has not, however, held its place as a species. In 1845 at Cambridge appeared "An Enumeration of North American Lichens." The first part of this little work is an essay on the natural systems of Aken, Fries and Endlicher, which is followed by a general view of the structure of lichens and an enumeration of those of North America, arranged according to the Friesian system. The "Synopsis of the Lichens of New England, the other Northern States and British America," Cambridge, 1848, was the first full descriptive list of our lichens published in this country. It enumerates and describes 295 species of which twenty are new.

In Lea's "Catalogue of the plants of Cincinnati," Philadelphia, 1849, is a list of 53 lichens arranged by Prof. Tuckerman. In Agassiz's "Lake Superior," Boston, 1850, is a list of seventy-one lichens arranged by him.

Between 1847 and 1855 Professor Tuckerman issued at Cambridge "Lichenes Americæ Septentrionalis exsiccati," a collection of about 150 species of lichens, mostly from the White mountains. Up to this period his studies appear to have been confined mainly to the temperate region of North America. But soon they began to embrace a larger field and to assume a wider scope. And it was this period that the application of the microscope to the study of lichen structure opened wider views and rendered necessary some modification of opinions in regard to system. In the *Am. Jour. Sci.* II. xxv. 422–430 (May, 1858) and xxviii. 200–206 (Sept., 1859), were two supplements to an "Enumeration of North American Lichens," describing many new species and including plants from the Southern states and from California. In 1860 he began contributing his "Observationes Lichenologicæ" to the *Proceedings* of the American Academy, in which he showed a constantly increasing range of knowledge, breadth of view, and power of independent judgment. These papers were published in vol. iv. pp. 383–407 (1860); v. 383–422 (1862); vi. 263–287 (1864); and xii. 166–185 (1877). The second and third of these papers are largely devoted to the Cuban collections of

Charles Wright; a portion of this collection was issued in 1864 under the title "Caroli Wrightii Lichenes Cubæ curante E. Tuckerman." The other portion was sent to Dr. Nylander, of Paris, for determination, in whose hands it remained for many years, when it was transferred to Dr. J. Müller, of Geneva, Switzerland, by whom it was issued in 1884, but with most of the plants still unnamed and undescribed, much to the disappointment of those who had purchased this noble collection hoping to find it an aid in the determination of tropical lichens. The determinations of the Pyrenocarpæ were, however, published by Dr. Müller in 1885, and that of the Graphideæ may perhaps be expected before long.

The "Lichens of the Wilkes' Exploring Expedition," published in 1861, were described by Prof. Tuckerman, illustrated with admirable drawings by Mr. Sprague.

The "Lichens of California, Oregon, and the Rocky mountains," pp. 35, Amherst, 1866, foreshadowed the systematic views which the author had adopted, and which he was preparing to develop in his subsequent work, the *Genera*.

The "Lichens of the Hawaiian Islands" collected by Horace Mann was published in the *Proceedings* of the Am. Acad. vii. 223–234 (1866).

The "Geological and Natural History survey of North Carolina" by Rev. M. A. Curtis, Raleigh, 1867, contained a list of lichens of which it was said that it had been arranged by Prof. Tuckerman. But he refused to acknowledge it as it had been made up from an old list with changes and additions which he had not been permitted to see.

In 1872 appeared the result of over thirty years' study, observation and reflection, the "Genera Lichenum" pp. xv. 281, Amherst. Always adhering to these systematic views, he adapted to them the changes rendered necessary by the growth of knowledge while maintaining their main features. The main features of this work are the comprehensiveness of its views, its ample discussion, derived from a wide range of knowledge, and almost requiring an equal knowledge duly to estimate them, its comprehensiveness in regard to the limitation of species, and its rejection of the chemical tests by which species have been indefinitely multiplied in Europe. His views have met with scant recognition there where it has become the custom, as he once wrote, to consider every marked variety as a species and every marked species as a genus; but if lichens survive the onslaughts now making on them by those who deny their autonomic existence, the philosophical views of Tuckerman must at length prevail, and they should be the guide of future students of this difficult class of plants.

It now remained for Tuckerman to embody his ideas in a descriptive work including all the North American lichen flora, the first part of this work "A synopsis of the North American Lichens comprising the Parmeliacei, Cladoniei and Cœnogoniei," pp. xx. 262, was published in Boston in 1882. In this work his conservative views in regard to species, and his admirable faculty of bringing together allied plants and showing their relations, are finely exhibited; while the descriptions are models of clearness and conciseness, and have not their equals in the English or any other language. But this work was destined to remain incomplete. His health began to fail, he frequently became discouraged, he suffered the demands of others upon his time to divert him from its regular purpose, and he felt pained at the absolute want of public recognition abroad of his first part. But still he labored on as long as possible, up to within a few months expressing his determination to go on. But it could not be, and his monument is incomplete, though it is to be hoped that some portion of his manuscript may be in a condition that will enable it to be issued in a final supplement.

It only remains to notice some minor lichenological publications:

Can lichens be determined by chemical tests? *American Naturalist*, ii. 104–107 (1868), takes the negative side of the question.

A catalogue of plants growing without cultivation within thirty miles of Amherst College, by Edward Tuckerman and Charles C. Frost, Amherst, 1875, lichens, pp. 54–61.

The question of the gonidia of lichens, *Am. Jour. of Science*, III. xvii. 254–256 (1879), in which reference is made to the discoveries of Dr. Minks, in regard to the microgonidium, which he regarded as firmly established, and as deciding the question as to the autonomy of lichens.

Lichens of the Howgate Polar Expedition of 1877–78, Washington 1879, pp. 167, 168.

Two lichens of Oregon (Sticta Oregana and Rinodina Hallii), *Bull. Torr. Bot. Club*, v. 20 (1874).

Lecidea elabens, *Flora*, 1875, pp. 63, 64, an exclamation against this name being attached to Lecidea melancheima Tuckerm.

Lichens of Kerguelen's Land, *Bull. Torr. Bot. Club,* vi. 57 (1875).

U. S. Exploration of the 40th parallel, Washington 1872, lichens, p. 412.

U. S. Geological survey west of the 100th meridian, Washington, 1878, lichens p. 350.

New western lichens (Lecidea Brandegei, L. Pringlei, Acolium Sti. Jacobi, Pyrenothamnia Spraguei), *Bull. Torr. Bot. Club*, x. 21 (1883).

A new Ramalina (R. crinita), *Bull. Torr. Bot. Club*, x. 43 (1883).

Two lichens of the Pacific coast (Lecanora melanaspis Ach., Staurothele Brandegei Tuckerm.), *Bull. Torr. Bot. Club*, xi. 25 (1884). This was his last publication.

There may be one or two short papers on lichens in the *American Journal* which are not noticed here, but they are not important.

[We take the liberty of adding to the above list the following:

On Oakesia, a new genus of the order Empetreæ, Hooker's London *Jour. Bot.* i (1842), 443–447.

Enumeratio methodica Caricum quarundam, Schenectady, *Riggs*, 1843.—In a letter to Mr. Willey accompanying this the author says: "I send a brochure of mine upon CAREX written some 20 years since when I was tolerably familiar with the common species both of Europe and America * * * I collected in most parts of the north of Europe in 1841–2 and formed a large herbarium from my correspondents' gifts and exchanges, the whole of which I gave afterwards to Boott of London. Since his death the greater part of this has been returned to me." This little work is quite remarkable for its keen insight into the relationships of the numerous species of this difficult genus.

Observations on some N. England plants, with characters of several new species, *Am. Jour. Sci.* II. vi. (1848), 224–232.

Observations on some American species of Potamogeton, *Am. Jour. Sci.* II. vii (1849), 347–360.

Lichenes, Pacific R. R. Rept. vi. 94 (1857).—EDS.]

Revision of North American Hypericaceæ.—I.

JOHN M. COULTER.

Having studied the North American species of Hypericaceæ with all the material to be had at Cambridge, it seems to be proper, before putting the results into a more permanent shape, to present them to botanists for their criticism, that they may test them in the herbarium and field, and that the limitations of certain species may be better defined. It is with the earnest request that botanists will thoroughly examine this work during the coming season that this paper is presented, and any specimens which will correct either the characters or ranges given will be received as a great favor. Of course work done at the Harvard Herbarium is of itself an acknowledgment of the great courtesy that prevails there, and the patient criticism given to these pages by Dr. Gray has given to them probably their greatest value.

Our three genera may be grouped and characterized as follows:

* *Hypogynous glands none.*

1. **Ascyrum.** Sepals 4, very unequal, decussate; the two outer very broad and flat; the inner much smaller. Petals 4, oblique, convolute in æstivation, deciduous. Stamens numerous, distinct. Ovary one-celled, with 2 to 4 parietal placentæ: styles 2 to 4, distinct or united below: stigmas not capitate. Capsule ovoid.

2. **Hypericum.** Sepals 5 (rarely 4), similar. Petals 5 (rarely 4), oblique, convolute in æstivation, deciduous or marcescent. Stamens numerous (sometimes few), in 3 or 5 clusters: filaments distinct or united at the very base into phalanges. Ovary one-celled with parietal placentæ, or 3 to 5-celled with placentæ in the axis: styles 3 to 5, distinct or united even to the apex: stigmas often capitate. Capsule conical to globose.

* * *Hypogynous glands three.*

3. **Elodea.** Sepals 5, equal. Petals 5, equal-sided, imbricate in æstivation, deciduous. Stamens 9 (rarely more), strongly triadelphous; the large orange-colored glands alternating with the phalanges. Ovary 3-celled: styles 3, distinct: stigmas not capitate. Capsule elongated-oblong.

1. ASCYRUM L. St. Peter's-wort.

Low suffruticose leafy plants; with small black-dotted leaves and nearly solitary light yellow flowers; pedicels bibracteolate.—Gen. 903; Torr. & Gray, Fl. i. 156 & 671; Gray, Gen. Ill. i. 211, t. 91; Benth. & Hook. Gen. Plant. i. 164, excl. syn. *Isophyllum.*—A genus of 5 species, peculiar to Eastern North America and the West Indies.

* Diffuse: branches somewhat two-edged and winged above: leaves narrowed at the base, not clasping: inner sepals very small (about half line long) or obsolete, petaloid: petals about as long as the outer sepals: styles two, distinct or united.

† Pedicels long (¼ to ½ inch), bibracteolate near the base: inner sepals obsolete or nearly so: styles as long as the ovary.

1. **A. pumilum** Michx. Low (3 to 9 inches), with spreading branches: leaves linear-oblong to oval, sometimes spatulate or narrowly obovate, 2 to 4 lines long, about a line wide: pedicels becoming more or less reflexed: petals obovate, little longer than

the ovate, acute or obtuse outer sepals.—Fl. ii. 77; Torr. & Gray, Fl. i. 156.

A. pauciflorum Nutt. Gen. ii. 15; Chois. in DC. Prodr. i. 555.

Pine barrens of Georgia and Florida.

The specimens examined were all from Florida, collected by Canby, Chapman, Curtiss, and J. D. Smith. The original station given by Michaux is in Georgia, in which he is confirmed by Elliott and Nuttall, as well as by subsequent collections.

† † Pedicels shorter (a line or two), bibracteolate close to the flower: inner sepals evident: styles short.

2. **A. Crux-Andreæ** L. Low (half to a foot or less), much branched at base, generally decumbent: leaves narrowly obovate-oblong, ½ to 1½ inches long, 3 to 4 lines wide, more or less plainly biglandular at base: pedicels about a line long: outer sepals ovate or cordate-ovate, mostly obtuse: petals linear-oblong to narrowly obovate.—Spec. ed. 2, 1107, excl. Pluk. syn. (which is *Hypericum mutilum*), not ed. 1, 787, *fide* Torr. & Gray, Fl. i. 671; Chois. in DC. Prodr. i. 155; Torr. & Gray, Fl. i. 156, in part.

A. multicaule Michx. Fl. ii. 77.

From Nantucket, Mass., through the pine-barrens of New Jersey to Virginia, E. Texas, and S. Illinois.

The narrow-leaved forms south of this range should be referred to the following species, with which A. Crux-Andreæ has unfortunately been confounded. The western forms all seem to be taller and more robust than those of the Atlantic States. In reference to the confusion of the synonymy of A. Crux-Andreæ and A. hypericoides consult Torr. & Gray, Fl. i. 671, where the best course for settling the difficulty is suggested. The specimens examined were from Nantucket (*Mrs. Owen*), New Jersey (*Gray, Parker*), Pennsylvania (*Porter*), Virginia (*Curtiss, Dana*), S. Illinois (*Vasey*), W. Tennessee (*Fendler*), E. Arkansas (*Harvey*, 52), E. Texas (*Hall*, 36 in part).

3. **A. hypericoides** L. Taller (1 to 2 feet), more erect, branched above: leaves linear to linear-oblong, 3 to 10 lines long, a line or two wide, conspicuously biglandular at base: pedicels longer: outer sepals usually narrower, often acute.—Spec. ed. 1, 788, as to Plum. syn., ed. 2, 1108, excl. Pluk. syn.; Chois. in DC. Prodr. i. 555, in part; Griseb. Fl. Brit. W. Ind. 112.

A. Crux-Andreæ Torr. & Gray, Fl. i. 156, in part; Griseb. Plant. Cub. 40 Chapm. Fl. 38; indeed of all southern authors.

A. Crux-Andreæ var. *angustifolium* Nutt. Gen. ii. 16; Torr. & Gray, Fl. 1. 156.

A. Plumieri Bertol. Bot. Misc. xiii. 19, t. 3, f. 3.

South Carolina to Florida, Louisiana, and Texas. Also in the Bermudas, W. Indies, and Mexico.

Much uncertainty has arisen from attempting to reduce A. hypericoides to a form of A. Crux-Andreæ, but the larger more branching habit, narrower leaves with conspicuous basal glands, as well as a decidedly more southern range, serve to distinguish it. The Bermuda and Jamaica plants are typical forms of the species, and can by no means be taken for forms of A. Crux-Andreæ, but those of the continent are more apt to be perplexing. The specimens examined were from S. Carolina (*Ravenel*), Florida (*Curtiss*, 243), Louisiana (*Drummond*, 90 and 92), Texas (*Hall*, 36 in part, *Lindheimer*), Mexico (*Berlandier*, 989, 2419, *Botteri*, 373), Cuba (*Wright*, 2129), Jamaica (*Alexander*, *Grisebach*, 1497. 811), Bermuda (*Lane*, 331 in part).

** Erect, stouter, a foot or two high: stems simple or branched above, conspicuously two-edged, even winged: leaves broader and thicker, more or less clasping: pedicels 2 to 6 lines long: inner sepals 3 to 6 lines long, sometimes as long as the outer, seldom petaloid: petals mostly much longer than the outer sepals: styles 3 (rarely 4), generally distinct.

4. **A. stans** Michx. Leaves oblong to oval, closely sessile and somewhat clasping, an inch or two long and 5 or 6 lines wide: pedicels bibracteolate near the middle: outer sepals ovate to orbicular-cordate; inner ones lanceolate: styles short.—Fl. ii. 77; Chois. in DC. Prodr. i. 555 (but not "2-styled"); Torr. & Gray, Fl. i. 157; Gray, Gen. Ill. i. 212, t. 91.

A. hypericoides L. Spec. 788, as to Pluk. syn.; Pursh, 373.

Barrens of New Jersey and E. Pennsylvania to Florida, Louisiana, and W. Texas.

In a southern form (var. *obovatum* Chapm.) the lower leaves taper to the base and become almost obovate. The specimens examined were from New Jersey (many collectors), E. Pennsylvania (*Porter*), Florida (*Curtiss*, 244), Louisiana (*Drummond*, 91, also *Hale*, a very large specimen), W. Texas (*Young*).

5. **A. amplexicaule** Michx. Leaves ovate-cordate, often broadly so, clasping, half an inch or more long and nearly as wide: pedicels with very small bractlets near the base or none: outer sepals broadly ovate-cordate, resembling the leaves; inner ones linear-lanceolate: styles about as long as the ovary.—Fl. ii. 77; Torr. & Gray, Fl. i. 157.

A. stans Willd. Spec. iii. 1473.

A. stans var. β Chois. Prodr. Hyper. 61.

A. Cubense Griseb. Plant. Cub. 40 (*Wright*, 2128).

Hypericum tetrapetalum Lam. Dict. iv. 153.

Georgia and Florida. Also in Cuba.

The specimens examined were from Florida (*Buckley*, *Palmer*, *Curtiss*, *Garber*), Georgia, and Cuba (*Wright*, 2128).

2. HYPERICUM Tourn., L. St. John's-wort.

Herbs or shrubs; with cymose yellow flowers; the sessile leaves more or less pellucid-punctate and black-dotted: very variable in size of leaves, sepals, and flowers.—Gen. 902; Torr. & Gray, Fl. i. 157; Gray, Gen. Ill. i. 213, t. 92, 93; Benth. & Hook. Gen. Plant. i. 165, excl. *Elodea*. *Sarothra* L. Gen. 383. *Brathys*, *Brathydium*, *Myriandra*, *Roscyna*, and *Isophyllum* of Spach, Ann. Sci. Nat. 2. v. 367.—A genus of about 160 species, widely distributed, but chiefly of northern temperate regions; all but three of the 29 North American species restricted to the Atlantic U. S.

H. setosum L. Spec. 787, with the character only "floribus digynis, foliis linearibus," represents no plant known to Linnæus, but is a complex wholly founded on a phrase of Gronov. Fl. Virg., which belongs to *H. pilosum* Walt., and to one of Pluk. Alm., which is *H. nudicaule* Walt., whence the "digynis" and the suggestion of the specific name.

H. elatum Ait. Hort. Kew. iii. 104, proves to be *H. hircinum* L., or some nearly related Old World species.

H. triplinerve Vent. Hort. Cels. t. 58, must also be an Old World species, related to *H. hyssopifolium* L.

§ 1. Sepals and petals 4, or occasionally 5: stamens numerous, distinct styles 3, at first united into a long sharp beak, becoming distinct: capsule 1-celled, the placentæ projecting: branching shrubs.—*Isophyllum* Spach.

1. **H. microsepalum** Gray. Decumbent or erect, half to a foot high or more: leaves very small, oblong-linear, 3 or 4 lines long, hardly a line wide, obtuse: flowers showy, about an inch in diameter, clustered at the summit of the branches: sepals slightly unequal, linear to oblong, mostly obtuse, much shorter than the somewhat unequal petals: capsule oblong-ovate, 2 to 3 lines long; seeds oblong, minutely striate and fitted.—Watson, Bibl. Index, Polypet. 456.

Isophyllum Drummondii Spach, Ann. Sci. Nat. 2. v. 367.

Ascyrum microsepalum Torr. & Gray, Fl. i. 157; Gray, Gen. Ill. i. 212; Chapm. Fl. 39.

Georgia and Florida.

This species is intermediate between Ascyrum and Hypericum, and Spach separated it from both by founding the genus Isophyllum. The habit, small and nearly equal sepals, and long beak-like styles, all belong to Hypericum, while the 4-merous flower associates it with Ascyrum. As the flowers are also sometimes 5-merous it seems most proper to consider it an outlying species of Hypericum.

§ 2. Stamens very numerous, distinct, or more or less united into sets.

* Styles 5, united below, distinct above; stigmas capitate: capsule 5-celled, the placentæ turned far back from the axis: tall perennial herbs with large leaves and flowers.

2. **H. Ascyron** L. Usually branching above, 2 to 5 feet high: leaves ovate-lanceolate, clasping, mostly acute, 2 to 5 inches long, about an inch wide, pellucid-punctate with elongated dots: flowers an inch or two in diameter, solitary at the ends of branches and in terminal cymes: sepals lanceolate to ovate, acute, 4 to 6 lines long: capsule ovoid-conical, 9 lines long; seeds terete, with slightly winged rhaphe.—Spec. 2 ed. 1102; Maxim. Pl. Nov. Asiat. iv. 162.

H. pyramidatum Ait. Hort. Kew. iii. 103; Torr. & Gray, Fl. i. 158; Gray, Manual, 84.

H. ascyroides Willd. Spec. iii. 1443; Chois. in DC. Prodr. i. 545, Hook. Fl. Bor.-Am. i. 109.

H. macrocarpum Michx. Fl. ii. 82.

From Canada to Vermont, Massachusetts, Connecticut, and E. Pennsylvania, westward to N. Illinois, Iowa, Michigan, Minnesota, the Winnipeg valley, and probably farther northwest. Also throughout northeastern Asia, and in Europe.

Our plant can not be distinguished in any way from the Asiatic, and was included with it in the original Linnæan description ("*Habitat in* Sibiria, Canada, Pyrenæis.") Maximowicz (l. c.) has called attention to the identity of the North American and Asiatic forms, and a careful comparison of specimens has fully confirmed his opinion.

* * Styles united into a long, sharp beak, becoming distinct; stigmas minute, not capitate: more or less shrubby plants.

† Styles 5: capsule 5-celled: bushy shrubs with crowded leaves.

3. **H. Kalmianum** L. A foot or two high: leaves linear to oblanceolate, tapering at base, one or two inches long, 2 to 4 lines wide, pellucid-punctate with round dots, glaucous beneath: cymes few-flowered: sepals lanceolate to oval, half as long as the petals: capsule ovate, about 3 lines long; seeds abruptly and minutely pointed.—Spec. 783; Torr. Fl. N. Y. i. 86, t. 13; Torr. & Gray, Fl. i. 158.

Rocky shores, Canada, Niagara Falls, and about the Great Lakes.

† † Styles 3: capsule completely 3-celled: branching shrubs.

4. **H. Buckleyi** M. A. Curtiss. Low (half to a foot), widely branching from the base: leaves oblong, obtuse, narrowed at base, half to an inch long, 2 to 4 lines wide, paler beneath and more or less black dotted: flowers solitary and terminal, on long peduncles, sometimes in threes, about an inch in diameter: sepals obovate, not half as long as the petals: capsule conical, 4 to 5

lines long: seeds striate, with prominent rhaphe.—Am. Jour. Sci. 1. xliv. 80; Chapm. Fl. 39.

Cliffs, mountains of North Carolina and Georgia.

5. **H. prolificum** L. Leaves linear-lanceolate to narrowly oblong, narrowed at base, mostly obtuse and mucronulate, 1 to 3 inches long, 3 to 9 lines wide, with smaller ones in axillary fascicles: flowers numerous, half to an inch in diameter: sepals unequal, foliaceous, lanceolate to ovate, mucronate, much shorter than the petals: capsule lanceolate to ovate, 4 to 6 lines long; seeds striate.—Mant. 106; Chois. in DC. Prodr. i. 547; Torr. & Gray, Fl. i. 159, excl. var. γ.

H. rosmarinifolium Lam. Dict. iv. 159; Torr. & Gray, l. c.

Myriandra ledifolia Spach, Ann. Sci. Nat. 2. v. 365.

From New Jersey and District of Columbia, to Alabama, Arkansas, Missouri, Kentucky, Illinois, and Minnesota.

This species varies greatly in size, and in width of leaves, the southern forms often approaching the next species in appearance, but readily distinguished by the much larger and fewer capsules and flowers.

6. **H. densiflorum** Pursh. More shrubby and taller, sometimes 5 or 6 feet high, much more branching: leaves more crowded, narrower and shorter: flowers much more numerous and smaller: sepals smaller, not foliaceous: capsule 2 to 3 lines long.—Fl. 376; Chois. l. c.

H. galioides Pursh, 376, not Lam.

H. prolificum var.(?)γ Torr. & Gray, l. c.

H. prolificum var. *densiflorum* Gray, Manual, 84.

Myriandra spathulata Spach, l. c.

Pine barrens of New Jersey, to Florida, Tennessee, Arkansas, and Texas.

Large leaved forms from New Jersey (*Canby*) seem to intergrade with the last species, but the characters of capsules and flowers plainly indicate H. densiflorum. Between closely related species it is to be expected that intermediate forms will occur.

††† Styles 3: capsule 1-celled, or almost 3-celled by the projecting placentæ: shrubby at least at base.

‡ Placentæ projecting nearly to the center of the ovary.

= Sepals broad, ovate, foliaceous: flowers large and showy, solitary or in leafy cymes: leaves rather broad and somewhat coriaceous: shrubby.

7. **H. aureum** Bartram. Widely branched above, 2 to 4 feet high: leaves oblong, more or less attenuate at base, obtuse or acute, 1 to 3 inches long, 3 to 9 lines wide: flowers often solitary,

1 or 2 inches in diameter, very showy: sepals very unequal, often enclosing the capsule: petals orange-yellow, firm, reflexed: stamens excessively numerous: capsule ovate-conical, not lobed, 3 to 5 lines long.—Travels, 383; Torr. & Gray, Fl. i. 161.

H. frondosum Michx. Fl. ii. 81; Chois. in DC. Prodr. i. 544.
H. ascyroides var. β Poir. Suppl. iii. 694.
H. amœnum Pursh, 375; Nutt. Gen. ii. 10; Chois. l. c.
South Carolina and Georgia, to Tennessee, Alabama, and Texas.
Varies much in the size of its leaves and sepals, the mountain forms usually having smaller leaves.

8. **H. myrtifolium** LAM. More or less branching: leaves cordate-oblong, clasping, obtuse, half to an inch long, 3 to 6 lines wide, those of the cyme much smaller: flowers not an inch in diameter, in compound cymes: sepals resembling the leaves, larger than the floral bracts, often reflexed: capsule as in the last, but coriaceous and 3 or 4-lobed or angled.—Dict. iv. 180; Chois. l. c. 547; Torr. & Gray, l. c. 162.

H. glaucum Michx. Fl. ii. 78; Chois. l. c.
H. rosmarinifolium Chois. l. c., not Lam.
H. sessiliflorum Willd. Spreng. Syst. iii. 346; Torr. & Gray, l. c. 166.
From South Carolina to Florida and Alabama.

= = Sepals small, very narrow: flowers small, axillary and terminal: leaves narrow and much fascicled in the axils: shrubby and branching.

9. **H. fasciculatum** LAM. One to three feet high: leaves very narrowly linear and revolute, coriaceous, crowded, closely sessile, not tapering at base, usually with a line of large pellucid glands upon each revolute edge, 2 to 8 lines long: sepals resembling the leaves, shorter than the petals: capsule 3-lobed, oblong- to ovate-conical, few-seeded, a line or two long.—Dict. iv. 160; Chois. in DC. Prodr. i. 554; Torr. & Gray, Fl. 160.

H. nitidum Lam. l. c.
H. aspalathoides Willd. Spec. iii. 1451; Pursh, 376.
H. fasciculatum var. *aspalathoides* Torr. & Gray, l. c. 672.
Myriandra nitida, *brachyphylla*, and *galioides* of Spach.
Wet pine barrens, from North Carolina to Florida, Louisiana, and E. Texas.
Very variable in length and fasciculation of leaves. Lamarck's original specimen is our short-leaved form (var. *aspalathoides*), while his *H. nitidum* is a loose, long-leaved form, approaching some forms of the next species.

10. **H. galioides** LAM. Like the last, but leaves longer and broader, linear-lanceolate to oblanceolate, generally mucronate,

always tapering and subpetiolate at base, not so revolute, half to three inches long, as many lines wide: sepals linear-lanceolate, acute, tapering at base, shorter or longer than the petals.—Dict. iv. 161; Chois. l. c. 550; Torr. & Gray, Fl. i. 159.

H. axillare Lam. l. c. 160, not Michx.

H. fasciculatum Michx. Willd. Spec. iii. 1452, not Lam.

? *H. ambiguum* Elliott, ii. 30; Torr. & Gray, l. c. 162 and 673.

H. galioides var. *ambiguum* Chapm. Fl. 40.

Myriandra Michauxii Spach.

Wet ground, from Delaware to Georgia, E. Tennessee, and Louisiana.

These two species are inextricably connected by intermediate forms, and it is a question whether H. *galioides* should be considered more than a variety of *H. fasciculatum*. But the extreme forms are so remarkably different in appearance that for the present, at least, they are kept separate.

= — = Sepals small: flowers small, in naked cymes: leaves rather broad, thin and veiny: somewhat shrubby at base, a foot or two high, simple or branching.

11. **H. adpressum** BARTON. Leaves linear-lanceolate to narrowly oblong, mostly acute, ascending, about two inches long, 3 to 4 lines wide, revolute, pellucid-punctate without black dots, translucently veiny: cymes leafy only at base, dichotomal flowers very short pedicelled: sepals linear to lanceolate, acute, half to two-thirds as long as the petals, often reflexed: capsule ovate to oblong, about 2 lines long; seeds oblong.—Fl. Philad. ii. 15; Torr. & Gray, Fl. i. 159.

H. Bonapartea Barton, Fl. N. Am. iii. 95, t. 106.

H. fastigiatum Elliott, ii. 31; Torr. & Gray, l. c. 166.

H. adpressum var. *fastigiatum*, Torr. & Gray, l. c. 673.

Moist ground, Nantucket to Rhode Island, New Jersey, Pennsylvania, and Georgia.

12. **H. cistifolium** LAM. Leaves ovate-lanceolate or oblong, obtuse, 2 or 3 inches long, half an inch wide, pellucid-punctate with very small crowded dots: cymes pedunculate, loosely-flowered, dichotomal flowers pedicelled: sepals variable, linear to oblong, about half as long as the petals: capsule ovate-conical, about 3 lines long; seeds cylindrical, with prominent rhaphe.—Dict. iv. 158, not of Torr. & Gray, Fl. i. 674, Chapm. Fl. 41, etc.

H. nudiflorum Michx. Willd. Spec. iii. 1456; Torr. & Gray, l. c. 162; Chapm. l. c.; Gray, Manual, 84.

From North Carolina through Georgia and Alabama to Texas.

As our *H. nudiflorum* has proved to be Lamarck's *H. cistifolium*, the latter name as applied in Watson's Bibliographical Index, p. 125, must disappear.

This leaves, as the oldest unoccupied name, *H. opacum* of Torrey & Gray, which accordingly reappears as a specific name.

‡‡ Placentæ projecting a little, or not at all: sepals unequal.

= Leaves mostly linear, with rather large and scattered pellucid dots: flowers in somewhat leafy-bracted cymes: capsule conical or globose; seeds large, oval, strongly rugose transversely.

13. **H. sphærocarpum** Michx. Simple or branched, 1 to 3 feet high: leaves linear to narrowly oblong, mostly obtuse, 2 to 3 inches long, 3 to 6 lines wide: cyme loosely-flowered, dichotomal flower mostly sessile: sepals varying from small and linear to ovate and as long as the petals: capsule from depressed globose to ovoid, about 2 lines long; rhaphe almost winged.—Fl. ii. 78; Torr. & Gray, Fl. i. 163.

Rocky banks of the Ohio and its tributaries, southward to Arkansas.

This stands as a very good species, easily distinguished from any likely to be confounded with it, by its strictly one-celled capsule and large very rough seeds. In fact, the seeds are the most characteristic ones of the genus. By some mistake the specific name has been often written *H. sphærocarpon*, while the original name is as above.

14. **H. dolabriforme** Vent. Low, straggling, 6 to 18 inches high: leaves linear to linear-lanceolate, widely spreading, about an inch long, a line or two wide, mostly acute: cyme few-flowered, dichotomal flower pedicelled: sepals large and foliaceous, lanceolate to ovate, acute or acuminate, as long as the petals: capsule ovate-conical, almost triquetrous, about 3 lines long, coriaceous.—Hort. Cels. t. 45; Pursh, 378; Chois. in DC. Prodr. i. 547; Torr. & Gray, Fl. i. 162.

H. procumbens Desf. Willd. Spec. iii. 1450; Michx. Fl. ii. 81; Pursh, 379; Chois. l. c.

Dry hills, Kentucky and Tennessee.

= = Leaves oblong, obtuse: flowers in nearly naked cymes: capsule ovate; seeds oblong, minutely striate and pitted.

15. **H. opacum** Torr. & Gray. One to four feet high: leaves linear oblong, about an inch long, 2 to 4 lines wide, closely sessile, pellucid-punctate with minute crowded dots: flowers 3 to 5 lines in diameter, in divaricate cymes, the dichotomal flowers mostly sessile: sepals oblong to obovate, about half as long as the bright yellow petals: capsule 2 to 3 lines long.—Fl. i. 163.

H. punctulosum Bertol. Bot. Misc. xiii. 18, t. 3, f. 2.

H. cistifolium Watson, Bibl. Index, Polypet. 125, not Lam.

South Carolina to Georgia, Florida, and Mississippi.

16. **H. ellipticum** Hook. Mostly herbaceous, 10 to 20 inches high: leaves elliptical-oblong, sessile or tapering at base, $\frac{1}{2}$ to $1\frac{1}{2}$ inches long, 3 to 5 lines wide, pellucid-punctate with large scattered dots, translucently veiny: flowers 4 to 6 lines in diameter, in few-flowered cymes, the dichotomal flowers pedicelled: sepals mostly foliaceous and spreading, oblanceolate to narrowly obovate, usually shorter than the pale yellow petals: capsule as in the last.—Fl. Bor.-Am. i. 110; Torr. & Gray, Fl. i. 164.

H. sphærocarpum Barton, Fl. Philad. ii. 14, not Michx.

In moist ground, from Canada to Pennsylvania, westward to the Winnipeg valley.

Origin of the Flora of Indiana.

HARVEY THOMSON.

In an article of this nature it would not be advisable or necessary to enter into the details of the argument to prove that the original birthplace of our present flora is in the far north, near or even beyond the Arctic circle.

The origin of our present flora and the causes producing its present distribution present a rich field for thought and theory both to botanists and geologists, as the establishment of this theory of the northern origin of plants determines the temperature and climate of those regions in past geological periods. Many of the best thinkers of the botanical world have very ably discussed this subject in their writings. Noticeable among these are Dr. Asa Gray, Sir Joseph Hooker, Sir W. Dawson, De Candolle, Darwin, Wallace, Lesquereux, and others. Dr. Asa Gray first advanced his theory, before anything was known of the fossil life of the high northern latitudes, based upon the striking resemblances between eastern Asiatic and eastern American floras. The other writers have based their theories and conclusions upon the identity of many fossil plants, found in the cretaceous rocks of Greenland and the extreme northern part of the continent, with those of temperate latitudes of both America and Asia. These fossil plants were found by Dr. Lyall, Sir John Richardson and Sir Alexander Armstrong, and determined by Prof. Heer, of Zurich. There can, therefore, be no doubt as to the identity of these plants and, consequently, as to the origin of our temperate flora or the climate of those regions in the periods preceding the tertiary, as it is conceded that plants become acclimatized very slowly, if ever. During the glacial epoch these plants must have been pushed much farther south than Indiana, as the glaciers themselves reached its southern border. The plants of Indiana have then stopped on their return journey from the south, during the epochs immediately succeeding the glacial, because they here found their original and natural climate and surroundings. Of course there may have been several minor countermarches included in this general movement to the south and return, but these would not affect the general fact of the movement in the least. The physical geography of Indiana gives it an extremely variegated and abundant flora, from the high "knobs" of the Ohio valley on the south to the low swamps and tamarack groves of the lake regions of the north. This flora is also receiving continual additions from the railways and streams which traverse it or extend along its borders.

In the table below I have attempted to give, in the first column, the direction from this state in which the plants seem to be most abundant and most widely distributed; in the second the proportion of these which have the limit of their range in Indiana or some immediately adjoining state; in the third the proportion which go beyond this limit; in the fourth the proportion of the plants of each direction relatively to all those of the state; and in the last the number from each direction.

Direction.	Limited by Ind.	Extending beyond Ind.	Proportion of No. in State.	No. in State.
SOUTHEAST	72 per ct.	28 per cent.	about 23.p.ct.	274
All along the eastern coast from Canada to Florida and westward	52 " "	48 " "	" 17.9 "	213
NORTH	54 " "	46 " "	" 15.5 "	184
EAST	53 " "	47 " "	" 12.9 "	154
NORTHEAST	41 " "	59 " "	" 12.3 "	147
Common to all N. A. or at least to all U. S. and far northward.	....	....	" 8.2 "	98
Local, or limited by immediately adjacent states.	....	....	" 3.2 "	38
SOUTH	77 " "	23 " "	" 2.2 "	26
Along the Mississippi river	....	....	" 1.7 "	20
NORTHWEST	21 " "	79 " "	" 1.6 "	19
SOUTHWEST	89 " "	11 " "	" 1.5 "	18
Total number of plants in the state	....	....	....	1191

To this total number should be added a few more which have been found in the state since this list was made, in order to get the full number in the state at present. In this list all plants of European origin, or which have escaped from cultivation, have been omitted.

The fact that a little more than four-fifths of our plants have a range extending north and east of our state, and that those south and southeast are found mostly on mountains, proves that the temperature of the arctic regions, where our flora originated, was some cooler during the cretaceous period than that of Indiana at present. As the same laws which now produce the warm equatorial current from the southwest prevailed during the tertiary period, no doubt the same difference in temperature between the eastern and western coasts of America existed then and extended much farther inland, owing to the absence of such high mountain ranges to break the force of the warm current. During the Champlain epoch, therefore, when these plants were seeking to escape the heat, they moved in an easterly as well as northerly direction.

It will be noticed that a much larger proportion of those plants belonging to the south southwest and southeast is limited by Indiana than of those from the north. This is caused by the natural barrier to northern progress presented by the Great Lakes and also by the fact that any plants remaining in or reaching the Mississippi valley will be very liable to be borne south by its river currents, so that a plant which is most abundant in the north may be found scattered along the banks of the Mississippi as far south as climate will permit its growth.

The Polypetalæ, Gamopetalæ and Monocotyledons have near the same proportions in the different directions and about that given in the table for all; while the Apetalæ, of which there are only one hundred and thirteen in Indiana, have 32% of their number southeast and the next largest number east—which in the table means along the eastern coast, but not so far north as Canada or south as Florida.

Among the Polypetalæ the Leguminosæ have the largest number in the southeast and next along the eastern coast from Canada to Florida, while the Rosaceæ are most abundant north and along the eastern coast respectively.

The Compositæ among Gamopetalæ have the largest number southeast, while those along the eastern coast are about as numerous.

Among Monocotyledons, however, the Cyperaceæ and the Gramineæ especially have a very large proportion common to all North America, or at least to the United States and far north into British America. Perhaps the mode of growth and reproduction of these families will partially account for their wide distribution.

BRIEFER ARTICLES.

Primula Cusickiana Gray.—I have just received from Mr. E. M. Salt, of Boisé City, Idaho, living specimens of this species collected near that place. Heretofore it has been reported only from Union county, E. Oregon, by Mr. W. E. Cusick, in whose honor the specific name was given. The "whitish line down from the sinuses" of the calyx tube is the white mealiness so common in P. farinosa, and is very apt to disappear in older or much handled specimens. Of course this mealiness often leaves a bleached out line which may persist or not. Mr. Salt says that the plant had been blooming since the middle of February.—J. M. COULTER.

Bentham on citation of authorities.—Referring to our editorial on the citation of authorities we are asked to give the other side of the question by reprinting some remarks by Bentham in the *Journal* of the Linnean Society, xvii (1878). p. 190. Although willing to conform to usage, we fail to see that this affects our position in the least.—EDS.

Besides the young liberal-minded botanists who scorn to submit to any rule but their own, there are others who differ materially in their interpretation of some of the laws, or who do not perceive that in following too strictly their letter instead of their spirit they are only adding needlessly to the general disorder. In the application as well as in the interpretation of these rules they do not sufficiently bear in mind two general principles: first, that the object of the Linnæan nomenclature is the ready identification of species, genera, or other groups for study or reference, not the glorification of botanists; and, secondly, that changing an established name is very different from giving a name to a new plant.

Although much credit may be due to the collector or botanist who has discovered or distinguished really new species (and it is but fair that their discovery should be commemorated), yet it is only second-rate botanists who pride themselves on the number of names, good or bad, to which their initials can be attached. In all cases, therefore, when the object is only to speak of a plant as in catalogues, references, physiological treatises, or even local floras, for practical use one can not attend too closely to the observations of DeCandolle and say *Matthiola tristis*, or *Matthiola tristis Br.*, without any additions (such as *Linn., sub Hesperide*), explanatory of the history of the name. Such a history, absolutely necessary in a full monograph, for instance, should always be considered as belonging to the description and history of the species, not as forming part of its name. It is also with sincere regret that we see distinguished botanists endeavoring to combine rejected with adopted names by the obviously false nomenclature exemplified in *Matthiola tristis* Linn.

There is one practice which has grown up of late years, adding largely to the number of useless synonyms, against which I can not refrain from taking this opportunity of entering a strong protest. I mean that of creating a new name in order to combine an old specific with a new generic one. In ferns, the wanton multiplication of ill-defined, or undefinable genera, according to the varied fancies of special botanists, has had the effect of placing the same species successively in several, some times seven or eight, different genera; and it is proposed to maintain for the specific appellation the right of priority, not in the genus alone in which it is placed, but in the whole of the genera to which, rightly or wrongly, it has been referred. This has been carried to such a degree as to give to the specific name a general substantive aspect, as if the generic ones were adjuncts—a serious encroachment on the beautiful simplicity of the Linnæan nomenclature; and it is to be feared that there is a tendency in that direction in phænogamic botany. When a botanist dismembers an old genus, rule 57 requires that he should strictly preserve the old specific names in his new genera; and when he has wantonly and knowingly neglected this rule, it may be right to correct him. But when a botanist has established what he believes to be a new species, and has therefore given it a new name, the changing this name after it has got into general circulation, because it has been discovered that some other botanist had previously published it in a wrong genus, is only adding a synonym without any advantage whatever, and is not even restoring an old name; for the specific adjective is not of itself the name of a plant. A generic name is sufficiently indicated by one substantive, for no two genera in the vegetable kingdom are allowed to have the same name; but for a species the combination of the substantive and the adjective is absolutely necessary, the two-worded specific name is one and indivisible; and the combining the substantive of one name with the adjective of another is not preserving either of them, but creates an absolutely new name, which ought not to stand unless the previous ones were vicious in themselves, or preoccupied, or referred to a wrong genus. It is probably from not perceiving the difference between making and changing a name that the practice objected to has been adopted by some of the first among recent botanists, such as Weddell, though under protest.

Thalictrum.—It is desirable that attention be given to our polygamo-diœcious species of this genus, namely, T. purpurascens and T. Cornuti of the Manual, and I shall be grateful for specimens throwing additional light on them. After carefully working over the material in the Gray, Torrey and Lapham herbaria, together with the numerous specimens in the duplicate collection of the late Charles Wright—now in the hands of Dr. Goodale—I should characterize these species as follows:

T. PURPURASCENS Linn.—Stem stout and tall, green or mostly purple, leafy: leaves ample, 3-4-ternate, the lowest petioled: leaflets as much as 2 in. long, short-stalked, firm, the upper surface dark-green, mostly oblong or oblong-cuneate with three entire pointed lobes above: flowers nearly diœcious (very rarely with a few stamens when fertile), purplish, in a loose leafy panicle: stamens numerous, their long and spreading filaments widening to the linear-oblong cuspidate anthers, which are 2-3 mm. long: achenia densely clustered, 3 mm. long, ovoid-acuminate with mostly eight sharp longitudinal wings, those at the sutures most prominent, thin-walled, tapering into the slender persistent style. —Canada to Florida and Texas; west to Arizona, Montana and Saskatchewan.

Varies from glabrous or granular to pubescent or glandular-pubescent on the lower surface of the leaves, etc. When conspicuously glandular-pubescent it is *T. graveolens* Muhl., in Fl. Lancast. *Mss.*, which is the variety *ceriferum* Austin, of the Manual. Veiny and with strongly revolute margins it is *T. revolutum* DC.; with pubescent achenia it is *T. dasycarpum* Fisch. Mey. & Lall., which commonly approaches the next species in having anthers scarcely 2 mm. long and papillately-roughened filaments occasionally equalling the anthers in width and involute when dry. A form with thin leaves (scarcely thicker than in dioicum) and very long slender stigmas is *T. macrostigma* Torrey *ined.*, from Louisiana (*Hale*) and Indian Territory (*Palmer*); which appears to be partly connected with the type by shorter-styled Arizona specimens collected by *Rusby*.

T. POLYGAMUM Muhl. (*T. Cornuti* of the Manual).—Of the general appearance of the last but often less purple and with smaller leaves and leaflets: flowers most commonly polygamo-dioecious, more corymbosely clustered at the ends of the nearly naked branches of the panicle, more conspicuous in the male plants from the shorter crowded erect stamens: filaments white, broader than the oval blunt (or rarely short mucronate) anthers and involute when dry, appearing then clavate and rugose: achenia mostly narrower and more stipitate.—New Brunswick to Florida and Louisiana; west to Ohio, but mostly confined to the Atlantic States.

Glabrous or pubescent, but not glandular. When conspicuously downy it is *T. pubescens* Nutt. The achenia are rarely pubescent.

So far as I have been able to observe, glandular and non-glandular trichomes never occur on the same plant, nor have I seen any glandular specimens with the characteristic stamens of T. polygamum, so that the presence of glands appears to be characteristic of T. purpurascens, so far as these two species are concerned. Where no stamens occur it is impossible to identify fertile plants with certainty unless this character can be utilized, and it must then be used only as a positive character, since glabrous or pubescent forms occur in both species. In T. purpurascens a variety can not conveniently be based on it, for several other species of the genus (e.g. T. sparsiflorum) include both glabrous and glandular forms, not separable by associated characters. No good reason exists for separating T. purpurascens into two species (revolutum and dasycarpum) as has been done by Lecoyer;* nor, in the opinion of Dr. Gray, is there sufficient doubt as to the plant intended by Linnæus to warrant the rejection of his name in this instance, though this is necessary in the case of T. polygamum.

Specimens occur both in the north and south which resemble T. dioicum in having very thin glabrous (rarely sparingly pubescent) pale leaflets rounded and with 7 to 9 round lobes at the apex, but with the fruit, as in these species, *i. e.*, thin-walled, stipitate, 2-edged and wing-nerved (not subsessile, thick-walled, terete and deeply and evenly grooved). It is doubtful whether these forms should not be regarded as hybrids, and cases of the simultaneous flowering of T. dioicum and either of the late species should be noted.—Wm. Trelease.

The Brothers Tulasne.—It is but a few months since the botanical journals announced the death of Charles Tulasne at Hyeres in the south of France, on August 21, 1884, and we are now called to mourn the death of his elder brother, Louis René Tulasne, who died at Hyeres on December 22, 1885. In their lives and botanical work the two brothers were so intimately associated that botanists have almost come to use the name Tulasne as representing a single person. They were so modest and reticent with regard to themselves that few details of their lives could be learned even by their associates. The older brother, Louis René, was born at Azay-le-Rideau, Indre-et-Loire, September 12, 1815, and studied law at Paris. His first botanical work was in connection with Auguste St. Hilaire in the preparation of his flora of Brazil. In 1842 he was appointed aide-naturaliste at the museum of the Jardin des Plantes, and, in 1854, he was elected to the Academy as the successor of Adrien de Jussieu. About 1864 his health failed and he was obliged to retire from active service at the museum. His brother Charles was born at Langeais, Indre-et-Loire,

* Monogr. du genre Thalictrum, Gand. 1885.

September 5, 1816, and began the practice of medicine in Paris in 1843. Soon after the withdrawal of Louis from active life the two brothers removed to Hyeres on the Mediterranean, where they passed the remainder of their lives in seclusion, absorbed in the service of the Roman Catholic Church of which they had always been most devout followers.

From a letter written by Dr. Vidal to the President of the Academy at Paris, we learn that, on December 22, M. L. R. Tulasne, who appeared to be in good health, accompanied a friend for a part of the way from his own residence to Hyeres, but on his return he was suddenly seized with an apoplectic fit and remained unconscious until his death at 4 P. M. The following extract from Dr. Vidal's letter expresses the esteem in which M. Tulasne was held by his neighbors: "You will have at Paris all the information regarding his scientific work; but what will never be known is the amount of good which he did to those about him. M. Tulasne lived very retired in the country; he received all persons with the same affability, but one saw that, to interest him actively, it was necessary to point out to him those who were unfortunate and in need of consolation, and then his goodness and charity were equally inexhaustible. Aided by his brother, Dr. Tulasne, who died last year, he established charitable institutions pretty nearly everywhere in this region. His life so well spent may be summed up by saying that he did good, nothing but good and always good."

In their botanical works the illustrations were generally made by Charles, while the text was written by Louis, although, in a number of cases, the text was the joint work of both. Of the fifty titles given under their names in the Royal Society's Catalogue, eleven bear the names of both brothers. Their active work began with "Observations sur le genre *Elaphomyces*," in the Annales des Sciences of 1841, and their latest work was probably the paper on *Tremellini* in the Annales of 1872. Of their contributions to phænogamic botany the most important were monographs of the *Podostemaceæ* and *Monimiaceæ* in the Archives du Museum, some articles on *Leguminosæ*, and an account of Madagascar plants, all showing careful and accurate work in descriptive botany, while the "Etude d'embryologie végétale," in the Annales of 1847, showed their ability in a very different and difficult field.

But it is in connection with their work on the structure and development of fungi that they are best known and, in this department of botany, their writings, we might almost say, form the basis of modern views on the subject. As in most all cases Charles furnished the illustrations and, at times, also a portion of the text, we need not distinguish between the two brothers in speaking of their mycological works. Their attention was, at first, directed to hypogæous fungi, and from them it naturally turned to the structure of *Gasteromycetes*, an order which was in a chaotic condition at that time. The structure and affinities of the principal genera of this order formed the subject of several of their papers. The *Ustilagineæ* and *Uredineæ* were treated in two important papers, "Mémoire sur les Ustilaginées comparées aux Urédinées," in the Annales of 1847, and "Second Mémoire sur les Urédinées et les Ustilaginées," in 1854. In these two admirable papers, to a knowledge of the anatomy there was added a study of the germination and development of the spores in the different genera with the result of showing clearly the relations of the uredo- and teleutosporic forms, and affording a proper basis of classification of the two orders.

The metamorphoses of *Pyrenomycetes* gave rise to a number of papers in which the connection of secondary forms as conidia, pycnidia, spermogonia, with ascosporic forms was clearly shown. On this fruitful topic, the superb illustrations have been the envy of all later botanists, and their observations on the development of ascomycetous fungi threw a flood of light on one of the most obscure corners of mycology. In this connection should be mentioned the memoir on ergot and also the "Mémoire pour servir á l'histoire organographique et physiologique des lichens" in the Annales of 1852, one of the most important treatises on the structure of lichens.

The complete studies of the Tulasnes on hypogæous forms appeared in 1851, when they published a folio volume, "Fungi Hypogæi," of which only a hundred copies were printed. This work was followed in 1861–65 by the "Selecta Fungorum Carpologia" in three volumes, containing an elaborate account of the different conditions of *Erysiphei, Pyrenomycetes*, and all other ascomycetous fungi. These four volumes, which really form a single series, are most elaborately and luxuriously printed and illustrated, and are certainly unequalled, artistically considered, by any other work on fungi. They will remain a lasting monument to the memory of these two men, who were as talented as they were modest. Always courteous to their contemporaries and quick to recognize the value of their work and that of their predecessors, it is not strange that they were universally esteemed. Their lives seem almost a romance from the time when they began their botanical career as young men at Paris to their death at one of the most beautiful spots on the Mediterranean. The spirit which guided them through life and inspired them in their scientific work is indicated in the quotation which is placed at the head of the beautiful plates of the last volume of the Carpologia: "Non nobis, Domine, non nobis sed Nomini Tuo da gloriam."—W. G. Farlow.

The Grasses of Coulter's Manual.—In his preface the author invites criticisms or corrections with the view of hastening the production of a second edition, and the remarks here offered are made with the hope that they may be of some use in the direction indicated. Being more intimately acquainted with the order Gramineæ than with the other families, these notes will be confined to this order.

The sequence of the genera of grasses is in accordance with that of Bentham and Hooker's *Genera Plantarum*, and we have here the first attempt at introducing into an American text-book that nomenclature of the parts connected with the flowers, as adopted by Bentham, designed to express their true morphological relations. The term glume is applied not only to the two lower bracts that embrace or subtend the spikelets, but also to the bract that subtends the flower which, in other American text-books, is termed the lower palet or palea. The latter term (palea) is applied only to the "upper palea" of authors, the real character of which has never been clearly demonstrated. Bentham suggested that this palea with the lodicules might represent perianth segments of an outer and inner series which, if confirmed, would justify our designating as a neutral flower that in which the palea alone or the palea and lodicules without stamens or pistils are developed; but we must not include in the flower the bract or glume which subtends it.[1]

[1] Bentham, Notes on Gramineæ, Trans. Linn. Soc. xix., p. 24.

In characterizing the order, p. 397, the author has failed to present clearly this modification of terms by adhering too closely to the characters given in Gray's Manual. The same may be said in reference to the specific descriptions. In describing Panicum capillare he says, "sterile flower neutral and of a single glume." A glume in no way constitutes a "flower," and in order to conform with the nomenclature generally adopted, the expression should be "third glume empty," *i. e.*, devoid of a palea or any of the essential organs. In the same description he calls the 2d glume the "upper one," and the 4th or flowering glume he calls a "*somewhat obtuse perfect flower.*" In describing Stipa spartea he says the glumes, meaning the two empty ones, are longer than the "palets." One of these "palets" is called a "flowering glume" in the characterizing the genus on p. 399. Again, under Stipa viridula, he speaks of the "lower palet." There are other instances of lack of uniformity in the use of terms employed to designate the parts of a spikelet, but it is not necessary to refer to them, as our purpose is merely to call attention to this matter. In this connection it may be well to suggest that the expression "outer glumes," although admissible in many cases and sufficiently exact, may lead to inaccuracies or confusion if too generally used. It is understood to refer to the two lowest or the first and second glumes of the spikelet when these alone are empty glumes. When the structure of the spikelet will permit its use in this sense there may be no objection in using it, but in other cases it would be better to designate the glumes by number, as 1st, 2d, 3d, etc. In Reimaria, Leersia, Zizania, etc., there are only two glumes in the spikelet, and, of course, both are "outer" glumes, in a literal sense, but one of them is a flowering glume. In such cases it would hardly be correct to say that there was but one "outer" glume. On the other hand in Panicum, and a number of other genera, there are often three empty glumes below the flowering one. Here the use of the expression in question would lead to needless complication.

In the synopsis of genera, page 398, there are a few errors of fact or misuse of terms that call for a revision. Beckmannia is said to have three empty glumes and a flowering glume. In the European plant there are four glumes, the two lower ones empty while the third and fourth are flower-bearing, or the third may enclose only palea. In the American plant, so far as it has been examined, only three glumes have been discovered—the two lower ones empty, the third enclosing a perfect flower.

The genus Panicum is described as having only three glumes, two empty and one "fertile." Now, the most important character in distinguishing Panicum from Paspalum is the fact that in the spikelets of the former there are *four* glumes while the latter has but three. The same error occurs in describing Setaria, which in the number and character of its glumes are the same as in Panicum. We have here also the expression "the flowering glume with its *palets.*" This may have been an oversight in correcting the proofs. The flowering glume in the Andropogoneæ is said to be "often bearded." It is often *awned* but never bearded. The flower in the genus Phalaris is stated to "consist of two glumes, sometimes called palets." There are no true paleæ in Phalaris, and it is hardly necessary to say that the stamens and pistil constitute the flower, and that the glumes are only bracts subtending it. In Phalaris there are five, or more often six glumes; two large, complicate outer ones, two smaller inner ones enclosing the flower and two (sometimes only one) intermediate ones which are small and lanceolate or are reduced to simple bristles.

In the synopsis, Agrostis and Cinna are separated from Deyeuxia by having "no bristle standing opposite the palet." In Cinna pendula, the only species described, the rhachilla is very often prolonged behind the palea into a short, naked bristle, and in *Agrostis humilis* Vasey, a well marked species found in Colorado, Montana, etc., there is a similar extension of the rhachilla.

No one would look for *Graphephorum flexuosum* Thurb. in Graphephorum as characterized on page 402, where it says "outer glumes nearly equaling the rather remote flowers." In G. flexuosum the outer glumes are one-half shorter than the spikelet and the florets are usually crowded. In a former number of the GAZETTE (vol. ix. p. 169) it was stated that this grass constituted a good genus by itself distinct from Colpodium and Fluminia and still farther removed from Graphephorum melicoides. Its true relationship is somewhat obscure, but there can be no hesitation in placing it with the Festuceæ. As to Graphephorum melicoides and Wolfii, their affinities are with the Aveneæ. The former was first published under Aira and the latter under Trisetum.[1] They differ from Trisetum only in the less pointed lobes of the flowering glumes and in the shorter awns. Graphephorum melicoides, usually described as awnless, is sometimes short awned like G. Wolfii. So closely allied are these two species, that slender forms of the latter might easily be mistaken for the former. That this mistake has occurred is evident from the fact that Utah and Wyoming are given in the range of G. melicoides, where only G. Wolfii has, as yet, been found.

On page 403 *Panicum amarum* Ell. is described. It is exceedingly doubtful if this plant has ever been found in the interior.

Setaria setosa, var. *caudata* Vasey, should read *S. setosa*, var. *caudata* Griseb. (See Griseb. Flor. Br. W. Ind. p. 555.)

Andropogon furcatus Muhl. has an older synonym, *A. provincialis* Lam. (See Scribner, in Trans. Kansas Acad. Sci. ix. p. 116.) *A. Hallii* Hackl. Sitzb. der k. Akad. d. Wissensch, Band lxxxix. p. 127) is not an infrequent species in the Rocky Mt. region from Arizona to Montana. It is No. 651 Hall & Harbour.

Muhlenbergia sylvatica, var. *setiglumis* Watson (p. 409) is *M. ambigua*, Torr. in Niccolet's Rept. p. 164.

Vilfa cuspidata Torr. and *depauperata* Torr. were first placed in Sporobolus by Scribner. (See Bull. Torr. Bot. Club, ix. No. 8.)

Aira flexuosa Linn. is *Deschampsia flexuosa* Griseb. (Spic. ii. p. 457), and not of Beauvois.

In placing *Aira latifolia* Hook. in Deschampsia, a new specific name must be given, as *latifolia* is already taken. It should be called *D. Hookeriana*.

Munro never named any Poa, *P. Californica*. He did have a *Sclerochloa Californica*, which is abundantly distinct from the *Poa Andina* of Nuttall.

Buckley should be quoted as the author of *Poa tenuifolia* (see Proc. Acad. Phila., 1862).

Poa arctica (on page 422) is *P. leptocoma* Trin. *Poa arctica* Br. is *P. cæsia* All.

Bromus breviaristatus should be given to Buckley, who published the species under that name in 1862, twelve years before Thurber's publication.—F. LAMSON SCRIBNER.

EDITORIAL.

THE CUSTOM, which happily is now quite general among botanical writers, at least in America, of distributing separate copies or "extras" of articles published in periodicals, reports of societies, etc., is one especially to be commended. It is mutually helpful to the author and the recipient, and places the publications directly in the hands of those who can make the best use of them, irrespective of the circulation of the medium through which first issued. It is evidently desirable that the excerpt should furnish the possessor with all the data necessary to make a proper citation from it, the same as if the volume in which it was first published were consulted. For this reason it is essential that the original paging should not be changed, and that it should bear the name

[1] Bot. Gaz., ix. 168.

of the publication from which it is taken, together with the number of the volume and the date. These items are not infrequently overlooked, and the excerpt is accordingly shorn of an important part of its usefulness. But it often happens that the author in his distribution does not send a copy to some one who is interested in the subject, and who for various reasons would be glad to possess one. In this country almost the only course open to him is to apply directly to the author for it. In Germany he would usually have no difficulty in purchasing a copy for a small sum of some one of the numerous second-hand bookstores. We on this side of the Atlantic may now and then buy "extras" from the dealers in Berlin and Leipzig of the writings of Dr. Gray, Dr. Farlow, and other American authors, but we must pay for the journey they have taken. An American dealer having the confidence of both the authors and the purchasing public, who would take pains to gather up such papers as we have been speaking of, and offer them at reasonable rates by means of classified lists, would merit the gratitude of scientists, and we do not doubt would meet with pecuniary success. Then the modest author would feel certain that a demand indicated a real interest in his writings, and the modest purchaser, who lacked the temerity to solicit the article from the writer of it, could still supply his needs.

OPEN LETTERS.

Nasturtium lacustre Gray.

The upper leaves of *Nasturtium lacustre* detach themselves when fully matured and emit roots and a stem from the lower extremity. I have seen quantities of such young leaf-plants floating in deep rivers. I do not find this fact recorded.

L. H. BAILEY, JR.

Agricultural College, Mich.

A double Orange.

My attention has been lately called to an interesting variety of orange which has been for sale in this market, said to have come from California. The fruit is about the size of a medium orange, with a slight swelling at the upper end. Dissection reveals a small orange almost completely enclosed in the skin of the large one. The core runs from the stem to about the center of the fruit, and is of about normal size. Then it expands, and for half of the remaining distance is more than twice its previous size. At this point is situated the small orange. This is composed of from seven to eight segments arranged as in the main orange. No seeds are found in the fruit, and it is sweet and juicy. This duplication of fruits was observed not in one orange alone, but in a whole box, and perhaps exists in more. At the upper or flower end of the fruit the skin does not wholly inclose the pulp, but exposes the segments of the smaller orange.

JOS. F. JAMES.

Cincinnati, Ohio.

Arrangement of Herbarium.

I take out and put back the sheets of my grasses many times in the course of a month. My own collection of genera is arranged alphabetically; that of the college herbarium according to Bentham and Hooker's Genera Plantarum. The alphabetical list is much the handiest to use. I shall soon arrange the species of grasses in each genus alphabetically. I shall be glad to hear the views of others on this subject, especially of those who have tried both ways.

Agricultural College, Mich.

W. J. BEAL.

Tamarack in Indiana.

Since writing my paper on the "Origin of the Flora of Indiana," I have received through Prof. Coulter a specimen of wood from Johnson county, in the southern part of this state, which proved to be Larix Americana. This wood was found buried in the blue clay underlying the glacial drift, and had been so well preserved that one would easily distinguish it as a conifer at sight, while its tissue structure was readily recognized as that of L. Americana. I have also heard of other cases in which pieces apparently of the same species have been found in various similar situations throughout the southern part of the state. Now we have only a very few in exceedingly favorable places in extreme northern counties. Prof. Heer found at least some of its near congeners among the specimens from the cretaceous rocks of Arctic North America. These facts help confirm the conclusion that our flora originated in the far north, was driven south during the glacial period and again north during subsequent periods, and distributed as we now find it. H. THOMSON.

Crawfordsville, Ind.

The Fertilization of Campanula Americana.

In a paper under this title read before the A. A. A. S., and published in this journal (Vol. x. p. 349), I described the introversion of the hairs on the style, and referred to Strasburger's confirmatory account of C. rapunculoides, in which, however, he gives no indication that the matter had previously been worked out in another species. My attention has been called to a paper by W. Wilson, entitled "Further remarks on the pollen-collectors of Campanula," etc., in Hooker's *Journal of Botany*, vii (1848). 92. Respecting C. rotundifolia Mr. Wilson says: "The hairs . . . . are simply *pollen-collectors*, and nothing more; they discharge this function admirably; and having performed it they retire, each within its own cell, by virtue, I suppose, of some action of exosmosis. . . . . The whole of the exserted hair is retracted into its base which forms an embedded cavity in the substance of the style." While this matter is only incidentally mentioned in my paper, it is proper that credit be given to Wilson for an observation far antedating Strasburger's and mine. Thus do we, for lack of knowing what has been done, grind over and over the same grist. C. R. BARNES.

Cambridge, Mass.

CURRENT LITERATURE.

Report of the Botanist to the New York Agricultural Experiment Station. By J. C. Arthur. Extracted from the third annual report for 1884, pp. 353-385, and from fourth annual report for 1885, pp. 241-265. 8°.

Professor Arthur was appointed botanist to the New York Agricultural Experiment Station in March, 1884. These two reports embrace the results of his investigations for the years 1884 and 1885. These have been mostly confined to the investigation of fungous diseases, and especially those of cultivated plants. The great importance of this line of study is evident to all who know anything of the magnitude of the losses incurred by fungous parasites. Four introductory pages of the first report are occupied with a statement of the nature and habits of fungi, following which are the details of various experiments with several injurious species. The list of investigations includes diseases of the pear, apple, quince, peach, tomato, oats, and other plants of the field and garden. The investigations upon the pear blight appropriately take a leading place in both reports, and as this work has been of such importance as to attract the notice of the general press of the country, it is only necessary to here state that the cause of pear blight has been demonstrated to the satisfaction of those who are most familiar with the subject. This destructive blight is due to *Micrococcus amylovorus* B., a bacterium discovered by Professor Burrill a few years ago, in connection with pear and apple blight. The minute germs find entrance to the tree through the tender surfaces of flowers and young twigs in spring time and then multiply, producing the familiar burned appearance of the leaves and twigs in mid-summer. By a careful filtration of the juices accompanying the bacteria, and by a long series of cultures in the usual way for the elimination of all foreign matter, it was demonstrated that the cause of the blight resides with the bacterium germ and not in the enveloping liquid. It was a happy thought that led to the innoculation of the very susceptible flesh of the growing fruit, and it serves as a hint to all investigators that they should seek for every possible advantage in applying their tests. It remains for the fungicide to be found. If some otherwise harmless chemical will prove effective, it seems that with this additional discovery the work of the scientists in this case would be fairly completed. Until such remedy is found the old one of the knife used upon all discolored branches should be vigorously applied. The blight of the apple and quince are of the same origin and require the same treatment.

Professor Arthur has made observations on another blight or scab, *Fusicladium pyrinum* Fckl., that works upon the leaf of the pear. Another species of the same genus, *F. dendriticum* Fckl., works in like manner upon the apple leaves covering them with rusty spots, and upon the fruit, sometimes causing much damage.

The amount of smutted grain in an ordinary field of oats was carefully determined to be nine and one-half per cent. This strikingly points to the fact that doubtless the loss of grain from smut is greater than generally supposed. Much of the smutted grain is overlooked by the ordinary observer.

The lettuce rust and mildew have both been subjects of investigation, and both are illustrated with engravings. The rust, *Septoria Lactucæ* Pass., causes the lettuce leaves to turn brown and become unfit for use. Experiments with fungicide as yet have developed no satisfactory remedy. The mildew, *Peronospora gangliformis* DeB., is a genuine rot and a close relative of the potato rot. The wild lettuce is a natural propagating bed for this disease and should be eradicated wherever found.

Extensive investigations have been made upon the rotting of cherries and plums, caused by *Oidium fructigenum* S. & K. This fungus passes the winter in decayed fruits that frequently remain hanging to the trees. Sowings of the fungus spores upon the flowers of cherries quickly produced the rot in the young fruits. The disease spreads rapidly from fruit to fruit when the latter are in contact, and there is little doubt that the mycelium has the power of penetrating the fruit skin, though some writers hold that they can only pass through stomata, or ruptures in the fruit. It has been stated by Von Thümen and others that this fungus acts as an antiseptic. This impression may arise from the fact that when it has coated the surface of a fruit, it excludes the entrance of more active putrefying germs, as those of bacteria. Professor Arthur's experiments lead him to as extreme a view of the case as the following, which we give in his own words: "Doubtless such destructive species as the Peronosporæ of potato-rot and lettuce-rot are not the direct cause of the offensive putrefaction, but it is due to the bacteria associated with them. We very properly hold the higher fungus accountable for the result, however, for it first produces by its growth those chemical products upon which the bacteria are able to thrive. . . . The inability of the usual putrefactive bacteria to overcome the resistance of the living cells and start decay, has been well illustrated by numerous experiments performed in connection with other topics, and particularly by the ineffectual inoculation of green tomatoes with bacteria taken from a rotting fruit in which were only bacteria and fungous mycelium." The remedy suggested for the serious rotting of fruits is the destruction of all decaying fruit, whenever and wherever found. When practicable hogs should run under the trees.

In *Entomophthora Phytonomi* Arthur we have a new species of fungus that is welcomed to a place among those forms preying upon destructive insects, and are therefore friends of the farmer and gardener. This fungus, the life history of which, as far as known, is described and illustrated in the report, infests the bodies of the clover-leaf weevil (*Phytonomus punctatus* Fabr.), causing the host insects to die. The behavior of the ravaged weevils and the methods of dispersing the spores of the fungus are particularly interesting.

In conclusion, Professor Arthur tabulates the weeds and the number of each which grew upon one-twentieth of an acre of plowed and otherwise unoccupied land during 1885. To this subject is added notes upon some of the fungi that prey upon weeds—a list of friends, when they confine themselves to undesirable hosts, as the Canada thistle, pig-weed and purslane. We hope to see an annual contribution to our limited fund of knowledge of plant diseases from Professor Arthur for many years to come. Many of his subjects demand continuous investigation through several seasons. BYRON D. HALSTED.

Text-Book of General Botany. By Dr. W. J. Behrens. Translated fromt he 2d German edition. Revised by Patrick Geddes. 8°, pp. viii, 374. Edinburgh: Young J. Pentland. 1885.

Germany has produced many text-books of botany, of all grades of excellence, and several of them have been honored by an English translation. We are more than willing to acknowledge Germany's leading position in botany, but why this special text-book was selected for translation we can not discover. Not that there is anything bad in the book itself, for it is a good book of its kind, but there is nothing about it of such surpassing excellence that it should deserve this high compliment. The translation, in this view, simply seems unnecessary. The book is welcomed to every botanist's library, not because of its excellence as a text-book, but it gives profuse and most excellent illustrations, new statements of old facts, many new illustrations of facts, in short, just such a book as one likes to consult now and then in "working up" a subject.

It is divided into five parts, with no sub-divisions into chapters, and strikes one as being out of proportion for a "Text-book of General Botany." Part I deals with Morphology in about 100 pages, the plant organs being considered under the four heads of root, stem, leaf, and hairs. Part II, with about 60 pages, is devoted to Systematic Botany. Here the American student will be lost, and maybe he ought to be. The classification adopted is of course German, and probably more nearly expresses natural relationships than the confessedly artificial grouping that we use. But this aside, all this systematic presentation of orders in a "text-book" is so much barren waste, so far as class work is concerned. It reduces that part of the book to reference rather than to reading. Part III, with 70 pages, bears the title of Physiological Botany, but is all devoted to flowers and insects. It occurs to us that this title is a misnomer, and the space occupied by this very interesting subject is out of all proportion to the rest of the book. When one looks for a description of the process of "fecundation," he is met with the primitive statement that the pollen grain contains protoplasm, and that the embryo-sac is a cavity in the ovule filled with fluid (p. 168), and that the "mingling of the contents of the pollen-tube with those of the embryo-sac is the essential feature of the process of fecundation." It must be said that the subject of cross-pollination is beautifully worked out, both in illustrations and text. Part IV contains about 80 pages, and is entitled Anatomy and Physiology, though it would be hard to explain why one part is called Physiological Botany and another Physiology, although the former only deals with insects and flowers. At the opening of this part we are treated to an anomalous thing. Here, towards the end of the book, under anatomy and physiology, we encounter an introduction to the study of botany, giving its scope, its history, etc., with brief biographical sketches of the older systematists, followed by others who were physiologists. Some 30 pages is given to a good and finely illustrated discussion of the cell. After this, the subject of "histology" is taken up, though why the study of cells would not come under that head it would be hard to guess. Then to physiology proper 10 pages are given! There can surely be no excuse for so reducing this great subject in a general text-book. Part V, with 40 pages, is entitled "The Lower Plants," under which title are grouped both cryptogams and phanerogams with their subdivisions, chief attention being given to the former. What mycologists will say to the following groups as correlatives is not hard to guess: protophytes, fungi, algæ, liverworts, mosses, ferns, horsetails, rhizocarps, clubmosses, conifers, monocotyledons, and dicotyledons. It is said that except in the protophytes spores are "the product of sexual conjugation," and that they are "destitute of an embryo having plumule, radicle, and cotyledons," though what their embryo does have is not said. So then, under the comprehensive title, "Systematic Botany," we have grouped only the phanerogams, while under the restricted title, "The Lower Plants," we have all plants grouped.

How much of this is due to the translator we have no means of judging. Our frank opinion, then, with respect to the book, is that it lacks perspective, proportion, arrangement, and proper titles; while it does have an abundance of capital illustrations and much most excellent information presented in an interesting way. While, therefore, it can never be considered a good "Text-Book of General Botany," as a treatise on botany it will find a place on our shelves and be frequently consulted.

Plant Life on the Farm. By Maxwell T. Masters, M. D., F. R. S. 16°, pp. iv, 132. New York: Orange Judd Company. 1885.

This little book is a step in the right direction. It is high time that our cultivators should be informed of some of the most important facts of physiological botany. They may be well informed about the structure of plants, for we have many good books treating of this subject, but simple and concise books upon how plants live are very few, and no department of botany can be more important to those whose whole occupation is to cultivate plants. The class addressed has neither time nor training to master and apply all the details of this subject, nor is it of practical importance that it should, but, as the author says, "experience shows the increasing necessity of furnishing him (the cultivator) with new tools and new weapons to enable him to utilize the resources of nature, and to contend against adverse circumstances. It is the object of this book to point out these resources and suggest methods of utilizing them." The subjects of the nine chapters are very suggestive, and treated, as they are, in a simple yet scientific way, give to the reader a fair knowledge of the life work of plants. The subjects are: Plant Nutrition, the work and the materials; Nutrition, the machinery; Growth; Sensitiveness; Development; Multiplication; The Battle of Life; Practical Inferences; Decay and Death. It is a good thing for science when some leading worker stops long enough to teach common people a few things that are useful for them to know. The other alternative is to leave it to quacks and professional book-makers who do it so badly that it had better not be done at all. Dr. Masters has been able to draw upon a great fund of experiments furnished by the famous experiment station at Rothamsted. A good point is made in trying to get the cultivator to understand how important to his own work is that of the microscopist and chemist, as the "life-history of a plant is, in essence, the life-history of protoplasm and of its covering the cell-wall," a thing which the "practical man" finds it difficult to realize. The author, of necessity, touches upon some very difficult problems, but is wise in not confusing his readers by discussing them, although properly leaving the impression that they are not fully understood, as for instance the function of chlorophyll, p. 28. Most of the definitions are very clear, when one considers that they are made for those with no basis of technical knowledge. Exception might be taken to the following, however, p. 49, where the exogenous stem is said to have woody bundles made of "wood-cells" and "bast cells," and on the "*outer side of each bundle* is a thin layer of cambium." On the same page the endogens are said to have "their cambium tissue in the center of each bundle." A difference of opinion might also be held in reference to the statements on page 87, that "cross-fertilization secures variation," and self-fertilization represses it. We can cordially recommend the book, not only to the practical cultivator, but also to botanists, many of whom know far too little of the principles of physiological botany.

On the Structure of the Testa of Several Leguminous Seeds. By **L. H. Pammel.** Extracted from the Bullitin of the Torrey Botanical Club. Vol. xiii (1886), pp. 17–24, t. 2.

In this brochure, Mr. Pammel describes the structure of the seed coats of Phaseolus vulgaris, Gymnocladus Canadensis, Physostigma venenosum and Mucuna urens. The structure of the very hard seed-coats he finds quite homologous with that of less resistant ones, differing chiefly in the greater development of sclerenchyma cells which are commonly present. The work has been carefully done, and much of the extensive literature regarding leguminous seed-coats is cited by the author.

NOTES AND NEWS.

THE GERMAN imperial government has ordered the establishment of chairs of bacteriology at all universities of the empire.

THE PAPER of Dr. W. Pfeffer on intramolecular respiration, noticed in the March GAZETTE, is taken, as we are informed by Dr. N. L. Britton, from *Untersuchungen des botanischen Instituts in Tübingen*, vol. i.

THE ENUMERATION of the species of the genus Phyllosticta by George Martin is terminated in the March number of the *Journal of Mycology*. It includes seventy species, found upon sixty-four species of host plants.

EXTENSIVE BACTERIOLOGICAL studies are now carried on at the U. S. Army and Medical Museum at Washington. The most recent apparatus and methods are used, and the facilities are considered quite equal to those of German laboratories.

THE FOLLOWING new grasses are described by Dr. Geo. Vasey in the *Bulletin of the Torrey Club* for February: Panicum Nealleyi, Imperata brevifolia, Aristida Arizonica, A. Harvardii, and A. Orcuttiana. Seven new varieties belongingto other species are also described.

ÉDOUARD MORREN, the well-known professor of botany in the University of Liége, vice-president of the Royal Botanical Society of Belgium, editor of *Belgique Horticole* and of *Correspondance Botanique*, died on the 28th of February last, at the age of 52 years.

IN ANSWER to an enquiry, Professor Gray informs us that he is not quite disposed to place on sale copies of his papers in the American Academy's Proceedings and elsewhere, especially as he pretty freely presents them to his principal correspondents, so that there are not very many left over. Still, to oblige those whom he has to overlook or can not keep the run of, and to recover a portion of the cost, he has arranged that orders for them addressed to the curator of the Herbarium of Harvard University will as far as possible be filled, at the rate of thirty-five cents for each paper.

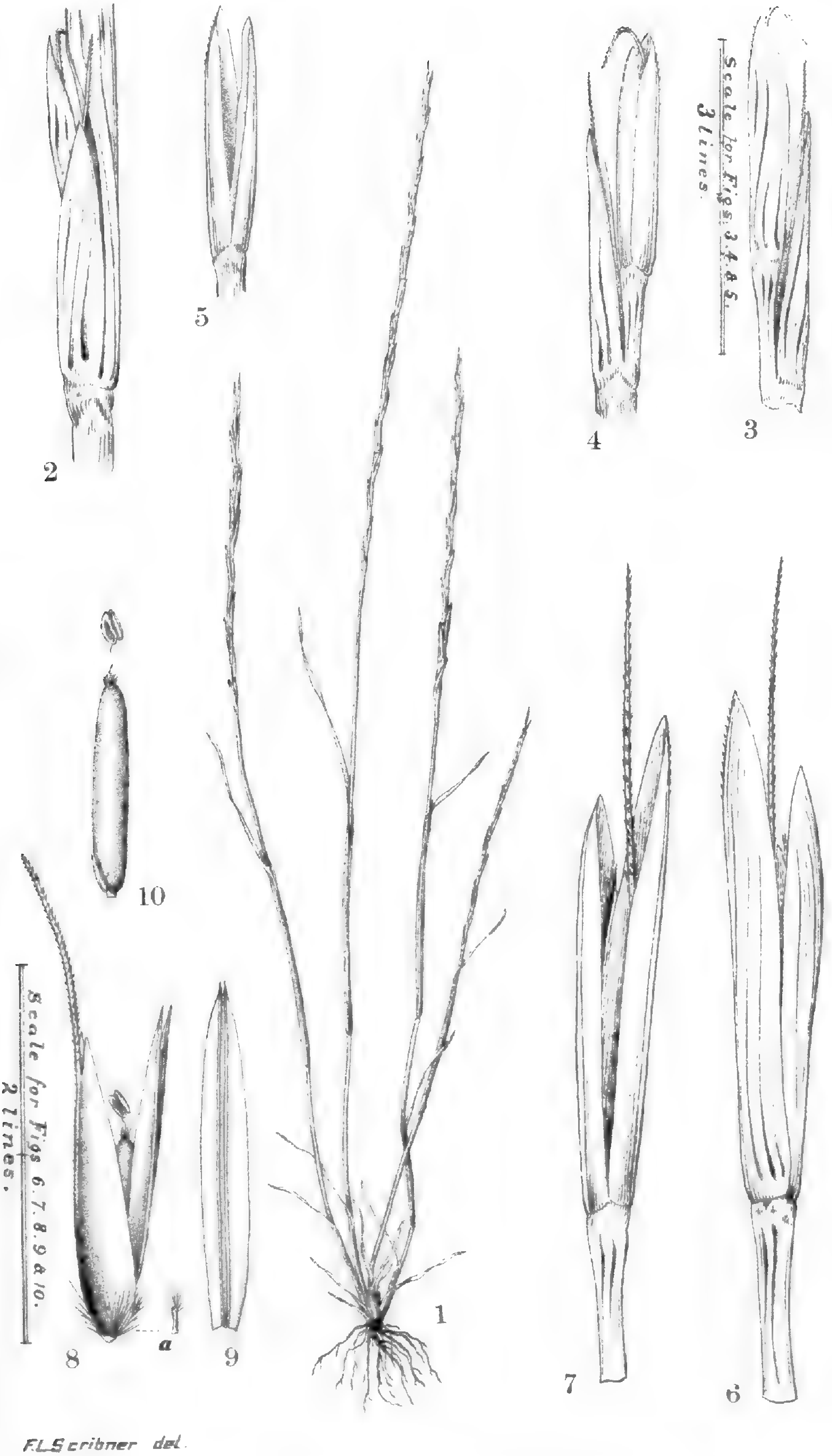
W. C. WALKER, F. R. M. S., of Utica, and H. H. Chase, M. D., of Geneva, N. Y., have issued a fascicle of eight quarto pages and two plates dealing with some new and rare diatoms. Twenty-two species are mentioned, all of which are figured. Of the forms marked as new five species are by Mr. Walker, two species and two varieties by Dr. Chase, two species by Prof. H. L. Smith, one species by Mr. E. S. Nott, and one variety by Mr. B. W. Thomas. The plates are photographs from free-hand drawings by Mr. Walker, and are fine examples of this kind of work. We suppose it is by a slip that the figures are said to be magnified 400 diameters, for being free-hand they must necessarily be variable. We are informed that this is to be followed by other numbers.

IN AN ARTICLE on horticultural botany read before the Western N. Y. Horticultural Society, of which extra copies have been distributed, Dr. E. L. Sturtevant suggests the words *pomiculture* and *olericulture* to embrace respectively fruit culture and vegetable culture. It is pointed out that the latter deals with plants which have a pedigree, being mostly raised each year from seed, while the former deals with plants without a pedigree, but with only a parentage, being mostly propagated by division. The one class of plants reproduces the various forms from seed with much certainty, which are properly called varieties, the other not being able to reproduce them with any certainty should not have the forms called varieties, but variations. Whenever a valuable variation occurs it is propagated indefinitely by division; should it also be capable of reproduction by seed, it becomes a true variety.

THE FIRST NUMBER of a new quarterly journal devoted to algæ, called *Notarisia*, has just appeared. It proposes to treat of the current bibliography of this branch of botanical science, to collate references and Latin descriptions of new species, to furnish communication between algologists, and to some extent to publish original articles. The journal is designed to be truly international; communications will be published in Italian, French, or Latin. The price will vary according to the required size, but will not exceed fifteen francs ($3.00) per annum. Subscriptions should be sent to the editors, Dr. G. B. de Toni and David Levi, S. Samuele 3422, Venice, Italy. The present number consists of sixty-four octavo pages with heliotype portrait of De Notaris, to whom the journal is dedicated. It also has an appendix of eight pages with two plates illustrating the genera of Florideæ. There is no doubt about the need of such a journal, and this gives promise of meeting the want.

OPPORTUNITY is again offered to any who desire, to obtain the whole or any part of the *Flora Danica*. This magnificent work was commenced in the latter part of the last century, and has been published by the liberality of the king of Denmark. It is now complete, excepting the index, and it is proposed to reprint such parts as may be called for. The entire work contains explanatory text and over *three thousand* plates representing 4000 species belonging to Denmark, Norway and Sweden, Iceland and Greenland. Single fascicles consisting of 60 plates with text can be had for 19 fr. 50 c., or, colored, for 55 fr. 50 c. Considerable discount will be made when 10 or more fascicles are ordered. The editor also proposes to issue from the same plates the following works: 1. *Icones Floræ Groenlandicæ* consisting of 330 plates with text, price, uncolored, 65 fr. 50 c. or, colored, 250 fr. 25 c.—2. *Arboretum Scandinavicum*, illustrations of the trees and shrubs of Denmark, Norway and Sweden, 160 plates, uncolored 40 fr., colored, 126 fr.—3. *Icones plantarum officinalium Scandinaviæ*, 300 plates, uncolored 60 fr., colored, 240 fr. Those who wish to obtain any of these works or the whole or part of the *Flora Danica* should communicate their wishes to the editor Dr. Joh. Lange, Thorvaldsens Vej 5 (V.) or to MM. Lehmann & Stage, Klareboderne 3, Copenhagen K. The *Flora Groenlandica* will be especially valuable to North American botanists.

WE LEARN FROM the *Bulletin de la Société de France* that S. Groslik has been carrying on experiments to determine the influence of light upon the development of the leaf parenchyma. He selected for the purpose the leaves of Eucalyptus globulus which exhibit three distinct stages of development. The parenchyma of the very young leaf consists only of isodiametric cells, which the author designates as "primitive mesophyll." In the second stage the leaf is vertical and develops a layer of palisade parenchyma under both surfaces. In the third stage the leaf is horizontal and has a layer of palisade parenchyma as usual only under the upper surface, the palisade of the under side having gradually been transformed into spongy parenchyma. M. Groslik holds that these changes are induced by the change in the illumination and gives the following experiments to demonstrate this: Taking a leaf in the first phase of development, he kept it in a horizontal position when it developed palisade only on the upper face. Keeping a leaf in the second stage (i. e., one having palisade on both surfaces) in a constantly vertical position the inferior palisade did not become converted into spongy parenchyma. The author therefore argues that from the primitive mesophyll of the leaf either spongy or palisade parenchyma is developed and that the character of this adult mesophyll is dependent on the illumination, a strong direct illumination favoring the development of palisade and shade favoring the formation of spongy parenchyma. M. Groslik's conclusions are hardly new, but his experiments are interesting and can be used in laboratory demonstrations.



F.L.Scribner del.

HACKEL ON SCRIBNERIA

HELIOTYPE PRINTING CO BOSTON

VOL. XI. NO. 5.—BOTANICAL GAZETTE.—MAY, 1886.

Scribneria, gen. nov.

AUCTORE E. HACKEL.

WITH PLATE V.

Tribus—Hordeæ, Benth & Hook. Gen. Plant. III. 1093.
Subtribus Leptureæ, Benth. & Hook. l. c. p. 1094.

Spiculæ unifloræ in spica simplici ad nodos haud excavatos rhacheos demum articulatæ solitariæ vel rarius versus basin spicæ binæ, altera tum sessilis, altera pedicillata, alternæ, angustæ, rhacheos faciei parelle insertæ, rhachilla brevissima supra glumas inferiores (steriles) articulata, ultra florem in stipitem brevem breviter penicellatum producta, floræ hermaphroditæ. Glumæ inferiores 2 vacuæ, collaterales, angustæ, rigidæ, acutæ, parum inequales, carina excentrica, ita ut latus anterior cujusvis glumæ 2-nervis, posterior enervis evadat. Gluma florens vacuis tertia parte brevior, membranacea, carinata, bidentata, ex incisura aristam rectam glumas vacuas superantem exserens, callo barbato. Palea illam subsuperans, tenuis, bicarinata, acute bidentula. Lodiculæ 2. Stamen unicum, anthera parva. Stigmata brevia, plumulosa, sessilia. Caryopsis linearis, a latere compressa, exsulca, embryone parvo, hilo punctiformi. Gramen annuum humile tenueque foliis angustis brevibus. Spica terminalis elongata rigida at tenuis, recta, subcompressa, spiculis subdissitis liberis (minime in excavationibus rhacheos inclusis).

Affinis *Lepturo* et *Kralikiæ* et *Psiluro*. *Lepturus* differt rhacheos internodiis excavatis, spiculis semper solitariis, gluma floririfera integra mutica callo nudo, staminibus sæpissime tribus. *Psilurus* differt gluma vacua unica brevissima quam florens multoties breviore, hac ex apice aristata. *Kralikia*, quæ callo barbato convenit, differt spiculis bifloris rhacheos faciei oppositis, staminibus 3.

Dedicavi genus hoc F. Lamsonio Scribnero de graminibus americanis optime merito, qui primus discrimina inter hoc et Lepturi genus in litteris ad me indicavit.

Species unica: *Scribneria Bolanderi* Hack. (Lepturus Bolanderi Thurber in Proc. Amer. Acad. of Arts and Sciences VII. p. 401). California, Oregon.

EXPLANATION OF PLATE V.—Fig. 1. A plant, slightly reduced.
Fig. 2. A portion of the rhachis showing two spikelets in situ.
Fig. 3. The two spikelets, exterior view.
Fig. 4. The same, a view of the sides opposed to the rhachis.
Fig. 5. The empty glumes of these spikelets, anterior view.
Fig. 6. One of the spikelets with a short pedicel, exterior view.

Fig. 7. Same from the interior or the side next the rhachis.
Fig. 8. Flowering glume, with its palea, etc., removed from the outer glumes.
Fig. 8a. The short rhachilla which is prolonged behind the palea.
Fig. 9. The palea, dorsal view.
Fig. 10. The fruit, to which is attached by adnation a stamen, the anther of which is seen above.

Revision of North American Hypericaceæ.—II.

JOHN M. COULTER.

* * * Styles 3 or 4, very long, distinct and spreading, stigmas capitate: capsule ovate, strictly one-celled, a line or two long; seeds minutely striate and pitted: simple or branching herbs, 1 to 3 feet high, with small distant ascending sessile or clasping leaves, and the uppermost branches of the cyme bearing alternate distant flowers.

17. **H. virgatum** Lam. Leaves ovate or oblong-lanceolate, acute, half to an inch long, 2 to 4 lines wide: flowers bright yellow, 4 to 8 lines in diameter, in nearly naked cymes: sepals lanceolate to ovate, acute or acuminate, keeled below, more or less foliaceous and enclosing the small capsule.—Dict. iv. 158; Chois. in DC. Prodr. i. 547; Torr. & Gray, Fl. i. 166.

H. angulosum Michx. Willd. Spec. iii. 1453; Chois. l. c. 546; Torr. & Gray, l. c. 164 and 673; Gray, Manual, 85.

H. hedyotifolium Poir. Suppl. vii. 700.

Wet pine barrens of New Jersey, to Florida and Kentucky.

This species is exceedingly variable in the size of its leaves, but this is a characteristic of the whole genus, and has led to much confusion in attempting to construct species upon leaf characters. The broader-leaved, more northern forms are to be referred to the species, while associated with it at the south is

Var. **acutifolium.** Usually taller and more branching: leaves linear-lanceolate, tapering to a very acute apex, an inch or more long, a line or two wide.

H. acutifolium Ell. ii. 26; Torr. & Gray, Fl. i. 167.

18. **H. pilosum** Walter. Seabrous tomentose, mostly simple: leaves ovate-lanceolate, usually appressed, 4 to 6 lines long, about a line or two wide, sometimes much reduced: flowers 3 to 5 lines in diamater, in few-flowered cymes: sepals ovate-lanceolate, acute: petals more than twice as long, involute when old.—Fl. Car. 190; Chois. l. c. 549; Torr. & Gray, Fl. i. 163.

H. setosum L. as to Clayton's plant in Gronov. Virg. 88.

H. simplex Michx. Fl. ii. 80; Chois. l. c.

Ascyrum villosum L. Spec. 788.

Wet pine barrens, South Carolina, to Florida and Louisiana.

**** Styles 3, long, distinct and usually spreading; stigmas capitate: capsule ovate, 3-celled, more or less glandular and exhaling a heavy odor when crushed; seeds as in the last: whole plant (including petals and anthers) more or less black dotted: herbs, with rather large leaves and flowers, the petals much longer than the sepals.

† Eastern species: plants 1 to 4 feet high: capsules mostly not lobed.

19. **H. PERFORATUM** L. Much branched: leaves linear to oblong, obtuse, mostly tapering at base, half to an inch long, 1 to 5 lines wide: flowers numerous in loose cymes, about an inch in diameter: sepals linear-lanceolate, very acute or acuminate: petals bright yellow, black dotted along the margin: capsule conical-ovate, 2 or 3 lines long.

Common everywhere in old fields as a weed difficult to extirpate. (Nat. from Europe.)

20. **H. maculatum** WALTER. Simple below, more or less branched above, conspicuously dotted all over: leaves oblong to lance-ovate, obtuse or acute, more or less clasping, sometimes tapering at base, 1 to 3 inches long, 4 to 9 lines wide: flowers smaller, 3 to 6 lines in diameter, crowded: sepals lanceolate to ovate, acute: petals pale yellow, with black lines as well as dots: capsule conical-ovate, 2 or 3 lines long.—Fl. Car. 189; Michx. Fl. ii. 80; Torr. & Gray, Fl. i. 161 and 673.

H. Virginicum Walter, 189.

H. punctatum Lam. Dict. iv. 164: Chois. in DC. Prodr. i. 547; Reich. Hort. Bot. i. 61, t. 88.

H. corymbosun Muhl. Willd. Spec. iii. 1457; Torr. & Gray, l. c. 160; Gray, Manual, 85.

H. micranthum Chois. Prodr. Hyper. 44, t. 5; Hook. Fl. Bor.-Am. i. 109.

From Canada and Minnesota to Florida and Texas.

This species is quite variable in the length of its styles, and upon the characters of short and long styles H. corymbosum and H. maculatum were formerly separated. This distinction, however, does not hold, as although the northern forms are mostly shorter styled the same forms are also found at the south associated with the longer styled forms. Besides it is only in extreme cases that the styles are very different in length, and there is every gradation between. The long styled forms of the south represent this species as formerly defined, which must now be made to include also H. corymbosum. The southern plants also usually have more glandular capsules.

21. **H. graveolens** BUCKLEY. Simple, or somewhat branched above: leaves large, elliptical-oblong, obtuse, closely sessile or clasping, 2 or 3 inches long, about an inch wide: flowers an inch or more in diameter, in few-flowered cymes: sepals lanceolate,

very acute: petals very scantily black dotted, if at all: capsule somewhat lobed, ovate, 3 to 5 lines long.—Am. Jour. Sci. I. xlv. 174; Gray, Genera Ill. i. 214, t. 92, Manual, 85; Chapm. Fl. 41.

Mountains of North Carolina.

† † Western species: plants 3 inches to 2 feet high: capsules 3-lobed, 3 or 4 lines long: petals bright yellow, often tinged with purple, with a few black dots along the margin.

22. **H. formosum** HBK. var. **Scouleri.** From running rootstocks, simple or somewhat branching, often with numerous small branchlets, a half to two feet high: leaves ovate-oblong, obtuse, more or less clasping, about an inch long, half inch or more wide (those of the branchlets much smaller and often tapering at base), usually black dotted along the margin of the under surface, veiny: flowers half to an inch in diameter, in loose corymbs: sepals lanceolate to ovate, obtuse or acute: styles mostly erect.

H. Scouleri Hook. Fl. Bor.-Am. i. 111; Torr. & Gray, Fl. i. 160; and of all authors.

Throughout all our western mountain systems, and extending into British Columbia.

Exceedingly variable. The species is Mexican, and differs from our variety only in its narrower and acuminate sepals. It is really questionable whether our forms deserve to rank even as a variety, as there are found among them sepals which are almost indistinguishable from those of H. formosum.

23. **H. concinnum** BENTH. Somewhat shrubby and branching at base, 3 to 18 inches high: leaves linear to oblong, not clasping, usually folded, half to over an inch long, 1 to 4 lines wide, acute: flowers over an inch in diameter, few, in rather close clusters at the summit of the stem, with black lines as well as dots: sepals ovate, mucronate-acute, or very acuminate, longer than the capsule.—Pl. Hartw. 300; Brewer & Watson, Bot. Calif. i. 81.

H. bracteatum Kellogg, Proc. Calif. Acad. i. 65.

California. First collected by *Hartweg*, in the "Sacramento Valley."

§3. Stamens 5 to 20, mostly in 3 clusters: styles 3 (sometimes 2), short, distinct; stigmas capitate: capsules ovate to conical, one-celled; seeds yellow, more or less striate and pitted: small and slender annuals, with very small flowers, and petals shorter than the sepals.

* Procumbent or ascending, or forming dense mats, diffusely branching: leaves rather broad, obtuse, clasping: capsule a line or two long.

24. **H. anagalloides** Cham. & Schlecht. Often forming dense mats: stems an inch to a foot long: leaves oblong to broadly ovate, very obtuse, 5 to 7-nerved at base, 2 to 6 lines long, almost as broad: flowers 3 or 4 lines in diameter, in few-flowered naked or leafy cymes: sepals foliaceous, unequal, lanceolate to broadly ovate, longer than the ovate capsules: stamens 15 to 20.—Linnæa, iii. 127; Torr. & Gray, Fl. i. 167 and 674.

? *H. mutilum* Watson, King's Report, v. 46.

In wet ground from Southern California to Washington Territory, Montana (*Watson*), and British Columbia. Also in adjacent Mexico.

Possibly this is but a form of *H. Japonicum* Thunb.

25. **H. mutilum** L. Like the last, but more erect and diffusely branching, a half to a foot (or even two feet) high: leaves narrowly oblong to somewhat ovate, half to an inch long, 2 to 4 lines wide, 5-nerved at base: flowers in very loose leafy cymes: sepals linear to lanceolate, usually shorter than the ovate capsule: stamens 6 to 12—Spec. 787; Torr. & Gray, Fl. i. 164.

H. quinquenervium Walter, Fl. Car. 190; Chois. in DC. Prodr. i. 550; Hook. Fl. Bor.-Am. i. 110.

H. parviflorum Willd. Spec. iii. 1456; Pursh. 377.

H. stellarioides HBK. Nov. Gen. v. 196.

Low grounds, from Canada to Florida and Texas. Also in adjacent Mexico.

Quite variable in size, and in some forms closely resembling the last species.

** Almost simple, with strict stems and branches: flowers in naked cymes: sepals linear to linear-lanceolate, acuminate.

26. **H. gymnanthum** Engelm. & Gray. A foot to three feet high: leaves cordate-ovate, clasping, often quite distant, half inch or more long, 5 to 7-nerved and 3 to 5 lines wide at base, tapering to an acute or obtuse apex: flowers in strict mostly few-flowered elongated cymes: sepals a line or two long, about as long as the ovate-conic capsule: stamens 10 to 12.—Pl. Lindh. 4; Walp. Ann. ii. 188.

H. mutilum var. *gymnanthum* Gray, Manual, 86.

Delaware, Pennsylvania and Illinois, to Louisiana and Texas.

The strict habit and naked cymes resemble the following species. In the *Berichte der Deutschen Botanischen Gesellschaft* for Feb. 1885, R. v. Uechtritz and P. Ascherson refer this species to *H. Japonicum* Thunb. They well establish it as a species distinct from H. mutilum, but an examination of many specimens of H. Japonicum shows it to be very distinct from that species also. If H.

Japonicum is represented in our flora at all, it is our western H. anagalloides. This last named species approaches very nearly our eastern H. mutilum, to which species H. gymnanthum has been referred. This is the closest relationship we can trace between H. Japonicum and H. gymnanthum. If these two are one, then must H. mutilum and H. anagalloides follow, and with such a limitation our species of Hypericum could be reduced to very few.

27. **H. Canadense** L. A half to a foot or more high: leaves linear to linear lanceolate, glandular dotted beneath, mostly tapering to the sessile 3-nerved base, half to an inch or more long, a line or two wide: flowers in loose cymes: stamens 5 to 10: capsule very acutely conical, 2 or 3 lines long, longer or shorter than the sepals.—Spec. 785; Torr. Fl. N. Y. 1. 89; Torr. & Gray, Fl. i. 165.

H. thesiifolium, pauciflorum and *Moranense* HBK. Nov. Gen. & Spec. v. 192 and 193.

Wet sandy soil, from Canada to Georgia, Illinois, Wisconsin, and the Winnipeg valley.

Exceedingly variable in size. The extreme forms may be grouped under the following varieties:

Var. **major** Gray. Stems much stouter and taller: leaves larger, an inch or two long, 4 to 6 lines wide, lanceolate, more or less clasping, often very acute: flowers in larger more crowded cymes: sepals long pointed: capsules larger.—Manual, 86.

From Canada to Pennsylvania, Illinois, and about the Great Lakes.

Var. **minimum** Chois. Dwarf, 1 to 3 inches high, simple, few-flowered: leaves oblong, obtuse, 4 to 5 lines long, a line or two wide, smaller and more crowded below.—DC. Prodr. i. 550; Hook. Fl. Bor.-Am. i. 110.

On wet rocks, Canada, to Wisconsin (*Lapham*), and "Cypress Hills," N. W. T. (*Macoun*).

* * * Bushy branching, with rigid erect black-dotted stems and branches: leaves very slender and rigid or minute, erect or appressed: flowers scattered along the upper part of leafy branches.

28. **H. Drummondii** Torr. & Gray. Stem and alternate branches rather stout, 10 to 30 inches high: leaves linear-subulate, erect, a fourth to an inch long, one-nerved: flowers pedicellate: stamens 10 to 20: capsule ovate, about 2 lines long, not longer than the sepals; seeds large, oval, strongly ribbed and transversely lacunose, brownish yellow.—Fl. i. 165.

Sarothra Drummondii Grev. & Hook. Bot. Misc. iii. 236, t. 107.

In dry soil, Georgia and Florida, to Illinois and Texas.

29. **H. nudicaule** WALTER. Stem and opposite branches filiform, wiry, appearing naked from the very minute awl-shaped appressed leaves, 4 to 20 inches high: flowers very small, mostly sessile: stamens 5 to 10: capsule very acutely conical, 1 to 3 lines long, much longer than the sepals; seeds very much smaller, oblong, minutely striate and pitted, light yellow.—Fl. Car. 190.

H. setosum L. Spec. 787, as to Pluck. syn.

H. Sarothra Michx. Fl. ii. 79; Torr. & Gray, Fl. i. 165; Gray, Gen. Ill. i. 214, t. 93, f. 1–7, Manual, 86.

Sarothra gentianoides L. Spec. 272; Lam. Ill. t. 215, f. 1.

S. hypericoides Nutt. Gen. i. 204; Barton, Fl. N. Am. iii. 59, t. 92, f. 1.

Dry sandy soil, Canada to Florida, and the Mississippi valley.

3. ELODEA JUSS., PURSH.

Perennial herbs, in marshes or shallow water; with small close clusters of flesh-colored flowers in the axils of the leaves and at the summit of the stem; sepals much shorter than the acute capsules.—Juss. Gen. 255, partly; Pursh. Fl. 360; Torr. & Gray, Fl. i. 167; Gray, Gen. Ill. i. 216, t. 94. Not *Elodes* Adans., Spach, nor *Elodea* Michx. *Triadenium* Raf.—A genus of two species, peculiar to Eastern North America.

1. **E. campanulata** PURSH. A foot or two high, mostly simple: leaves oblong to ovate, very obtuse or emarginate, clasping by a broad base, about an inch and a half long, half inch wide, glaucous beneath and black dotted: axillary flower clusters at the ends of elongated branches: sepals lanceolate to ovate: filaments united below the middle: capsule 4 or 5 lines long.—Fl. 379.

E. Virginica Nutt. Gen. ii. 17; Torr. & Gray, Fl. i. 167; Gray, Gen. Ill. i 216, t. 94; Manual, 86.

Hypericum Virginicum L. Spec. 2 ed. 1104; Chois. in DC. Prodr. i. 546.

H. campanulatum Walter, Fl. Car. 191.

H. emarginatum Lam. Dict. iv. 154.

From Hudson's Bay to New Jersey and North Carolina, westward to Minnesota and the Winnipeg valley. Also in adjacent Asia and Japan.

2. **E. petiolata** PURSH. Resembling the last, but usually taller and more branching: leaves longer (2 to 5 inches), half to an inch wide, tapering to a sessile base or petioled, not so glaucous or black dotted beneath: axillary flower clusters almost

sessile: filaments united about to the middle.—Fl. 379; Torr. & Gray, Fl. i. 168.

E. tubulosa Pursh (*Hypericum tubulosum* Walter) has not been identified, but is probably this species, from which it differs only in its "tubular corolla," concerning which there must have been some mistake; see Torr. & Gray, Fl. i. 168.

Hypericum petiolatum Walter, Fl. Car. 191.

H. axillare Michx. Fl. ii. 81.

H. paludosum Chois. in DC. Prodr. i. 546.

From Virginia to Florida, Louisiana, and Arkansas.

A Trip to Willoughby Lake, Vt.

WALTER DEANE.

The region about Willoughby Lake, Vt., is so rich in interesting flowering plants and ferns that a short account of my visit there, during the latter half of July, 1885, may be of interest to botanists.

I arrived there with my wife and Judge J. R. Churchill, of Dorchester, Mass., an enthusiastic botanist, on the evening of July 18th. A pleasant ride of about eight hours in the cars from Boston, on the Boston & Montreal Air Line, brought us to West Burke, on the Passumpsic railroad, where we left the cars and took stage for the Willoughby Lake House. The ride of six miles, through a hilly country, over a rough road, was quite refreshing, for the air was clear and bracing, and, during our stay of two weeks, we were never oppressed by the heat.

Willoughby Lake lies in the northern part of Vermont, in the township of Westmore, between Willoughby mountain on the east, and Mt. Hor on the west.

The lake, which runs north and south, is six miles long and from half a mile to a mile and a half broad. Its surface is about 1200 feet above sea level. It empties into Lake Memphramagog through Willoughby river, and from there finds its way into the St. Lawrence river. The Willoughby Lake House, at which we stayed, stands at the head of the lake and commands a magnificent view, especially when the sunset clothes the towering cliffs on Willoughby Mt. with a rosy hue. The country is well wooded, even to the summit of the mountains, with the usual trees and shrubs that prevail in this section. Prominent among them were Tilia Americana, Acer saccharinum, Acer rubrum, Acer Pennsylvanicum, Acer spicatum, Fraxinus Americana, Fraxinus sambucifolia, Ulmus Americana, Fagus ferruginea, Betula papyracea, Betula lutea, Populus tremuloides, Populus grandidentata, Thuja occidentalis, Picea alba, Picea nigra, Tsuga Canadensis, Abies balsamea, and Larix Americana.

Alnus viridis was very abundant, while, in the bogs, was found Ledum latifolium, and Rhamnus alnifolius, the latter with its black berries, bearing a close resemblance to the buckthorn, Rhamnus catharticus, of our hedges.

One of the first expeditions was to the ledges on the steep sides of Willoughby Mt., whither I had often wandered in fancy, as I read in the Manual of "Arabis petræa, Willoughby Mt., Vermont, H. Mann," "Primula Mistassinica, Willoughby Mt.," and I longed to see and collect the plants for myself.

The cliffs of Willoughby Mt. rise sheer and straight for many hundred feet above the lake and their base is only reached by a hard scramble of about an hour's duration, up a very steep ascent over bowlders and fallen trees and, in places, through a dense undergrowth. This slope is heavily wooded from the water's edge almost to the very base of the cliffs. Land slides are not infrequent, and it is easier to climb up their rocky beds over the loose rocks and crumbling stones than to push through the woods. In the rich soil at the base of the mountain we found Allium tricoccum, in full flower, in abundance, and Monotropa Hypopitys was frequently met with, pushing its creamy-white flowers and stems through the rich leaf-mould under the trees. Pushing our way up one of the "runs", as the bare paths, left by the slides, are called, we passed abundance of Asprella Hystrix, Elymus Canadensis, and Muhlenbergia Mexicana, growing among the rocks, and, on nearing the top of the slope, we found Rosa blanda covering the rocks in great profusion, interspersed with Astragalus alpinus, in full fruit. Arrived at the foot of the ledges, a new field was opened out before us. Above us towered the bold, bare, threatening cliffs, so steep that, should a stray bowlder loosened from above come tumbling down (an event which often happens), I felt that by pressing against the rock, I could avoid it. More than once that morning we heard the ominous falling of rocks from the cliffs across the lake. Small streams from above, trickling down the ledges, keep them wet. In the chinks and crevices within our reach and too often, to our disappointment, far beyond, grows a rich and attractive flora.

Scattered here and there on the dripping ledges were bright yellow patches of the beautiful yellow mountain saxifrage, Saxifraga aizoides, while its near relative, the little Saxifraga oppositifolia modestly clothed the rocks with its small patches of green. Its open pods were all that was left of its fruit. We found this plant much more abundant on the cliffs of Mt. Hor. The pretty little Primula Mistassinica was growing everywhere in the wet chinks of the rocks. The time to gather this plant in flower is early in June, but we secured as many specimens in fine fruit as we cared to take away. The withered corolla was still covering the well-developed capsule, which, with the scape, was bright yellow, contrasting strangely with the bright, green leaves.

The most interesting of the twenty-seven species and varieties of the genus Carex that we found and collected during our visit, was Carex scirpoidea, which grew here in great profusion on the rocky slope, as well as on the cliffs of Mt. Hor. Both sterile and fertile spikes were equally abundant. Though the sedge itself is not very striking in appearance, yet, when collected properly, with its root-stock and base leaves, it makes a handsome specimen. It is rather difficult to get the plant up by the roots, and botanists are apt to leave them behind. Carex Oederi was also very abundant, varying in height from three to eight inches. The only other cyperaceous plant that we found here was Rhynchospora capillacea. Erigeron hyssopifolius and Calamagrostis stricta were interesting features of this locality.

I must not forget the Hedysarum boreale, with its pretty purple flowers and jointed pods. It seemed to be well aware of its great attraction to botanists, for most of it was growing defiantly far above our reach. The Arabis petræa, which we had particularly desired to find, was abundant everywhere on the same dry slopes where Horace Mann found it in 1862. It was past flower, however, and its long slender pods had burst and were freely scattering their seeds. I collected several specimens of Potentilla fruticosa, which, on these bold exposures, we rarely found more than a foot high. But the day, at length, was drawing to a close, and with our presses and boxes well filled we reluctantly descended the mountain and returned to the hotel.

Our trip, the next day, was to the cliffs on Mt. Hor, on the western side of the lake. It was here that I realized, for the first time, a fact which I had often heard before, that the Willoughby Lake region was famous for its ferns. Here they were in the deep woods, in the wildest profusion, even the common species wearing a most attractive appearance, from their freshness and fine development. Aspidium aculeatum, var. Braunii, grew abundantly in the deep shade below the cliff, with its circlet of gracefully curving fronds, which were sometimes three feet long. We passed through beds of Adiantum pedatum, and amongst the moss-grown bowlders near the water were magnificent specimens of Phegopteris Dryopteris, P. polypodioides, and Aspidium spinulosum, var. intermedium, while everywhere was the common Polypodium vulgare. Our most interesting finds, however, among the ferns, were growing in the wet crevices of the cliffs, carefully hidden by the overhanging rock and sheltered by the trees. These were Pellæa gracilis and Woodsia glabella. We found both of these ferns afterwards in other localities, but nowhere in such abundance as here. The little Pellæa had hidden its delicate rootstocks so deep down between the narrow chinks that it was difficult to procure full specimens. With care, however, we succeeded in procuring all we wanted. We found essentially the same flora on these cliffs as on the Willoughby ones, though the various species seemed to differ in relative abundance. We added to our collection here Draba arabisans, Impatiens pallida, Trisetum subspicatum, var. molle, and Microstylis monophyllos. M. ophioglossoides we found afterwards in abundance on the dry sunny hillside near the hotel. This latter plant I have often found in Shelburne, N. H., and always in similar locations. The "ostrich-fern," Onoclea Struthiopteris, was growing rank by a running brook, while the little Equisetum scirpoides was in full fruit, covering the wet turf by the edge of the water. We reached home, this day, in time for dinner, but found plenty to do during the rest of the afternoon in laying away our plants.

One day we made an expedition over Willoughby Mt., and we were well rewarded with magnificent views and full presses. Here again the ferns were everywhere. It is not so much of their variety that I speak, though we counted thirty different kinds, as of their omnipresence. They greeted the eye at every step from the coarse Pteris aquilina by the roadside, to the graceful Cystopteris bulbifera in the damp woods. I was struck with the strong, sweet fragrance of the latter. I have collected Aspidium fragrans in abundance in Shelburne and Gorham, N. H., but its fragrance did not compare with the delicious odor of the "bladder fern." Aspidium Goldianum was abundant near the foot and on the summit of the mountain, but it was difficult to find perfect fronds owing, as it appeared, to the attacks of some insect. Half way up the mountain, which is about 2,500 ft. above the level of the lake, is a bold rock projecting over the cliff beyond the trees, whence a fine view is obtained. It is called "pulpit rock" and is an interesting botanical locality, for here we found plenty of Draba incana, and Clematis verticillaris in fruit, with Solidago bicolor, var. concolor, just coming into flower. The trees on the summit of the mountain do not differ from those below, though they are somewhat stunted. We took one bunch in the warm sunshine, near abundance of Carex canescens, var. alpicola, which was growing in dense tufts. I was surprised to find Muhlenbergia glomerata, which is credited in the Manual to bogs, growing here among the dry rocks. Farther down in the woods we found Viola pubescens, with its variety eriocarpa, and V. Canadensis, in various stages of fruit and flower. After descending the mountain we walked back through the woods along the shore of the lake. Fragaria vesca and F. Virginiana, were both abundant along the roadside, and we had a good opportunity to observe the differences between the two species. The thin, light green leaves and small fruit with superficial achenia of Fragaria vesca make it easily distinguishable from the other species, with its much darker leaves and imbedded achenia. I had not realized that the fruit of the two species presented such a different appearance. The fruit of Fragaria vesca is very insipid to the taste, as compared with F. Virginiana.

A small muddy pond and a bog behind the hotel well repaid more than one visit. Naias flexilis and Chara intermedia cover the bottom of the pond, while its margin is lined with many interesting plants, among others, Lobelia Kalmii, Habenaria obtusata and H. hyperborea.

Our two weeks sped quickly by and we were obliged to leave this enchanting spot just as the asters, solidagos and other composites were coming into bloom. My object in this short sketch has been, not to enumerate all, or nearly all, of the interesting plants that we found in this locality, or to tell anything new, but to show what a rich botanical field lies within easy reach of all who have the leisure and the desire to visit Willoughby Lake.

BRIEFER ARTICLES.

√ **Notes on Eatonia.**—Having recently made some investigation into the genus Eatonia, I wish to call the attention of botanists to such forms of that genus as they may meet with. The indications are that there are several new species or very marked varieties, of which I think the two following may be well separated as species:

1. Eatonia Dudleyi.—Culms 2 to 2½ feet high, very slender: cauline leaves only 1 or 2 inches long, abruptly acute, spreading; the radical ones 3 to 6 inches long: panicle slender, nearly linear, 3 to 6 inches long, the branches few and mostly appressed: upper empty glume obovate, obtuse, broadly scarious on the margins, smoothish; the lower glume broader than in E. Pennsylvanica, and nearly as long as the flower next above it; flowering glumes linear-oblong, obtuse or abruptly acute, the second one hispidulate. Grows in open

dry woods, from Michigan to Long Island, and Pennsylvania to North Carolina.

Easily distinguished from E. Pennsylvanica by the slender culms and panicles, the very short cauline leaves, the longer and wider lower glume, the more obtuse and shorter upper glume, and the shorter obtuser flowering glumes.

2. EATONIA FILIFORMIS—*E. Pennsylvanica*, var. *filiformis* Chapman. Very well characterized by Dr. Chapman in the Flora of the Southern States. It is easily distinguished by the very long filiform leaves, slender culm and panicle, short obtuse flowers, and very obtuse smoothish upper glume. Florida to Texas.

There are several varieties of E. Pennsylvanica and of E. obtusata, and in Louisiana there is a peculiar form with often 3-flowered spikelets, the flowering glumes acuminate and sometimes mucronate.—GEO. VASEY.

On the characters of species in Cacti.—Just what are good characters or not for distinguishing species of Cactaceæ is worthy of study. As the species are so difficult to determine in herbaria, I try to get living specimens and watch their growth. Some two years ago I had sent to me by a stranger in Texas a plant which he called Mammillaria applanata, with a hint that if I sent money and trusted to him, he would send living plants of the cacti of that region to the value thereof. I sent five dollars, but have never had cactuses, or answers to letters since. Though my plant, therefore, cost me five dollars, it seemed to agree pretty well with Engelmann's description in *Pl. Lindheimeriana*, of M. applanata. Haage & Schmidt of Erfurt, in the midst of men who know cacti, sent me another as M. applanata. Dr. Engelmann, in *Botany of Mexican Boundary*, speaks of his M. applanata and M. hemisphærica as being after all but "different forms" of M. Heyderi, Muhlenpf. Now M. applanata, as described by Engelmann, is "depressed," with yellowish lobes to the stigma, and yellowish stamens. M. hemisphærica is "hemispherical," with yellowish-red stigma-lobes, and reddish stamens. Now this last suits my German specimen, and it should be that "form," but Engelmann says it has much fewer and shorter spines than the "form" applanata; but this has just as many and just as long, but they are so slender that they might be termed cilia, and they are slightly recurved. The other, which being depressed might be applanata, has stiff and rather lighter spines. The plant is about three inches high by four wide; the hemispherical one about four by six. The tubercles in the depressed one are so close together that we can note no fleecy wool in the axils, while in the other they are all distinct, and the little mass of wool is plainly seen. In the depressed form the flowers are so comparatively short that they can not expand fully, through the interference of the spines; in the other they are longer, so long that the petals spread over the bundles of spines, and when in full sunlight give the plant quite a gay appearance. So far as we usually judge of species among cacti, we have characters for two good species. Outside of this are characters not mentioned by Englemann. Supposing the depressed one to be M. applanata, the lobes of the stigma are green, not yellow, and about two lines long. The lobes of M. hemisphærica (?) are four lines long.

But there is a something almost indescribable by which the student of cacti can class the "forms," and as these are now blooming before me to-day in my greenhouse (March 6th) he would say "these are all one." The florist would want to keep them separate, and give them separate names, for the rounder one is by far the most showy. The forms of the same species open their flowers almost simultaneously. Flowers on different plants will open on almost the same day of the month. Then again the numerical order in which they appear in the axils of the tubercles is a good specific point. Counting from the uppermost tubercle on which the bundle of spines seems fully formed, and following the spiral down, the flowers will sometimes come from the axil of the second, or of the third, the fourth, or the fifth. Sometimes there will be two circles of flowers. In this Heyderi and "forms" there are three circles, from the second, third, and fourth.

The point I desire to make in this note is that cacti are not only hard to determine, but harder than we have been led to believe them; that in all probability characters that we have depended on as distinguishing, are of less value than has been assumed; and that those who find new "forms" should hesitate considerably before loading science with a heavy burden of synonyms. There was one special lesson of interest from the study of these two forms of Mammillaria. Everyone knows that the fronds or joints in Opuntia are not always of uniform shape on the same plant. One generally with an almost orbicular section will sometimes have sections much elongated. I have noted on Opuntia Rafinesquii, that when the frond is elongated, the ovarium is elongated and the petals are more slender. Elongation goes through the whole morphological course. This experience is repeated here; the more elongated plant has longer and more slender sepals and petals, and longer and more slender stigma-lobes. THOMAS MEEHAN.

EDITORIAL.

IT IS TIME for botanists to be looking forward to their meeting at Buffalo next August. Those who were present at Ann Arbor can bear testimony that they spent a delightful time together, that they were stimulated in their work, and that the year that has elapsed since has felt the constant influence. The personal friendships formed at such a time are not only pleasant to remember, but exceedingly profitable. As Buffalo is more centrally located, and as there are many botanical reminiscences connected with it, we expect even a larger attendance than at Ann Arbor. The Botanical Club has grown into a very vigorous life, not so much on account of its organization, for it has none, but on account of its informality, the strong bond holding it well together being a community of sentiment. As many botanists will come to Buffalo with the warm feelings aroused by the companionship of the last few years, and as there is an active local botanical society, we may all expect a week of great enjoyment and profit. Arrangements will be made for meetings and excursions, and abundant opportunity given for talks in the herbarium and in the field. We bespeak thus early a large attendance, that plans for the summer may be made to include a week at Buffalo, beginning August 18. One feature of the Club meetings can be spoken of now. The June GAZETTE will be an herbarium number, devoted to the collection and preservation of plants, but it is found almost impossible to describe portfolios, presses, cabinets, etc., so as to be well understood, without taking too much space. Therefore, at the coming meeting, an evening will be set apart for an exhibition of the appliances of botanical work, such as portfolios, presses, the most effectual poison, the best mode of glueing, the quality, size and cost of genus covers and herbarium sheets, the best size and form of labels, the best form of cabinets for security of contents and ease of referring to them, etc., etc. As botanists will have in most cases their portfolios and presses with them, a comparison of these will be easy, and a discussion of the subject generally will result in much advantage to the fraternity, in bringing about uniformity of action and in saving of money and time. A full account of what botanists may expect at Buffalo will be given in our July number.

THE BOTANISTS of the country may well ask themselves if they take the interest in the government support of botanical work that the importance of the matter deserves. We venture to say that barely a dozen botanists outside of Washington are aware that the "Botanical Division" and "Mycologic Section" of the Department of Agriculture are purely hypothetical departments without official recognition. To be sure the commissioner is allowed a botanist and assistant botanist, and the work goes on the same as in the days when there was an officially recognized Botanical Division, but not much growth can take place under these conditions. Did the law-makers appreciate the important relations of modern botany to the economic interests of the country, we feel sure the work would be more liberally supported; and it is not to be overlooked that the law-makers must more or less directly catch their inspiration and learn what is required from the botanists themselves. This is forcibly brought to mind by the bill which is now (April 20) before the House of Representatives, for the annual appropriation for the work of the Department of Agriculture. The Commissioner recommended for botany, including the study of plant diseases, about one-third of the amount named for entomological work, or exclusive of salaries one-fifth as much; while the bill as reported by the committee, and as it now stands (it may be modified before its final passage) gives one-ninth as much, or exclusive of salaries one-fiftieth—that is, admitting that one-half of the one thousand dollars allotted to the support of the "museum and herbarium" will be used for the latter. The urgent necessity for the investigation of plant diseases is ignored; although "the loss from contagious diseases of animals is a mere bagatelle in comparison," as a correspondent puts it, it is liberally provided for, as it should be. Botanical science as a factor in the wealth and welfare of the nation needs more earnest advocates to gain for it the recognition it merits.

THE APPOINTMENT of Mr. Bernhard E. Fernow as chief of the forestry division of the Department of Agriculture seems to have been a move in the right direction. Mr. Fernow, who has had practical and theoretical training as a forester, has already begun actively an attempt to enlist the help of botanists in the study of forest problems. He proposes, as far as possible, to assist those who are working or will work in this line, "and to publish and distribute in pamphlet form as their work, over their name, such monographs as they may prepare." The plan commends itself to us as a good one, and with proper precautions likely to result in effective work in this division. One investigation, in which almost all botanists can assist, is the contemplated series of phenological observations. Blanks (and further information) can doubtless be obtained by any of our subscribers who will express a desire for them.

OPEN LETTERS.

Seeds of Mentzelia.

Can any botanist send me seeds of Mentzelia ornata, in good condition for germination? JOHN M. COULTER.
Crawfordsville, Ind.

Liquid Glue for mounting plants, etc.

Glue, half pound; acetic acid, half pint. Break the glue into small pieces, put it into the acid and set it on the back part of the stove for a few hours, and then it is always ready for use. Cork it up in a bottle and it will keep any length of time. Good to put the back on books, etc.
Paola, Kan. DR. J. H. OYSTER.

Arrangement of Herbaria, etc.

Professor Beal's inquiry in the April GAZETTE prompts the following reflections:

After a trial of both plans, I have come to use the alphabetical arrangement of genera and species, arranging the orders according to Bentham and Hooker. To facilitate the arrangement in the approved sequence, whenever this becomes temporarily necessary for any order, I pencil the number of both order and genus under the name on the genus-cover, following the Genera Plantarum, thus cc. 4. This arrangement is followed in cryptogams, as well as phænogams, though the numbering is obviously impossible with the former.

An alphabetical or numerical sequence is at best a compromise, for convenience of reference. In an herbarium it is less objectionable than when applied to notes and references. Some eight years ago, when I began an extensive specific subject-index in certain branches of botany, I arranged my cards alphabetically. There is no question but those referring to a given genus are found most readily with this arrangement, but this is not all of the story. In studying the pollination or other biological features of a genus, or the fungi that attack it, it is always necessary to consult the slips on related genera. With the Genera Plantarum before us, we can pick them out, in an alphabetical index, but it is far better to find them in proper sequence, and as rapidly as possible my cards are being arranged according to the natural system. With the experience of Dr. Gray, I am not at all sure that I shall not wish my genus covers were similarly arranged, as his are. However, the task of rearranging them is less onerous than that of rearranging a large index.

A word as to exsiccatæ. Some time since Professor Bessey stated in the *Naturalist* that such collections of fungi as Ellis, Roumeguère and Winter are best divided and the species distributed where they belong, in the herbarium. I think this will ultimately prove a source of annoyance to those who try it, for without a perfect system of cross-references the species of some groups will soon become inaccessible in consequence of the frequent removals they experience from genus to genus in this changeable group. With occasional indexes these collections are as useful as books, which no one thinks of cutting up and distributing in his herbarium. WILLIAM TRELEASE.

Shaw School of Botany, St. Louis, Mo.

Prof. Beal, in the April number of the GAZETTE, desires the experience of others in the arrangement of the herbarium. My practice is about parallel to his. In the college herbarium in my charge, the arrangement is by Bentham & Hooker for orders and genera. In my private herbarium, kept at my house, and hence subject to incessant consultation, I arrange my orders as above, but where the order is a large one, place the genera in alphabetical sequence. While this is much the most convenient way for ready reference, I know that in my own case I lose by it something of familiarity with the generic affinities. With a too faulty memory one is apt to acquire an alphabetical rather than an actual notion of the relations of things. W. WHITMAN BAILEY.

Brown University, Providence, R. I.

Adopting the suggestion made by Prof. Beal (April GAZETTE, p. 98) that the experience of others in herbarium arrangement would be of interest, I note the methods found most expedient in the herbarium at the National Museum.

The genera are all arranged in the cases according to the *Genera Plantarum* of Bentham and Hooker. Pasteboard "flaps," labeled with the contents of each compartment, serve to direct the search for any particular genus, and this is all that is required, for one working constantly about an herbarium soon learns where, approximately, everything is. But the species are all arranged alphabetically, and it is found to be of the greatest convenience. Originally some of the larger genera were arranged systematically, after some monographer (the oaks and Junci after Engelmann, the willows after Bebb, etc.), but this was found to be cumbersome in the extreme, and was abandoned. In a large herbarium like this, where a genus is often represented by from fifty to two hundred species, no method as satisfactory as the alphabetical has been proposed. F. H. KNOWLTON.

National Museum, Washington, D. C.

CURRENT LITERATURE.

Tendril Movements in Cucurbita maxima and C. Pepo. By. D. P. Penhallow, Am. Jour. Sci., Jan., Feb. and Mar., 1886.

Under this title Prof. D. P. Penhallow gives the results of more than 400 complete observations upon the tendrils in motion. During the process of the development of the tendril, a variety of movements are noted and remain to be accounted for. These are: (1) torsion, which, contrary to Sachs, is easily shown to exist in tendrils of Cucurbitaceæ, (2) circumnutation, (3) effects of irritation, (4) spasmodic movements at end of activity, (5) coiling about a support, and (6) free coiling. Believing that all these motions are but varied phenomena of plant growth, dependent upon the same conditions, experiments with the vine, the terminal bud, and the fruit were entered upon, that the conditions governing growth in general might be made the basis of tendril investigation; and for the peculiar manifestations in the tendril, reference was made to its histological structure and the accepted theory of the continuity of protoplasm.

The squash tendril is composed of the following tissues: the central pith, which gradually breaks down at maturity; a ring of wood bounded by one of parenchyma, beyond which lies the most important region, that of the collenchyma tissue, extending to the epidermis—its continuity broken at three well-defined points by large-celled parenchyma.

These three parenchyma regions can be recognized on the surface of the tendril, as dark green bands extending through its length on the upper side and on the right and left. Among these the greatest growth occurs in turn without regular order, and here the activity longest remains. The name vibrogen is applied to these bands, as designating their importance in the circumnutation and coiling of the tendril.

Unequal growth in the wood, the collenchyma and the vibrogen produces unequal tension in these tissues, hence resulting movements of the whole body. It has been demonstrated by Sachs and Darwin that a band of rapidly growing cells traveling around the circumference of an organ is sufficient to account for the phenomenon of circumnutation, but a study of the irregular figure described by the squash tendril shows that recourse must be had to the vibrogen for explanation of the movement here, particularly as it appears from investigation that the horizontal movements are twice as great as the vertical ones, a fact depending upon the peculiar distribution of the three vibrogen bands.

Torsion is produced by the rapid growth of the vibrogen bands not followed by a corresponding growth elsewhere.

Irritation upon the surface of the tendril, particularly in the region of the collenchyma least broken by the parenchyma, *i. e.*, the lower surface, causes cessation of growth and condensation of structure, hence a bending toward the irritating surface. The same is true when coiling results from contact with a support.

When mechanical irritation is applied at any part the impulse is conveyed from cell to cell through the continuity of protoplasm which is best demonstrated in the collenchyma tissue.

The other movements enumerated are also explained upon similar grounds, and the manifestation of these movements in tendrils alone is accounted for by the localization of the vibrogen bands, the disproportion between length and diameter, the great flexibility of the organ and the greater effect of unequal tension when exerted longitudinally through a filamentous structure.

GRACE E. COOLEY.

Handbook of Plant Dissection. By J. C. Arthur, C. R. Barnes, and J. M. Coulter. Henry Holt & Co., New York. 1886. 12°. pp. 256. 2 plates.

The aim of this volume has been to provide for instructors and students a detailed account of a series of representative types illustrating the different groups of the vegetable kingdom from the lowest to the highest. As the title implies, it is not a general treatise to which the student is to go for information, but a practical handbook to be used in the laboratory while examining common plants, such as can be obtained anywhere at the proper season. In general the plan is that of Huxley and Martin's Elementary Biology, but the species selected for study are different. The Thallophytes are represented by five, the Archegoniata by three, and the Phænogams by four species. The student is supposed to begin with Protococcus viridis, a plant more easily obtained in quantity than P. fluvialis, and better adapted than the yeast plant for showing the typical structure of the vegetable cell. Each chapter starts with a short account of the general appearance and mode of collecting the plant to be examined. There then follow minute directions for studying the gross and minute anatomy, and at the end of the chapter the student's attention is drawn to the relation of what he has seen to the structure of the vegetable cell and the phenomena of plant growth and reproduction in general. In an introductory chapter is a short account of the apparatus and reagents needed in the laboratory.

There is a great need of a book like the present, for the number of persons who wish to study botany by what we may call the type-plan is already large and increasing. In a work of this kind the temptation is to include too much and make a small encyclopædia rather than a working handbook. The authors have happily escaped this difficulty and given us a book of convenient form with all the necessary information condensed in a small space. There is a great but unwise demand for plates in books of this sort, but, not to mention the necessarily high cost of a book with numerous good plates, it seems to us better that a laboratory handbook should not contain plates, but, if plates are required, they can better be provided in the form of charts or atlases.

The selection of plants to be studied is a good one and large enough to occupy the student's time for several months at least. We would suggest, however, that it might have been well to add some common lichen like Physcia stellaris, for the biological relations of the lichens are important and likely to interest the student. The proportions of the book are to be commended, for, although a greater number of species of Thallophytes are presented, the space devoted to that group is less than half as great as that devoted to Archegoniata and less than a third of that assigned to Phænogams. By the arrangement adopted, the student starts by observing a few things, and as he advances and becomes more proficient he can work more exhaustively.

If it is necessary to train the observing powers of students, as is almost always the case at the present time, there is, of course, a danger that a handbook like the present may be abused and that the student may rely too closely on the directions given. In the preface, the authors call attention to the possibility of such an abuse and make the important suggestion that, if a teacher finds that his class are following the handbook blindly and not using their own eyes, he should substitute other species nearly related botanically to those given in the book. The directions for work would apply as before, but the student would have to work out details for himself. W. G. Farlow.

Vorlesungen über Bacterien. Von A. de Bary. Leipzig: Wilhelm Engelmann, 1885. pp. 146. 18 woodcuts. 8°.

It is within a year that the author published a brief treatise upon bacteria as part of his *Morphologie und Biologie der Pilze Mycetozoen und Bacterien.* The present work follows to some extent the same line of treatment, but of course is more complete, touching upon many themes not permissible within the compass of the previous work. It is also, for the most part, in a more simple and flowing style, which comes from the matter having first been given in a series of lectures.

The author does not attempt to provide a treatise devoted to particularities regarding all cases of interest and importance, a "bacteriology," but to afford a general survey of the subject which may enable one to find his way intelligently among the multiplicity of details. As one can not properly see the city for the houses, or the forest because of the trees, unless a commanding position be obtained, so it is in the mazes of this new science. This is the great service which the author has done, to point out in a masterly way the true relation of the facts to one another, and to bring the whole into harmony with the other departments of biology.

The following is an outline of the contents of the book. The use of the words bacteria and fungi is discussed. The structure of the bacterian cell, the forms of cells and of cell-families, and their development are successively treated. When the author points out how simply the different forms of the single cells of bacteria may be illustrated, he more deeply enlists the interest of the student who is at the same time an instructor. He says: One may separate them into round-celled forms and two rod-forms, straight and spiral. A billiard ball, a pencil and a corkscrew represent these three forms with much accuracy, so that expensive illustrative models are not needed.

The whole work has been presented with much perspicuity; it has also been divested of that remoteness and strangeness with which we are wont to regard the subject. This has been done by tracing many analogies with familiar facts pertaining to higher vegetation. In speaking of the necessity of taking into account the modes of grouping in order to be able to distinguish between such minute objects, he says that "in the phenomena of grouping there appear specific characters which must, indeed, be present in the single cells, but with the means at our command can not be recognized or only with difficulty, yet, as it were, become cumulative in larger masses. This is, however, nothing peculiar. Of cells, which in comparison with bacteria are enormously large and richly organized, we can not say with certainty, when they are presented singly, whether they belong to a lily or to a tulip plant. In their natural combination or grouping, however, the one always goes to build up the tulip only, and the other the lily, and herein we know that they are different."

Probably one of the most interesting parts of the book to the general reader is the fourth chapter, which deals with the *pro* and *con* of the existence of species among bacteria, and their affinities and position in the system. There are some kinds of plants, the author says, in which there is a constant recurrence of the same forms with relatively small individual variation. Most of the common higher plants and animals are examples of these, as well as many low, simple kinds. With some practice one can name them from single pieces dissociated from their developmental connection. A horse chestnut may, *e. g.*, be determined from a single detached leaf. Other kinds of plants are pleomorphic, subject to many changes of form, partly from external and partly from internal causes. In contrast to the horse chestnut the white mulberry produces very dissimilar leaves, some simply cordate, others lobed and cut. One would not be able to determine the species from the last, if he had previously only seen the cordate form. Among lower plants pleomorphism is not confined to bacteria, but is common among the algæ and fungi. The pleomorphic species differ from the relatively simple forms, therefore, only in their more varied development; the characteristics of species do not the less occur in them than in the others. There was no question regarding true species among bacteria for 150 years after their discovery; the controversy was introduced by Cohn when he published his memorable classification of growth forms.

So we might continue to give the author's views regarding these form-species, the errors which have arisen by inattention to details of manipulation in performing cultures, even by such noted investigators as Nägeli and Buchner, and the systematic affinities and peculiarities of the bacteria. These and many other topics will prove of great interest to the biologist.

The fifth chapter considers the occurrence and distribution of bacteria, followed by processes of growth, relations to the substratum, parasites and saprophytes, important examples of the latter described, the phenomena of parasitism, harmless parasitic kinds in warm-blooded animals, relation of bacteria to infectious diseases of animals and plants, which takes us to the end of the fourteenth chapter. A bibliography of important works and a name register closes the volume.

The importance of a work like this is not easily overestimated. It may not bring out many new facts, but it places those which are already known in their true light, and makes clear the real position of the science.

The Methods of Bacteriological Investigation. By Dr. Ferdinand Hueppe. Translated by Hermann M. Biggs, M. D. New York: Appleton & Co., 1886. 8°. pp. 218. 31 woodcuts.

Die Methoden der Bakterien-Forschung. Von Dr. Ferdinand Hueppe. 3d ed. Wiesbaden: C. W. Kreidel, 1886. 8°. pp. 244. 2 colored plates and 40 woodcuts.

This work by Dr. Hueppe was written at the request of Dr. Koch, the most renowned of bacteriologists, whose name imparts a guarantee of value to the book. It does not, however, stand in special need of a sponsor, for the most casual examination shows it to be superior to any work upon technological methods yet issued. The subject is presented in a careful, well-balanced, well-digested form, not encumbered with unnecessary diffuseness and not marred by too great attention to pathological and omission of non-pathological details. Investigations in bacteriology, in order to carry weight, must be conducted with a full appreciation of the absolute need of refined manipulation, and their completeness depends upon a knowledge of the numerous ways in which they may be conducted and of the ends to be attained by each process. This work admirably meets the requirements of a safe and practical guide to both the student and the specialist.

Some of the topics treated are the principles of sterilization, direct examination of bacteria, uses and methods of staining, pure cultures, cultivation in fluids, fractional and dilution methods, opaque and transparent solid cultures, slide, plate and test-tube cultures, determination of the causal relation of bacteria to decomposition and disease, septic and parasitic bacteria, the effects of temperature, pressure, gases, and electricity upon bacteria, how to study the bacteria in earth, air and water. Many other topics are also considered, but an enumeration of all of them would still fail to give a just idea of the book's real value, which lies to a considerable extent in the admirable manner in which each topic is treated.

Some fault might be found with the translation, but as the defects do not affect the truthfulness of the work, so far as noticed, they may well be left to the captious. The American publishers have done their part of the work well, although the matter has been spread over one-fourth more space than in the German edition. The two fine colored plates are omitted, but a useful index is added.

The German work was published in February, 1885. It ran through two editions, and in November, 1885, a third much improved and augmented edition was prepared, but was not received in time for the translator to make use of it. This third edition adds seventy pages of new matter and nine new woodcuts. The additions are scattered throughout the work, upon nearly every page, the most considerable being descriptions of Fol's sterilizing kettle, Chamberland's porcelain filter, apparatus for sterilizing and cultivating at constant temperatures below 75° C., other forms of culture vessels and inoculating instruments, additional nutrient solutions, and the principles of staining. The four pages of the original work upon the classification of the bacteria have been nearly tripled and entirely rewritten. The colored plates illustrate slide, plate and test-tube cultures, cultures on opaque solid media, and staining for several purposes.

Bacteriological studies in America can not fail to receive a decided impulse from the advent of this admirable work, and we shall not be surprised to find that new editions are demanded often enough to keep pace with the growth of technic.

NOTES AND NEWS.

THE *Western Druggist*, published in Chicago, has a good botanical department, edited by Prof. E. S. Bastin.

AN INTERESTING article on Pezizæ by J. B. Ellis is given in the April number of the *Journal of Mycology*.

DR. GOODALE is giving a course of semi-weekly lectures before the Woman's Education Association of Boston.

IN THE JUST established Buffalo College of Pharmacy, Dr. D. S. Kellicott has been appointed professor of botany and microscopy.

A WORK on the forms of bacteria and their relation to genera and species has been published by Dr. Hueppe, and is reviewed in this number.

THE APRIL number of the *Journal of Microscopy and Natural Science* contains a sketch of Charles Darwin, being an address by H. W. S. Worsley-Benison, F. L. S.

DR. VASEY in the *Bulletin of the Torrey Botanical Club* records finding tubers on Hydrocotyle Americana. They were oblong, and from a quarter to half an inch long.

DR. J. H. OYSTER, of Paola, Kansas, has just lost by fire all the copies of his "Catalogue of the Plants of America." Next winter he proposes to publish a new edition.

GARTENFLORA, of March 15, contains a notice of Dr. Gray's seventy-fifth birthday, and also an outline of his life, taken from the biographical sketch in the January GAZETTE.

AN EXPLANATION of the mechanical causes of the various methods of æstivation is attempted by K. Schumann in *Berichte* der deutschen botanischen Gesellschaft, iv. 53-68.

AUG. SCHULZ records a case (Ber. d. deut. bot. Gesell. iv. 52) in which the outer walls of certain epidermal cells of Salicornia herbacea were found to separate entirely from the side walls.

FROM THE report of the Montreal Botanic Garden we learn that there are 197 known botanic gardens. Germany has 34, Italy 23, France 20, Great Britain and Ireland 12, West Indies 6, United States 5.

PROF. J. L. BUDD, of the Iowa Agricultural College, has issued a bulletin of 64 pages, containing revised lists of fruits, trees and shrubs from N. E. Europe, that have been on trial on the college grounds.

THE READERS of the GAZETTE will be interested in the complimentary dedication of a new genus of grasses to the well known American agrostologist, by Prof. Hackel of Austria, especially as its first publication is made through an American journal.

THE JOURNAL of the New York Microscopical Society has reached the end of its first year. The editor, Mr. Braman, who has managed its publication with marked success, finds it necessary to resign. The journal is deserving of ample support.

WE WOULD CALL attention again to the sections of the leaves of Abietineæ, to be obtained of Rev. J. D. King, of Fall River, Mass. They are admirably mounted and stained and are well calculated for a critical study of these peculiar leaf structures.

PINUS ENGELMANNI has turned up again. Forty years ago Wislizenus collected in the mountains of Mexico a single specimen, which is now in the Berlin herbarium. Good specimens of leaves and cones have lately been received at the Gray herbarium.

THE ALGA, Pithophora Kewensis, first found in a lily tank at the Kew Gardens and supposed to be tropical, has been found by Mr. Wolle, Mr. Balen and others in several localities in eastern United States, according to the *Journal of the N. Y. Microscopical Society.*

SOME MARKED DIFFERENCES in the structural character of the flowers of different varieties of the apple are illustrated and described by Dr. W. J. Beal in the February number of the *American Naturalist.* It is suggested that such characters might well be used in horticultural descriptions of varieties.

MR. JOHN MACOUN of the Survey of Canada is on a visit to Europe. Before leaving this country he completed the writing of Part III of the Catalogue of Canadian Plants, which carries it through the Coniferæ. This part will also include an addendum bringing the whole work up to date, and a complete index.

A LARGE COLLECTION of Scandinavian mosses belonging to the late J. E. Zetterstedt is for sale, either in sets or by single specimens. The first series of 209 specimens is offered for seven dollars, or specimens may be selected for less than five cents each. The specimens and labels are in envelopes unmounted. Address, Dr. H. Wilh. Arnell, Jönköping, Sweden, using either English, French or German.

THE BACTERIOLOGICAL EXAMINATION of drinking water is attracting much attention, and the remarks of Dr. Theobald Smith before the Biological Society of Washington, printed in the *Amer. Microscopical Journal* for April, are timely. Before unskilled investigators publish results they should carefully peruse this article, and not unwittingly bring such work into disfavor by overlooking the simple fact that the germs of water are largely innocuous, and that the detection of disease germs in drinking water is at present extremely difficult.

DR. JULIUS RÖLL, of Darmstadt, is publishing in *Flora* an extended paper, "Zur Systematik der Torfmoose." The Sphagna present a well worked but always tempting field for study, especially tempting to German systematists, as they exhibit almost interminable variations and give abundant opportunity for the description (if not discrimination) of innumerable varieties, forms and subforms.

IN THE *Bulletin of the Torrey Botanical Club*, for April, Mr. Douglas H. Campbell describes (with plate) the development of the antheridium in ferns, the observations being principally upon Asplenium filix-fœmina, Onoclea Struthiopteris, and O. sensibilis. In the same issue Dr. George Vasey proposes eight new species of Gramineæ and two new varieties, six of which belong to the genus Agrostis.

THE SIZE of the bordered pits of coniferous wood is found by Rev. J. L. Zabriskie[*] to be quite constant in the same species, but to have up to a hundred per cent. variation among different species. The largest examined are those of the sugar pine (Pinus Lambertiana) and the smallest of the canoe cedar (Thuja gigantea). The former are about $\frac{1}{1000}$, and the latter about $\frac{1}{2000}$ of an inch in diameter.

WE DO a good service to all teachers and students of botany by calling their attention to the announcement of the summer course at the Botanic Garden of Harvard University. The course as planned is an admirable one, and all who have heard Dr. Goodale lecture know how attractive morphology and physiology become in the hands of a master. Mr. Sargent lectures on cryptogams, and directs the laboratory work.

THE BOTANICAL DEPARTMENT of the University of Nebraska has been receiving some excellent additions in the way of books and exsiccatæ, as we learn from the students' journal, *Hesperian*. Among the books are full sets of the Annales des Sciences Naturelles, Pringsheim's Jahrbücher für wiss. Botanik, Boott's Illustrations of Carex, and Bentham's Flora Australiensis. The exsiccatæ include some 14,759 species belonging to over twenty different publications.

WINTER STORMS often result in an enormous destruction of buds. Last winter, at Cambridge, Mass., during a wind storm of almost unprecedented severity and of five days duration, the snow was thickly covered with buds switched off the elm trees by the thrashing branches. These fallen buds collected under the lee of walls and walks in piles. The number lost from each good-sized tree must have been in the thousands, yet the trees seem in no wise the worse as they unfold their leaves this spring.

IN THE *Journal of Botany*, for April, Mr. J. G. Baker has begun a synopsis of the Rhizocarpeæ. In this first part the genera Salvinia and Azolla are included, the former with thirteen species, the latter with five. No species of Salvinia is recorded from North America, but there are five in South America, six in Africa, of which three are peculiar to Madagascar, one in Asia, and one (S. natans) common to Europe and Asia. The five species of Azolla are tropical, but one (A. Caroliniana) extends into the United States.

A BOTANICAL CLUB has been organized in Utica, N. Y., and bears the name "Asa Gray Botanical Club." The name is peculiarly appropriate, both from the position of the botanist whose name it commemorates, and also because the club is situated in his native county. It numbers 24 members at present and has an organization like that of the Torrey Botanical Club, and from the spirit shown we prophesy for it a successful future. Its officers are Dr. J. V. Haberer, President: Miss Phelps, Vice President: Prof. George C. Hodges, Secretary: Rev. Wm. B. Coleman, Treasurer: Mr. W. P. Shepherd, Curator.

DR. W. G. FARLOW gives some notes on certain vegetable parasites of fish in the *Bulletin of the U. S. Fish Commission* for February 8. One of these is Clathrocystis roseo-persicina of Cohn which causes the reddening of codfish and which has been identified with that on red fish in France, and presumably the same as said to have caused sickness of soldiers in Algiers who ate red fish. Sarcina morrhuæ of Farlow has been found associated with it upon our coasts, and has recently been identified with S. litoralis found by Poulsen on mud in Denmark. The latter name has precedence. The third species is Oidium morrhuæ of Farlow.

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*Jour. N. Y. Micr. Soc., I, p. 218.

AN ACCOUNT of some highly interesting experiments "On the transpiration-stream in cut branches," by Francis Darwin and R. W. Phillips, is given in Proc. Camb. Phil. Soc. v., 330–367 (1886). These experiments were undertaken to help decide between the two theories as to the place of the stream of water which supplies the loss by transpiration, viz: whether the chief and essential path of this stream is in the *walls* of the wood-elements or in their *cavities*. The results favor strongly the latter view. The apparatus used by them for measuring transpiration is so simple and with proper precautions so accurate that a description of it will be useful to teachers of physiology. It consists of a large T-tube placed in this position ⊢. The now horizontal limb is bent up so as to be parallel to the vertical one. The upper end of this bent limb is to receive the branch to be experimented on. The upper end of the straight limb is closed with a rubber cork, while from the lower descends, through a rubber stopper, a capillary (thermometer) tube 30–40 cm. long. The whole apparatus is now filled with water and the experimental branch attached by means of a short piece of rubber tubing. The severing of the branch and attaching it to the T-tube must be done under water as in all such experiments. The apparatus is now to be supported in an upright position with the capillary tube dipping into a cup of water supported on a low block. After a few minutes remove the cup and allow a bubble of air to enter the lower end of the capillary tube. This index bubble must be of equal length in all experiments and must be allowed to travel to a mark 10 cm. up the tube before readings commence. These readings consist of the rate at which the bubble traverses from this point a fixed length of tube, say to its upper end. The time of travel must be recorded by a stop-watch or other device for measuring accurately fractions of seconds. The reciprocals of these times give a series of figures proportional to the amount of water absorbed by the branch in a given time. Particular care must be taken to prevent leakage at joints and stoppers.

M. LÉO ERRERA'S results (Berichte d. deut. bot. Gesell, iv. 16–18 [1886]) from a study of the transpiration-stream also militate against the imbibition theory. His experiment is simple and adapted to the lecture table. An injection mass is prepared, consisting of gelatine 20 parts, water 100 parts, to which is added enough Chinese ink, well-rubbed up, to render the mass black. This mass melts at 33° C. and solidifies at 28°. Leafy twigs of any plant with large vessels (Errera used Vitis vulpina) are to be severed from the plant, one in the air, another under water, and a third under the just-melted gelatine mass. The latter is then to be quickly plunged into cold water, and a fresh surface made by removing a thin slice from the previous cut. Thus the vessels are closed (as can readily be seen) with the black gelatine, but the walls of the wood-elements are exposed to the water. All having been placed in water, the injected twig soon wilts and can be shown, by measuring the water, to absorb vastly less (not $\frac{1}{30}$ in the experiment with Vitis) than even the twig cut in air. The wilted twig can, however, be revived, if within half an hour the gelatine-filled portion be cut off.

A CAREFUL and sympathetic sketch of the life of John Williamson, botanist and artist, written by R. M. Kelley, and illustrated with a portrait, several decorative designs, and a half dozen photographic reproductions of his etchings, is given in the *Southern Bivouac* for March. The writer had good opportunity to learn the story of his life, and presents it in very full and interesting detail. Williamson was noble-minded, ambitious, and undaunted. In spite of most unpropitious circumstances he achieved a lasting reputation, especially through his ferns etchings. These are unexcelled, having received the commendation of no less an authority than Philip Gilbert Hamerton for their artistic excellence, and of many botanists for their scientific accuracy.

THE APPROPRIATION BILL for the Department of Agriculture for the year 1886-7, which has been recommended to Congress by the House committee on agriculture contains a number of items which should interest botanists. One will naturally look first for the Botanical Division, and will doubtless be surprised to find there is none recognized. There is, however, a Microscopical Division, for which an appropriation of $4,000 is asked; but this is evidently not botanical, as the money is to be expended for chemicals, fibers, investigations into adulteration of food, and for salaries. The experimental gardens and grounds, which ought to be of real value to the botanical and economic interests of the country, are allotted $21,450, besides which there is $2,000 for the introduction of foreign medicinal plants. The Seed Division—all know what that is—asks for $108,240; forestry is allotted $10,000; for the purchase of entomological, botanical, chemical, mineralogical, agricultural and other works and periodicals for the library $1,500; for collecting and preparing material for museum and herbarium $1,000. This covers all appropriations in any way affecting botany, except the salaries of the botanist and assistant botanist.

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Specimens and Specimen Making.

MESSRS. J. D. SMITH, MARTINDALE, CHICKERING, BESSEY, CHAPMAN, CRATTY, DAVIS, JOHNSON, C. E. SMITH, AND M'CARTHY.

In arranging the material under this head it has been necessary to omit a part of some of the articles in order to prevent unnecessary repetition, an unavoidable contingency when the same subject is treated independently by several writers, but no other material changes have been made.—EDITORS.

Comparing old herbarium material with that of recent distribution, one is struck with the fact that the art of specimen making has of late years, and particularly in this country, reached a degree of perfection never aimed at by the collectors of former days. The present herbarium sheet permits a fullness of representation that was not practicable on the foolscap pages of Linnæus; and accordingly we must now give the whole plant if possible, or as much of it as can conveniently be doubled up within the space of 16½ by 11½ inches. The ideal specimen presents all possible material requisite for its critical determination or complete description. Better therefore for science is a sheet covered with a crowded, bulky plant, than one decorated with scraps of leaves, flowers and fruits. But in such cases, and in many others too, the flowers detached from their peduncles should be dried separately, and should have the benefit of the collector's utmost skill *præparationis conservatricis opere.* Envelopes of very bibulous paper, cotton pads, heated driers, and pressure graduated according to wilting, will serve as an embalming process, preserving every structure and organ, from petal to embryo, uninjured, and ready to live again at the demand of the student and the touch of hot water. Such objects ought not, like the rest of the plant, to be glued down to the sheet; they should be kept in pockets attached to it. At some future day more skill may be exacted of the specimen-maker. The countryman and the cabinet-maker recognize trees by their bark and grain of wood. When the botanist shall have invented terms to describe them, a complete specimen of an arboreous plant will include bark and wood-sections.

Methods that hurry the drying out of plants in press are valuable to the traveling collector. With that view let him use latticework frames to separate every four to six inches of the pile. They will permit the passage of evaporating air and heat, and will serve also to bring the sides and corners of the pile under better pressure. The pile of plants thus separated, and bound as tightly by three straps as may be thought best, should be kept in about the hottest place on the premises. A metal roof in the sunshine by day, a warm corner in the kitchen by night, will draw off rapidly vast quantities of moisture, and will give fresh, bright specimens. For this process driers not less than 18 by 12 inches are needed.

Although the numbering of distributions is now very general, still, it is not done universally, and not always with the right conception of its object. M. de Candolle, whose experience gives him a better right to speak than any other botanist, has insisted with emphasis that all collections distributed among important herbaria should be numbered. The number is not to show the collector's systematic reference of the specimen, and it does not necessarily include all his specimens that belong to the same species. It designates merely specimens that belong to the same stock, or such as from locality, date or other circumstances, he can with equal certainty assume to be identical with each other and true duplicates. The citation of such numbers, fulfilling as it does phytography's law of brevity, has become very general on the part of authors of Floras, Monographs, etc., and every specimen under the same number in other herbaria becomes in this way elevated to the rank of a voucher and original of a description.

Each volume, excepting the first one, of DC. Monogr. Phaner. tabulates under collectors' names in a separate index the numbers of all the specimens cited. This facilitates greatly the application of authoritative determinations to the unnamed material in herbaria. It is to be hoped the precedent will be followed. *Les noms changent, c'est inévitable, les numéros seuls subsistent.* M. de Candolle appeals to the vanity of the collector and assures him that the names of species and their authors have but a precarious existence; whereas he guarantees an immortality to the numbers of Commerson, Burchell, Berlandier, Wydler, and others. A like distinction may be prophesied for such citations as: Pl. Cubens. Wright, 2740; Fendler Pl. Venez. 2176; Glazion Pl. Brasil. 15795; Parry Rocky Mt. Fl. 311; Curtiss N. Am. Pl. 1186; Pringle Pl. Mex. 696; Reverchon Texas Fl. 1618; Patterson Colorado Fl. 154.—JOHN DONNELL SMITH.

So much has been written concerning the methods of preparing specimens for the herbarium, that it would seem almost needless to make much addition thereto; but in looking through my own collection of tens of thousands of specimens it is a noticeable fact that certain ones strike the eye more forcibly than others. If I am examining a western plant I look for Pringle's or Greene's specimens; if central United States, I want Bebb's; if southern, I hunt up those of Curtiss and Garber; if from New Jersey, I search for a Parker label; and the reason is that invariably I find good characteristic specimens made by these notable botanists.

The great value of my herbarium to-day is in the large, abundant and characteristic specimens. I have picked up from time to time a great many fragments of plants in my travels as mementoes of a journey, or indicative of a locality, but I make it a rule, when I want to show what the plant really is, to get as large a specimen as my mounting paper will receive. If the plant is small I get several of them, and mount them all on the same sheet, flowering and fruiting specimens side by side, with separate labels giving dates of collection, locality, etc.

One can not but feel a regret in looking at the type specimens of Nuttall and others of his day, that they are such poor representatives; except that they are the original types they would possess but little value as showing the habit of growth. Of course I well know that in that early botanical day the facilities for collecting and preserving were very poor, as journeys were made amid great danger and hardship. It is almost a wonder that anything collected by the pioneers of the western wilds has been preserved to us.

Do not collect specimens in the rain or when the dew is on, if it can be avoided, and always collect the best specimens, those that represent the habit of growth. Have a portfolio to lay them in immediately after gathering; the use of a tin box for that purpose is obsolete. The portfolio I use is made of two pieces of binders' board, each twelve by eighteen inches, and covered with leather, the pieces being so joined together as to form a book about four inches wide, a strong leather handle to carry by, and two straps to fasten on small hooks (rather than with a buckle) in front to keep tightly closed when not in use. Within this portfolio are loose leaves of heavy manilla paper, held in place by an elastic cord. Between these leaves I place the specimens as collected; if only a short ramble is made a few leaves will suffice; if for several days' collecting a reserve of dry leaves, to replace those dampened by continuous use, will be found of advantage. On the return home, I transfer all the specimens I desire to preserve, placing each between sheets of soft white paper, and these between the driers, and then the whole in the press. In the case of bushy specimens the impress of the stems sometimes makes wrinkles on others; this can be avoided by inserting a few thin boards through the package. In this way I have often had 200 or 300 specimens in press at one time. I have found a screw press the most serviceable.

The secret of making good specimens lies in the frequent changing of the plants, putting in fresh driers so as to take up the dampness as fast as possible. When I have a large number of plants in press and desire to hurry them through to make room for others, I have frequently warmed the driers before using, and then set the press where it got the benefit of the heat from the sun, and often with excellent success set the press near the fire, turning it frequently so that the heat might be evenly distributed.—ISAAC C. MARTINDALE.

Nearly thirty years ago, in connection with Messrs. Bebb, Canby and others, then young botanists, having done what I could to improve the quality of herbarium specimens and not have them mere collections of "dried tea leaves," I am glad to say a word in behalf of making a herbarium a "thing of beauty," as well as a storehouse of scientific facts. I have correspondents whose specimens are "a joy forever," so that it is always a new delight to get from them a fresh package, and the temptation is generally irresistible to add every one to my herbarium, no matter how many of that species I may already have. While there are others who are able to send rare and interesting species, their specimens constantly excite a righteous indignation that man should have it in his power so to deform and abuse the beauty of nature.

Where the species is abundant an inferior specimen should never be preserved; of Shortia we should be glad of any sort of specimen, even a fragment. For collecting the portfolio is greatly to be preferred to the old regulation tin box, except on long tramps to places seldom visited, where several hours, or even days, may elapse before paper and press can be reached. I have now one battered old box which has traveled many hundreds of miles, and in which often ericaceous and orchidaceous plants from the Maine and New Hampshire mountains have been preserved several days, or even have come into full flower when home was reached, though only in bud when gathered.

After putting in press it is well to change the driers twice a day at first, and then once a day till the specimens are thoroughly dry. My habit is to use quite a heavy pressure, with plenty of driers between the specimens, as I think it shortens the time of drying, and gives to the petals a more enduring texture. I greatly prefer a lever press to either a screw or a strap, as the lever keeps the pressure constant, following the pile as it inevitably settles. My press consists of a heavy frame, with a lever six feet long, the pressure applied one foot from the fulcrum. I use a forty pound weight, so that by moving it along the lever it gives a pressure of from 40 to 200 pounds. For succulent and delicate plants of course I use more moderate pressure at first, increasing it as they become dry.—J. W. CHICKERING, JR.

For drying paper I use a good quality of "carpet-felting" or "carpet paper." I buy it by the roll and cut it up into sheets of the usual size (12 by 18 inches). I use no tissue paper in drying ordinary plants, using it for delicate ones only. My press is composed of two boards about twenty inches square (one for the floor, the other for the top), and my weight is a great stone. My botanizing case (pedantically called a *vasculum* in books, but never so far as I know so called by any one in the field) is twenty inches long, and is elliptical in cross-section, the measurements being 7½ by 4½ inches. The door or lid (which fits as tightly as possible) is on one side, and is 6½ by 18½ inches; in other words, it is very nearly as large as one whole side of the case. It is hinged below, and closes with a simple clasp above. The hinges are placed high enough on the side of the case so that when the lid is open the plants will not drop out.

I rarely carry my case by slinging a strap over my shoulder, but provide for such strap and use by having the usual rings or cleats attached at the ends and top. For ordinary use I have a common "tub-handle" fastened to the top of the case.—CHAS. E. BESSEY.

I am out in the woods, and am probably too late to be of any service to the herbarium number of the GAZETTE, so I will merely say that in making good clean herbarium specimens the important point is to dry them as quickly as possible. I have always used old newspapers for driers, and prefer a weight of 75 or 100 pounds to straps or screws.—A. W. CHAPMAN.

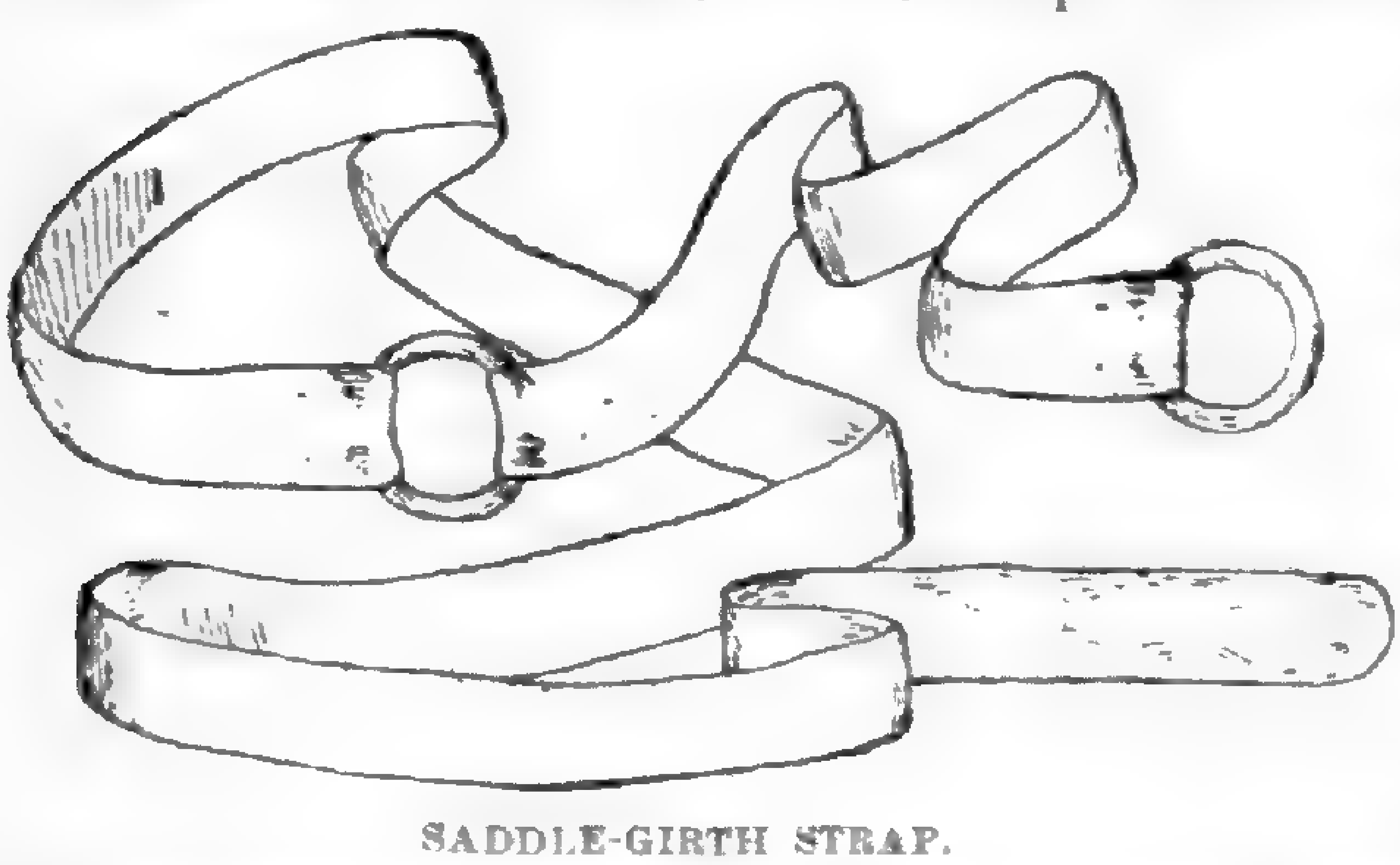
When not too large I collect the whole plant with the root attached. The roots of annuals especially should be collected, or enough to show the character of being an annual. The fruit should, whenever possible, be collected as soon as mature. Too little attention is given to this matter. Some of our best collectors almost invariably fail to collect fruit. Annuals can generally be collected so as to show both flowers and fruit on the same plant, but this is seldom the case with perennials. I have heard the complaint that some collectors are too scientific to be neat; but great care should be taken that in being neat the scientific features are not sacrificed.

In pressing I use a pressure of from 100 to 300 pounds, according to the character of the plants, or the number in press at one time.

Grasses and carices can be dried very quickly and well by using driers just after they are brought in from the hot sunshine; but for almost all other plants the driers should be thoroughly cooled before they are used, or else the plants will be blackened.

In my catalogues I mark all plants as I receive them as follows: - flowers only, - - fruit only, — flowers and fruit. By marking in this way I can easily tell by referring to my catalogue what is needed to complete any specimen, and can call for what is lacking of the first correspondent who offers the plant. I always make a note of the locality and date of collection of every plant as I find it, and when it occurs at a distance from home I place after the note the name of some plant which I know to be in flower at home, where I can see it every day, always using some plant which is just ready for collection for the first time during the season. For example, after Silene stellata I place in parenthesis (tem. Astragalus Canadensis); also for Carex Crawei I have (tem. C. Meadii). By making these notes I often save a long tramp to some favorite's haunt, only to find that I am either too early or too late.—R. I. CRATTY.

I do not know how generally the "saddle girth" strap is used for obtaining pressure. It is made of two straps connected by a ring and with a ring at the end, the distance between the rings being such that they will just come in contact when the press is empty. The loose end is passed through both rings several times and then drawn tight and there is no slipping, and the pressure can be regulated nicely. Dr. P. R. Hay, of Racine, Wis., tells me that he first used the principle in the botanical press. My herbarium specimens are kept loose in sheets which are folded at the bottom and placed in portfolio covers so that they stand upright. The fold of the sheet, being at the bottom, prevents the falling out of small specimens, fruits, etc., and the sheets are easily run over in the search for a particular species.—J. J. DAVIS.



SADDLE-GIRTH STRAP.

In the pressing and drying of many plants in the orders Lycopodiaceæ, Cyperaceæ, and Gramineæ, and many others more conspicuous for a fibrous or chartaceous nature, considerable time and labor may be saved by ironing them with a common flat-iron, slightly cooler than is used by a tailor. By using one or two thicknesses of blotting paper and a hot iron, green specimens may be dried in a few seconds, with a result equal to that obtained by any other method.

Plants which are at all succulent do not do well under such treatment, as they become brittle and consequently useless.—CHAS. F. JOHNSON.

The way which has given me the best results is to carry a portable press into the field. Press 10 by 17 inches, secured by straps; two exterior boards half an inch thick, to separate the dry papers not in use from the damp ones containing plants. The middle board is only used on long trips, when it is necessary to dry the plants on the journey. At other times it is left at home. Felt gives uniformly better colors than paper. Its advantages are (1) uniformly better colors, (2) only one-quarter the time, (3) no work changing papers. The disadvantages are that only one layer, 6 or 8 specimens, can be dried at once.—CHARLES E. SMITH. [Upon examining specimens sent by Mr. Smith we testify to the much superior quality of those dried in felt.—EDS.]

I prefer the old fashioned tin box except for ferns and certain plants, like Rhexia, whose petals are extremely fugacious. The box requires less time to open, is more manageable in windy weather, preserves the plants fresh for examination at home, and is especially serviceable when some time must elapse before the plants can be placed in the press. The straw paper which some authors recommend for drying is unsatisfactory. The best quality of regular drying paper is the cheapest where good specimens count for anything and when time has any value.

However it may be with the portable wire presses sold by the dealers, a rude home-made affair has given me excellent results. With such a press I have dried specimens in three days, being less than half the time required by the board press, and with only one change of driers. Of course to obtain such results the best quality of drying paper must be used, and the packages must not be very thick.

I prefer to press pretty strongly and set the package on a roof having a southern exposure.—GERALD MCCARTHY.

It is probable that the collecting can and the portfolio will always have their respective advocates. Could a full and unbiased statement of their merits be made, it would likely be found that each has good cause for its continued existence. Our contributors have well brought out the value of the portfolio for collecting near home, when rambles do not exceed a few hours each, for preserving plants with delicate flowers or foliage, and of lightening subsequent work of arranging for the press; and the value of the collecting can for extended trips, for keeping plants fresh for further study before pressing, and for the opportunity it gives to do the work of selecting and arranging the specimens in press in the shade and comfort of one's home. The choice largely turns upon individual preferences, one prefers to do most of the work in the field, the other prefers to do it at home. But aside from personal tastes there are circumstances where now one and now the other method has decided advantages.—EDITORS.

How to Collect Certain Plants.

MESSRS. ENGELMANN, BEBB, BAILEY, SCRIBNER, MORONG, HILL, RAU, ALLEN, SARGENT, MORGAN, PECK, RAVENEL, SEYMOUR, HOLWAY, HERVEY, WOLLE, FARLOW, TRELEASE, AND MISSES CUMMINGS AND BUTLER.

What is usually said about herborizing is intended to apply to the common flowering plants and ferns, and such others as readily adapt themselves to the same treatment. There are classes of plants, however, for which these methods are inadequate or not applicable, and it is to supply information in regard to these that the following matter has been brought together. It is given in the words of the authors whose names are appended, each of whom is a specialist in the subject treated, and speaks from wide experience.—EDITORS.

CACTUSES (CACTACEÆ).—At the request of the editors of the GAZETTE the following directions have been prepared by Professor Trelease from the manuscript notes of the late Dr. Engelmann, which are made available through the courtesy of his son, Dr. Geo. J. Engelmann, of St. Louis.

Living cacti bear transportation well if young or medium sized specimens are selected. The entire plant, or, if large, a joint or cutting, is thrown in the shade for a few weeks to shrivel, after which the specimens are wrapped in dry hay or moss, and loosely packed in well-ventilated boxes. Treated in this way they preserve their vitality for from six to sixteen months. Seedlings are easily raised from seeds thoroughly dried and packed *in situ*. If the fruit is large and pulpy it is sliced to facilitate the drying, and should be kept from moisture, but exposed to a free circulation of air.

Herbarium specimens are best made by removing the flowers from the plant and pressing them separately in the ordinary way, after first sectioning some of them. When not too large the fruit may be dried in the same way, otherwise it is halved and excavated before being put in press, the seed being air-dried. The entire stem if small, or characteristic joints of it is compound, may be pressed till dry, after allowing it to shrivel, or if it is too large for this, a piece is removed showing the top, the insertion of several bunches of spines and of the flowers, and some of the tubercles or ribs. Sometimes it is necessary to split and excavate these specimens, and cross-sections dried under light-pressure are desirable. If the means of transportation permit, entire plants or well-selected parts are rough-dried without pressure. These "skeletons," preserved in boxes in the herbarium, are often more instructive than the more ornamental pressed fragments. When possible, it is also desirable to make alcoholic specimens of the flower and fruit.

Cacti are at best poorly preserved for the herbarium, and should always be accompanied by the fullest possible notes and sketches made on the spot. Aside from the usual notes of locality, habitat, date of flowering and period of fruit-ripening, others should be taken upon the following points: In the trunk note habit, presence or absence of aerial roots, form and direction of branches if compound; shape, form of articles if jointed; glabrous, granular, pubescent or mammilated surface; and form of ribs and grooves when present, both in section and profile, especially near the apex of the stem. The last features are best shown in diagrams. Leaves are present in few groups, but when they occur their duration, size, form and direction are to be noted. All cacti produce more or less woolly or prickly buds known as areolæ, on which the flowers and spines are inserted. It is important to observe whether they are immersed or prominent, and their form and usual distance apart. Young and old areolæ should be compared, and particular attention given to the character and color of their woolly or bristly covering. The very characteristic spines occur on the areolæ, and differ greatly in number, relative location, size, form, direction and color, all of which are to be observed. Diagrams aid in showing the form of the areolæ and the location and section of the spines. An important character is the stability of the spines, for in some species the areolæ increase in size, and the spines become more numerous from year to year, while in others this change does not occur, and the spines may fall with age.

Flowers usually come from areolæ on the sides of the trunk or on undifferentiated branches, but in some genera (Melocactus, ? Pilocereus, etc.,) the sterile and flowering parts are very different. The origin of the flowers (from old, one-year-old or nascent branches) and their time of expansion (diurnal, nocturnal, or diurnal persisting through the night) should be observed, together with size, shape, color and fragrance. The form and size of the (inferior) ovary, and the shape, approximate number and character of the reduced sepals that often cover it, with the nature of the wool, hairs or spines in their axils, are all important, as are the shape, size and coating of the tube of the flower. In a longitudinal section it is to be observed whether the lower part of the tube is naked or nectariferous within or not, together with the distance from the top of the ovary to the lowest stamens, the presence or absence of a vaulted arch partly closing the tube, and the form and disposition of the stamens. Any color peculiarities of these, and the color, form and relative length of the style, and especially the stigmas, are to be noted. The shape, color, texture, taste and odor of the fruit, the presence of scales and the character of their axillary products should be observed, as also whether the flower is withering-persistent on the fruit or deciduous, and in the latter case, the form of the resulting scar (umbilicus). The occurrence of few or many seeds is also important.—[GEORGE ENGELMANN.]

WILLOWS (SALIX).—In collecting willows take staminate flowers when in full bloom, pistillate (preferably) a little after anthesis, and again just before the capsules are fully ripe, but not so old as to burst in drying. Tag bushes from which specimens are taken, and make note of localities. Gather leaves of both sexes late in the season; better have specimens with a few lower leaves already turning yellow than attempt to use the succulent growths of early summer. Do not try (save in a tentative way, as an aid in collecting) to match the sexes or determine the species until after your final collections in the fall. A season's experience in this way may be profitably supplemented by making initiative collections of leaves in autumn, and gathering flowers and fruits to match the next spring.—M. S. Bebb.

Carices or Sedges (Carex).—The first requisite to the study of carices is fully mature and complete specimens. A complete specimen represents the the habit of the plant as well as the characters of the inflorescence and perigynia. Whether or not the plant is cespitose or stoloniferous should be represented by the specimen, or, if the plant is large, the fact should be recorded in accompanying notes. Some characters are apt to be obliterated or injured in the most careful collecting and pressing, and they should be mentioned in a short note on the label. Such characters are the aspects of the leaves, as to whether plane or canaliculate, and the color of the plant, as to whether glucose, dark green, light green or yellowish green. Make the notes short. Specimens should exhibit some of the leaves which do not immediately surround the culm. The short and broad root leaves of C. arctata are characteristic, yet rarely represented in dried specimens. The second requisite is a small number of species correctly determined and representing several sections of the genus, with which the student can compare other species. This demand arises from the fact that the characters of many species are such that they can not be represented distinctly by words, and furthermore, it is impossible, in a genus so large and so critical, to define groups so positively that one can always be sure of their limits, or to draw up a key, either natural or artificial, which will be infallible. It is necessary, therefore, that the student should at once set up certain landmarks by the critical study of a few representative species in different groups. Half the difficulty in the study of the perplexing Acutæ is overcome when one secures a good knowledge of the common forms of C. stricta. Collect abundantly of all common species. If the student has no means of securing authentic specimens he will find it to advantage to delay his study until he has accumulated a dozen or more clear species, which he can compare with each other. When he has fixed in his mind the essential features of a representative species of each important group, his progress will be comparatively rapid and easy. Especial care should be taken not to use too much weight in pressing species like C. Tuckermani and C. monile, which have inflated and papery perigynia. To flatten the spike by pressure is to destroy the natural shape of the perigynia. It is a good practice to cut holes in the upper sheet of drying paper to allow the spikes to project into them. I usually place a few perigynia from my impressed plant in a pocket.

Specimens which are frequently used should be glued tightly upon the sheet throughout their whole extent. I had rather have my specimens laid loosely upon firm paper, than to have them strapped on sheets in the ordinary manner. If the specimens are properly glued, and pockets are used for a few loose perigynia, the herbarium will be entirely satisfactory for purposes of study. I do not like specimens arranged in alphabetic order, unless in genera which I am not studying. With the two volumes of the Synoptical Flora, and the occasional synopses and monographs of outlying genera, we are able to arrange species of familiar genera in systematic order, and if the synopsis has an index we need experience little difficulty in finding any specimen. A brief synopsis of American carices is forthcoming.

Tall and leafy specimens should be pressed in such a manner that the culms shall stand out distinctly from the leaves. It is a common but bungling practice with such straggling specimens to tie leaves and culms together in one confused bunch before pressing. The culms should be bent over separately from the leaves, and a bit of slitted paper inserted over the junction of the broken portions to keep them in place. Similar treatment should be given long leaves.—L. H. BAILEY, JR.

GRASSES (GRAMINEÆ).—Among phænogamous plants none are more easily dried and preserved than grasses. Good dried specimens (and there is small excuse for having anything but good specimens in this order) present all the essential characters for identification in a condition but little inferior to the fresh and living plant. Excepting Phragmites communis and the species of Arundinaria, we have no natives that may not, with a little care in doubling or folding the stems, be preserved entire—inflorescence, stem, leaves and enough of the root to show its character—and yet not exceed the bounds of the standard size herbarium paper. In an order where there is so much similitude between the species the importance of having specimens illustrative of all the characters of the plant is sufficiently evident. Among some of the groups it requires very close discrimination to find definite characters for distinguishing the species, and, unless the specimens are carefully prepared and made as complete as possible, the very characters required may be wanting. The worthlessness of "snips," merely showing the flowers and inflorescence, is as true of grasses as of other plants, and happily collectors are becoming aware of this fact, yet a glance into almost any herbarium shows a neglect in certain particulars of a more or less serious character. The distinguishing of many species is dependent almost entirely upon the root or other underground portions of the plant. Notably is this true of the species of Agropyrum and some of the Poas, yet there are no parts more often neglected in the making of specimens. The importance of the preservation of all the leaves of the culm uninjured goes without saying, but it is not so generally understood that it is quite as important to preserve the sterile shoots—the "*innovationes*" of Hackel—in a way to show their foliage and their manner of growth. The value of the characters presented by these "innovationes" is sometimes greater than those exhibited by the flowering stem itself, from the fact of their being less subject to variation. Their importance in distinguishing species and varieties closely related is well illustrated in Hackel's Monograph of the Festucas of Europe. It is only by a close attention to these organs that we can hope to define the many forms of F. ovina and allied species of the Rocky Mountain region. By a careful attention to these "innovationes" we may yet find a key to the multitudinous and intricate Rocky Mountain forms of the genus Poa.

The inflorescence of the paniculate-flowered species should be illustrated when possible by samples showing the habit just previous to and following the period of bloom. In some species the panicle is expanded only for a very short time (during the period of actual bloom), following which the branches quickly become erect or appressed. Upon the adherence of the flowering glume or palea to the grain important characters are based, and it is scarcely necessary to add that ripe seed form a part of a good herbarium specimen. Grasses may be fastened to the sheets of the herbarium either with glue or strips of gummed paper. The latter method is especially suited to the peculiar habit of grasses, and even when fastened with glue the strips should be applied to the stems and stiffer parts, or they will quickly break away from the paper in handling.—F. L. Scribner.

Aquatic Plants (Naiadaceæ, etc.).—The Potamogetons will serve as a type for dealing with all other aquatic plants. My plan is to collect specimens, if possible, at least twice in the year at the same locality. Two things are of great importance, *submerged leaves* in good condition and *mature fruit.* Submerged leaves are at their best when the plant is young, or a little previous to flowering. In some of the species they can not be obtained at all in anthesis, as they decay and drop off before reaching that state, and in all the species they become more or less imperfect by the time the fruit matures. Mature fruit is absolutely necessary in order to identify some of the species. For instance, P. pectinatus and P. marinus can be distinguished with certainty only by the fruit. The same is true of P. pauciflorus and P. Hillii; while in the case of P. hybridus and P. Spirillus both fruit and submerged leaves are needed. It is also well to remember that a number of the species may or may not develop floating leaves. Of the thirteen species found in North America twelve have this peculiarity. Floating leaves, however, are not a typical characteristic in this genus. Prof. Tuckerman long ago observed that "the Potamogetons are typically submersed plants, and their floating leaves become of importance in characterizing the species only when taken in connection with the submersed ones." Whether such leaves are present or not will depend upon the depth of the water and the temperature of the season; and collectors must not suppose that they have discovered a new species because the floating leaves described in the books are absent, or because they appear on forms to which they are not attributed. I should not be much surprised to find floating leaves upon abnormal forms of any of the two groups which Dr. Robbins has named "Conformifolii" and "Angustifolii."

The drying of specimens is a very simple matter. All the specimens should be kept wet until placed between driers. After lying upon the table for a few moments to clear from dripping water, they should be laid separately between thick pads of drying paper. Common newspapers or coarse wrapping paper will answer the purpose very well, if sheets enough are placed between the specimens. Only a very moderate pressure should be applied, ten or twelve pound weights laid upon a pile ten or twelve inches high being quite enough. After being subjected to this pressure for two or three hours the driers should be changed entirely, even to the two sheets next to the specimens. This is the most important part of the process, and so I repeat, *a complete change of driers should be made within two or three hours* after the specimens are placed between them, and while the specimens are still moist. A neglect to do this in time will be very apt to cause the plants to adhere to the sheets, and produce those miserable specimens so common with hasty and slovenly collectors. After this no further change is necessary, as the specimens and papers will dry themselves thoroughly within a day or two. I prefer, however, to remove the specimens the next day into the preserving sheets, or they may be mounted at once if thought best.

In the case of the more delicate species, such as P. Vaseyi, P. pusillus, P. hybridus, etc. (including Zannichellia), the specimens should first be floated in water upon card-board in the same manner as the coarser plants. Indeed, all the finer leaved forms will furnish much handsomer specimens if pains are taken to spread the branches and leaves under water upon sheets of white paper.

Naias and Ruppia are to be treated like the coarser species of Potamogeton. The two marine genera, Zostera and Phyllospadix, are best collected when in flower and fruit. Some of the specimens should be prepared with the spadix drawn partly out of the spathe so as to show the inflorescence distinctly.

The above directions are applicable to all other delicate aquatics, such as Isoetes, Schollera and Callitriche, and more or less to Elatine, Utricularia, etc. —THOMAS MORONG.

To get aquatic plants from the water (root and all, if necessary, for lower leaves are often required, as well as underground stems), I have a hook, or blade, made something like a "bush-hook," used by farmers to cut off small shrubs when clearing land. Any blacksmith can make one, and the cost is but a few cents. It is about eight inches long, with one cutting edge. The eye is about ¾ inch in diameter, so as to receive a handle stiff enough for work. This blade is carried in the tin collecting box to the place of work, with a gimlet, two or three screws, and a small screw-driver, such as go with sewing machines. With a pocket knife a stick six or eight feet long is cut, inserted in the eye, which is drilled on one side to receive a screw. If the wood is hard, a hole made by the gimlet enables the screw to be forced in, and one is ready for work, to reach out and haul in specimens, or to dig in the ground. When done for the day, the screw is withdrawn and the handle thrown away. —E. J. HILL.

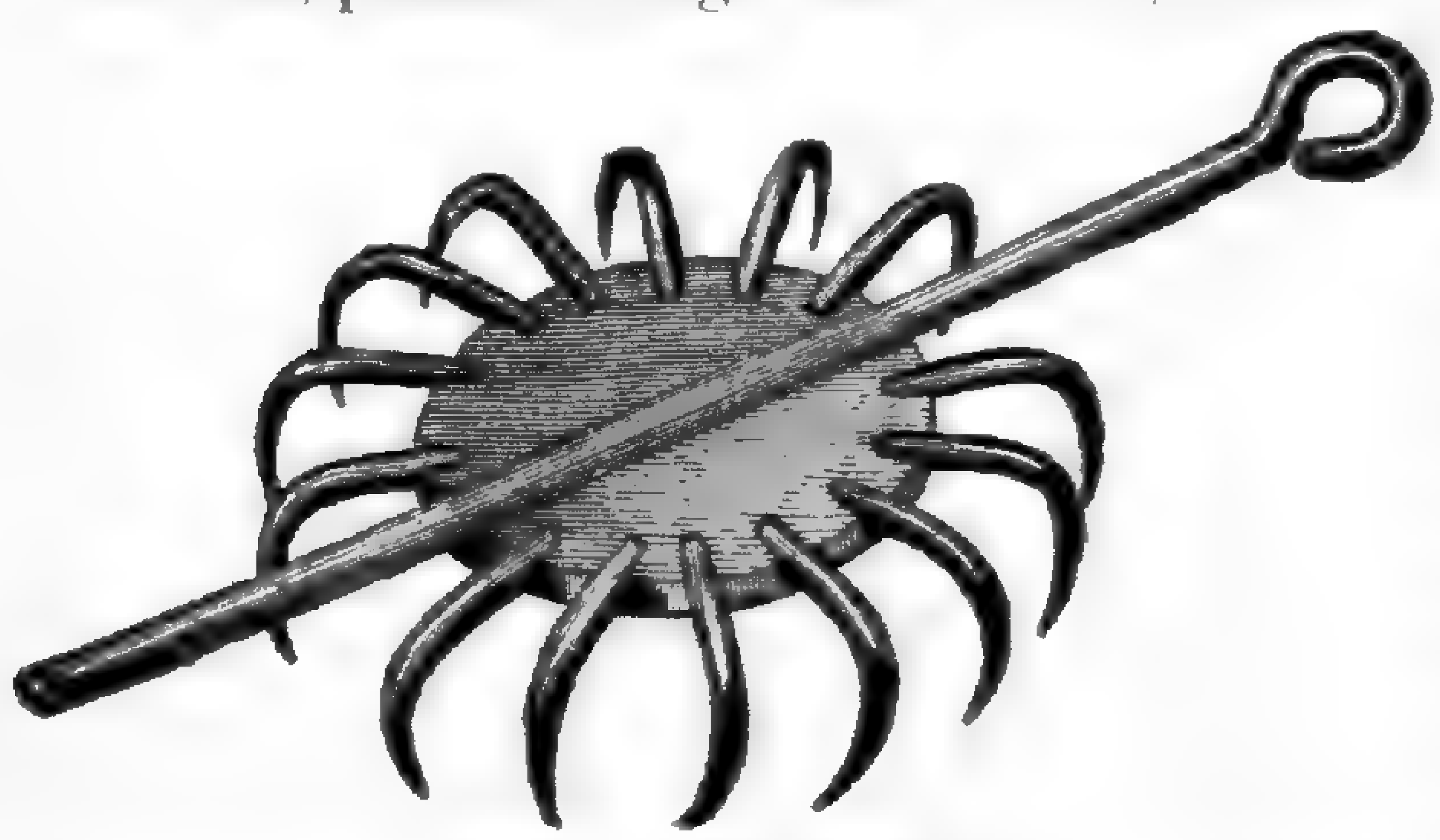
MOSSES (MUSCI).—Mosses can be put into envelopes, or each specimen folded up separately in paper, and carried in a plant portfolio or other suitable receptacle. Where it is an object to preserve the spores for microscopical examination, these should at once be wrapped in waxed paper. The specimens should be removed from the envelopes or wrappers, in which they were collected and pressed, in the same manner as phanerogams. Aquatic species, like Fontinalis, Sphagna, etc., may be spread out on the floor of a shady attic until freed of their superfluous moisture to some extent, then transferred to driers.

The following are notes from the late Mr. C. F. Austin in regard to the collection of mosses: "Mosses should be collected as soon as, or a little before, the capsule matures, *while the operculum is still present.* Some species seldom or never fruit with us; these should not be neglected. Hepaticæ in general are best collected late in the fall, during the winter, or in early spring. The Jungermanniæ about the time, or a little before, they send up their fruit-stalk. All are best collected before they shed their spores."—EUGENE A. RAU.

I began by using a portfolio, but soon came to the conclusion that it took too much of the field time to prepare each specimen for pressing, and often they were not in a proper condition as regards moisture, being either too dry or too moist. A vasculum is too heavy, especially for mountain excursions. So I made an inexpensive knapsack which I have found very serviceable. It is made of carriage cloth, with a flap which buttons in front. To the back are attached loops, so that it can be suspended from the shoulders by a strap. Plenty of newspaper should be taken and each species wrapped separately. This bag when packed full will not weigh much more than the ordinary vasculum. Do not break the specimens into too small fragments.—CLARA E. CUMMINGS.

CHARAS OR STONEWORTS (CHARACEÆ).—The Characeæ, growing wholly under water, are generally overlooked by collectors. Some species grow in quite shallow water (if protected from waves) and may be reached easily by the hand from a boat, or by wading. Others grow in water from ten to twenty feet deep, and can only be obtained by dredging.

For this purpose a dredge made as follows is recommended: An iron rod $\frac{5}{16}$ of an inch in diameter and about 12 inches long, bent to form a small ring at one end, passes through and carries, below its center, a disk of lead about 3 inches in diameter. This disk holds embedded in it 12 to 14 iron hooks all bent toward the same side. The hooks project about an inch from the leaden disk and curve inward about an inch. The iron rod projects about three inches beyond the leaden disk, so that the end of the rod strikes the bottom first. The lead should be heavier on the side towards the hooks, so that the dredge will fall with the hooks downward.



DREDGE FOR CHARACEÆ.

This dredge was recommended to me by Prof. Nordstedt and may be made much smaller if desired. It will bring up immense quantities of material in good condition.

The plants should be gathered when in fruit and laid out regularly upon paper and dried. The more delicate species must be floated out like algæ and protected by coarse cloth to prevent adhesion to both upper and lower papers, as they are apt to be infested by glutinous algæ. Most specimens are in condition in August and September, but a few are in fruit in the spring.

The forms that are covered by calcareous deposits, and which become very brittle, must be kept from breaking, either by glueing to stiff paper, or by packing in bundles protected by stiff boards.—T. F. ALLEN.

LICHENS.—In collecting lichens I find it a great convenience to have along with me some small paper bags such as grocers use. They take up very little room until wanted, and lichens put into them may be prevented from rattling around and breaking to pieces, as many of them will do if merely thrown into a box. Specimens to be preserved are either (1) those for the herbarium, or (2) those, such as rock specimens, which can not be kept on sheets. The latter I keep in trays in a cabinet. The former I keep either in paper pockets, attached to the herbarium sheets, or else they are glued to suitable sizes of rather stiff paper and these are attached to the sheets by tiny ribbon pins, a pin to each upper corner. Specimens in pockets may be more easily handled and so studied more satisfactorily. Specimens glued on paper are more readily seen when one is running over a cover full of sheets, and thus rapid reference is facilitated. When I have specimens enough of a given collection I try to have some glued and some in a pocket. The form of a pocket which experience has shown me is the easiest and quickest to make, and the easiest to handle, is one which I suppose is familiar to most botanists. It is made as follows: Fold a piece of paper so that the under part shall project about $\frac{3}{4}$ of an inch beyond the upper; fold the projecting part over the other, making the top of the pocket. Turn the pocket over and fold back the right and left edges for about $\frac{3}{4}$ of an inch. The pocket is now finished and is to be attached to the sheet by a small spot of glue on the center of the back. It is an easy matter to fold several pockets at once.—F. LEROY SARGENT.

FLESHY FUNGI (HYMENOMYCETES, ETC.).—I gather fungi of all sorts in a basket. This is a common cheap basket with two handles which keep the lid down; it costs 25 cents. It is 13 inches long, 9 inches wide, and 9 inches high to the top of the lid. Inside this basket is a paper box, $4\frac{1}{2}$ inches high and filling half the space; filling the other half of the space on the bottom is a common cigar box. Inside the cigar box at each end are two seidlitz powder boxes (paper) and between these two boxes standing on their edges, and just filling the remaining space are two small paper boxes with sliding cover; these two small boxes are filled with cotton, with a bit of stiff paper fitting upon it. A copy of the *Commercial-Gazette*, with the pages folded twice and cut into sheets; then these folded again and laid in the top of basket on the boxes completes the outfit for taking care of every sort of specimen that can be gathered.

The tools are (1) a very strong steel kitchen knife, handle and blade all welded into one; it costs 10 cents, and is stuck in the slots inside the basket; (2) a first class pocket knife, with the blades, large and small, kept very sharp, (3) a good lens—I use a Coddington.

The larger and firmer Agarics and Boleti will go in the larger box, the smaller or more tender ones, such as Coprini, in the smaller boxes. The two sliding boxes filled with cotton are intended primarily for Myxomycetes; but they are equally useful for Mucedines, Mucorini, small Pezizas, that is, anything small and delicate. The sheets of paper can be used to wrap up sets of leathery and woody specimens such as Polypori, or sets of leafy fungi can be placed inside their folds and laid out flat in the bottom of the basket. In the case of very large specimens, such as Agaricus illudens for example, the boxes can be taken out and the whole interior of the basket used. I sometimes come in with the small boxes in my pockets, the larger ones in one hand and the basket in the other, with the folded papers on the top of the lid between the handles.

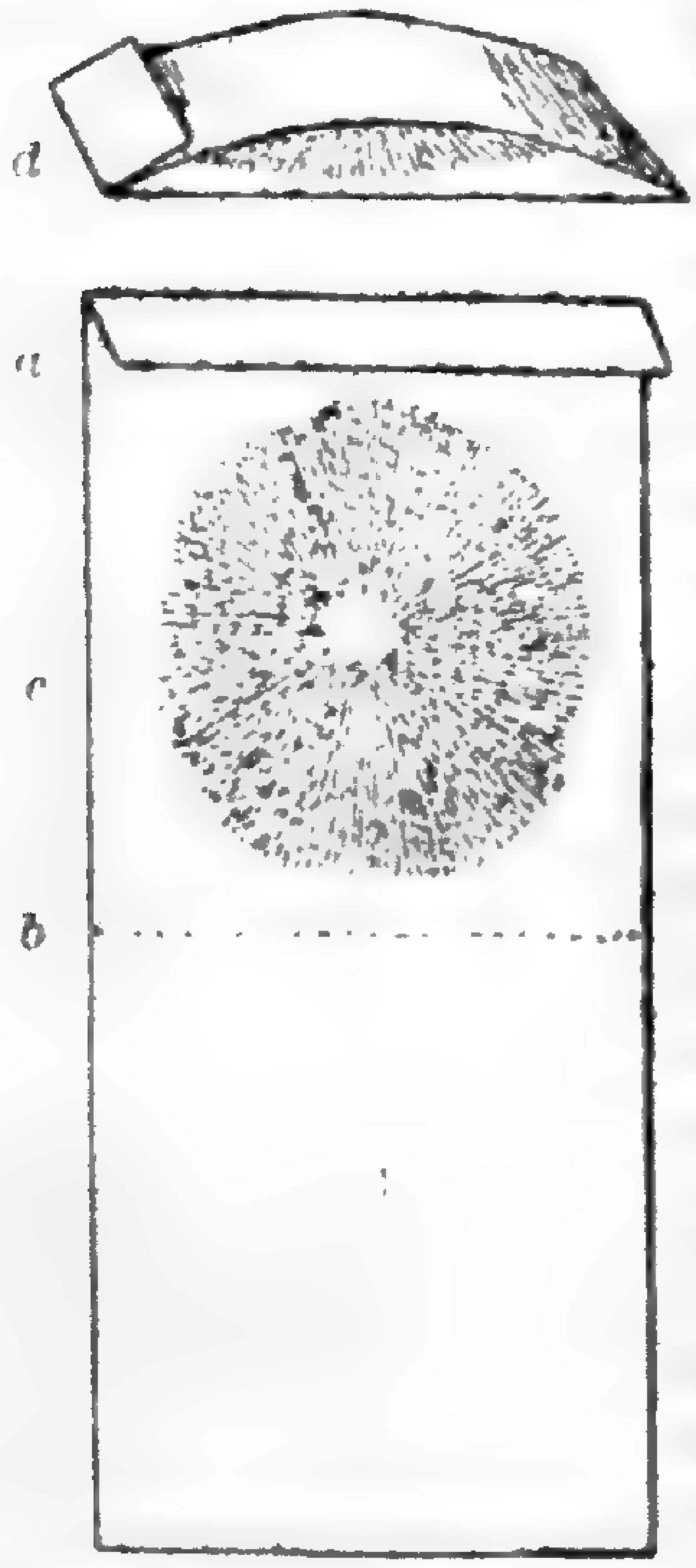
The strong knife is used for digging, or for prying off pieces of wood, bark, etc. The sharp knife shaves off thin slices bearing Myxomycetes, molds, Pyrenomycetes, etc. I seldom go after specimens of fungi in the afternoon, but usually return with my specimens at noon. They are immediately spread out on the floor on newspapers to dry and to be examined; the caps of Agarics and Boleti are cut off and placed on white paper to catch the spores, a glass slide being slipped under also. After dinner the most perishable specimens, Coprini for example, are immediately figured; those that will keep over night can be figured next day. The figures are made the easiest, quickest and best with oil on prepared paper. Our sheets are 7 by 10 inches. We sometimes use water colors for slender branched Clavarias and for small Pezizas. There need be no attempt at picture making in these figures; the outlines must be brought out exactly in true perspective and the colors and gloss must be perfect. In the afternoon, too, the fleshy perishable fungi should be carefully examined and determined if possible. Some will probably get away every time before they can be satisfactorily made out and figured. Such as appear to be new species should be carefully described, using the nearest related species as a model, carefully stating the points of difference and indicating its proper place in the genus. New species will do to rest in the stocks a long time; and you will find after a while that three-fourths of them have been described, and then you can publish the remaining fourth. My note book has "n. sp." in it four or five years old, and I am not the least afraid somebody will find them and publish before me.

I dry my specimens around the stove if there is a fire, as in autumn, or in a warm dry attic in summer. The air should not be too hot, as in an oven; warm dry air from a furnace is excellent, and the specimens can be placed on the register. After being thoroughly dried they can be dampened by being rolled up in a piece of wet newspaper for a short time; then spread out and subjected to gentle pressure to fit them for the herbarium sheets. Dried Agarics, however, are not very satisfactory specimens without their figures: they seldom preserve any microscopic characters, like Pezizas. Dried puff-balls, however, are extremely valuable specimens; they should be stored away in boxes and kept in their natural shape. I store up Polypori in the same way.—A. P. Morgan.

Of the fleshy fungi, the living plant is in the best condition for study and identification, properly dried specimens stand next, and moderately pressed specimens are third in value. Alcoholic specimens, badly pressed specimens, and sections or fragments dried in the plant press, are practically worthless for these purposes.

Select the best specimens and reject old, worm-eaten, water-soaked, badly deformed or otherwise imperfect examples. Collect freely of each species whenever it is possible, for some specimens may be spoiled in drying or in analyzing, some may be needed for exchanges, and at least four should be reserved for the herbarium. If the pileus is hygrophanous, viscid, or striatulate, these characters should especially be noted. There is also some advantage in ascertaining at once the internal character of the stem and the color of the flesh. This may be done by making a vertical secton through the center of the pileus and its stem.

In the Agarici it is of the first importance to ascertain the color of the spores. The numerous species have been arranged by Fries and other authors in series depending upon this character, and, when it has been ascertained, the first step has been taken toward the proper location and identification of the species. The color of the lamellæ in mature specimens often corresponds very nearly to the color of the spores, but there are many exceptions. Sometimes specimens will be found to have dropped their spores on subjacent objects in such quantity that their color can be readily ascertained at the time of collecting. Microscopic examination may approximately reveal it, but in some respects the old method of receiving the spores on paper, as they drop from the lamellæ, is the most accurate and most satisfactory method of ascertaining their color. It is then presented to the naked eye in a manner in which it may be preserved for future use. Rather stiff white paper should be cut in slips a little wider than the diameter of the pileus whose spores are to be caught. The length should be a little more than twice their breadth. Make a transverse fold about half an inch broad across one end. Select a fresh, well-developed plant, and cut the pileus from the stem. Place the former in its natural position, lamellæ downwards on the paper between the folded margin and the middle of the slip. This leaves the other half of the paper free, and after the spores have been dropped it is to be doubled over and its free end thrust under the transverse fold already made. It then covers and protects the spores. This covering fold should be a little longer than the part holding the spores beneath it, that it may form a low arch over them and not press upon or disturb them. (See annexed diagrams.) If the spores prove to be white, or it is suspected at first that they are white, black paper may be used, as white spores will be more conspicuous on it. Generally in a few hours or a single night a stratum of spores thick enough to show the color satisfactorily will be obtained. If the pileus is very small or thin a goblet or other suitable vessel may be inverted over it, that the moisture may be retained and the pileus not shrivel before it has dropped its spores. The paper bearing the spores should be properly labeled and kept in a tin box with a close-fitting cover. It should contain a small open bottle of chloroform, otherwise insects will be likely to find and devour the spores.



Paper with spores on it. *a*, The narrow transverse fold at the end of the paper. *b*, Dotted line through which the second fold is to be made. *c*, Space on which the spores fall. *d*, Side view of the paper as finally folded.

After the specimens have been dried they may be dampened by placing them in front of an open window during a rainy day or dewy night, or kept for a time beneath several layers of damp paper. Water should not be sprinkled upon them, but very thick, firm specimens are sometimes softened by steaming. They are then subjected to light pressure in the plant press.

The hard bulky and corky species of Polyporus, Trametes, etc., need no preparation except poisoning. They should be kept on shelves or in drawers. In public herbaria where space is available they should be placed in trays and kept under glass in table cases. If it is desired to have them represented in their proper place in the herbarium, make vertical sections through the central part of the pileus. These may be from ⅛ to ¼ of an inch thick and can easily be attached to the sheets.

It is very important that the specimens should be poisoned. It is best to apply the poison as soon as convenient after the specimens are dried. Various preparations have been tried, but I find none better than the ordinary mixture of corrosive sublimate and alcohol. A paste made of raw rubber soaked in bisulphuret of carbon is the most satisfactory for mounting specimens of anything I have tried. Fragile or delicate specimens may be protected by attaching a thin piece of cork to the sheet by the side of the specimens.—Chas. H. Peck.

The specimens should be put in the sun, gills upward. Unless very large one day's bright sun will dry them thoroughly. The large thick Boleti will require two days or more. When thoroughly dessicated, they are left out in the night air (under cover from rain), which gives them sufficient flexibility to be pressed into shape. The small group of Phalloids is perhaps the most difficult of all the Fungi to preserve well. They, too, must be exposed to the sun, or dry air, until perfectly dry, and the repulsive fetid odor destroyed. But they shrink so much in drying, and are so distorted from their fresh state, as to be very unsatisfactory. Full notes should be taken from the fresh specimens of all the chief characters, and if one can overcome the nauseous fetid odor long enough, a drawing should be made.—H. W. Ravenel.

A rapid and very satisfactory way of drying fleshy fungi is to use a chemist's drying oven heated with steam or hot water. With suitable regulation of the temperature, which a little experience will make easy, the best and most uniform results may be obtained, and without the usual tediousness and uncertainty. By this method the most deliquescent sorts can be preserved as easily as any other. When dry the specimens can be placed at once in a covered jar or pail with a wet sponge, and in an hour or two will be limp enough to be put between driers, and the next morning be ready for poisoning and mounting.

Parasitic fungi (Uredineæ, etc.).—Experience and observation teach that a beginner in parasitic fungi is almost certain to be deceived by the work of insects, mites or related animals. To distinguish between these in some cases is impossible without microscopic examination; but eventually one learns to distinguish in most cases by a glance. No general rule can be given and a description of special cases would be long. A collector must train himself to see and to distinguish. Probably one can succeed best by beginning with some particular group of fungi. Some knowledge of the plants to be looked for is a great help. Begin with the group in which you are most interested, say Uredineæ. Look over the published lists and descriptions to which you have access; get an idea of how many species there are, what they grow on, what time of year they occur. Notice particularly some likely to appear soon, and look at specimens of them if possible. These will be impressed upon your mind and when you go out you will look sharply for any unusual appearance of that host. You will find a few species that are well known and these will be a nucleus. They are marked by certain appearances of the host. Similar appearances on other plants will be more easily seen and each new success will bring increased interest and increased ability. If you are not interested in other groups and know nothing about them, you will scarcely see any of their species. You may, however, look for all kinds, but your greatest success will be in the groups which you know best and in which you are most interested. As knowledge and experience increases, new groups will be brought in, but the field is so large that it is bewildering to attempt all kinds at first.—A. B. SEYMOUR.

The equipment necessary is a tin box, 8 by 12 inches, and 6 inches deep, with a tight fitting lid, a small portfolio (or an old book), and a pocket lens. Nearly all specimens will keep well for a day in the box, but the portfolio is useful in keeping leaves which cure quickly, and for the more careful preservation of rareties.

The last of May or the first of June, depending upon the season, I go to a favorite valley about half a mile wide, with a creek running through it, well shaded by large trees. On the south side are low hills, covered with young trees, with occasional springs running down and forming small bogs in the valley. On the north are higher rocky hills, with here and there a deep gully worn by the waters from the land above, thickly overgrown by small shrubs.

Walking along the hills on the south my attention is attracted by some leaves of Anemone nemorosa, and A. acutiloba, which are smaller than their neighbors, and borne on longer petioles. An examination of the under surface of the former reveals on some the beautiful cups of Æcidium punctatum, and on others the dark sori of Puccinia fusca; the thickened leaves of the latter are covered with Æcidium hepaticatum. A further search among the leaves of A. nemorosa is rewarded by the purple dots of Synchytrium Anemones, the frosting of Peronospora pygmea, the black pustules of Urocystis Anemones, and the small cups of Æcidium Ranunculacearum. A good contribution for the little may-flower!

Going towards the valley, I find a luxuriant growth of Podophyllum peltatum, infested with its bright orange cluster-cup, Æcidium Podophylli, and a little later in the season, a similar locality furnishes Puccinia Podophylli. At the edge of the valley, the lovely Claytonia Virginica is blooming, and a short search adds to my treasures Puccinia Mariæ-Wilsoni and its æcidium. Walking down the valley, with a sharp look at every plant, I come to a mass of the delicate Isopyrum biternatum and soon find Æcidium Ranunculacearum. Then Arisæma triphyllum contributes Æcidium Caladii, and a subsequent visit gives me the uredo and teleutospores of Uromyces Caladii. A plant of Ranunculus abortivus, a little taller and more slender than it should be, shows the work of Æcidium Ranunculi. Viola pubescens gives Æcidium Violæ, and later Puccinia Violæ. Tramping on, Mertensia Virginica stops me by the yellowish spots on the leaves; I examine with my lens, and doubt its being a fungus, but throw a leaf into my box. A microscopical examination at home shows it to be Entyloma canescens, new to the United States—and then I wish I had been less skeptical.

Crossing the valley, I add Puccinia Cryptotæneæ on C. Canadensis, and climbing up a deep gully, I am delighted with the discovery of a large Lonicera Sullivantii, every leaf spotted by Æcidium Periclymeni. Coming out, I find small shrubs of Zanthoxylum Americanum, leaves and petioles bright with Æcidium Zanthoxyli. A visit to the bogs adds Peronospora obducens on cotyledons of Impatiens, and later in the season, Puccinia spæta on Mitella diphylla. During the season this valley yields several species of Peronospora, Entyloma, Septoria, Cercospora, and many of the Erysiphei.

Few localities are as rich in species as this, but something can be found almost anywhere. I have found heavy woods the most barren. River bottoms, low meadows, deep ravines, hills with springs running down them, and especially recent clearings in the woods, are good collecting grounds. Sloughs and swamps give the species on Sedges, Iris, Acorus, etc., and the grasses of dry rocky hills are usually covered with Puccinias.

Reaching home with my box packed full, I take my pile of driers, lay the leaves carefully between sheets of paper, a drier between each, and when all are arranged, place a board on top, with a small weight, just enough to keep the leaves well flattened; too much will injure Æcidia. It is necessary to change the driers *often* to make good specimens. When dry I poison them with corrosive sublimate and carbolic acid (BOT. GAZETTE, vol. 1, p. 27), place in wrappers of good white paper, and glue the wrapper to the herbarium.—E. W. D. HOLWAY.

MARINE ALGÆ.—The flora of the sea is distributed through a belt nearly touching the high tide mark on the one side and extending to a depth of several fathoms on the other. Most of the plants, however, grow between tide marks or at a little distance below. It is evident that these can be collected without difficulty at low tide, taken from the rocks by the hand or with the aid of some simple tool. For getting plants which grow just below tide, a pair of rubber wading boots, which will allow one to go into the water up to the knee or above, is very convenient. And for capturing plants which come floating up on the waves or are attached to the rocks just out of reach of the hand, the writer has found very handy an instrument made in the following way: At a kitchen furnishing shop buy a wire spoon. It is used I think for taking various things out of boiling water, in the process of cooking. This can be tied to a stick of any desired length. I find nothing more convenient than the two lower joints of a common fishing rod. These may be quickly taken apart or put together to make the handle of our spoon shorter or longer.

Those plants growing in deep water may be sought for either by the use of a grappling hook attached to a line and thrown down among the plants to pull them up and bring them to the surface, or by hunting among the *rejectamenta* upon the beaches, or watching for them in the waves of the incoming tides.

All but the coarser forms, like the Fuci and Laminariæ, are mounted by "floating out" on paper and dried in a press. The paper best adapted to the purpose is a good quality and weight of demy or some lighter kinds of drawing paper. It should be cut in three or four regular sizes by dividing the sheets into quarters, eighths, sixteenths, etc.

A simple and handy apparatus for floating out the plants consists of a shallow tin dish, which may be had at any tin shop, 8 by 11 inches, and 1 inch deep, and a plate of zinc 12½ by 6½ inches, perforated by six rows of half-inch holes, an inch and a half apart in the rows, the perforations extending over only about 10 inches of the plate. Fill the dish three-quarters full of sea water, wet the paper and lay it on the zinc, thrust both into the water and lay on the plant. Spread it out carefully, lift up the end of the zinc which will draw the paper and plant out of the water. Let it drain a moment and then remove to the press. Lay the paper, plant up, on a sheet of drying paper. Spread a piece of old cotton over the plant, and over this put a sheet of drying paper. Another floated out plant, cotton, drying-paper, and so on. Put in press for 24 hours. Change the cloths and drying paper and put in press, under more pressure, for 24 hours longer. Nearly all of them will be quite dry by this time. If not, change again, and so on till they are dry. Such plants as do not adhere to the paper by their own substance may be fastened to the sheets with strips of gummed paper. The Laminariæ and Fuci, and such like coarse forms, should be partly dried before putting in press. It is well also to wash them in fresh water, and such as will bear it to soak them out in fresh water, to get as much of the salt as possible out of them. These plants are arranged in the herbarium in the usual way.—A. B. HERVEY.

FRESH-WATER ALGÆ.—They should be looked for in ponds, quiet or sluggish waters, in swampy grounds with pits which retain water during the summer months, mountain ravines with cascades, moist, shaded and dripping rocks, and sheltered angles of lakes and rivers. The equipments may be simple, unless for a long and thorough search. A few wide-mouthed vials and some small sheets of brown paper, five or six inches square, will be sufficient. Filamentous algæ will drain quickly, are then placed upon a sheet of paper which is folded, and in this way may be kept for days in good condition. Water likely to contain desmids and other small floating plants is to be placed in the vials. If a larger vessel is at hand dip the material into it, allow it to settle, drain off the water and bottle the thicker substance. The bottled material will become fetid after several days, but it may be preserved for months and even years by the addition of a few drops of carbolic acid, just enough to make its presence perceptible. It may be well to bear in mind that the freshest and brightest green forms are not usually the most desirable. Among the older and more unsightly more mature and fruiting specimens may be found.—FRANCIS WOLLE.

DESMIDS (DESMIDIEÆ).—Unlike their near relatives, the diatoms, which may be found in greater or less quantities in all waters, desmids are select and elusive, the result of long tramps, the reward of perseverance, long-suffering, and other kindred virtues. A collector of desmids needs to be provided with a large stock of patience, considerable endurance, and some courage, a pair of rubber boots, and vials *ad libitum.*

Except the most common forms of Closteria and Cosmaria, they particularly affect clear pure water. For instance, a summer's search in Dakota was fruitless on account of the alkaline water. Strong currents are also unfavorable to their deposition. I have made my best "finds" in small pools or ponds, fed by springs, or connected with larger lakes by underground channels, such water being pure and undisturbed by currents or waves.

Desmids sometimes form a delicate green film on the banks or bottom of a pool, in which case they can be gently urged by the help of a spoon into a wide-necked bottle; but more commonly they can be found clinging to the stems and leaves of aquatic plants, such as Vallisneria, Anacharis, Myriophyllum, etc. When I find sphagnum under water I am jubilant, for it has never failed with me to produce desmids in abundance. They can be stripped from the leaves by the hand, or, better still, the moss can be gathered, being careful to dislodge as little mud as possible, and washed thoroughly in water. When the sediment has settled pour off the superfluous water. Your microscope may show the remainder to be a rich harvest of such inexpressibly rare and beautiful forms as to make one forget all fatigue and vexation.—ELOISE BUTLER.

NOSTOC GROUP (PHYCOCHROMACEÆ).—Thin gelatinous species, which form expansions on the ground or on rocks, are prepared by removing them with small portions of the substance to which they are attached and allowing them to dry under slight pressure between plates of glass or other hard substances to which they will not adhere. The smaller and more delicate aquatic species should be floated out on pieces of mica or glass and dried in the air, but not exposed to strong sunlight. They may also be floated out on paper like larger algæ, but, before pressing, they should be allowed to dry a few hours in the air. In the press they should be covered with thin unglazed cloth as in the case of algæ. Species like Oscillariæ, which have a vibratory notion, may be placed in a large drop of water on a moistened paper, and left over night. In the morning the threads will have separated from one another so that the specimen has expanded into a circular shape and the threads have arranged themselves radially. Large nostocs of an irregular shape may be pressed like larger algæ, but they sometimes are a good while in drying. Prepared in this way they are not unfrequently considerably distorted, and it is well to keep a few specimens rough dried for study. On remoistening they swell to nearly their original proportions. Specimens preserved in alcohol or glycerine are of little value.—W. G. FARLOW.

SLIME MOLDS (MYXOMYCETES).—The excellent account of the methods of collecting and preserving this class of plants given by Dr. Geo. A. Rex in this journal a year ago makes it superfluous to go over the ground again. We, however, desire to call attention to a superior manner of preserving material for the herbarium and ready examination under the microscope, which Dr Rex now uses, and which the writer had the pleasure of seeing upon a recent visit. Instead of using small boxes, which are somewhat awkward for placing under the microscope, the specimens are mounted in a metal cell, which is firmly fastened to an ordinary glass slide, and provided with a close-fitting metal cap. The bottom of the cell is covered with dark green wax, on which the material is mounted so as to give both vertical and lateral views. The cap is so nicely made as to exclude dust and insects and yet be readily removed for examination. The slides can be placed in a suitable shallow box and slid into place in the herbarium, as explained elsewhere in this number. This cell was devised by Mr. J. Pierce, of Providence, R. I. We are indebted to J. W. Queen & Co. for the use of the cut illustrating it.

THE PIERCE CELL.

BACTERIA (SCHIZOMYCETES).—Bacteria are commonly preserved for the herbarium by drying some of the zooglea, or drops of fluid swarming with them, on bits of mica, and placing these in small envelopes gummed or pinned to the herbarium sheet. They are apt, however, to flake away from the mica after a time and may ultimately be entirely lost, as the dried film is exceedingly friable. To obviate this difficulty the specimen may be incorporated with a drop of some mucilaginous substance, like Althæa extract, freshly prepared and filtered. It has been asserted that this preserves their vitality, so that they may be used for starting new cultures after a long duration in the herbarium.

No specimens are so satisfactory for study as mounted slides, prepared by smearing a *very thin* film of distilled water containing the bacteria over the middle of a slide, drying it rapidly (but without heating too much) over an alcohol lamp, staining with a drop of freshly-filtered fuchsine, methyl violet, or some other aniline dye, which is removed at one side by a bit of blotting paper, after which the slide is dried as before, a small drop of fluid balsam or benzole-balsam added, and a cover-glass at once applied.

Few persons are aware how easy it is to obtain a considerable number of pigment species, several of which I have described in my "Observations on Zooglœæ, etc.," all that is necessary being to rub pieces of boiled potato about on the floor, in sinks, etc., where dust collects, and set them away for a few days, covered by inverted tumblers to keep them moist.

No slide or herbarium specimen is worth much unless accompanied by full notes on the nature and color of the zooglœa it comes from, or the effects it produces; and a slide or specimen which contains more than one species is an abomination which had best be destroyed as soon as made, before it has opportunity to do harm.—WILLIAM TRELEASE.

YEAST (SACCHAROMYCETES).—The yeasts should be spread out in a thin layer on pieces of mica or glass. The pieces can be moistened in spots and used as microscopic slides and answer well enough for the comparisons of different forms.—W. G. FARLOW.

The Gray Herbarium of Harvard University.

No one need be told that this is the largest and most valuable collection on this continent. For its beginnings we must look to the collections begun by Dr. Asa Gray while a student at Fairfield Medical College in the year 1828. When Dr. Gray was called to a professorship in Harvard College he found no collections of dried plants. Such as had been made by previous incumbents had been considered as personal property. The collection which Dr. Gray had got together up to this time amounted to between four and five thousand species, including many European and arctic American specimens procured from foreign correspondents.

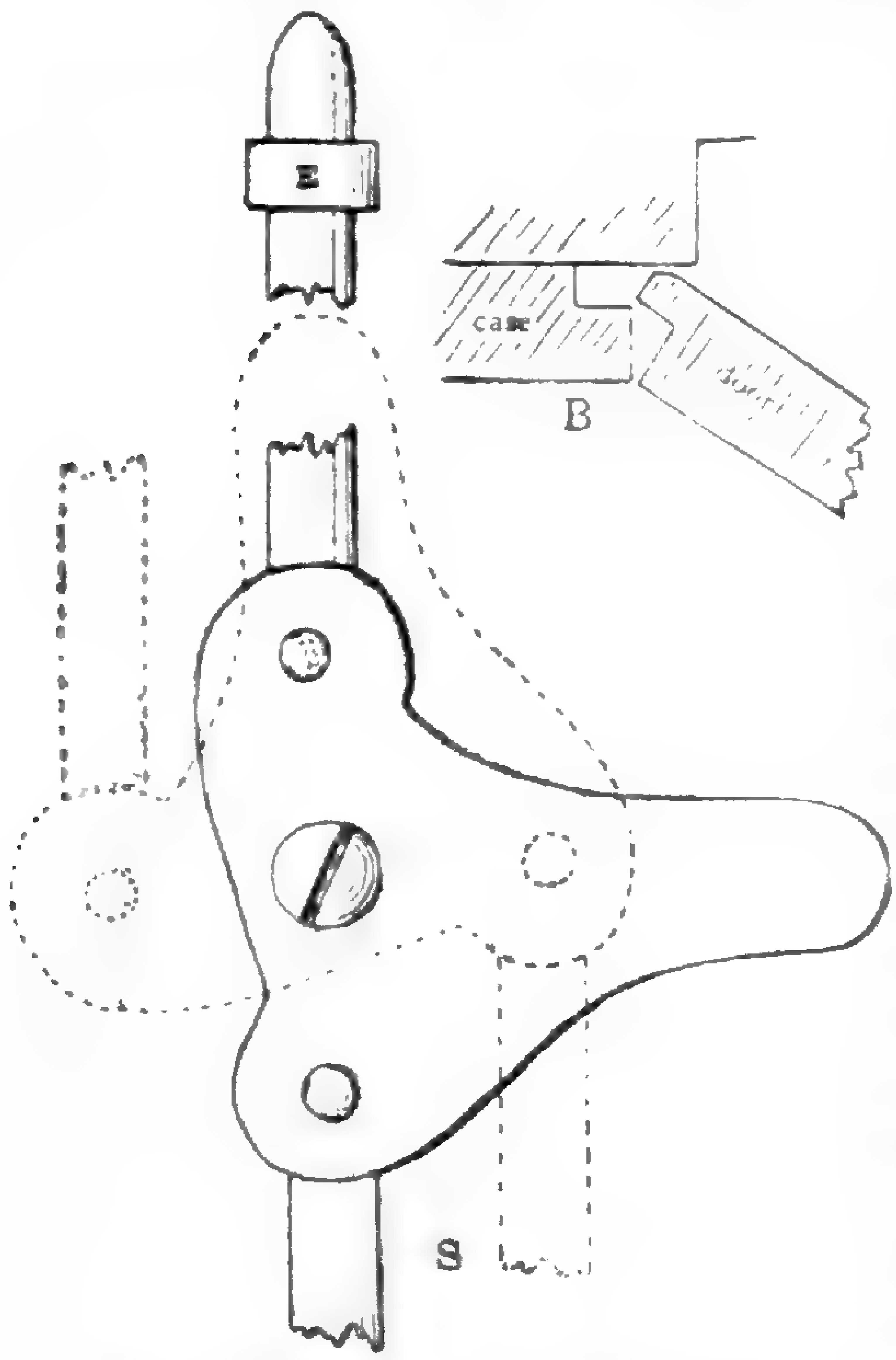
This collection increased, more and more rapidly as its extent and scientific value increased, until it became too large to be cared for by its owner and too valuable to be longer at the mercy of a frame house. Consequently it was offered as a gift to the University on condition that a fire-proof building be erected to contain it. In this building, the gift of Nathaniel Thayer, it was placed in the year 1864. The herbarium building proper is situated on a terrace in the midst of the Botanic Garden, overlooking a large part of it, and is flanked by the library on one side and the laboratory on the other, with both of which it is directly connected as these are respectively with Dr. Gray's dwelling and the greenhouses.

The herbarium occupies the main room, about thirty-five by twenty-five feet, with walls twenty-five feet high. The room is lighted by a very large double window (the full height of the walls) looking to the north-west, and by a sky-light in the center. The walls to the height of sixteen feet are practically covered with cases, a balcony giving access to the upper tiers. Besides these there are five floor cases, the three largest of which contain the Compositæ. The total capacity of the cases now in place is somewhere near 350,000 sheets, allowing for an average number of genus-covers. It is impossible to estimate with any accuracy the present extent of the collection. It is probably equal to two-thirds or three-fourths of the total capacity. This rough guess does not include the Sullivant herbarium of mosses nor any of the other collections of lower cryptogams in this building.* The records kept for the last sixteen years show that the average annual additions to the herbarium are 6306 sheets.

The wall cases are of the usual form and are closed with ordi-

*The large Cryptogamic herbarium of Dr. Farlow is in the Agassiz Museum building.

nary doors, with common spring-catches in the middle. But the floor-cases may be taken to represent the best that can be constructed in the light of Dr. Gray's extensive experience and long observation. They have the important advantage of being out of contact with walls, a point to be strenuously insisted upon. No matter how dry the room, dampness will surely result if the cases are directly against a brick or stone wall. These cases are of ash, about eight feet high, each containing four compartments divided in the usual manner. These are closed by doors whose construction and fastenings are shown in the accompanying figure. The hinged edge of the door is provided with a tongue which fits into a corresponding groove in the case (B) when the door closes. The fastening, as seen from the inside (S), consists of an irregularly three-pointed piece of brass to the short ends of which are pivoted two blunt-pointed steel rods, reaching to the top and bottom of the door, near which they pass through guiding eyes, E. The longer free tip of the brass piece engages with a slot on the side of the case and the rods enter brass sockets in the case above and below the door. The pointed tips of the rods and the outer beveled surface of the middle catch cause the door if it becomes warped to be drawn forcibly into place as the handle is turned. Thus at all times it is drawn snugly against the case. This compulsory contact for its whole length, together with the tongue and groove arrangement at the hinged edge of the door comes as near excluding dust and insects as can be done consistently with facility in opening and closing.



DOOR FASTENING FOR HERBARIUM CASE.
S, door-catch, as seen from inside when door is closed. E, eye, which holds rods in place. The dotted line shows the position of catch when door is opened. B, section of door and case, showing relations of tongue and groove.

The herbarium has a small endowment, which provides for limited expenses. No one could do botany a greater service than to provide an endowment which would permit the employment of special students to assist in working up the wealth of material accumulated. Since its transference to the custody of the University the herbarium has had but two curators, the late Charles Wright and Dr. Sereno Watson.

National Herbarium at Washington.

GEORGE VASEY.

This Herbarium was organized in 1869. It was based upon the Government collections which had for many years been accumulating in the Smithsonian Institution, from which they were transferred in the original packages to the Department of Agriculture, to be prepared and mounted, so that they might be accessible for investigation. These collections were principally as follows:

Those of the U. S. Exploring Expedition under Commodore Wilkes from 1838 to 1842. Those of the U. S. North Pacific Ex. Expedition under Commanders Ringgold and Rogers from 1853 to 1856. A small lot from Commodore Perry's Expedition to Japan in 1856. A portion of Fendler's collections on the Isthmus of Panama in 1850. A collection of Berlandier's plants of Texas and Mexico, made from 1828 to 1830. Lindheimer's Texas Collection of 1846. The large collections of Mr. Charles Wright in Texas and New Mexico from 1849 to 1852. The Collections of the U. S. and Mexican Boundary Commission, and those of the Surveys for Railway route to the Pacific made in 1853 and 1854 by Lieuts. Whipple, Parke, Williamson, and Fremont, and Gov. Stevens of Oregon. A collection made by Lieut. Ives on the Exploration of the Colorado River in 1857 and 1858. Collections made in Alaska by Dr. Rothrock, Dr. Kellogg and others.

Of foreign collections, numerous packages contributed by the Imperial Botanic Garden and Herbarium of St. Petersburg, containing not only plants of Russia, Siberia and Turkestan, but also many from Brazil and Japan. Numerous packages mostly of European plants, from the Royal Herbarium at Kew, England. Other European collections from Paul Reinsch and Mr. A. Schott of Germany, Mr. Karl Keck of Austria, Dr. Lagger, Switzerland, and Prof. Boeck of Norway. The large and valuable Cuban collections of Mr. Chas. Wright in 1865 and 1869. The collections of the San Domingo Commission in 1871.

To these have since been added the plants collected under the different Geological and Geographical Surveys of Lieuts. Wheeler and Hayden and of Major Powell. A set of the plants of California collected by Kellogg and Harford in 1868 and 1869. Various sets collected by Mr. J. G. Lemmon in California and Arizona; of Messrs. Howell and Cusick in Oregon; of Mr. W. N. Suksdorf in Washington Territory; of Mr. G. R. Vasey in Washington Terr., California, Arizona and New Mexico; of Mr. C. G. Pringle in California, Arizona and Mexico; of Dr. E. Palmer in Mexico, Arizona and Utah; of Drs. Parry and Palmer in Mexico; of Mr. C. R. Orcutt of San Diego; of the Parish Brothers in Southern California; the collection of G. R. Vasey in Alabama and North Carolina; and the numerous fascicles of Prof. A. H. Curtiss of Florida, those of Mr. J. Reverchon of Texas, and numerous contributions from the south and west. Also of recent foreign collections obtained by purchase, exchange or contribution, plants of Sweden collected by Mr. Oldberg; plants of France, Italy and Algiers, also a set of Bourgeau's plants of Mexico, collected in 1865–'66, from the Herb. Museum of Paris; and the large European collection of Mr. J. Moggridge communicated through Dr. Gray; and portions of the collection of the late J. Gay of France.

The plants of the eastern portion of the United States are represented by a set from the collection of Mr. Oakes of New England; plants of Pennsylvania from Prof. Porter, Mr. J. MacMinn, and Dr. Garber, together with minor contributions, exchanges and large local collections.

Colorado plants are represented by some of the collections of E. Hall, and of H. N. Patterson and G. W. Letterman, besides those of the government collectors.

Of special collections there is a set of the Juncaceæ of the U. S. by Dr. G. Engelmann; the Carices Boreali-Americanæ by Prof. Olney; the ferns of Trinidad by Mr. A. Fendler, and a type set of N. Amer. Willows by Mr. Bebb.

Of mosses there are the large European collections from Mr. R. Oldberg, Dr. Gattinger, Paul Reinsch, and others, as well as the mosses collected on the Wilkes' Exploring Expedition, elaborated by Mr. W. S. Sullivant, and a set of the Musci Alleghaniensis of Mr. Austin.

Of lichens there is a considerably large collection from the various expeditions and surveys of the government, supplemented by donations from Mr. J. Wolf, Dr. Ravenel of South Carolina, and some centuries of the European collections of Rabenhorst and Fries.

The Algæ of the Herbarium are largely those of the Wilkes' and the North Pacific Expeditions, with additions chiefly from foreign sources.

The mycological collection contains Ravenel's Fungi Americani exsiccata, Ravenel's Fungi Caroliniani, Ravenel's Texas Collection, Ellis' North American Fungi, a large collection by the late G. W. Clinton of Buffalo, New York, a small collection of New England Fungi by Dr. B. D. Halsted, communicated by Prof. C. V. Riley. Recent additions are from M. E. Jones, 60 species; from E. W. D. Holoway, Iowa, 125 species; from Prof. W. A. Kellerman, 350 species, chiefly from Kansas and Ohio; and from T. J. Burrill, 11 species, the types of his new species of Uredineæ, and many interesting and valuable specimens from Rev. A. B. Langlois of Louisiana.

All these collections of fungi have been mounted on sheets of herbarium size, a single species on a sheet, with space for the addition of specimens from various localities or different hosts. There are 150 mounted sheets of Puccinia, representing nearly as many species, 50 sheets of Hypoxylon, 75 of Cercospora, 35 of Phyllosticta, 30 of Peronospora, 20 of Ustilago, and 7 of Tilletia. The foreign collection is as yet small, represented chiefly by six centuries of Rabenhorst's Herbarium Mycologicum.

The Herbarium was for nearly three years under the care of Dr. C. C. Parry, who gave unremitting attention to the mounting of the specimens and to their arrangement in the cases. Since April, 1872, it has been in the charge of Dr. Geo. Vasey, and has grown to large proportions.

It is located on the second floor of the Agricultural building, occupying four rooms, the largest two being devoted to the cases for the mounted plants. One room is occupied by Prof. F. L. Scribner, the assistant botanist, and devoted to the mycological collections and mycological investigations. The fourth room is for preparing specimens, and for sorting and distributing duplicates, etc.

The two rooms occupied by the cases are twelve feet high, well lighted and comfortable. The cases occupy more than eighty feet in length, with a height of nine feet, and are divided for the reception of specimens into spaces or shelves, thirteen inches wide, eighteen inches deep and six inches high. There are more than 1,300 shelves or spaces. Each shelf or space is furnished with a pasteboard cover to which is hinged a flap five inches high, which drops in front of the specimens, excluding them from light and dust, and also furnishing a place for appropriate labels of the natural orders and the genus or genera which are contained in that space.

The arrangement of the specimens is in accordance with the Genera Plantarum of Bentham and Hooker. The number of shelves or spaces occupied by the larger natural orders is about as follows: Ranunculaceæ 12, Cruciferæ 20, Caryophyllaceæ 12, Malvaceæ 12, Leguminosæ 80, Rosaceæ 35, Onagraceæ 14, Umbelliferæ 20, Rubiaceæ 16, Compositæ 180, Ericaceæ 18, Borraginaceæ 14, Solanaceæ 12, Scrophulariaceæ 25, Labiatæ 24, Polygonaceæ 18, Euphorbiaceæ 15, Cupuliferæ 16, Coniferæ 20, Liliaceæ 22, Cyperaceæ 36, Gramineæ 120, Filices 40.

No complete catalogue of the plants has been made, but it is estimated that of the 10,000 or more species of the United States (excluding the cellular cryptogams) there are represented about nine-tenths. Of foreign plants the Herbarium contains probably fully as many species as of native ones.

The native species are represented in many cases by a large number of specimens showing the range of the species, derived from important government surveys and expeditions, which gives them an historic value, as well as representing the types upon which the species were founded. The entire number of mounted sheets is from sixty to seventy thousand.

The Library connected with the Herbarium contains all the common North American botanical text-books and manuals, all the United States government reports, most of the other larger works relating to the flora of this country, and nearly all the large systematic works published in English or Latin. These pertain especially to flowering plants and ferns, few important accessions on the cellular cryptogams having yet been received.

The Herbarium and Library are at all times accessible, during business hours, to students and investigators, and is well worthy of the attention of specialists and botanists who may visit Washington.

BRIEFER ARTICLES.

Articles in back numbers.—Arrangement of herbaria, xi. 98,120; treatment of exsiccatæ, xi. 20; mounting plants, cement, ix. 62, glue, iv. 215, xi. 67,120; preserving plants, carbon bisulphide, ii. 100, poison, i. 27; pressure in making specimens, i. 21; shipping live plants, ii. 107, 133; Myxomycetes, their collection and preservation, x. 290.

Mounting delicate plants.—To mount delicate ferns and other plants, take a pane of glass of sufficient size and coat lightly with rather thin fish glue. Lay the plant on the glass and put a newspaper over it, or the reverse. With handkerchief in hand, rub the paper so that every part of the plant will touch the glue. Remove the paper, then carefully lift the plant from the glass and lay it, glue side up, on the table or another newspaper; apply the sheet of mounting paper and rub as before. With reasonable care, this method gives the most excellent results.—A. B. SEYMOUR.

Liquid fish glue is unequaled for herbarium use. It is now offered for sale in the stores as Le Page's Liquid Glue, in small tin cans, at 75 cents per can. It can be obtained of the Denison Manufacturing Company, Milk street, Boston, for 35 cents per pint, or in five gallon lots at $1.65 per gallon—with an antiseptic added to prevent spoiling. To be sure that it shall not spoil, add a few drops of carbolic acid or corrosive sublimate.—A. B. SEYMOUR.

Disposition of thick specimens.—It is a problem what to do with thick specimens—rough-dried Hymenomycetes, puff-balls (which are valueless if pressed), acorns, cones, etc. Minute specimens, like the Myxomycetes, Aspergillus, etc., which are likely to suffer from pressure, are easily preserved in shallow pill-boxes, glued to the herbarium sheets; but this plan will not do for the larger things I have mentioned. I think I have solved this problem, so far as my wants are concerned, by having heavy pasteboard boxes made, with deep covers reaching nearly to the bottom. These boxes are two, three and four inches deep, to accommodate specimens of different sizes, the smallest being most needed, and measure outside 11½ x 16½ inches, so that they may set in the herbarium case. To facilitate their removal, each is provided with a strong double tape passing through the front and bottom and spread on the latter beneath the paper lining. These boxes are "spaced" within by small boxes of several sizes, to meet different needs, the largest of these being two to four times the size of the smaller, so that they are interchangeable at will. To keep out the all-pervasive smoke and dust of St. Louis, these inner boxes are covered by a folder of heavy manilla. Boxes of this description, reinforced at the angles with muslin, are made for me by the Holman Box Co., of this city, for $15.00 per hundred. The "spacing" costs about $12.00 per hundred additional. By using them, the acorns, say of a section of white oaks, are grouped in a box immediately under the covers containing the mounted specimens, and so in the same compartment of the case with them.—WILLIAM TRELEASE.

FOR SMALL FRUITS, cones, etc., and especially for the Myxomycetes and other fungi, which have to be preserved in little boxes, I provide shallow boxes 11½ x 16½ inches, and one inch deep. In these I arrange the species boxes. The larger boxes may be used as *genus boxes*, in case the species are numerous enough. I do not do so yet, but may have to before long. Put the label on the front end of the box and slip it into the herbarium case in its proper place.—C. E. BESSEY.

EDITORIAL.

THE PREPARATION of this number has given us more than usual pleasure on one account especially. This is in respect to the hearty coöperation with which the botanists of the country have aided the undertaking. They have contributed liberally, and when for any reason a contribution was not possible, they have in many instances sent their good wishes. It has not been possible to use all the material sent in, and a number of the articles have necessarily been cut down in order to bring them within our space and to prevent repetitions. There has been no attempt to cover the whole ground of collecting and preserving plants—that could only be done in a large treatise—but to give some of the special and most approved methods as actually practiced by representative botanists. Even with this restriction, and by the utmost compression, thirty-two pages have not been ample enough for our material, and some interesting articles are deferred until the July number.

THE GRACE of liberality needs cultivation among botanists who love the science lest "exchanging" degenerate into barter. If one exchanges merely to increase the aggregate number of species in his herbarium he wofully lessens his opportunity for usefulness. Between correspondents it should not be necessary to balance the accounts at the close of each season. Let private collectors emulate the example of the large herbaria and make distribution of their duplicates to correspondents whenever enough has accumulated to make the package worth sending. "The liberal soul shall be made fat."

A STRONG protest ought to be entered against the practice of sending specimens to a specialist to be determined, with the request that they be returned. Except under unusual circumstances such a request is an impertinence. Specialists are usually glad to receive and determine specimens in their departments, but they have neither time nor inclination to tie up and perhaps pay postage on numerous packages.

OUR PROMISED article on Early American Collectors is crowded out by other fresher matter. Those specially interested in this matter will find a most entertaining sketch of the principal European herbaria of interest to North American botanists in the *Am. Jour. Sci.*, I. xl. 1–18 (1841) from the pen of Dr. Gray*. Mention is there made of most of the earlier collectors and the herbaria where their plants are to be found.

DO NOT collect too narrowly. Remember that the lichens, mosses, liverworts, algæ and fungi of your vicinity are of interest to some one whose address you can easily obtain, even if they do not interest you. Pick up whatever comes in your way, sort it and send the materials to specialists whose work you will aid and whose gratitude you will merit.

NOTES AND NEWS.

REV. W. W. NEWBOULD, a collector and bibliographical botanist of England, died in London on April 16, sixty-seven years of age.

SEVERAL CORRESPONDENTS state that fleshy plants, such as Sedum, the joints of cactuses etc., dry readily after being dipped in boiling water.

MOULDS can be allowed to dry and be kept in paper envelopes but, in this condition, they are not to be compared with good microscopic mounts.

*This article was reprinted in Hooker's *Journal of Botany*, iii. 353–374 (1841).

A NEW Æcidium, Æ. Phrymæ, is described by Dr. B. D. Halsted, in the *Journal of Mycology* for May. It occurs upon Phryma Leptostachya, and was found in northwestern Iowa.

PROF. L. H. BAILEY is making some sets of carices for fall distribution, comprising a number of representative species, for the benefit of those who wish a start in the study of this genus.

MISS C. E. CUMMINGS, instructor in cryptogamic botany in Wellesley College, has been granted leave of absence for a year's study in Europe. She expects to sail shortly after commencement.

W. W. CALKINS speaks of the cryptogamic botany of a Florida log in a short paper in the *Journal of Mycology* for May, having found fifteen species of lichens and fungi on one log, besides several mosses.

AN INTERESTING account of a botanical trip in the mountain region of Virginia and North Carolina, including a visit to Mts. Roan and Mitchell, is given by Mrs. E. G. Britton in the *Bulletin of the Torrey Club* for May.

THE RECOMMENDATION in Gray's Structural Botany, p. 381, that species sheets for the herbarium should weigh 28 lbs. per ream of 480 sheets should read ***18 lbs.*** This typographical error has escaped detection until now.

THE FIFTH ITEM under "Notes and News" in the May number in regard to Dr. Hueppe's new work on the forms of bacteria and their relation to genera and species should have stated that it will be reviewed in a future number of this journal.

IT IS PROBABLE that the herbarium and drawings of Bromeliaceæ belonging to Edouard Morren, together with his library, will be purchased by the Belgian government and placed in the Liège Botanical Institute, of which he was one of the chief promoters.

J. G. BAKER has recently given a carefully prepared lecture on Kew and its work, which has been printed in the *Gardener's Chronicle*. It gives an excellent account of this extensive and many-sided botanical institution, and of the interests which it subserves.

ÆCIDIA are difficult to preserve. Even a very light pressure is apt to break the cups. Prof. Seymour says the best results are obtained by tying a strong cord around the dryers containing them and exposing to the heat of the sun without pressure till dry. This makes the leaves of the host brittle but the cups are well preserved.

A FLORA of Missouri prepared by Professor S. M. Tracy of the State University is printed in the report of the Missouri Board of Agriculture for 1885. It occupies about one hundred octavo pages, and appears to be carefully prepared. It gives 1,785 names of phanerogams and vascular cryptogams with the localities of the less common plants, and the authorities for the same.

BOTANISTS who have once attended the meetings of the American Association since the organization of the Botanical Club need no urging to come again; those who have not done so, should make inquiry of their friends who have, or accept the assertion of others that they can not spend a week in summer more pleasantly and profitably. The next gathering at Buffalo, August 18 to 24, bids fair to be one of the best yet held.

THE BOTANICAL CLUB of the A. A. A. S. is formed from those members of the American Association who take special interest in botany. The only requirement for membership is to suitably fill out a registry blank at the desk of the local secretary. The objects of the Club are to encourage the informal presentation and discussion of all topics of botanical interest, to promote good fellowship among its members, and to raise the standard of the botanical papers brought before the Biological Section of the Association.

THE MORE RECENT additions to the herbarium of the University of Nebraska include nearly fifteen thousand species of exsiccatæ. Some of the most interesting of these are Curtiss' Florida plants (650), Parry's Western Plants (1000), Austin's Mosses of N. A. (352) and supplement to the same (100), Gottsche & Rabenhorst's Liverworts of Europe (660), Massalongo's Lichens of Italy (360), Thuman's Myc. Universalis (2300), Areschoug's Algæ of Scandinavia (400), and Rabenhorst's Algæ of the World (2600). This information is gathered from *The Hesperian*, the college paper.

IN REFERENCE to the method of drying plants in felt, suggested by Mr. Chas. E. Smith, in one of the leading articles, it must not be understood that it is simply another way of doing what may be done as well in the old way. It is entirely different from every other method and is very successful in preserving all the colors of plants. If any botanists desire details as to the kind of felt to use (it comes of all thicknesses from 1/4 to 1 inch), where to get it and the cost, whether to stand the press up on edge or to lay it flat (which affects the results very sensibly), etc., Mr. Smith will be glad to furnish the information.

FOR FASTENING SPECIMENS to the herbarium sheet, Mr. Isaac C. Martindale uses gummed paper, which can be procured cut into strips similar to those known as "election stickers." He says: "I use three widths, one-eighth, three sixteenths, and one-quarter of an inch. When a number of specimens are to be fastened down, I cut these gummed strips into various lengths, from one inch to six inches, as the size of the specimens may require. By the use of a pair of curved forceps these short strips can be readily picked up, the gummed side moistened, and placed over the specimen. After a little experience the mounting can be rapidly, neatly and effectually done."

THE CITIZENS of Buffalo, who take an interest in botany, have organized a club in order to more effectively devise and carry out plans for entertaining the botanists who may attend the meeting of the American Association next August. They propose to do all that time and opportunity will permit. Among the most prominent means of entertainment will be a special excursion, during some afternoon not yet decided upon, to as good collecting ground as can be found within convenient distance of the city. This will doubtless be to one of the several swamps which afford a rich flora or to the lake shores. Some of the most interesting points, such as Bergen marsh, Rock City, and the falls at Portage are so far away as probably to make a visit to them impracticable. Point Abino, on the Canadian shore of Lake Erie, has been suggested, and is not only attractive on account of its vegetation and sand dunes, but also for the yacht ride by which it is to be reached. These localities are described in Mr. Day's Catalogue of the Plants of Buffalo. Upon the customary Saturday excursion, the botanists will have an opportunity to visit some collecting field of interest. A reception for the members of the Botanical Club is also proposed. The final arrangements must be left to be announced hereafter. It is sufficient at present to know that the next meeting promises to afford superior opportunities for botanists to become acquainted with each other under the most favorable auspices, and that they will meet with a most cordial reception from the scientists of Buffalo. It is to be hoped that botanists will come to the meeting prepared for more than simply to attend. It is very desirable that they present worthy papers before the section of biology. Since the organization of the Botanical Club the botanists have been coming to the front in Section F and it is a laudable ambition to desire to still more prominently stand for botany as a most important part of biology. These papers should be prepared with care, that there may be no slipshod delivery, and should by all means be based upon original work rather than upon original thinking, and least of all a rehash of somebody else's thoughts. Botanists who have been active through the winter have worked to little purpose if they have nothing to present to their fellows. Buffalo should then see botanists in great numbers, enthusiastic, and ready with papers.

VOL. XI, NO. 7.—BOTANICAL GAZETTE.—JULY, 1886.

The Genus Asimina.*

ASA GRAY.

One object of this communication is to ask for fruits of the southern shrubby species, which seem to have been rarely collected. I possess ripe fruit of only one of these, namely, A. parviflora. Another object is to set right the generic character, in particular that of the æstivation of the corolla.

Formerly one of the diagnostic characters of the order Anonaceæ was the valvate æstivation of the petals. Their evident overlapping in the flowers of our so-called Papaw was one reason for dissenting from the conclusion of the old Flora of North America, where *Asimina* was reduced to a section of *Uvaria*, and restoring the genus in the Genera Illustrated. Since then it has been ascertained that all the genuine species of Uvaria have their petals imbricated in the bud, as I had suspected of some of them, and that in this they accord with several other genera; so that, indeed, Mr. Bentham, in the Genera Plantarum, brought them together to form his tribe *Uvarieæ*. It was purely my fault, as is recorded on p. 68 of the fifth volume of the Journal of the Linnean Society, that he did not include in it the genus Asimina. Misled by an imperfect observation, making sections of the lower part only of some flower-buds, I informed him that I had "ascertained that they were truly valvate." The fact is that, in this, as in many other genera of the order, the petals are of comparatively late growth; in the young bud they are distant, later their lower portion may come merely into contact and so give the idea of valvular æstivation of each series; but when they grow up and cover the globular mass of the genitalia, their summits overlap somewhat largely in the imbricative manner. At least this is the case in A. triloba, and I find it essentially the same in the long- and narrow-leaved species which I name *A. angustifolia*. The following notes which I made upon living plants of A. grandiflora, in Florida, in the spring of the year 1875, show the same thing, with some difference. "Outer petals with their tops well overlapping in the early state of the bud, one external, one intermediate, one interior, and remaining so as they enlarge; down their sides only contiguous, their bases distant; in anthesis enlarging greatly. Petals of the inner series remote in the bud, enlarging only moderately, remaining erect, never coming into contact, their margins above the middle becoming revolute as they grow, and thus not actually overlapping.

* Issued May, 1886. see p. 190

Their base becomes more and more deeply concave within, where it develops protuberant longitudinal and roughened ridges. The flowers as they open are much frequented by thrips or other small vermin, which are attracted to this secretive surface. The anthesis is strongly protogynous. The stigmas are effete much before any pollen is shed, which, indeed, takes place only when the anthers loosen and separate as they begin to decay and fall." I did not notice that the blossoms were "sweet-scented," though Bartram so describes them. The scent of the flowers in the genus is generally unpleasant.

Notwithstanding Baillon's view, it seems evident that our plants are not congeneric with the Old World Uvariæ. Asimina seems to be well characterized by the dissimilar petals of the two series; the outer always larger, much accrescent, thin and veiny, and spreading, while the inner are concave and erect, mostly of thicker texture, at least at the concave or almost saccate base, and quite different in shape, although the difference is least in A. triloba and A. parviflora.

I have not seen the Australian *Fitzalania* of Mueller, which is said to have small inner petals, and their texture is not described. I have not sufficient materials for a proper investigation of the Cuban species, which Grisebach referred to Asimina. Their coriaceous and nearly homogeneous petals forbid their union with our genus, but they may belong to the still obscure genus Porcelia. Nothing can be determined respecting the place of Baillon's *Uvaria Hahniana*, of Mexico, until its flowers are known. As to Seemann's *Sapranthus* of Nicaragua, of which we have flowers collected by the late Charles Wright, by no means as large as those figured by Seemann, the homogeneous petals, all six alike, plane, thin, veiny, and equally accrescent, would seem to indicate a genus as distinct from Porcelia as from Asimina. I will conclude these remarks with a synopsis of the species of Asimina, as they now appear to stand. But further observations are needed on some of them.

ASIMINA, Adans.*

* Flowers from the axils of the deciduous leaves of the preceding year; these ample, acute or acuminate at both ends, thin, the reticulation of veinlets inconspicuous: petals moderately accrescent, from green becoming brown-purple, ovate or roundish; the inner moderately concave and nearly even within, not very much smaller: the first a tree or shrub: the second a low shrub.

A. triloba Dunal. Pedicels about the length of the middle-

*As to the French-colonial name, *Assiminier*, Mr. Gerard of New York informs me that it was adopted from the Ojibway Indian name of the fruit of A. triloba.

sized flowers: styles distinct, introrsely stigmatic at and below the tip: ovules numerous in two rows: seeds flat.

A. parviflora DUNAL. Pedicels very short and flowers much smaller: petals less accrescent: stigma sessile on the ovary: ovules about 10, nearly in a single series: seeds few, turgid.

** Flowers from the axils of less deciduous leaves (commonly in pairs or accompanied by a leafy shoot from the same axil); these furfuraceous-tomentulose when young, retuse or obtuse, becoming subcoriaceous in age, then with conspicuous reticulation of veinlets: petals white, very unlike in size and shape; the outer much accrescent and membranaceous, roundish and at length obovate; inner thicker, saccate-concave at base, the concavity purple or pink and conspicuously rimose-corrugate longitudinally; stigma sessile and depressed: low shrubs.

A. grandiflora DUNAL. Leaves when young with both sides (as well as the shoots) tomentulose: leaves spatulate-oblong to obovate or oval: outer petals 2 inches or more long when full-grown, 3 or 4 times the length of the revolute-margined inner ones.

A. cuneata SHUTTLEWORTH in distrib. coll. Rugel. Less pubescent: leaves smaller (an inch or two long) and mostly narrower, glabrate, even the nascent ones glabrous or nearly so above: pedicels solitary: outer petals only an inch long, about twice the length of the inner.—Pine barrens of S. Florida; first coll. near Lake Monroe, in young fruit only, by *Rugel*, no. 8. Several years later in flower, by *Palmer*, *Havard*, and apparently by *Feay*, if it is *A. reticulata* Chapm., Fl. Ed. 2, 603, as I suppose from the description.

*** Flowers in the axils of extant subcoriaceous and subsessile reticulate-venulose leaves: outer and inner petals very unlike: those of inner series rimose-corrugate in the concavity, as in the preceding section: ovaries distinctly styliferous and 8 to 10-ovuled: fruit not seen: glabrous under-shrubs (rarely some minute pubescence); the flowering stems mostly simple and hardly woody, but springing from a woody base or stock.

A. angustifolia. Stems 2 or 3 feet high, erect: leaves elongated, from narrowly linear (and 5 or 6 inches long by 2 to 4 lines wide) to narrowly spatulate: flower white, large, commonly erect: outer petals much accrescent, 1½ to 2 inches long, oblong; inner much narrower and smaller, lanceolate above the saccate-concave internally purple-spotted base: ovaries almost glabrous.—This is the *Orchidocarpum pygmæum* of Michaux, in part, perhaps mainly, and the *Asimina pygmæa* figured by Dunal in his monograph, also in part the *Uvaria pygmæa* of Torrey & Gray's Flora. Good specimens of it were distributed in Curtiss's collection as *A. pygmæa*, var., no. 87*. But it is not the original *Annona pygmæa* of Bartram, as his description and good figure show. Shuttleworth and his collector Rugel discriminated the species, but, following Dunal, took it for *A. pygmæa*, and so gave new names to the old species of Bartram. It is not rare in the sandy pine woods of Florida. In setting the species right I am obliged to give it a new name.

A. pygmæa Dunal, Monogr. 84, as to syn., etc. Stems a foot or two high, commonly declined or arcuate: leaves from cuneate-linear to oblong, 1 to 4 inches long, half inch to full inch wide, reticulated: flower greenish turning purple, strongly nodding: outer petals moderately accrescent, at most half inch long, ovate and becoming ovate-lanceolate, not broader nor more than half longer than the ovate inner ones.—*A. pygmæa* largely of authors, and of Curtiss distrib. no. 87. *Annona pygmæa* Bartram, Trav. ed. Amer. 18, t. 1, the figure and description both unequivocal. Bartram says that "the flowers both in size and colour resemble those of the Antrilobe." *Antrilobe* is a puzzle, but I guess it to be a printer's mistake of *An. triloba*. The foliage varies greatly. The commoner narrow-leaved form figured by Bartram was named by Shuttleworth *A. secundiflora*. A form with small and comparatively broad leaves is his *A. reticulata*.

Revision of the North American species of Nuphar.

THOMAS MORONG.

(WITH PLATE VI.)

Along the shores of Lake Champlain there grows a species of Nuphar, which has long been a puzzle to botanists. It has been variously regarded as *N. luteum* Sm., *N. luteum*, var., *N. Kalmianum* Pursh, and *N. intermedium* Ledeb. Some have pronounced it a hybrid. This Nuphar first attracted my attention two years ago in the Adirondack regions of New York, where it was very abundant in Little Tupper lake and the adjoining waters, Rock Pond and Charley Pond Since then botanical friends have sent it to me from Ottawa, Canada, from Lake Memphremagog and other places in the Northern States.

Last summer I spent a portion of my vacation in collecting and studying this plant at Ferrisbergh, Vt. It occurs plentifully at that point in the mouths of Lewis and Little Otter creeks, and thence along the Vermont shore to Missisquoi Bay. There

MORONG ON NUPHAR.

is also a specimen in the Gray herbarium, which was collected not far from Philadelphia, Penn.

This form appears, therefore, to be widely distributed in the eastern part of the northern United States.

It has also been noticed in some of these localities for quite a number of years. Prof. H. G. Jesup speaks of having observed it at Missisquoi Bay in 1872, and so long ago as 1856 Prof. Caspary had occasion to notice an American Nuphar in the gardens at Kew, England, which I judge to have been this form.

The study of this plant has led me to some very interesting conclusions.

The first noticeable fact is, that it is immediately associated, and so far as I know or can learn, *invariably* associated with two other species, *N. advena* Ait. and *N. Kalmianum* Ait.

The second fact is, that it appears almost exactly intermediate in all its parts between the two associated forms. The plate accompanying this paper shows this very clearly. The stigmatic shield or disk of N. Kalmianum is distinctly star-shaped, the rays separated half way down, that of N. advena is crenate or waved at the margin, while the intermediate form has a shield, the margin of which is more deeply crenate than that of the one, and yet not so deeply cut as that of the other. I find a variation in the specimens as though the shields ran now towards one form and now towards the other in this particular. The fruit of the intermediate form, as a general thing, resembles that of N. Kalmianum, but the neck and shoulders exhibit a tendency towards N. advena. The other organs speak for themselves in the drawings.

Curiously, too, the disk colors of N. advena and N. Kalmianum when growing seem to blend in the other, being in the first pale red, in the second dark red, and in the third a beautiful bright red or crimson. This is not seen in herbarium specimens, as in the process of drying they all become uniformly dark.

The next fact is, that this intermediate form, as I found it in the Adirondacks, produces *no fruit*, or scarcely any. After a long and careful search in all the localities in that region, I could find only a single imperfectly developed pericarp, and that had but two or three ripened seed in it, while the associated species bore an abundance of good fruit. The pollen of the intermediate form, also, when examined under the microscope, proved to be unsound. The same defect has been found in specimens of this plant gathered in Canada. Prof. Caspary, of Königsberg, Prussia, to whom flowers were sent by J. Fletcher, Esq., of Ottawa, reported to him that out of 155 grains of pollen examined he found 95 per cent. bad. This accords nearly with my own determination. We have, therefore, good physiological as well as morphological evidence that this Nuphar is in *these* localities a hybrid between N. advena and N. Kalmianum.

But how is it with the same plant in Lake Champlain? It still remains associated with the other two species, but in some spots it has wandered to the distance of a mile or more from the others. At Ferrisbergh it is even more abundant than the parental forms. *It also bears an abundance of well developed fruit.* I collected dozens, and could have collected scores of full, ripe berries. The grains of pollen in the freshly opened flowers were scattered freely over the stigmas, and proved, when examined microscopically, *as sound as those of either* N. advena or N. Kalmianum.

I am therefore led to believe that in this locality, on Lake Champlain at least, the hybrid *has been developed into a good species,* perfectly capable of propagating itself by seed; while in other places it still remains a hybrid and infertile. It seems to me that we have the transition complete, first the association of two species, next a mule progeny, and finally a new and perfect species.

I have accordingly ventured to regard it as an undescribed species, and to call it N. rubrodiscum from its bright red stigmatic disk.

To account for the blending of the two parental species in so many instances, we are to remember the unusual facility of intercourse between them, which is possibly aided by some special innate tendency to assimilate. The flowers of both are very conspicuous on the surface of the water, for one thing, and when in fresh blossom the corolla is frequently full of small winged insects. I scarcely opened a flower but I found a host of these visitors either upon the stamens or the nectaries. I also noticed a variety of aquatic insects which seemed to make their home upon the leaves and stalks, and to dispute possession of the flowers with their winged rivals. Now here we have a means of spreading the pollen from one flower to another, which is no doubt very effective. The plants also flower all summer long, beginning in May and continuing till September. Besides this they grow generally in quiet water and sheltered nooks where they are protected from disturbing winds and waves. We should therefore expect just such results as we have if there were any hybridizing tendency at all in the species.

I have been led on by interest in these three related forms to look up the other North American species of Nuphar, and the following is offered as a revision of the genus:

Nuphar SMITH. Flowers yellow, cup-shaped, single on a stalk which rises to the surface of the water, with the odor of the orange: sepals 5–12, the outer partly greenish on the outside and often ruddy within: petals one or more rows, small, stamen-like, nectary-bearing beneath, inserted with the stamens upon the receptacle around the ovary, sometimes gradually changing into stamens: stamens numerous, in 3–9 rows, at length recurved; anther cells linear, adnate, introrse: the ovary rising at the summit into an urceolate circular or stellate disk, upon which lie 8–21 stigmas in radiating lines or ridges: fruit an ovoid or globular berry, its apex often oblique to the body, having as many cells as there are stigmas, many seeded, the oval seeds without aril. The leaves at base deeply lobed, with a sinus nearly $\frac{1}{3}$ the length of the blade (except in no. 5), the floating coriaceous, the submerged thin, crisped and broadly cordate, rising from a thick scaly looking rhizome which creeps widely under the mud.

An inhabitant of pools and muddy streams, flowering all summer; of 7 or 8 species in the North Temperate Zone.

1. **N. advena** AIT. Flowers $1\frac{1}{2}$–2 inches in diameter when expanded: sepals oblong or cuneate, unequal, the largest $1\frac{3}{4}$ inches long: petals fleshy, oblong or dilated towards the truncate apex, 4–5 lines long by 2–3 wide: stamens 5–7 rows; anther equaling the filament: stigmas 12–20, on a level with the surface of the disk or slightly raised above it, occasionally not reaching more than half way to the margin; stigmatic disk waved on the margin, pale red when fresh: fruit without a neck under the disk, the largest about 2 inches long by $1\frac{1}{4}$ inches in diameter: leaves smooth, sometimes pubescent beneath, roundish or ovate, 5–12 inches long by 5–9 inches broad, the sinus usually open; the petioles and peduncles smooth or slightly pubescent; rhizome covered with the scaly scars of former leaves.

Var. (?) **minor**. Specimens without leaves are in Herb. Gray which have flowers about one inch in diameter when expanded, the disk margins more deeply crenate, ten stigmas, and small fruit an inch long by one-half an inch broad.

They are labelled "Smith's Pond, Herkimer Co., Litchfield, New York." Further material is very desirable.

The species is common in the Atlantic States and occurs as far west as the Uinta Mts., Utah, and northward.

2. **N. rubrodiscum**. Sepals similar to the foregoing, the largest $1\frac{1}{2}$ inches long by $1\frac{1}{4}$ wide: petals more dilated upwards or even spatulate or obovate, 3–4 lines long by 2 lines broad: the anther about equal to the filament: stigmas 9–12 ridges; disk more deeply crenate than in the preceding, a beautiful bright red or crimson

when fresh, the stigmas lighter in color: fruit with a narrow neck under the disk, about an inch long by an inch diameter: floating leaves vary from 3 to 8 inches in length and 2 to 6 in breadth, the sinus open or closed, occasionally pubescent beneath; submerged leaves orbicular.

N. luteum Gray Man. non Sm. The true *N. luteum* Sm. has larger flowers, petals larger and generally more obovate, and stamens larger with broader filaments, as shown in the plate.

Lake Champlain, Vt. Intermediate between N. advena and the following, and produced from a hybrid between them. Still a hybrid in many localities.

3. **N. Kalmianum** Ait. Smaller than N. rubrodiscum, flower an inch broad or somewhat less when expanded: sepals 6–7½ lines long: petals thin and delicate, spatulate or obovate, about 2 lines long by 1 broad: stamens 3 and 4 rows, narrowly linear; the anthers occupying only ¼ of the length: stigmas 7–10 ridges of a golden color upon a dark red stellate shield, which is 2–3 lines in diameter: floating leaves from 2–4 inches long and from 1–3 broad, commonly more or less pubescent beneath, the sinus open or closed; submerged leaves circular, very thin.—Ait. f. Hort. Kew. 3, 295.

N. pumilum Caspary, Ann. Mus. Lugd. Bat. 2. 256. Macoun's Cat. Can. Pl. *non* Smith. *N. luteum* Sm., var. *pumilum* Gr. Man. 57. *N. lutea*, var. *Kalmiana* T. & Gr. Fl. 1. 58.

A beautiful little plant which occurs from Newfoundland to Penn. and as far northwest as the Saskatchewan. It bears a strong resemblance to the European N. pumilum, but that differs from our plant morphologically in having the filament much thinner and broader, and the anther broader and shorter. The difference is shown in the plate. The European plant also is commonly much more pubescent. When crossed the two plants produce a hybrid, showing a physiological difference.

4. **N. polysepalum** Engelm. Flowers the largest of the genus, 2–5 inches across when open: sepals 7–12, the largest 2 inches long and nearly as broad: petals 12–18, thick, often reddish, 5 lines long by 3–4 wide, dilated upwards, truncate: stamens 7–9 rows, 5–6 lines long by 1 wide; anthers truncate, equaling the filament: stigmatic disk deeply urceolate, with entire or crenate margins, often pubescent on the top, the stigmas hardly reaching the margins: fruit smooth, ovoid, 1–2 inches in diameter, contracted into a short neck under the disk: seeds rather small as compared with those of N. advena: leaves smooth, broadly ovate, 7–12 inches long by 5–9 broad, the sinus open or closed: peduncles and petioles smooth or pubescent, generally quite pubescent when young.—Trans. Acad. St. Louis, 2. 282.

This species is found from Colorado to California and thence northward to Alaska. The seeds are said by Dr. J. S. Newberry to form the principal winter subsistence of the Indians.

5. **N. sagittifolium** PURSH.—Flowers small, about an inch across when expanded: sepals 5: petals dilated upward, about 3 lines long by $1\frac{1}{2}$ wide: stamens 4 or 5 rows; the anthers about $\frac{1}{2}$ their length: stigmas 11–15 ridges on a disk with crenate margins: fruit ovoid, without a neck under the disk, the largest an inch in length: leaves olive-green, smooth, oblong, rarely ovate, broadly obtuse at the apex, sagittate, the sinus $\frac{1}{10}$ the length of the leaf; the floating varying from 8 to 15 inches long by 2 to 3 broad; the submerged larger and more numerous: the petals sometimes transformed into stamens.—PURSH, 370.

Confined to the Southern Atlantic States from North Carolina to Florida.

EXPLANATION OF PLATE VI.—The figures are drawn from herbarium specimens and are enlarged one-third.

1. Sepal of N. advena. 2. Two forms of petals of same, both common, one showing the nectary on the back. 3. Stamen of same. 4. Stigmatic disk of same. 5. Sepal of N. rubrodiscum. 6. Two forms of petals of same, both common, one showing the nectary. 7. Stamen of same. 8. Stigmatic disk of same. 9. Petal and stamen of the European N. luteum. 10. Sepal of N. Kalmianum. 11, 12, 13. Petals, stamen and stigmatic disk of same. 14, 15. Petals and stamen of the European N. pumilum. 16. Fruit of N. rubrodiscum. 17. Fruit of N. Kalmianum, one of the berries oblique, as is frequently the case in all the species. 18. Fruit of N. advena.

Grasses of Yellowstone National Park. I.

F. LAMSON SCRIBNER AND FRANK TWEEDY.

The following grasses were collected by Mr. Tweedy, of the U. S. Geological Survey, during the seasons of 1884–85, and he has also furnished the notes upon the distribution of the species. Sets of the grasses here enumerated were sent to Dr. Asa Gray, to the Academy of Natural Sciences of Philadelphia, and to the U. S. Department of Agriculture.

1. (263, 580.) PANICUM DICHOTOMUM Linn. var. PUBESCENS Gray, Man. p. 649. *P. pubescens* Lam., Michx. Flor. 1.49; Torr. Flor. U. S. 144; Steud. Gram. 86. *P. thermale* Boland. Proc. Calif. Acad. II, p. 181. Very common over the hot spring and geyser areas, often forming matted, carpet-like masses around the borders of the springs themselves.

This variety should perhaps be kept distinct from *P. dichotomum* L., but until a more thorough study can be given the interminable diversity of forms presented by the *P. dichotomum* of American authors, and careful comparisons made with the types of the species founded by Lamark, Kunth and others, any attempt to classify them will be worse than useless.

2. (579.) Phalaris arundinacea Linn. (Coulter's Manual, p. 40). Bogs, Yellowstone Lake, rare.

3. (648.) Hierochloa borealis R. & S. (Coulter, Man. 406).—Mountain meadows from 8000 to 9000 ft. alt., not common.

4. (591.) Alopecurus occidentalis, n. sp.—"*A pratensis*, var. *alpestris* Wahl. (*A. glaucus* Less.) ex Gray," Thurber in list of Hall and Harbour's Rocky Mountain plants. *A. alpinus* Porter and Coulter, Flor. Col. p. 251; Coulter, Man. p. 406.

A tall erect grass, usually glaucous throughout, with thick ovoid heads. Stems 60–90 cm. (or, in very dry soil, 20–30 cm.) high, erect, sheaths smooth or finely scabrous, much shorter than the internodes, loose, at least the upper ones, but not inflated. Ligule 1–2 mm. long. Leaves erect or ascending, 5–15 cm. by 4–7 mm., flat except at the cartilaginous and sharply pointed apex, smooth beneath, scabrous on the prominent nerves above. Panicle usually long exserted, sometimes partially enclosed in the upper sheath, 2–3 cm. long and half as thick. Spikelets 3.5–4.5 mm. long (usually about 4 mm.), the rather abruptly acute empty glumes equaling or slightly exceeding the obtuse flowering glume, which is scabrous and more or less ciliate near the tip. Awn about 6 mm. long, smooth and twisted below, more or less bent near the middle, scabrous above.

Mirror Lake Plateau, alt. 8800 ft. Rather common in mountain meadows, associated especially with *Phleum alpinum* L. In similar situations in Montana this grass is not infrequent, sometimes covering large areas to the exclusion of other species. In the mining regions it is cut for hay, for which purpose it is highly esteemed under the name of "mountain timothy."

I have seen no specimens of *Alopecurus glaucus* Lessing, but our grass certainly does not agree with the diagnosis of that species given by Grisebach in Ledb. Flor. Ross. IV, p. 462, nor in all respects with that of Steudel in Syn. Gram. p. 150. It is a much taller plant than *A. alpinus* Sm., to which it is most nearly allied, and besides its glaucous color and more rigid foliage, the hairiness of the glumes is less woolly in character, and the awn is always more developed. The true A. alpinus has not yet been found within our limits. The plant in question differs from A. pratensis in its shorter and more ovoid spikes, more hairy, less conspicuously nerved and shorter empty glumes, and in the comparatively shorter and more obtuse flowering glume. *Alopecurus arundinaceus* Poir. (*A. ruthenicus* Weinm., *A. nigricans* Hornem.), a species which our plant resembles in habit, has a more cylindrical spike, and differs especially in having the acute tips of the less hairy empty glumes curved outwards, and further also in the much shorter awn.

5. (592.) ALOPECURUS GENICULATUS Linn., var. ARISTULATUS Torr. Flor. U. S. p. 97, Niccolet's Rept. p. 163. *A. aristulatus* Mx. Flor. I, p. 43; Gray, Man. p. 608; Coulter, Man. p. 407. Wet shores of ponds and banks of streams. Cache Creek, alt. 6800 ft., Turbid Lake alt., 7900 ft.

Although ranked as a species by most American authors, we are disposed to consider this grass a variety only of the Linnæan species. The points of difference are its usually more erect habit, more slender spikes or rather panicles, smaller spikelets and generally shorter awn. In these particulars it is essentially *A. fulvus* Smith. In A. geniculatus the spikelets are about 3 mm. long and the outer glumes are usually *longer* than the floret; in the variety the spikelets are scarcely more than 2 mm. long while the flowering glume is as long as or slightly exceeds the outer ones. The awn varies from being nearly obsolete to twice the length of the spikelet.

6. (262, 609, 613.) STIPA VIRIDULA Trin., Act. Petrop. 1836, p. 39; Thurber in S. Watson's Bot. Calif. II, p. 288. *S. parviflora* Nutt. not Desf. *S. spartea* Hook. Fl. Bor.-Am. II. 237, not Trin. (*teste* Thurber.)—Meadows, Mammoth Hot Springs, alt. 6200 ft., Sour Creek, alt. 8000 ft., junction of the East Fork and Soda Butte Creek, alt. 6700 ft. Common everywhere over the dry open areas up to 8000 ft. altitude.

This grass varies a good deal in height of stem, length of leaves and size of panicle, but it is readily distinguished from the other species of the region by its strict, rather densely flowered and generally elongated panicle, and small spikelets. It is a valuable forage plant, as it does not possess the long and very sharp-pointed rhachilla below the flowering glume which renders *S. spartea* Trin. ("porcupine grass") so injurious to stock.

8. (611.) STIPA RICHARDSONI Link. Hort. Berol. 2, p. 245; Coulter, Man. 408.—Soda Butte, alt. 6800 ft., comparatively rare or local. This is a very graceful species with short leaves, slender stems (60–90 cm.) and a nodding purplish panicle of widely spreading few-flowered branches. Spikelets 8–9 mm. long—the length of the lowest glume, which is nearly twice the length of the flowering glume. The latter is thinly covered with short hairs, rests upon a very short and obtuse (or acute) rhachilla, and terminates in a slender, scabrous, once or twice geniculate awn, 12–20 mm. long.

8. (610.) STIPA COMATA Trin. and Rupr., var. INTERMEDIA. Flowering glume including the rhachilla at the base 15 mm. long, awn about 7 cm., straight beyond the geniculations. A form intermediate between S. comata and S. spartea, but belonging rather to the former.

Junction Butte, alt. 6000 ft., growing with S. viridula, but less common.

In both Stipa spartea and S. comata the rhachilla below the flowering glume is 4–5 mm. long and is densely pubescent except at the very sharp point. In S. spartea the usually dark colored flowering glume is of very firm texture, and, excepting for a line of rather stiff hairs near the margins that often extend its whole length, is very smooth and shining above; the awn is very strong and rigid and nearly straight beyond the geniculations. In Stipa comata there is no distinct line of hairs on the pale green flowering glume, but its entire outer surface is thinly covered with short silky hairs; the rather slender awn is much elongated beyond the geniculations in the type, and more or less curled. In S. spartea the panicle is long exserted, the branches strictly erect and one to two flowered. In S. comata the base of the somewhat spreading one-sided panicle is never entirely free from the upper sheath.

The variety named above resembles some forms of *Stipa setigera* Presl., but in that species the palea is hyaline, and scarcely one-third as long as its glume There are other characters of difference, but this alone will serve to distinguish the two.

9. (615.) Oryzopsis asperifolia Michx. Fl. 1. 64; Gray, Man. p. 617. (Not in Coulter's Manual.)

Pine woods, Soda Butte creek, rare.

10. (614.) Oryzopsis exigua Thurber in Botany of Wilkes' Exped. p. 481. (Not in Coulter's Manual.)

On rocky bare knolls along Slough Creek; alt. 6700 ft. Not seen elsewhere.

This is a densely tufted grass with slender wiry stems 15–25 cm. high. It has much the habit and appearance of *Oryzopsis Canadensis* Torr., but differs essentially in its simple and contracted panicle, its shorter outer glumes, and in its longer and somewhat persistent awn.

11. Oryzopsis cuspidata Benth. Jour. Linn. Soc. XIX, p. 82; Coulter, Man. 410. *Eriocoma cuspidata* Nutt. Gen. I, p. 40. *Urachne lanata* Trin. Panic. p. 126.—Sparingly scattered over the low and dry open areas.

12. (649.) Phleum alpinum Linn.; Coulter, Man. 410.—Bogs and meadows, common between 8000 and 9000 ft. altitude.

13. (590.) Sporobolus depauperatus Scribn. in Torr. Bull. IX, p. 103. *Vilfa depauperata* Torr. in Hook. Flora Bor.-Am. II, 257, t. 236.—Common about Yellowstone Lake.

14. (605.) Agrostis varians Trin. Agrost. II. 68; Thurber in S. Wats. Bot. Calif. I, p. 273. (Not in Coulter's Manual.)—Bogs, Mirror Lake plateau, common.

15. (258, 606, 607, 608.) AGROSTIS SCABRA Willd.; Coulter, Man. 412.—Meadows and dry slopes, very common up to alt. 8000 ft.

The more common form of the species is represented by no. 258. No. 607 is a low (10–20 cm.) densely cespitose form with short and subulate radical leaves (*Trichodium subulatum* Nutt. in Herb. Phila. Acad.). No. 606 is an unusual form, and is referred to Agrostis scabra only after very careful comparisons and examinations. It has the rather short and very narrow radical leaves and the characteristic spikelets of that species, but the cauline leaves are comparatively broader and longer, especially the uppermost one, and the panicle is also narrower and apparently more densely flowered. The panicle is 6–10 cm. long, with 3–5 unequal (1–5 cm.) branches at each joint which, with the pedicels, are not so decidedly scabrous as in the type.

16. (604.) AGROSTIS EXARATA Trin. Agrost. II. 87; Thurb. in S. Wats. Bot. Calif. II. 273; Coulter, Man. 412.—Wooded bogs and along mountain streams, not common.

The specimens distributed were gathered near Pelican creek, alt. 8000 ft. They differ considerably from the type as figured by Trinius (Icones t. 27), but the limits of the species are not clearly understood, a great variety of forms having been referred to it, this along with others.

17. (259, 603.) AGROSTIS HUMILIS Vasey in Torr. Bull. X, p. 21. (Not in Coulter's Manual.)

Cool mossy bogs and mountain meadows, alt. 7000–9000 ft., rather common.

This very well marked and pretty little species, has the rhachilla produced behind the palea into a short naked bristle, a character not noted in the original description. (It is No. 671 Hall & Harbour.)

18. (581.) CINNA PENDULA Trin. *C. arundinacea* L. var. *pendula* Gray; Coulter, Man. 413.—Wooded bogs and streams, East Fork, alt. 8600 ft., not common.

This species is at once distinguished from C. arundinacea by its smaller (4 mm. or less) spikelets and equal or nearly equal outer glumes. In many specimens examined, both from New England and from the northwest, we have found the rhachilla prolonged behind the palea into a short naked bristle. Mr. Tweedy collected in Washington Territory a variety (var. *glomerula* Scribn. Proc. Acad. Phila. 1884, p. 290) with the spikelets arranged in small dense clusters or little glomerules along the extremities of the branches of the very diffuse panicle. The spikelets were scarcely more than 2 mm. in length, with very narrow acuminate-pointed empty glumes.

19. (248.) DEYEUXIA LANGSDORFFII Kunth, Gram. I. 77, Enum. Pl. I. 243; Hooker Arc. Pl. 307 & 345; Coulter, Man. 413. *Calamagrostis Langsdorffii* Trin. Gram. Uni-Sesquifl. 225; Gray, Proc. Am. Acad, IV. 77, Manual, 615; Thurb. in S. Wats. Bot. Calif. II. 279. (To this species is referred *Deyeuxia purpurea* Kth., which name should, perhaps, take precedence.)—Common in wooded and open mountain meadaws and bogs, alt. 7000–9000 ft.

The specimens are exactly like the eastern plant with the awn attached considerably below the middle of glume which it equals or slightly exceeds. The leaves are much narrower than the ligule, which is 5–8 mm. long, more or less scabrous and remarkable for being strongly nerved.

20. (584.) DEYEUXIA CANADENSIS Hooker, Arc. Pl. 307 & 345; Coulter Man. 413. *Arundo Canadensis* Michx. Fl. I. 73. *Calamagrostis Canadensis* Beauv. (not Nutt.); Gray, Man. 615. *Calamagrostis Mexicana* Nutt. Gen. I. 46. (The C. Canadensis of Nuttall is Deyeuxia Nuttalliana.)—Common with the last.

The specimens represent a slender form with rather smaller spikelets than usual and more acute glumes. Flowering glume about 2.5 mm. long, deeply bifid and terminating in two very slender awn-like teeth. Awn attached at or a little above the middle. Palea scarcely half as long as its glume.

21. (585.) DEYEUXIA DUBIA, n. sp.—Empty glumes between 3 and 4 mm. long, lanceolate or oblong-lanceolate, either gradually tapering to the apex or abruptly acuminate, finely scabrous on the back above. Flowering glume nearly as long as the empty ones, bifid at the apex and irregularly 4-toothed by the prolongation of the prominent lateral nerves, minutely scabrous above the middle below which is attached the straight and rather stout awn that equals the outer glumes in length. Palea a *very little* shorter than its glume, distinctly 2-nerved, irregularly 2-toothed. Hairs on the rhachilla below the glume scanty and short behind, more abundant at the sides and $\frac{2}{3}$–$\frac{3}{4}$ the length of the glume.

A tall (60–90 cm.) grass with the foliage and habit of D. Canadensis or D. Langsdorffii, but differing from both in the less spreading and more densely flowered branches of the panicle, the stouter branches at each joint flower-bearing to the base. From D. Canadensis this species is at once distinguished by the longer and stouter awn, shorter hairs surrounding the flowering glume and firmer and longer palea. The spikelets are smaller than in D. Langsdorffii, the empty glumes are much smoother and less rigid or firm in texture, the hairs are less copious as well as shorter and the palea is proportionately longer.

Meadows, Slough Creek, alt. 6700 ft. (= no. 365 Scribner, Montana collection. Found in open woods, Elk Creek, near Ft. Logan, alt. 5500 ft., July 25.)

21. (253, 582, 583.) DEYEUXIA NEGLECTA Kth. Gram. I. 76, Enum. Pl. I. 242. *Calamagrostis stricta* Beauv. (1812), Trin. Gram. Uni-Sesquifl. 226; Gray, Proc. Am. Acad. IV. 78; Thurb. in S. Wats. Bot. Calif. II. 282 *Deyeuxia stricta* Coulter, Man. 414 (not HBK.)

Dry meadows and slopes between 7000 and 9000 ft. altitude. So far as observed this species affects drier situations than the other species of the genus here named.

This species is distinguished by its rather rigid, erect and few (2, rarely 3) jointed stems, narrow rigid and usually erect leaves, strict and densely flowered panicle—often spike-like above, lobed and more or less interrupted below—the spikelets being crowded on short, usually appressed compound branches. The leaves of the sterile shoots are always very narrow and attain to one-half or two-thirds the height of the culm (their length is in marked contrast with the rather short leaves of the latter). No. 582 is a slender form (that may be designated as var. *gracilis*), 30–40 cm. high, with 3–4 stem leaves, the sheaths of which equal or much exceed the joints, and a narrow but rather loosely flowered panicle. The outer glumes are narrower and more pointed, less firm in texture and not so rough as in numbers 253 and 583. It is certainly of the same species, however.

Some of our specimens differ from the European plant in the more scabrous and firmer glumes, a difference that is by no means constant. *Calamagrostis confinis* Nutt. is too near this species to be kept distinct, and the same is probably true of *Calamagrostis crassiglumis* Thurb., which represents an opposed extreme in development. None of our forms of Deyeuxia neglecta exactly correspond with *Deyeuxia Lapponica* Kunth, from Europe. The differences, however, are slight and the two were united by Gen. Munro, the first name being made a synonym of the latter.

22. (616.) DESCHAMPSIA CÆSPITOSA Beauv., Agrost. 91, t. 18, f. 3; Coulter's Manual, p. 414. *Aira cæspitosa* L., Gray's Manual, p. 641. Dry and moist meadows and slopes, from 7000–9000 ft. altitude.

Although *D. cæspitosa* Beauv. and *D. flexuosa* Griseb. are at once recognized by one familiar with the two, the former is so variable, particularly in the Rocky Mountain forms, that it is not easy to find a constant character, which can be expressed, to distinguish them. It may be said, however, that in D. flexuosa the outer glumes are only 1-nerved (rarely the 2d is obscurely 3-nerved at the base) and much less firm in texture than the flowering ones. In D. cæspitosa the 2d (and sometimes also the

1st) glume is distinctly 3-nerved below, and the texture of the outer glumes is usually firmer than that of the flowering ones which are truncate at the apex and irregularly toothed, a character not observed in D. flexuosa. The awn in D. cæspitosa, usually about the length of the flowering glume, is sometimes quite as long as in D. flexuosa. I have never seen the latter species from the region west of the Mississippi.

23. (619.) TRISETUM SUBSPICATUM Beauv.; Coulter's Manual, p. 415.—Common in meadows from 7000–9000 ft. alt., low elevations preferring shaded or more moist situations.

24. (618.) TRISETUM SUBSPICATUM Beauv. var. MOLLE Gray. —Common with the preceding.

25. (249,250,617.) TRISETUM WOLFII Vasey in Bot. Wheeler's Exped. p. 294; Scribner, Torr. Bull. X, p. 64. *Trisetum subspicatum* P. B. var. *muticum* Bolander, ex Thurb. in S. Wats. Bot. Calif. II, p. 296 *Graphephorum Wolfii* Vasey in Descr. Cat. U. S. Grasses, 55; Coulter, Man. 433.—Moist meadows, generally in the shade, from 7500–9000 ft. alt., rather frequent. Associated with Deyeuxia Canadensis, Bromus ciliatus, etc.

The relationship of this grass to *Graphephorum melicoides* P. B., was indicated by Dr. Vasey in Wheeler's Report, and at that time he questioned whether it might not prove identical with that species, but more recent and better material has fully established its specific rank. It differs in having rather stouter and more rigid stems, a more densely flowered and erect panicle, more nearly equal outer glumes and in the comparatively longer paleæ. In later publications this species has been referred to the genus Graphephorum, but the only character—the very short or nearly obsolete awn—by which it has been seperated from Trisetum, is one of no generic value in itself. The fact that the flowering glumes are entire or merely obtusely two-lobed at the apex has no special significance as we not infrequently find the flowering glumes in T. subspicatum terminating similarly. The plant in question has in all respects—stem, leaves and inflorescence—the habit of T. subspicatum, and although a careful examination of the spikelets reveals its specific distinctions, it is not at all surprising that it should have been made a variety of that species. *Trisetum Brandegei* Scribn. (Torr. Bull. X, p. 64) is only a very robust form of T. Wolfii with 3–4 flowered spikelets.

26. (612.) AVENA STRIATA Michx.; Gray, Man. 640; Coulter, Man. 415. Wooded moist meadows and swamps, Slough creek, alt. 6800 ft., Soda Butte creek, alt. 7200 ft. Rather rare.

There is another Avena which may also occur within the park, as it is not infrequent in the mountain districts of central

Montana. It is distinguished from A. striata by its rigidly upright stems, strict, rather densely flowered, erect panicle, and larger spikelets. It is the Avena versicola of Hooker (Flor. Bor.-Am.), but certainly not of Villars. It equals no. 372 Scribner, Montana collection, distributed in 1884, under the name of *Avena pratensis* L. var. *Americana.*

Specimens of this grass were communicated to Prof. E. Hackel, of Austria, who states in a letter dated June 27, 1884, that it is a species he had long known, having first received it from European Russia and later from the Ural Mts. and also from the mountains of Altau and Dauria, in Northern Asia. He adds that he did not publish the species because he was uncertain of its specific distinction from *A. pratensis* L. and *A. compressa* Heuff., but at that time he considered it "quite as distinct as most of the species of the group of pratensis, which is a very perplexing one and can only be treated monographically."

27. (269, 597.) DANTHONIA INTERMEDIA Vasey in Torr. Bull., May, 1883.—Dry and moist meadows, from 7500 to 8500 ft. alt., rather common.

This grass is referred to *D. sericea* Nutt. by Dr. Thurber (S. Wats. Bot. Calif. II. 294), and Prof. Coulter follows him (Man. Rocky Mt. Botany, p. 416), but it is sufficiently distinct from Nuttall's plant and is undoubtedly a good species. Stem and leaves as in *D. sericea* Nutt., but not usually so tall, being rarely over 50 cm. high; the 1–3-flowered branches of the usually shorter (3–5 cm.) panicle, more appressed, and consequently the spikelets are more crowded; the outer glumes are about the same length as those in D. sericea (13–16 mm.) but they are fully *twice as broad* and have a different venation, while the flowering glumes are fully twice as large and perfectly smooth excepting along the margins below, as in D. Californica, but there are abundant differences separating it from that species.

In central Montana this grass occurs most frequently associated with Festuca scabrella at from 6000–8000 ft. alt.

28. (596.) DANTHONIA CALIFORNICA Boland. var. UNISPICATA Thurb. in S. Wats. Bot. Calif. II, p. 294; Coulter, Man. 415. *D. unispicata* Munro in Herb. *D. monostachya* Nutt. in Herb. Phila. Acad.—Dry rocky open places, Slough creek, rare.

29. (260.) KŒLERIA CRISTATA Pers.; Coulter, Man. 418. —Common everywhere in dry situations up to alt. 8000 ft. For notes upon this species see Scribner in Proc. Kansas Acad. Science, p. 117, plate III.

30. (577.) CATABROSA AQUATICA P. B.; Coulter, Man. 419. —In water, Gardener's river, alt. 5400 ft. Not seen elsewhere.

31. (268, 601, 602.) MELICA SPECTABILE Scribn. Proc. Acad. Nat. Sci. Phila. 1885, p. 45, plate I. f. 11, 12, 13.—Common in rich meadows and on slopes near the upper limits of the bunch grass areas especially at elevations of from 7000–8000 ft.

The difference in habit of growth between *Melica bulbosa* Geyer, and *M. spectabile* Scribner are thus stated by Mr. Cusick: "M. bulbosa grows in small tufts while M. spectabile is stoloniferous, the underground runners terminated by a small bulb which produces the culm. The runner, I think, soon dies and so the stems become independent, and are never cespitose in the least."

Outline for study of Chemical Botany.

LILLIE J. MARTIN.

Botanical text-books do not furnish sufficient aid to those desiring to learn to make investigations in vegetable physiology. Students with but a general knowledge of chemistry do not understand the bearing of the microchemical tests given. The result is, that most of the work is mechanical. In fact, any really satisfactory course in chemical botany must be introduced by a short course in organic chemistry. The student who has found out the nature and quantity of the more important constituents of a plant is prepared to trace these substances in its various tissues and even to observe the chemical changes that take place in the process of growth. The outline below, mainly drawn from that proposed by Dragendorff, is an attempt to put this idea into form for class work. No particular plant is suggested, because no one greatly superior to all others yet suggests itself. Corn smut is so rich in products and so easily prepared that at first thought it seemed particularly adapted to such work, but a superficial examination showed that it required too high a power of the microscope to be of value for the microscopical work. Possibly the histological work previously done upon the asparagus and pumpkin vine might make it desirable to use one of these plants.

I. Weigh out five grams of the pulverized plant, burn off organic matter and determine per cent. ash. Make a qualitative examination of half the ash by the method of inorganic chemistry. In the other half determine the amount of some one of the constituents found. Examine ash with microscope to learn if there is anything of a structural nature about it.

II. Weigh out five grams more. Dry at 100° C. until it ceases to lose weight. Calculate per cent. moisture. Put in a glass-stoppered bottle, add 10^{cc} petroleum spirit for every gram substance left. Macerate for a week or so, shaking several times each day. Filter.

<table>
<tr>
<td rowspan="6">A Filtrate:—
a. Evaporate an aliquot part to dryness and compute total solid.
b. Make a superficial examination of fixed oil and determine amount.
c. Ethereal oil should be looked for.
d. Use solutions of different strengths and by means of the spectroscope identify the chlorophyll by its spectrum.</td>
<td colspan="6">B. Residue:—Dry at ordinary temperature and treat with ether as with petroleum spirit.</td>
</tr>
<tr>
<td rowspan="5">C. Filtrate
a. Determine total solid.
b. Make a superficial examination of the resins.</td>
<td colspan="5">D. Residue:—Dry at ordinary temperature and treat with absolute alcohol as with petroleum spirit.</td>
</tr>
<tr>
<td rowspan="4">E. Filtrate
a. Determine total solid.
b. Make tests for
1. Tannins
2. Alkaloids
3. Glucoses</td>
<td colspan="4">F. Residue:—Treat with water.</td>
</tr>
<tr>
<td rowspan="3">G. Filtrate:—
a. Examine
1. Mucilage
2. Inulin
b. Test for
1. Malic
2. Tartaric
3. Oxalic and other acids.
c. Make distinguishing tests for saccharose and glucose and estimate glucose volumetrically by Fehling's solution.</td>
<td colspan="3">H. Residue:—Treat with dilute soda.</td>
</tr>
<tr>
<td rowspan="2">I. Filtrate:
a. Examine albuminoids with care.</td>
<td colspan="2">J. Residue:—Treat with hydrochloric acid</td>
</tr>
<tr>
<td>K. Filtrate
a. Qualitative and quantitative examination of starch.</td>
<td>L. Residue
a. Look for lignin and its allies.
b. For cellulose.</td>
</tr>
<tr>
<td>A′ Compare sections of the plant before and after treatment with petroleum. Note of the substances named above and observe change in the plant by use of the solvent.
Record the observations by drawings.</td>
<td>C′. Examine as in A′.</td>
<td>E′. Examine under microscope as in A′.</td>
<td>G′. As in A′.</td>
<td>I′. Under microsc'pe as in A′.</td>
<td>K′. Under microsc'pe as in A′.</td>
<td>L′ As in A′.</td>
</tr>
</table>

Professor Goodale classifies organic substances as follows:

A. Products free from nitrogen:—

I. Carbohydrates
- 1. The cellulose group. ....
  - (1) Cellulose
  - (2) Starch
  - (3) Inulin
  - (4) Dextrin
  - (5) Lichenin
  - (6) Gums
  - (7) Dextrin
  - (8) Pectin bodies
- 2. The sugar group..
  - 1. Grape sugar.
  - 2. Fruit "
  - 3. Cane "

II. Vegetable acids
- (1) Oxalic
- (2) Tartaric
- (3) Citric
- (4) Malic.

III. Fats or Glycerides. IV. Certain astringents. Tannins. V. Glucosides. VI. Resins. VII. Ethereal oils.

B. Products containing nitrogen:—

I. Albumin-like matter. II. Asparagin. III. Alkaloids. IV. Unorganized ferments.

Inorganic substances are there classified in "How Plants Grow":

Bases.
- Potash.
- Soda.
- Lime.
- Magnesia.
- Oxide of Iron.

Acids.
- Chlorine.
- Sulphuric.
- Phosphoric.
- Silicic.
- Carbonic.

Most of the substances named above are found in the analytical scheme proposed and by going through the work the student really becomes acquainted with them. If a typical plant is selected he may even learn the quantity in which some of the more important constituents occur. Something in the way of comparison is even possible. Different members of the class may take different parts of the plant at the same age or the same part at different ages and compare them as to amount of ash, water or some other constituent. Sach's discovery that "squash seeds, which, when ripe, contain no starch, sugar or dextrine, but are very rich in oil (50%), and albuminoids (40%), suffer by germination such chemical change that the oil rapidly diminishes in quantity, while at the same time starch, and in some cases sugar, is formed," suggests a great variety of more elaborate and by no means impracticable lines of comparative study on the part of botanical students. So much for micro-chemical comparisons. Micro-chemical comparisons as to the physical condition and position of the various substances in the specimens upon which the students are working will of course be made.

Even if desirable in itself two objections will be made to the course proposed—time required for the work outlined and its expense. It is thought that the large number of solvents used and the fact that they can be employed cold and that the drying and evaporating can be done at ordinary temperature will greatly facilitate matters. Of course some pieces of apparatus must be purchased, such as a good balance, polariscope and spectroscope that can be attached to the microscope, platinum dish, Liebig's condenser for getting distilled water, chemical thermometer, burrette, porcelain evaporating dish and glass stoppered bottle for each student, and test tubes, but tripods, forceps, alcohol lamps, desiccater, drying oven, etc., can be made by the students. The main reagents will be needed in some quantity, but one set of reagent bottles will hold the other substances needed.

BRIEFER ARTICLES.

Calochortus Obispoensis, n. sp.—Corm fibrous-coated, deep seated, one-half to one inch thick: stem simple or branched, one to two feet high, flexuous, leafy, often bulbiferous below: upper leaves reduced to subulate bracts, all convolute and long attenuate: flowers solitary or numerous; peduncles one to two inches long: sepals about an inch long, rotate-spreading, lanceolate, acuminate, soon convolute, veined within with brown: petals one-half to two-thirds as long, rotate or recurved in anthesis, oblong, truncate, often bifid and the lobes connivent backwards, lemon yellow becoming orange at base, brownish-red above beset more or less throughout with long hairs (3–4 lines), the lower yellow or deep orange, the upper dark reddish brown ; gland round-elliptical, naked but enclosed by a fimbriate ring of long, erect, converging, orange colored hairs: anthers light snuff-color, obtuse, two or three lines long : capsules narrowly oblong with thick, obtuse angles.

This peculiar Mariposa stands near C. Weedii and C. clavatus, resembling the former in its corm, leaves, etc., and the latter in its markings, pubescence, etc., but it is abundantly distinguished by its short, comparatively narrow, often bifid petals, etc.

On dry, stony hills near San Luis Obispo, Cal., on the premises of Dr. W. W. Hays, May 25, 1886. Collected in 1882 further eastward by Miss Georgie Hays, Miss Dalidet, Mrs. R. W. Summers and others.—J. G. LEMMON.

A rare fern.—Mr. John Spence, of Santa Barbara, recently discovered a rare fern in the high mountain regions of Santa Barbara county, which appears to be a South American Notholæna, *N. tenera* Gill., not heretofore reported in the United States except in a single locality in Southern Utah. In form and manner of growth it resembles *Notholæna nivea* Desv. (See Hooker & Baker's "Synopsis Filicum" p. 374.) As N. nivea is placed under the subdivision Cincinalis, characterized by the fronds being coated with white or yellow powder, and these specimens show no trace of such powder, they must be placed under the subdivision Eunothochlæna, in which the fronds are not farinose beneath, and under the specific name given above, a fern found in the Andes of Bolivia and Chili, which the best authorities (see Sir J. W. Hooker's Species Filicum, vol. 5. p. 112) state is a very doubtfully distinct species from *N. nivea*, from which it differs only in the absence of the powder beneath.

Prof. D. C. Eaton in his "Ferns of North America" figures N. tenera found in Southern Utah, but the plate is too poor to give a correct idea of the species, and the author expresses a doubt as to the correctness of the determination.

On comparing Mr. Spence's specimen with a specimen of N. nivea in my collection (also a South American species, not reported in the United States until found by Prof. Lemmon in Arizona in 1883), I find the resemblance complete, except that the Californian specimen shows no trace of powder on the under side of the frond, which corresponds with the N. tenera of H. & B. The pinnæ being less distant may be the result of climatic differences.

In the absence of further evidence Mr. Spence's discovery may, with reasonable certainty, be called Notholæna tenera.

Mr. Spence also found a rare form of Aspidium munitum in the same locality.—LORENZO G. YATES, *Santa Barbara, Calif.*

William S. Clark, Ph. D.—William Smith Clark, the well-known botanist and educator of Massachusetts, died at his home in Amherst, Mass., March 9th, 1886.

He was the son of Dr. Atherton Clark, and was born in Ashfield, Mass., July 31, 1826. He fitted for college at Williston Seminary, East Hampton, Mass., and entered Amherst College in 1844, graduating with the title of A. B., 1848. For two years after graduating he taught the natural sciences in Williston Seminary. He then went to Europe, entered the Göttingen University, Germany, and received his diplomas of A. M. and Ph. D. with Prof. C. A. Goessmann, the noted organic chemist and director of the Massachusetts Experiment Station.

Upon his return from Germany he was elected to the chair of chemistry and botany in Amherst College, which he retained until August, 1867, when he was elected president of the Massachusetts Agricultural College. He took active part in the rebellion with the Twenty-first Massachusetts regiment as its colonel.

Colonel Clark was noted for the energy and enthusiasm he put into everything he undertook, and in the class-room he imparted this to his students to such an extent that very thorough and rapid progress was always made. During the last fifteen or twenty years of his life he made the study of plant-life his specialty, and conducted a series of very careful experiments upon the circulation of sap in plants, the expansive force of plant tissues, the movements of plants, rapidity of the movements of sap, etc., most of which are recorded in the catalogues of the Massachusetts Agricultural College and the annual reports of the secretary of the Massachusetts Board of Agriculture.

These papers, which are valuable additions to botanical literature, are perhaps his most important writings, although he was always ready with lectures upon almost all industrial and natural scientific subjects whenever called upon and was a most brilliant and fascinating speaker. In 1876 he was granted a leave of absence and established the Royal Agricultural College at Sapporo, Japan.

His many pupils look back with pleasure to the profitable days spent under his instruction, in which they always found him a true friend and wise counselor.

S. T. MAYNARD.

Tuckerman bibliography.—The following correction and additions may be made to the list on page 74 of this volume.

Notice of some Cyperaceæ of our vicinity : Hovey's *Mag. of Hort. and Bot.* vii. 208–210 (1841).

Descriptions of several new plants of New England : *ibid*, ix. 142–3 (1843).

Carex argyrantha *s . nov.* : distrib. with descr. Amherst, Aug. 16, 1859; published in Wood's *Class-Book of Botany* 1861, p. 753.

Carex glaucodea *Mss.* : *Proc. Am. Acad.* vii. 395 (1868).

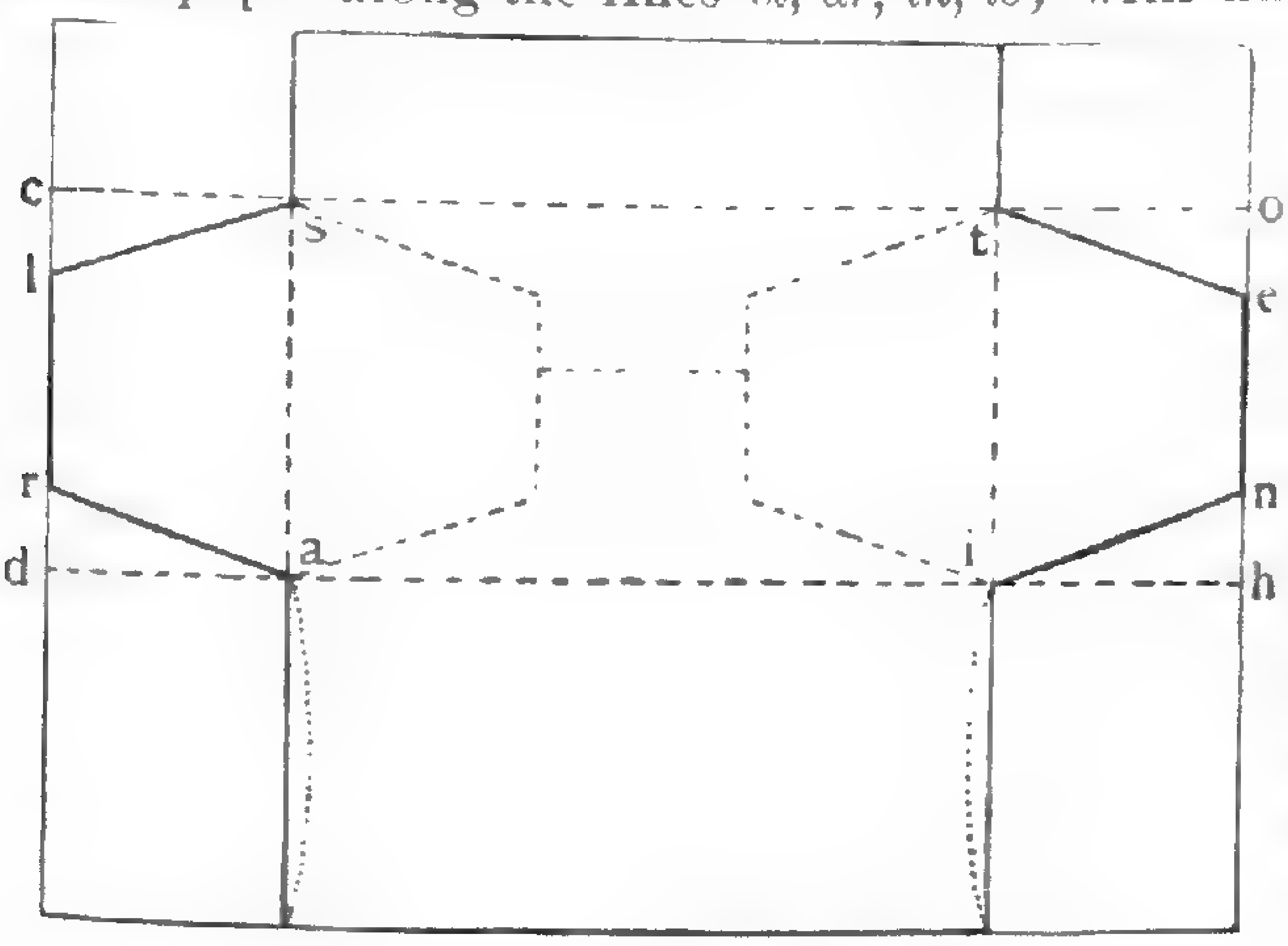
Lichens or fungi ? : *Bull. Torr. Bot. Club*, vii. 66–7 (1881).

Review of Minks's Symbolæ Licheno-Mycologicæ : *ibid.* ix. 143 (1882).

The Synopsis of the Lichens of the Northern U. S., etc., was first published in *Proc. Am. Acad.* i. 195–285 (1848).—HENRY WILLEY.

Vancouveria.—In the two most recent fascicles of the Bulletin of the Botanical Society of France, M. Franchet has published an elaborate review and monograph of the genus Epimedium. Adopting Baillon's idea, he refers back to it the Pacific-coast genus Vancouveria of Decaisne, which, M. Franchet insists, differs in nothing but the ternary instead of the binary plan of the blossom. For it seems that some common species of Epimedium occasionally produce petals which are not saccate or spurred (which certainly militates against Aceranthus), and in one the perianth is in a manner reflexed. But both Baillon and Franchet leave out of view a marked character of Vancouveria, namely, the unguiculate petals. In Vancouveria each petal consists of a long ligulate portion or claw, bearing at its summit an inflexed and bordered lamina, which is the homologue of the always sessile or basal sac of Epimedium. We recognize three forms or varieties of V. hexandra but can not make out more than one species.—A. GRAY.

To make pockets.—Fold a rectangular piece of paper of desired size along the line *dh* and again along *co*; bend the folded paper over a sharp edge (e. g. a tin paper-cutter) so as to mark the points *t, i, s, a;* with scissors cut the folded paper along the lines *sl, ar, in, te;* with knife or paper-cutter cut away the two upper layers of the folded paper along the lines *ti, as,* so as to leave the sheet when unfolded of the shape shown by the heavier outline. When folded into a pocket the appearance is indicated by the broken lines within *asti.* If the objects to be enclosed are large the lower flap must be cut away as shown by dotted line. These pockets are quickly made after a little practice and are indispensable for fruits, seeds, flowers and smaller specimens. Directions for making a simpler, equally effective but less convenient kind will be found in the June number, p. 142.



POCKET FOR HERBARIUM.

A botanical diary.—While gathering specimens for preservation in an herbarinm, and future study, some device for recording and ready reference to them is very desirable. After trying various plans, the following form of diary was devised, and has worked so well for the fifteen years of trial, that it has become a permanent thing in the economy of the writer.

A plain blank book, of a size suitable for carrying in the pocket, is obtained. It may serve for one year, or several, according to the amount of work done, and entries made. The plants gathered and studied are numbered from 1 to the last entry for the year. At the beginning of each year of work a new numbering is commenced, the year, as a date, heading the list. Two or three lines may serve for entry, unless peculiarities are recorded. If more space is expected to be needed than is used at the time of making an entry, a page or more may be left blank for future use, or whatever is thought necessary. To illustrate, taking some cases at random from the list of 1878:

"2. Weisia viridula. On the ground in meadows, Englewood, Ill., Mar. 16, Apr. 13."

"11. Draba Caroliniana. Sandy grounds, Englewood, Apr. 13. No. 2. Petals wanting on the later racemes." (This implies that two kinds of specimens were gathered, the second being marked "11, No. 2.")

"198. Dicranum congestum. High sandy hills; Boyne Falls, July 30. (Hills southeast of the village, 325 feet above Lake Michigan.) On the ground; loosely cæspitose."

Boyne Falls is in Michigan, and Mich. is placed after the name in connection with the first plant collected there.

At the time of placing a plant in the drying papers a card is put with it, corresponding to the number in the note book as "198. 78. Dicranum congestum." The latter number gives the year. This card is kept with the specimen till mounted. When mounted, by turning to the corresponding number in the diary, any particulars needed for the label may be found. When a plant is dried for the herbarium an entry is also made on the margin of the page of the botany used in identifying, using the last two numbers of the year in which it is collected. Opening my copy of Gray's Manual to Hippuris vulgaris, on the margin are found three numbers, "78, 80, 83." If any information is wanted this becomes an index to show where the information may be found. It saves much time to look it up here instead of in the cabinet, if the specimen itself is not needed. The number on the margin serves also as a record or check list of plants, so that it may not be repeatedly gathered, unless special reasons exist for it.

Note books kept in this way become very useful in the study of geographical distribution. It is an exact record, easy of access. The system is a kind of botanical book-keeping, as useful and accurate in its way as that of the accountant.—E. J. Hill.

Collecting Fossil Plants.—Fossil plants are to be looked for in the shale above the coal veins, and sometimes in the stigmaria clay below. In the sub-conglomerate coal measures of Arkansas the impressions occur in the shale within 18 inches of the coal. The best are found from 8 to 18 inches above. But few forms are found above 12 inches. Close to the coal is a layer of fragile shale a few inches thick, filled with indeterminable fragments, but sometimes yielding species not found in the firmer rock above. The impressions near the coal are never good, being nearly the color of the shale and much broken. To get the entire range of species it is best to examine all the shale from the coal to the barren rock above, at as many localities as possible. Carboniferous plants grow in clumps as they do in our modern swamps, and were often local. Species collected once at a locality may never be found again, and suddenly a dozen new ones may appear. Always save poor specimens of new or doubtful forms, but discard the small fragments of well-known and common species. Reverses, unless large and fine, are worthless. Break open any nodules found, as they often contain plant remains. Keep all the parts of an impression together when broken, as they may be mended by cement, or set in position in a plaster of Paris base. Better leave considerable shale with a good impression than run the risk of breaking it by trimming.

In shaping, a meat saw can be used to good advantage on fragile shales free from nodules. A pair of pincers is useful, also a wooden clamp to prevent forcing while trimming with a hammer. Shale from the coal measures of Arkansas, if dried either in the sun or shade without being exposed to rain, will not crumble, and will become firmer by drying. Shales containing iron pyrites are liable to crumble from oxidation.

Shales work easier when first taken out, as they are wet, but are more liable to crumble in splitting. While drying out lines of cleavage are developed, showing where to put the chisel to expose the best impressions. Promising shale can be stored away in a dry place and worked over at leisure. Different species occur in the shale at different levels, and experience soon teaches one how to work the shale for particular forms.

For collecting fossils, one needs a crow-bar, shovel or spade, pickaxe, and blasting material, if he is searching at a locality not worked. If at a mine in operation the above tools, if needed, can generally be borrowed from the miners. Several steel chisels from ½ to 1 inch wide and 8 inches long, and as thin as possible, are necessary, also one heavy and one light hammer. In splitting small shales a strong butcher knife and a light hammer have been used to good purpose. In opening large shales to expose surfaces it is best to insert several chisels along the supposed line of fracture and work continuously. The impressions should never be touched with the fingers as they are easily dimmed. Cigar boxes for small specimens and fragile pieces, and larger boxes for heavier shales are necessary. All specimens should be wrapped in paper and tightly packed on edge, and all the interstices filled with paper, sawdust, leaves or any available packing material.

Essential requisites in forming a cabinet of fossil plants are patience and perseverance on the part of the collector. He must be content to split shale all day in the hot sun or bitter cold, and often go home with empty boxes. Specimens in the cabinet should be laid flat in drawers, such as are used for minerals, or in show cases, if designed for exhibition. They are necessarily fragmentary, and a number of specimens of each form is desirable. The specimens must be numbered, to correspond with those of a record book, in which all data are given. A card placed with each specimen states where it is figured and described, and the front of the drawer is labeled with the contained genus and species. The color of the label can be made to indicate the group, as blue for ferns, etc. The specimens should never be wet, oiled, or varnished.—F. L. HARVEY.

The directions which Prof. Harvey gives for collecting in carboniferous strata apply in the main to all formations.

Drying plants out of doors in wet weather.—For 30 years I have collected plants in both wet and dry climates and of necessity have tried many plans. At present I have, I think, a perfect system and as it is all original I will give it in full. I have tried all other plans and none meets every case but my own. When out collecting I gather flowering plants in dry weather, and lichens, mosses and liverworts wet, especially lichens. My driers are either newspapers or the usual ones advertised in the GAZETTE. I collect cryptogams in a basket, and afterwards sort them and place them in flattened pieces or tufts on single sheets of paper of a slightly smaller size than the driers. I fill each sheet, taking no account of species, and place on it a slip with the date. I place each sheet between driers and when all are assorted I place the pile between boards and put on the pressure with leather straps.

Next morning when the sun gets hot I, or my man, take the parcel to an open and level place, spread out a water-proof sheet black side up and carefully taking off each sheet of specimens slide it into position on the waterproof, one of which will hold twenty-four sheets of specimens. I put small stones and sticks on the corners and so leave them exposed to the sun. In a very short time they are dry and at once packed away. In the winter I assort them. This plan *in part* I have practiced since 1875, when in northern British Columbia where the weather was so wet that we had rain every day during the month of June.

My plan for phænogams and mosses was only perfected last year, and for phænogams would be of no use without the thick and heavy driers. For the past four years I have been in the habit of placing my sheets of specimens when partly dry on a level surface of dry rock, earth or sand, and then exposing them covered with a single drier to the sun. This worked well in dry weather, but when everything was wet we could do nothing. Last June I was collecting in the Rockies and had showers four or five times a day, so that I could get no dry places for my plants. I had two wire presses, but they were too full, and the air was almost at the point of saturation. One day I spread out my plants in my old way and a thunder storm coming up I hastily covered them with my waterproof sheets. Five minutes after the rain cleared off the waterproof was dry. I now changed my tactics and put the waterproof beneath and I had beaten both weather and locality.

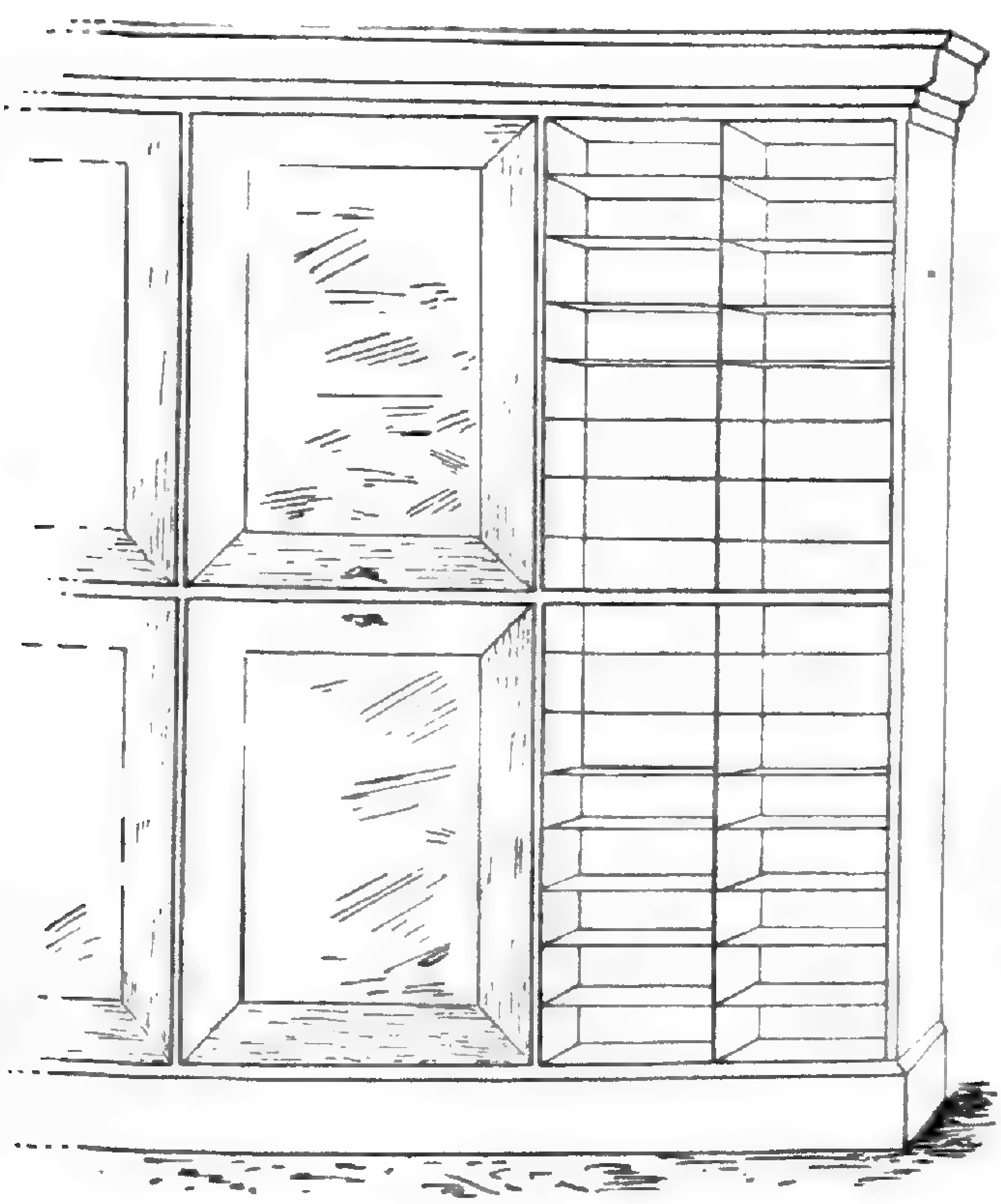
My plan for phænogams in full is this: I carry my driers and half sheets always with me when collecting. My whole outfit is a knife, a basket and a portfolio or press made of two boards of three-ply veneers with straps to fasten them together. I gather my specimens and place them on the half sheets while they are quite fresh, in fact they are put in the press as soon as collected. I keep the collection of each day by itself. Every morning before leaving camp I go over all the specimens *exposed* the day before and label and put away the dry ones, while the others are again exposed.

No matter how wet the weather may be, if I can get three hours' sunshine I can dry my plants without any difficulty. I usually keep my plants one day in the press before exposing them, as I find if they have not had time to wilt they curl in drying.

Let the ground be wet or dry I clear off a space for one or two waterproofs and lay them down with the black side up. As soon as they are warm I unstrap my press, taking a half sheet and drier (drier on top) and place them on the waterproof in rows. Each one holds about twenty-four. I now lay small sticks or stones on the margins or corners and leave them for three or four hours. They are again taken up and put in press until the next morning, when the dry ones are labeled and put away, while the others are again exposed.

By the methods given above I dried over 1,500 sheets last year in a wet region and all my specimens kept their color, although for weeks together it rained every day.—JOHN MACOUN.

Herbarium cases.—I make my cases low enough so that one can easily reach the uppermost specimens without leaving the floor. The pigeon-holes

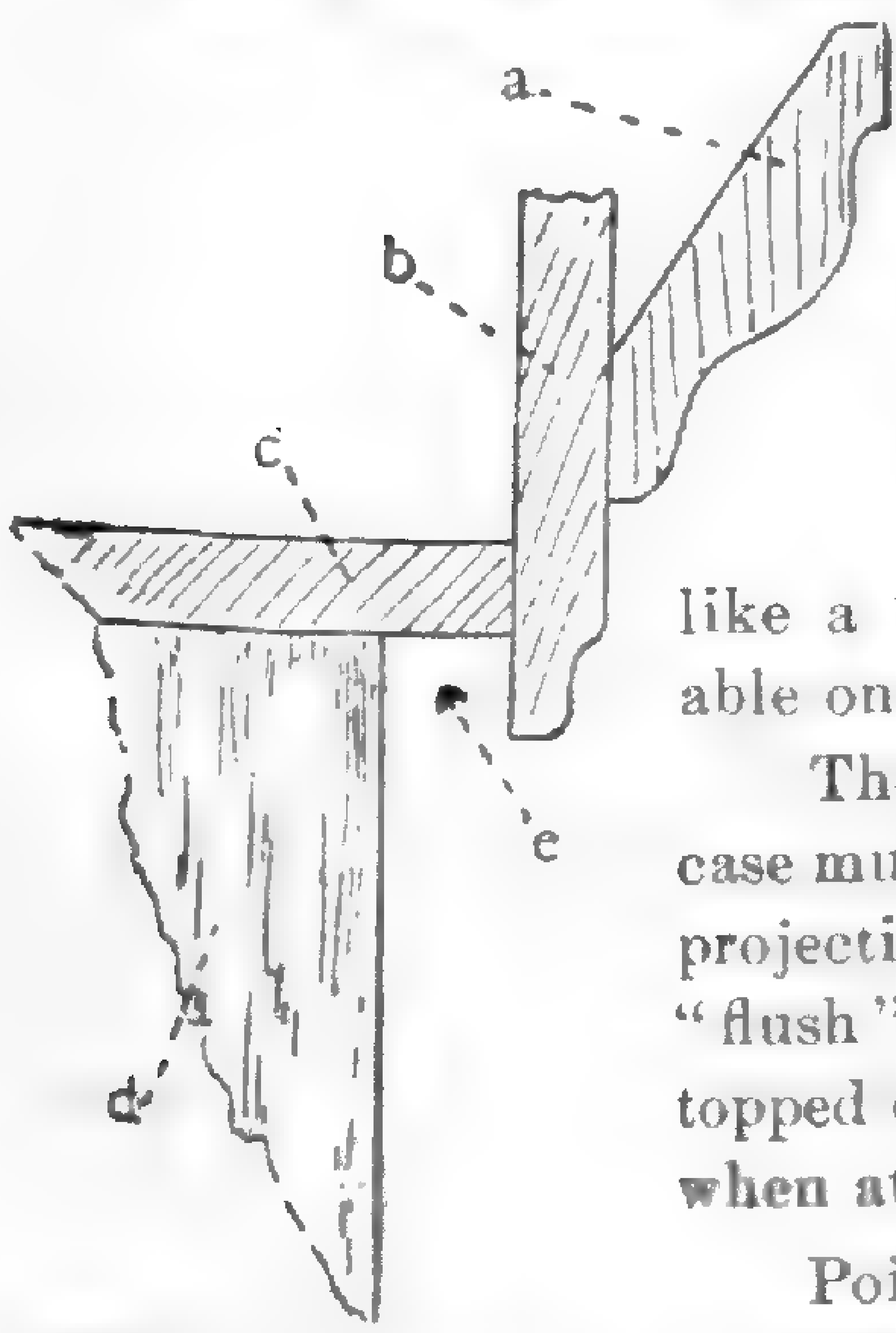


HERBARIUM CASE.

are $12\frac{1}{4}$ inches wide, 4 inches high, and 17 to 18 inches deep; all inside measurements. They are arranged in two series, a lower and an upper, *which are equal.* The lower series begins at from 7 to 8 inches above the floor, and contains eight pigeon-holes; then I have a heavy cross-bar or partition, and above this is the second series.

The doors to my cases are removable, and are of *equal size.* The lower doors cover the lower series of pigeon-holes, and the upper doors cover the upper series. Each door is a little more than two feet wide, and so covers two rows of pigeon-holes.

I use no hinges for fastening the doors. They are made as follows: The lower end of each lower door fits into a groove in the case, and the upper end is held in place by a simple button. The upper end of each upper door fits into a groove in the case, and its lower end is held by a button. The edges of the doors are properly rabbetted, so as to make them approximately dust proof. A little handle like a "drawer-pull," is attached to each door to enable one to draw it out.



SECTION OF CORNICE.
a, cornice molding; *b*, door guard; *c*, top of case; *d*, side of case; *e*, groove which receives top of door.

These moveable doors render the work about a large case much more agreeable, as one is not bothered by the projecting doors. I lay these doors (which are paneled "flush" on the inside) on light trestles, or even on flat-topped chairs, and so make a great amount of table room when at work in the herba-rium.—CHAS. E. BESSEY.

Poisoning and repoisoning specimens is a necessity in the herbarium, but with the greatest care insect pests manage to get a foothold somewhere or other every year. It is a mistake to suppose that the most careful poisoning will prevent their ravages. While

I believe in the liberal use of poison, I have long been convinced that it is hopeless to try and prevent the ingress of insects by this means alone, and shall model my herbarium cases after the new ones devoted to Compositæ in the Gray Herbarium, described in the June number. Such a case is as nearly dust-proof as can be expected, and is tight enough so that a cup of chloroform, set on one of the shelves occasionally, will destroy any insects that may be at work. A suggestion of Prof. Brewer to concave the fronts of the shelves *near the right-hand end*, for lifting out the sheets, and to have the shelves one inch shorter than the sheet, at the back, to allow dust to fall to the bottom, obviating the necessity of brushing out each shelf, is worth acting upon.—WILLIAM TRELEASE.

Corydalis aurea and its allies.—In former years Dr. Engelmann studied this group attentively, and gave me various notes and sketches; but hardly anything has been published except the few memoranda which I incorporated into the Manual. A careful study of the group now made has on the whole confirmed Dr. Englemann's views, but has led to the admission of one species, which he had concluded to be a mere state of C. aurea. It will be seen from the following notes that some points remain upon which further information is needed.

The species are conveniently arranged in two groups, as follows:

1. Hood or saccate tip of outer petals crestless, the back at most carinate: flowers golden yellow.

C. AUREA Willd. Commonly spreading and with slender pedicels: spur of corolla barely half the length of the body, somewhat decurved: capsules pendulous or spreading, terete, toruiose when dry: seeds turgid, obtuse at margin, the shining surface obscurely reticulated under a lens.

Extends from Lower Canada to British Columbia and Oregon, north to lat 64°, southwestward to Texas, Arizona, and into adjacent parts of Mexico. But *not* into N. E. Asia or Japan. The plant of the Rocky Mountains and westward commonly has longer spurs. Only southward do we find the marked form which Dr. Englemann was naturally disposed to separate as a species, but at length agreed to call

Var. OCCIDENTALIS Engelm. in Gray Man. 62. More erect and cespitose, stouter, often with thickened root which Engelmann took to be "subperennial," but probably, like the species, only biennial: flowers rather larger and in a stouter erect raceme, with spur almost as long as the body and commonly ascending: capsules thicker, less torulose, mostly incurved-ascending on short spreading pedicels: seeds less turgid and margins acutish.—*C. montana* Engelm. l. c. and Wood, Bot. 34.

Fendler's New Mexican plant was chiefly the original of this: but it is better represented by C. Wright's no. 1309 from near El Paso, by specimens which I myself collected there in the early spring of 1885, by Pringle's no. 198 of the same year from Chihuahua, by specimens collected in Arizona by Palmer in 1865, by Rusby in New Mexico, and by Hall & Harbour's no. 31 from Colorado, which has been referred to C. curvisiliqua. These all approach that species; but the pods seem to be terete, are shorter, and the seeds have the slight markings of those of C. aurea.

C. CURVISILIQUA Engelm. l. c. Habit of the preceding variety, and with spiciform raceme of rather larger flowers (over half inch long), the spur as long as the body: capsules *quadrangular* (inch and a half long, 2 lines thick), incurved and ascending or straightish on very short and stout diverging pedicels: seeds turgid-lenticular, with acute margins and minutely muriculate surface.

The only certain specimens I possess are those of Lindheimer's Texan collection, collected near New Braunfels in 1850 and 1851. Mrs. Bittle once showed me a fine drawing from the living plant, showing the perfectly tetragonal pods. Specimens from W. Texas, without fruit, which may belong here, were collected by Berlandier, Wright, and Girard. It is commended to the attention of Texan botanists.

2. Hood or saccate tip of outer petals (except in cleistogamous flowers) dorsally wing-crested.

* Flowers bright yellow, about two-thirds of an inch long: stem mostly erect.

C. CRYSTALLINA Engelm. l. c. Habit of the preceding: flowers spicate, with spur nearly as long as the body; dorsal crest short, very wide and salient, 3 to 4-toothed: capsules linear-oblong, terete, half or three-fourths inch long, erect on very short pedicels, pruinose when fresh with transparent vesicles (such as beset the leaves of Mesembrianthemum crystallinum): seeds acute-margined, the coat minutely tubercular-reticulated.

Prairies and fields of Arkansas and S. W. Missouri. Excellent specimens of this, collected by Prof. F. L. Harvey, in Curtiss's distribution.

** Flowers pale yellow, short-spurred, only a quarter or third of an inch in length: stems diffuse and slender: capsules linear and slender, torulose.

C. FLAVULA DC. Flowers conspicuously bracted and slender-pedicelled: outer petals surpassing the inner; crest very salient, 3 to 4-toothed: capsules pendulous: seeds acutely margined, rugose-reticulated, at least toward the margins.—*C. flavidula* Chapman, Fl. ed. 2, 604, a slip of the pen.

Lake Erie to Virginia, Tennessee, Missouri and Louisiana.

C. MICRANTHA. Flowers short-pedicelled and small-bracted, when full-developed a third of an inch long, narrow, with spur a line or two long, and with rather narrow lunate and entire crests; often with only cleistogamous and much smaller flowers, which are spurless and crestless or only slightly crested: capsules ascending on short or very short pedicels: seeds turgid, obtuse at margin, shining, as in typical C. aurea.—*C. aurea*, var. *micrantha* Engelm. in Gray, Man. l. c., only cleistogamous flowers known. *C. aurea*, var. *australis* Chapm. Fl. ed. 2, 604, who had only the normal flowers.

Texas to Missouri and Florida, and at Cape Fear, N. Carolina, *Havard*, whose specimens show earlier normal and later cleistogamous flowers on same individuals. On the Atlantic coast, from N. Carolina to Louisiana (where the normal form was collected by M. Langlois) this appears to be the only species. In Missouri it is said to grow intermixed with C. aurea. Confirmation of this is desirable.—ASA GRAY.

Development of Rœsteliæ from Gymnosporangia.—The culture of spores of the *Gymnosporangia* of this country upon different *Pomeæ*, which I have undertaken for several years, has been continued this year by Mr. Roland Thaxter in the Cryptogamic laboratory at Harvard. In my own cultures spermagonia only were produced on the different hosts, but Mr. Thaxter has been more successful, and has been able to produce the æcidia in several cases. His cultures are not yet completed, but I should like to call attention to some of the results reached, leaving details for Mr. Thaxter's paper on the subject, which will soon appear in print.

The spores of *Gym. clavipes* C. & P. growing on stems of Juniperus Virginiana were sown on young plants of Amelanchier Canadensis and were followed by a luxuriant growth of *Ræstelia aurantiaca* Peck. *Gym. clavipes* was detected for the first time on Juniperus communis at Weymouth, Mass., by Mr. J. F. Humphrey, and was afterwards found on the same host in another locality by Mr. Thaxter. Cultures were also made of the foliicolous *Gymnosporangium*, which causes the well known bird-nest distortion of J. Virginiana, which is stated in my paper on "Gymnosporangia of the United States" to be a form of *G. clavipes*. The shape of the spores and their pedicels, and the fact that they sometimes germinate at both ends as in *G. clavipes*, lead me to refer the bird-nest form to that species. This view is incorrect, and the bird-nest form is rather to be referred to *G. conicum* DC., and the cultures made by Mr. Thaxter developed the æcidia of *Ræstelia cornuta* Fr. on Amelanchier, thus agreeing with Oersted's experiments. The spores of *Gym. clavariæforme* DC. on J. communis sown on *Cratægus tomentosa* were followed by *Ræstelia lacerata* Fr., also agreeing with Oersted's experiments. The cultures of spores of other species of *Gymnosporangium* are still under way and have given some interesting results already, but a full statement will appear later in Mr. Thaxter's paper.—W. G. FARLOW.

The Arillus in Asimina was described by me and figured from Sprague's drawings in the Genera Illustrata. Some botanist, I think M. Baillon, has controverted the statement, taking the view that the so-called arillus was only a false membrane, a condensation of the pulp of the pericarp around the seeds. Fresh fruits of A. grandiflora and A. pygmæa, communicated by Mr. Curtiss from Florida, clearly show the distinct and rather firm membrane, investing the seed and firmly attached at the hilum. I have not been able to study its formation and growth, which is still needful.—A. GRAY.

Gymnosporangium macropus on Pirus coronaria.—The "cedar apples" were gathered from several small trees of Juniperus Virginiana on April 12th, and before any of the gelatinous masses or "horns" upon the excrescences had made their appearance. The "apples" were placed in water on a plate in the laboratory until the spores had germinated and produced their sporidia in great abundance. On April 23d, sowings of the sporids were made upon the young leaves of the wild crab apple (Pirus coronaria).

The leaves and tips of branches sown were at once covered with sacs of cloth similar to those used in crossing and hybridizing plants. The same number of sacs were placed upon tips of twigs on which no Gymnosporangium spores had been sown.

By the method of forcing the growth of the cedar apples by keeping them moist and in a warm room, the danger of a previous inoculation of the leaves sown was avoided.

On May 12th spermagonia were found in abundance in process of formation upon the leaves in every instance where sowings had been made. On the other hand, not a sign of a fungus was observed on the unsown leaves under the sacs or on any other parts of the trees. The success of the inoculation was so complete that the leaves receiving the sporids were on May 17th almost entirely orange-colored and the affected twigs could be distinguished several feet away.

On May 17th a second series of sowings under sacs was made. Two weeks later all of these latter had developed the fungus, while the leaves of the first sowing were becoming covered with dark dots, indicating the maturity of the spermagonia. After making the second sowings under sacs a quantity of the Gymnosporangium sporidia was scattered over the leaves of certain branches and left uncovered. At the time of writing these branches are easily distinguished by the prevailing orange-color of their affected leaves. The natural sowings are now beginning to develop as small orange spots, but they as yet are few in number and behind those from the artificial sowings. In case of the inoculations that have been made through the agency of the wind the spots are small, circular, and appear as the growth of one spore; while in the artificial sowings the blotches are very irregular and far more vigorous. The leaves first inoculated are now thickening in patches, preparatory to the formation of the rœstelia state of the fungus. It remains to determine the species of the rœstelia and carry the spores back to the cedar and determine if they will produce the teleutospores of the fungus direct, or whether a uredo state is necessary to complete the cycle of forms in this polymorphic fungus.

Sowings have been made upon the cultivated apple and other species of Pirus, as well as upon the genus Cratægus, but these results are less pronounced and not ready to be set down.—BYRON D. HALSTED, *Iowa Agricultural College, June 15.*

EDITORIAL.

THE *Popular Science Monthly* for June contains a portrait and biographical sketch of the late Dr. George Engelmann. The author is anonymous, but can hardly have been a botanist or he would not be so ignorant of the true authorship of the classic "*Plantæ Fendlerianæ*" as to say—

"In 1849 Dr. Engelmann published in the 'Memoranda [*sic*] of the American Academy of Arts and Sciences' the 'Plantæ Fendlerianæ.'"

He infelicitously adds, regarding Fendler—

"Fendler and he [Engelmann] had become acquainted on a governmental expedition to the Rocky Mountains, to which the former was attached as engineer. * * * He traveled in the Rocky Mountains, California, Mexico, Central America and Brazil."

Fendler did not become acquainted with Engelmann in this way; he was never attached officially to any governmental expedition; he was not an engineer; and he traveled neither in the Rocky Mountains, nor California, nor Mexico, nor Central America, nor Brazil! The writer of the paragraph can find correct information on these points in Fendler's autobiography published in this journal for June, 1885.

IT IS TO BE hoped that all botanists are taking note of the good things being provided for them at Buffalo. This meeting of the Botanical Club promises to be the largest one ever held, and being in a most interesting locality, can hardly fail of being both enjoyable and profitable. The great thing is to become acquainted with each other, and with the excursions and receptions arranged for, abundant opportunity for this will be given. Every one should come prepared to give some item to the club, the meetings of which are wholly informal. The first meeting will be held in the room assigned to biology, on Thursday morning at nine o'clock, the second day of the Association. No one interested in botany should fail to register and receive the badge of the club.

THE "HERBARIUM NUMBER" brought in so much material that it was impossible to crowd it all into our thirty-two pages. Nearly eight pages were held over and are given to our readers in this number. The stress of good material has become so great that we have been compelled to enlarge this number to thirty-six pages. Our contributors must not be deterred by this fact from continuing to send articles, but it explains the occasional delay in their appearance, a necessity regretted by no one more than the editors.

THE ONLY addition (so far as we know) to be made to the list of Engelmann's botanical papers. published in this journal for May, 1884, is his elaboration of the Euphorbiaceæ in the Bot. Mex. Bound. Survey. If the writer of of the sketch of Engelmann in the *Pop. Sci. Mo.* for June, who remarks that the list is incomplete, can add anything to it, he will confer a great favor on botanists by designating the omissions.

OPEN LETTERS.

Concerning Labels, etc.

While we are bringing together our various herbarium notions, let me say a word about labels. The point I chiefly wish to make is the importance of printing them legibly, and in good Roman type, on paper that is not too stiff. I think that one who has ever had much experience in attaching labels to the sheets will agree with me that one that curls upon itself when wet with the paste is a nuisance. Again, as the rule is to preserve the original collector's labels when sent, is it too much to ask of one in the field to make these as neat as possible? It is perfectly practicable to take with one on an excursion evenly cut slips of paper, instead of odds and ends of envelopes. Of style in labels I have spoken elsewhere; surely it exhibits the "man himself" as much as any style under heaven. I have in mind now certain examples always conducive to ophthalmia.

A word, too, concerning the forwarding of plants for exchange or identification. Do not snip off the tip end of a raceme and forward it to a botanist, without leaves, fruit, or underground parts. In fact, do nothing slovenly. I have had, and that recently, mildewed, discolored fragments sent me, and that by so-called botanists, tied together with strings, with long ribbons of paper wrapped around them for labels, and all rolled up in newspapers. With a beginner one is patient, but he loses his temper when one bedecked with collegiate degrees is guilty of such an offense. Particularly is such an occurence exasperating when the eviscerated fragments misrepresent plants which are *desiderata*.

Brown University, Providence, R. I. W. WHITMAN BAILEY.

Corrections, and a Dredge.

Please allow me to correct one or two typographical errors which occur in my article on collecting water plants, on page 139 of your last issue. I said, or meant to say, "Of the *thirty* species (of Potamogeton) found in North America," not "*thirteen* species," as you have it. On page 140 the phrase "the specimens should first be floated in water upon card-board, in the same manner as the coarser plants," should read, "floated in water upon card-board *and then dried on the board*, in the same manner," etc.

I beg leave to add a word as to a *dredge*. A very satisfactory article can be made of a small garden rake, such as is kept in almost all hardware stores for use in the flower garden. It has five or six teeth, each about two inches in length. Sometimes there are two or three teeth on the upper side also; these should be filed off, as they are liable to catch and tear the plants when wrapped about the rake. Saw off the handle of the rake, leaving about ten inches of it near the teeth, and your dredge is ready for use. It can be carried in the pocket or case till wanted, and then it may be tied to a pole, and used out of a boat or from the shore at pleasure.

For depths of water greater than eight feet, something like the crab recommended by Dr. Allen is better, but that can be used from a boat only, and is constantly liable to turn on the back, or to have the line broken by being fouled on the bottom. It does admirably for Characeæ, but the rake works better for larger aquatics. THOMAS MORONG.

Ashland, Mass.

Exotics in the Herbarium.

It might be well for the different herbaria, now so widely distributed, to add, for the particular instruction of the public, a collection of the exotics cultivated in gardens and conservatories. These are, of course, subject to incessant additions and mutations, but are of extreme interest. Such a department might well be kept separate from the general herbarium. Perhaps my idea is not altogether possible, but I think it has good in it, and hence venture to put it forth. W. W. BAILEY.

Brown University, Providence, R. I.

Books of Reference.

My books of reference are kept in book-cases in the room assigned to the herbarium. Thus, De Candolle's Prodromus, Walper's Repertorium, Müller's Annales, Bentham & Hooker's Genera Plantarum, and the many local floras, etc., etc., are all kept in the herbarium. In like manner the systematic literature of the lower plants is found in the same room.

I speak of this, because I know that in many places the botanical books are still considered as belonging to the general college or university library.

University of Nebraska, Lincoln, Neb. CHARLES E. BESSEY.

Herbarium for Sale.

Mrs. C. Robinson, widow of the late James F. Robinson, of Frodsham, England, being in straitened circumstances, desires to sell her husband's herbarium of British and foreign plants, valued at £30.00 for the small sum of £10.00. Her address is Main street, Frodsham, Cheshire. The specimens I have received from Mr. Robinson were excellent. It is a good chance to secure a herbarium of foreign species and to help a worthy lady who is left with seven children to bring up. W. W. BAILEY.

Providence, R. I.

Carices Wanted.

I desire to obtain live roots of all the Carices, especially at present of C. bullata, C. glaucodea, C. formosa and C. debilis.

Agricultural College, Mich. L. H. Bailey, Jr.

CURRENT LITERATURE.

British Fungi (*Hymenomycetes*). By the Rev. John Stevenson. Vol. I., Agaricus-Bolbitius. Edinburgh: Wm. Blackwood & Sons, 1866. pp. 372. Large 12mo. Illust.

It is two years since the preliminary notice of this work was received. The part before us bears out the high estimate then given it (Bot. Gaz., 1884, p. 116), and shows that the interval has been well used to perfect it in many ways.

The complete work will embrace a second volume. The present one is mostly filled with the genus Agaricus, which covers 346 pages, and includes 782 species. The few remaining pages give 33 species of Coprinus and 7 species of Bolbitius.

The order and number of the species are essentially the same as given by M. C. Cooke in his Handbook, a revised edition of which is now publishing as a supplement to *Grevillea*. Both works are founded upon the classic writings of Fries, and it is in the translation and interpretation of these that the present work aims to be superior to anything yet offered to the public. There are other featnres which will also strongly commend themselves. The descriptions of the species have been made more comprehensive, with the diagnostic characters indicated by italics, the convenient method used for flowering plants. To the descriptions are appended ample notes giving additional items drawn from careful observations, and also comparisons between different species which must prove of especial service in determining material. There can be no doubt of the value of good measurements, and it is a pleasure to find that these have been supplied for nearly every species. The size of the spores is given in mikros, and the authority for each measurement is appended. When authorities differ the user has the advantage of independent data.

The illustrations scattered through the text—thirty-nine for this volume—are drawn to scale, and are as good as could be expected. They are by W. G. Smith; their accuracy can not be questioned.

The large number of British species, which are also found in this country, makes the publication almost as great a boon to American collectors as to their fortunate associates across the water. It is a thoroughly satisfactory handbook, being the result of superior literary knowledge and extensive practical and critical acquaintance with the plants. A number of the first mycologists of England have taken active part in its preparation, including the Rev. M. J. Berkeley. We do not doubt that its sale in this country will be sufficient to aid materially in making it evident to the publishers that such a work is demanded and appreciated.

Handbook of Mosses, with an account of their structure, classification, geographical distribution and habitats. By James E. Bagnall, A. L. S. London: Swan Sonnenschein, Le Bas & Lowrey. 12°. pp. vii. 96. 1886.

This little book is not so pretentious as its title, and will serve a good purpose in enlightening beginners as to how and where to collect mosses, and how to prepare them for permanent preservation and study. The book is specially intended for young collectors and to them it will be helpful. They should be cautious however in relying too implicitly on the portions relating to the structure and development of the sexual organs and the fruit, where we notice some serious errors, apparently of carelessness. The engravings are poor, but at the very low price of the book (one shilling) we could hardly expect an elaborate work. It is well worth the money.

NOTES AND NEWS.

PROFESSOR CHAS. R. BARNES received the degree of Ph. D. at the last Commencement of his *Alma Mater*.

THE FOURTH VOLUME of Saccardo's Sylloge Fungorum, which includes 3,583 species belonging to the Hyphomycetes, has just been issued.

A CHEMICAL STUDY of Yucca angustifolia has been made by Helen C. DeS. Abbott of which reprints from the transactions of the Amer. Philosophical Society have been distributed.

J. C. ARTHUR received the doctorate in science during the recent commencement at Cornell University. The subject of the thesis presented was "History and biology of the pear blight."

MR. A. B. SEYMOUR, for the past year Professor of Botany in the University of Wisconsin, has resigned that position to accept the curatorship of the cryptogamic herbarium of Harvard University.

THE BIOGRAPHICAL SKETCH of the late Dr. Tuckerman in the Amherst *Record*, from which the GAZETTE notice was condensed, was written by Professor Goodell and not by Professor Tyler as was stated.

THE JUNE NUMBER of the *Pharmaceutische Rundschau* contains an interesting paper by Prof. J. M. Maisch on Mühlenberg as a botanist. We regret that lack of space prevents our giving extracts from the lecture.

MR. L. G. YATES, of Santa Barbara, Calif., is preparing a catalogue of all known ferns giving synonymy, habitat, etc. He will gladly receive and give credit for any information concerning new species, new habitats, etc.

BOTANISTS WHO have fruiting specimens of any species of Dentaria will confer a favor by sending them to Dr. Sereno Watson, Botanic Garden, Cambridge, Mass., who will be glad to repay postage and return specimens if desired.

IN THE SMITHSONIAN REPORT for 1884, just issued, Professor Theodore Gill, in his scientific record for that year in zoology, includes Myxomycetes among the Protozoans. In the bibliography of zoology, Zopf's "Die Pilzthiere oder Schleimpilze" is included.

OWING TO AN unlooked for increase in the subscription list of the GAZETTE the January issue for this year has been entirely exhausted. Unless copies can be obtained from those who have duplicates the subscriptions now coming in will have to begin with some later number.

IT IS NOTED with pleasure that the University of North Carolina has conferred the degree of LL.D. upon Dr. A. W. Chapman, of Apalachicola, Fla., and Mr. H. W. Ravenel, of Aiken, S. C. A tardy but well deserved compliment to these most eminent southern botanists.

DR. W. G. FARLOW has contributed notes on arctic algæ to the proceedings of the American Academy. They are especially interesting in the study of distribution. The collections were made by several American explorers, but principally by Mr. L. M. Turner Ungava bay.

SOME INTERESTING abnormal forms of Vaucheria are illustrated by Douglas H. Campbell in the *Amer. Naturalist* for June. The positions of the oögonia of V. geminata, var. racemosa are variously occupied by clusters of oögonia and vegetative filaments, and the antheridium in one case is replaced by a vegetative filament.

THE WEEDS against which the weed law of Wisconsin is directed are "Canada thistles, burdock, teasel, white daisy and snap dragon." There has been some doubt in the minds of the people regarding the particular plants to which these names apply, and Professor A. B. Seymour has done an excellent service in the interpretation which he has given in the third report of the Agric. Experiment Station of that state. The paper also contains much information about the habits of the plants, the history of their introduction into this country, and methods to be used in their extermination.

CALYPSO BOREALIS has not usually been credited with the possession of coralline roots. These were pointed out to Dr. Gray several years ago by Mr. Hitchings, of Boston, and the fact was called to mind lately by seeing such roots on fine specimens of this beautiful orchid brought to the Botanic Garden at Cambridge from the White Mts. by Dr. Goodale.

FROM A STUDY of Mahernia verticillata Mr. Meehan has been led to suggest as a theoretical explanation of many opposed stamens that they are developed from axial buds at the base of the petals. He does not mean to deny that in such case the stamen is not a phyllome structure, but that this structure is developed on an arrested branch and hence axillary.

THE WHOLE of Dr. M. C. Cooke's extensive herbarium of fungi has become the property of the British government, as we learn from *Grevillea*, and has been transferred to the Royal Gardens at Kew. It will be incorporated with the general collection, which is a wise thing to do. The collection of the Rev. M. J. Berkeley is at the same place, but kept distinct.

THE PROCEEDINGS of the sixth meeting of the Society for the Promotion of Agricultural Science (1885) has come to hand. It contains the following botanical articles: Vitality of seeds buried in the soil, W. J. Beal; The demands made by agriculture upon the science of botany, C. E. Bessey; Notes on injurious fungi of California, W. G. Farlow; The dandelion and the lettuce, E. R. Sturtevant; Variation in cultivated plants, W. W. Tracy.

A NUMBER of bacterial diseases of lepidopterous larvæ have been distinguished and carefully studied by Professor S. A. Forbes, of Illinois University. Artificial cultures of the bacteria were made, and the disease communicated from these to healthy larvæ. Descriptions and measurements of the bacteria are given, and the micrococcus producing flacherie in the cabbage worm is illustrated with photographs. This paper forms one of the bulletins of the Illinois State Laboratory of Natural History.

A REPORT on fruit blights and diseases of fruit trees made to the government of New Zealand by Professor T. Kirk shows that the people of that country are awake to the economic value of systematic observation and investigation in this subject. The report deals mostly with the depredations of insects. From it we learn that the most serious enemy of the apple is known as the American blight, which is a woolly aphis. What is called fire blight in the pear has no resemblance to the fire blight of this country, but is due to a parasitic fungus, a species of Rœstelia. The principal obstacle to successful peach culture is the peach blight. Thousands of acres of peach orchards have been destroyed by it, and from being one of the most common fruits in the colony, it has now become the rarest. The cause is not known, but it does not appear to be due to insects. It bears no resemblance to our peach yellows. The peach yellows and pear blight of this country have not been observed in New Zealand.

VOL. XI, NO. 8.—BOTANICAL GAZETTE.—AUGUST, 1886.

The Flora of our South-western Archipelago. I.

WM. S. LYON.

Under this very general heading, extended reference will be made to the flora of Guadalupe Island, which though lying far to the south of the Santa Barbara group, and without the territory of the United States, is affected by so many phenomena and conditions identical with those existing upon the more northern islands, that as might be expected the floras of each reveal many features of common interest and, as we expect to show, common relationship.

Speculations as to the origin, development and limitations of insular species enhance in value with the extent of the field under observation. With this end in view casual reference will be made to plants characteristic of islands other than those under direct consideration, but of whose flora our knowledge is still so fragmentary and imperfect, that until exhaustive collections shall have been made therefrom, ultimate conclusions based upon such references must be largely hypothetical and subject to future modifications.

The writer has enjoyed the rare advantage of several visits at different seasons of the year to some of the islands of the Santa Barbara Archipelago; made copious collections and field notes, and had, possibly (thanks to the courtesy of the San Clemente Sheep and Wool Company, and to the principal lessee of Santa Catalina Island), better facilities for the careful and extended observation of their respective floras, than had Messrs. Dall, Gambel, Wallace or Dr. Cooper, who had previously made brief excursions to one or more of these islands.

As for the islands to the south, Prof. Watson's admirable monograph on the "Flora of Guadalupe"[1] and the recent vigorous paper on the same subject by Mr. Greene,[2] together with ample specimens from Guadalupe, Cedros and the adjacent mainland, kindly communicated by the latter gentleman, has supplied me with invaluable material for a fair comparison of the flora of these islands with each other and with the immediate continent.

The general physical conditions existing upon our west coast islands seem to favor rapid and striking modifications in organic life, and if we show this to be the case, then their products afford

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[1] Contributions to American Botany by Sereno Watson, Proc. Am. Acad. XI, Feb. 1876.

[2] Studies in Bot. of Cal. and parts adjacent, by Rev. Ed. Lee Greene, in Bull. Calif. Acad. No. IV.

interesting material for the study of the durability and stability of species.

The short interval of ten years between Dr. Palmer's and Mr. Greene's visit to Guadalupe points strongly to the possible extinction of some species, the introduction or genesis of others.

Notably in the cases of Hosackia grandiflora, Juniperus Californica var. osteosperma and Polypodium Scouleri,[3] we apparently have examples of extinction proceeding at a rate sufficiently rapid to bring it within the observation of a single generation of man.

On San Clemente I noted in great profusion the lifeless stem and root of a Cotyledon and can readily credit the statement made to me that only eight years ago the island was fairly carpeted with this plant. A season of drouth drove the sheep to feed upon it, and it is easy to conceive that a succession of better years by affording more wholesome pasture and thus diverting the attention of the stock might enable the species from the few remnants left upon wholly inaccessible rocks to once more regain its pristine supremacy.

A species reduced to the verge of annihilation, or to so critical a condition as the Guadalupe Juniper, might, through a short succession of seasons of ample rainfall, be readily restored to its original vigor.

These somewhat forced illustrations are used to emphasize the fact that on little known islands the utter extinction of species is and will be a difficult matter to establish beyond a doubt. The same remarks apply in reference to the supposition of the recent introduction or creation of new species; some in such abundance now as makes it seem improbable that they should have escaped the keen scrutiny of the expert collector; yet in default of affirmative proof to the contrary, we must ascribe their absence to the first collector's omission rather than to the hypothesis stated.

Though entirely out of order to criticise any part of Mr. Watson's paper at this late day, I can not but express surprise that so conservative an author in drawing his final inferences should lay particular stress upon the absence of certain orders and genera of plants upon Guadalupe.

Due recognition does not seem to have been given to the fact that Dr. Palmer's collections were made in the spring and early summer, and hence (if the flora be at all Californian) would entirely fail to illustrate any of the later flowering Compositæ or Polygonaceæ.

[3]Bull. Cal. l. c., p. 210.

Many species of Eriogonum would scarcely be showing above ground by the end of May. In June, 1884, after a season of unprecedented rainfall and retarded vegetation, I could find no trace of Eriogonum nudum upon Catalina; the same localities revisited in July, 1885, a season of early maturity, showed an abundance only half-grown, and it was not finally obtained in perfection until October, of the same year.

Mr. Greene's discovery of Brodiæa capitata in abundance on Guadalupe conflicts with "the almost entire absence of Liliaceæ",[4] though failing to see any representative of that order upon Mr. Watson's list, the "almost" might have perhaps been altogether suppressed.

That the occasional errors which appear in scientific reports are due to the hasty ill-digested notes of explorers is illustrated in the published accounts of some of these islands.

Dr. Cooper found San Clemente to be "an island with scarcely any soil covering the rocks" * * * * * "and seems never to have been much resorted to by animals."[5] The first of these propositions is true only of the immediate neighborhood of the usual landing, which is environed by sterile rocks, and at low points along the coast by long reaches of barren sands. The mesas or table lands of the interior, however, show a great extent (many thousands of acres) of fine organic soil of great depth and apparent unbounded fertility. The second proposition is almost as faulty; of marine mammals such as seals, sea lions, etc., it has always, until exterminated, been the favored resort; while the island, since the earliest settlement of the country, has been overrun with field mice and a pretty little gray and red fox, the latter peculiar to the Santa Barbara group, and reported as never having been found on the adjacent mainland.

The absence of soil would imply the absence of much vegetation, combined with absence of animals it would imply a country almost unfitted to sustain organic life, and convey to the average mind a desert or howling wilderness, instead of a land of promise capable with water development of great possibilities. The same authority reports the existence of "one good spring of water upon Catalina," another statement which, though undoubtedly true, is hardly comprehensive enough, as after a season of unusual drouth (1885), the writer noted forty-two springs, streams, wells or different sources of water upon that island.

In comparing the floras of these islands with each other and

[4] Proc. Am. Acad. l. c. p. 3.

[5] Geology of California.—Vol. I. p. 183.

with Guadulupe, a brief geographical sketch of the principal islands of the Santa Barbara archipelago seems unavoidable.

Santa Catalina lies a little southwest of the shipping port of San Pedro, Los Angeles county, Cal., distant about twenty miles. Clemente has nearly the same bearings from San Pedro, and is some fifty miles distant. These islands as respectively named, are about twenty and twenty-two miles long with varying widths of three to eight miles. Both lie nearly northeast and southwest, and in shore line conform generally to the trend of the coast at Santa Barbara. Both are of volcanic origin; Catalina showing not only extensive lava masses but a well defined crater, and probably, like Guadalupe, was the result of one subterranean upheaval or disturbance.

Like that island, it is traversed for its length, excepting only at the isthmus near the west end, by a lofty and terribly precipitous mountain chain which, branching occasionally, makes place for several large, fertile, well-wooded and well-watered valleys.

Clemente is unquestionably the product of many upheavals, proven by the succession of terraces extending for its whole contour. The fact that the sea along the line of its former tide levels has not only smoothed and worn the faces of these adamantine basalt terraces, but mined great caves in them, is sufficient evidence to assume vast lapses of time between some of these disturbances. This porphyry formation, overlaid with a great depth of soil where shown by the excavations made by Indians when walling in their villages or walling out the winds, together with the terrace formations is enough to justify us in claiming for this island an antiquity far greater than either Catalina or Guadalupe. If this be true, then we might reasonably expect to there find a flora more distinctively peculiar than that pertaining to either of the other two islands. Such is not the case, however, and the geology of the island apparently is not verified by the botany as we now find it. Whether this apparent antagonism is real or fictitious, and due, and to what extent, to modifications arising from artificial or external causes, we will endeavor later to determine. As in Guadalupe, ice and snow are not of rare occurrence in the mountain valleys of Catalina, although the lesser elevation of Clemente probably exempts it from these phenomena.

Neither of the northern islands show any signs of the tropical vegetation (Erythæa) obtained in Guadalupe.

Lying more in the lee of islands to the north (Santa Cruz, Anacapa and Santa Barbara), the channel which separates Santa Catalina from the mainland is always smooth and pacific, save in the rare instance of the southeast gales, and from that island's greater proximity and readier accessibility to the mainland, as might be expected, it shows a larger preponderance of continental forms of vegetation than exist on either of the others.

The outward channel to Clemente is often boisterous in the extreme; and the long, unbroken surges of the Pacific give the squeamish traveler in a small boat the full flavor of a protracted sea voyage.

Nearly identical climatic conditions prevail on all three; cooler in winter than the mainland, hotter and drier in summer on the south sides, owing to the deflection of the cooling fogs by the mountain tops.

The prevailing winds and ocean currents are similar to those affecting Guadalupe, and whose nature and influence has been so clearly and ably set forth by Mr. Watson, that I can not do otherwise than refer for the details to his admirable paper.[6] Therein he shows the nature of our prevailing winds are in every way antagonistic to the introduction of continental species to Guadalupe; curiously he seems to have overlooked the converse of this proposition, which would be that this agency would actively favor the distribution of insular species to the mainland.

Whilst recognizing as a factor, I am of opinion that the value attached by authors to the common media of seed transmission, *i. e.*, agency of man, beasts, birds, watery currents and winds, is somewhat over-estimated; the history of our island plants tends to confirm and strengthen this belief.

1. The case of *Malacothrix insularis* Greene, and *Lavatera insularis* Wats. confined to the Coronados Isles, though only distant seven miles from the mainland.

2. The limitation of at least three well-defined species to Cedros,[7] which with the island of Natiridad forms the western barrier of San Sebastian bay, Lower California, and whose topography would seem to indicate that at no distant epoch they formed a continuous part of the mainland.

3. A new species of Pentachaeta, found originally near San Pedro in the spring of 1884 and confined to the area of a few square yards, was the following year traced to its original habitat on Catalina Island. The spot where found on the mainland has been for twenty-five years past constantly used for pasturing

[6] Proc. Am. Acad. l. c., p. 107.

[7] Veatchia Cedrosensis, Œnothera Cedrosensis and Senecio Cedrosensis.

No account is taken of *Krynitzkia Cedrosensis* Greene, less on account of its doubtful specific value than from the fact that apparently coincident forms have been collected on the mainland; but the whole genus is regretfully excluded from our consideration; the burr like character of the fruit makes it peculiarly available for artificial distribution and the establishment of a well-defined species so near the mainland, yet limited to the island, would be a potent argument in behalf of the opinion expressed.

sheep just disembarked from that island, and the case cited is probably as direct evidence of the agency of animals in seed distribution as any that could be quoted; nevertheless, with every circumstance conspiring during very many years to favor its introduction in manifold, the total "crop" of 1884 might readily have been the product of one fertile akene growing and maturing the previous year!

4. Prunus occidentalis is a species which, from its abundance, gives character to the vegetation in parts of Catalina. Its great size (25 feet) and conspicuous beauty seem to preclude the possibility of its having escaped the notice of the most unobservant explorers of islands to the north or south, and it is probably safe to assume its confinement to this island alone of all on our western coast, yet it is reported to me as native of the West Indies. The abundance of young and flourishing seedlings indicate that it germinates readily; while its large and luscious drupe greedily fed upon by squirrels, sheep, goats, birds and man would seem to provoke its widespread and rapid distribution. It grows far up on the roughest interior mountain ridges at an elevation of 3,000 feet, and down the fertile valleys and cañons to the very water's edge; at all altitudes and all exposures it flourishes with unequaled vigor, yet no trace of it exists on Bird Island, barely two miles distant.[8]

5. A somewhat analagous case is that of the Lavateras. This genus is largely represented on most of our western islands, from Anacapa on the north to San Benito, Lower California, on the south, with probably no congener on the mainland other than escapes from gardens where it has been largely planted. Yet the genus is indigenous to the south of Europe and adjacent islands: that it should owe its presence in the occident to the common methods of seed dispersion and leave no trace upon intervening continents is somewhat improbable: that it is due to systematic transplantation upon uninhabited islands is more than improbable —it is an unreasonable supposition.

That a great ocean is not an insurmountable barrier to the migration of species is a fact commonly known. A single Asiatic species of Castilleia illustrates it; yet that genus sweeps along the whole western coast of North and South America, from Arctic to Antarctic zones, and the chances have weighed heavily in its favor of finding an outlet from some of its myriad sources: no such conditions, however, obtain in the case of the Lavatera or

[8] For the benefit of botanists who have not seen it I wish to say that P. occidentalis is a most beautiful tree whose symmetrical form, glossy coriaceous leaves and white flowers approximates in appearance an orange tree, and in some valleys it forms unique plantations every way comparable to an orange grove.

still more restricted Prunus. That the physical conditions surrounding our island plants are extremely favorable for the rapid development, perfection, retrogression and perhaps ultimate extinction of new species, certain observations of their habits tend to show.

Of plants or species found conjointly upon the islands and mainland, the island forms are inclined to vary. The variation the most uniform and striking of all is in the preponderance of giant growths.

Brodiæa capitata on Guadalupe, though restricted in area, was of such great size as to elicit surprise from Mr. Greene that it should have escaped the notice of his predecessor, Dr. Palmer. The same plant on Clemente, also within narrow limits, showed the same immense habit. Mr. Watson unqualifiedly referred it to B. capitata, only noting immense size and a trifling difference in the stamens, not enough to justify varietal rank. Its absence from Catalina, apparent absence from Guadalupe only ten years ago, and scarcity on Clemente, induces me to think that not only is it of recent introduction from the mainland, where in many localities its abundance gives character to the spring vegetation, but that it is even now in a transitional state. That the presence of identical physical conditions should elaborate similar forms on even widely sundered islands, is not improbable; hence, to quote the ideas, if not the words of the distinguished author of "Plant Variations," it is not difficult to believe, that on each island, within a few plant generations, we may witness the outgrowth of a distinctively new type, sprung from a common stock, but different individuals, and varying from the parents with similar variations. This hypothesis would cover the case of the Prunus (the genus being continental), provided we could show co-existence at some past time of like conditions upon Catalina and its present West Indies habitat.

I revert once more to the genus Lavatera as showing not only abnormal development of island species, but illustrating the facility of some species to become exhausted or extinct when palpably uninfluenced by any other than strictly natural causes.

It is commonly known that very many plants, with skillful manipulation, "improve" under cultivation; *i. e.*, at least increase the size of flower and leaf. This is anything but the case with Lavatera assurgentiflora, which I collected on Clemente from larger plants, in finer foliage and greater size and brilliancy of flower than anything observed in gardens. Its introduction into cultivation, and from having become occasionally spontaneous upon the mainland, must forever be a bar to its complete extirpation; yet the *natural* tendency of the species I think we can show to be on the decline or toward extinction. Sealers report that once abundant upon Anacapa and San Nicolas, it is now scarce; on Clemente, it was only observed in two localities, and only one or two plants in each; yet only a dozen years ago it constituted unbroken forest, extending for miles upon the high plateaus. Extraneous causes alone are not sufficient to account for its disappearance; the few luxuriant specimens left are readily accessible to sheep and goats, and their ravages unsupported will not explain away its manifest decadence.

No trace of it is found on Catalina Island, and Bird Island, a rugged, rocky islet not two miles distant, carries it in some profusion. The latter island is not used for grazing stock, while Catalina is; yet a resident on that island before the first sheep or goat was introduced, thoroughly familiar with the plant, and for whose close observant power I have the highest respect, assures me that he has never seen a single plant within its limits.

Of other plants having mainland representatives, and whose heroic size arrest attention, we may briefly mention Solanum Xanti, var. Wallacei—a rank growing form.

Of Ceanothus sorediatus, from Catalina, Dr. Gray says, "never saw it before in such large leaf and fruit."[9] On the southern mainland a straggling shrub of 12 to rarely 15 feet; here it becomes a tree of 25 feet.

Our common Convolvulus occidentalis of the mainland becomes the well defined *C. macrostegius* Greene, although in elaborating the species he lays no especial stress upon its size.

Elymus condensatus in rich damp soils is not infrequently 6 feet or more upon the mainland; in dry sterile places on Catalina it overtops a tall man on horseback.

The genus Eriogonum which we readily recognize by its preponderance of tiny forms and slender, delicate habits of growth, confounds all our preconceived ideas by developing into immense arborescent species upon the islands. *E. arborescens* Greene of Santa Cruz I have not seen, but from name and description it presents a marked difference from anything continental. *E. giganteum* Wats. shows a contrast still more striking, outstripping in heroic dimensions anything yet known in the genus. Not rarely a bush 10 feet in height and the same diameter, uniformly topped with its magnificent cream-colored cymes eighteen inches

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[9] In a letter. = C. arboreus Greene! exs. vid.

in diameter, it forms one of the most beautiful and interesting features of our island flora.

Prunus illicifolius Walp. on our coast range mountains a small leaved, straggling shrub; on Catalina becomes a stately tree of 50 feet with leaves 2½ inches long.

Audibertia polystachya of abnormal size occurs on Catalina, and current with it A. Palmeri, common also to Guadalupe; the readiness of the genus to commingle and hybridize might lead us to anticipate under insular influences many modifications; none, however, were noted except in that of size.

The genus Rhus may be mentioned here as not only the genus of plants more than any other which from its abundance of individuals and species gives character to the vegetation of the island, but as might be expected shows a tendency to vary if not noticeably in size, at least in a manner not observed upon the mainland.

R. integrifolia was collected with very many ternate leaves, but in all other respects strictly identical with the normal type; observed in two widely diverse localities and in profusion. This form possesses great interest as marking perhaps the initial steps to subsequent specific modifications.

Leptosyne gigantea, another large type of probably strictly insular origin, is rapidly disappearing from at least the northern islands. The liking of man and beast for its succulent foliage as "greens" and "pasture" may account for its reported collection on the mainland, where it may obtain a stable footing, otherwise it must sooner or later have fallen within the great catalogue of unnamed ephemeral species which have once flourished, been modified, fallen into decadence or disappeared forever.

Examples could be multiplied, but the list as given is sufficient to show the activity of physical conditions upon these islands in the production of ultra vigorous vegetable growth. Further it should not be forgotten that the collections upon which these notes are based were made in a season of unparalleled drouth, when the collection of depauperate specimens upon the mainland was the rule, a season so adverse to the development of abnormal luxuriance in vegetation that the fruits of many species for the collection of which I especially revisited Catalina in October of last year, failed to mature seeds of germinative power.

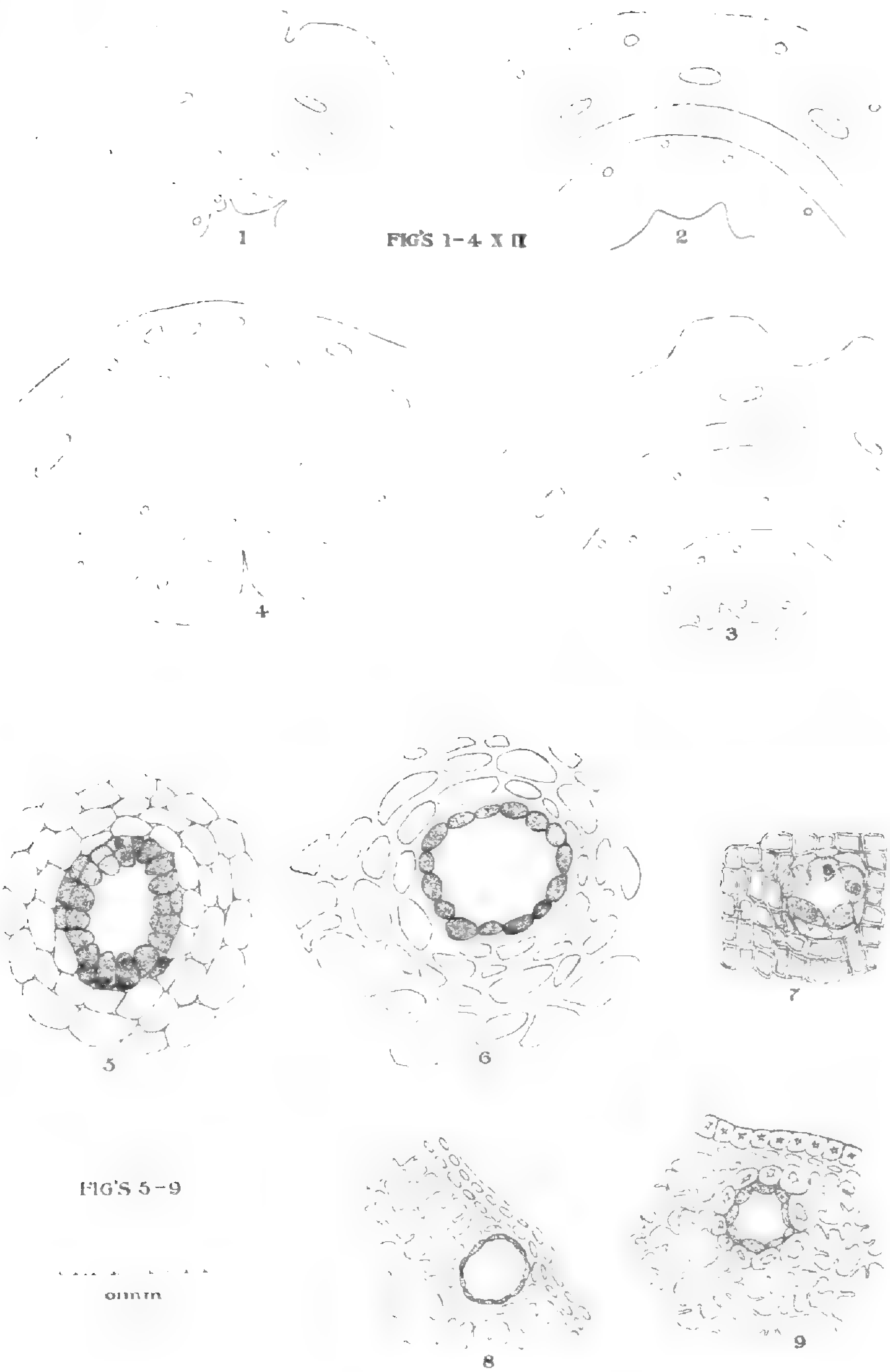
Structure and distribution of Resin Passages of the White Pine.*

ETTA L. KNOWLES.

WITH PLATE VII.

First a study was made of the general structure of the stem and leaf of the white pine (*Pinus Strobus*) with reference to both the relation and structure of different parts. The Scotch pine was studied in the same way and afterwards a comparison made between the two. Stems of one and two years growth were taken of each species and put into alcohol for the purpose of removing resin, and the material thus preserved was ready for use as needed. Leaves of each and young shoots cut at intervals of a few days were treated in the same way. Thin sections were cut, stained with Schulze's Solution and mounted in glycerine. For each point studied sections were taken of a dozen or more different stems. Drawings and measurements were all made with the camera. Upon comparing stems of the two species it was found that the general appearance is much the same, pith at the center and formed about it in successive rings, wood, cambium, phloem, cortex and epidermis, the main difference being that in the Scotch pine there is but one row of resin passages in the cortex and two rows in each year's growth in the wood, while in the white pine there are two rows or rings in the cortex and one row in each year's growth in the wood. In the cortex of the white pine the number of resin passages was found in some instances to be as high as 47 in a stem of one year's growth, while in the Scotch pine 9 or 10 seemed to be the limit. Figures 1, Scotch pine, and 2, white pine, show the distribution and arrangement of the resin passages in the two species in stems of one year's growth; figs. 3, Scotch pine, and 4, white pine, show the same for stems of two years' growth. Taking stems of the two species of as nearly the same diameter as possible, it was found that in the cortex of white pine stems of one year's growth the number of resin passages ranged from 20 to 47, the average being about 33. The number in the wood was more uniform and averaged about 13, giving an average of about 46 in a stem of one year's growth in white pine. In the Scotch pine the average for the wood was found to be 33 and for cortex 10, or about 43 for both wood and cortex. In the Scotch pine one ring is irregular in outline and lies just within the wood surrounding the pith, as seen in figs. 1 and 3. The average

* Selected for publication from original work of students in the botanical laboratory of the University of Michigan, 1885-'86.



KNOWLES ON RESIN PASSAGES.

number for this ring was found to be 18. Taking the second year's growth in the same way the average number for cortex of white pine is 28 and for wood 27, or 55 for wood and cortex. Scotch pine for cortex 9 and for wood 37, or 46 for wood and cortex. From this it will be seen that the number of resin passages varies greatly with the individual as well as with the species.

Shoots of present year's growth taken from the tree at intervals of a few days, from April 30 to May 30, showed little change except in the increased growth of the woody portion. In the cortex there were found as high as 47 resin passages, the average being 38, but no traces of them could be seen in the wood. In shoots taken from the tree June 21, the woody portion had united to form a ring and two resin passages were found, one apparently just formed and still in the cambium, just at the line where wood and cambium meet. It was much larger than mature resin passages in the wood, the growth of the parts around not having compressed it. Resin passages in the wood of the white pine do not begin to form until about the last of June.

Resin passages in the cortex of the young shoot of the white pine are cylindrical and have no walls of their own, being bounded simply by the surrounding cells, which are all thin-walled. Fig. 5 represents a passage found in a shoot cut from the tree May 6. As the stem grows, the tube, small at first, may become larger by division of the cells adjoining it. After a time it becomes lined with thin-walled epithelium, the cells of which project into its cavity, the walls of the cells outside the epithelium thicken and by the pressure of the parts about it as the stem grows, the larger passages are pressed into an elliptical form as seen in cross sections. It is at last, then, a cylindrical or flattened cylindrical passage lined with thin-walled epithelium, which is surrounded by a layer or more of thick-walled cells.

A large resin passage is situated opposite each vascular bundle, while the passages near the epidermis are much smaller. From May 6th (fig. 5) up to May 30th there was little change observed, but by June 21st the passages in the cortex seemed to be nearly or quite developed, looking very much as is shown in a passage from a stem of a year's growth, fig. 6, the walls of the surrounding cells having become very thick.

The structure of the resin passages in the wood is different from that in the bark. They are much smaller. There is the same lining of epithelium, surrounded in this case by one layer of thin-walled cells, which come in contact with the tracheides, the layers of the thick-walled cells being wanting.

Comparing the resin passages in the leaves of the two species the number for the comparatively tender and delicate leaf of the white pine was found to be from 2 to 3; the number in the Scotch pine from 5 to 8. They are nearer the surface in the leaf of the white pine, fig. 8, than they are in the leaf of the Scotch pine, fig. 9, the bounding cells in the former coming in contact with the epidermal cells.

The structure seems to more closely resemble that of the passage in the cortex than of that in the wood. There is the same lining of epithelium, very thin-walled, and the surrounding thick-walled cells, one layer in the case of the leaf, the surrounding layer being thicker in the leaf of the Scotch pine than in that of the white pine. The cells lining the resin passages of cortex, wood and leaf, form resin which they afterward pour into this canal. The cells surrounding the epithelium were found to contain a large amount of starch. The walls of these surrounding cells seemed to be thicker before growth started in the spring than afterward, sections cut from the tree in February showing thicker walled cells than those cut in April or May.

Notes on Campanula Medium.

BOLLING W. BARTON.

The plant upon which observations were made does not correspond satisfactorily with figures or description of this species, but I am assured by the best authority that it is nevertheless Campanula Medium. Only a single plant was under notice, and already many of its flowers had so far passed that the determination of several details of conduct of promising interest had to be deferred.

The flowers in question are of a delicate pink or rose color. The corolla tube is about 1¼ inches in length and ¾ inch wide at the mouth, and is not spreading like those of most of the genus, but is more cylindrical, being slightly constricted about half-way down the tube. The inside of the tube is entirely destitute of hairs. Reflexed lobes from between the sepals quite conceal the ovary. The flowers are uniformly erect and not horizontal or drooping, as is characteristic of many species. This character holds good until the corolla withers, when it may incline somewhat to one side. For the rest the structure is essentially like that of other species of Campanula, the peculiarities being the expanded base of the filaments fitting over the ovary and the linear introrse anthers, which lose their pollen on the hairy style as the flower unfolds, a good example of proterandy. Attention was directed to this plant by seeing in one of its flowers a large dipterous insect vainly trying to climb up its walls. After failing in this it turned to the hairy style, up which it climbed with ease, and over the stigma and took flight. The interpretation of these movements were simple enough, if they were shown to be constant. An insect visiting the flower for the nectar in the bottom of the corolla and not being able to escape by reason of the smooth corolla, except by climbing the style and over the stigma, and the plant being proterandous, cross-fertilization becomes almost inevitable. To test the matter further, especially as regarded the slipperiness of the corolla tube, the following experiments were made: A number of insects of different shapes and species were put into the flowers and their actions carefully observed. The first one tried was a small cricket, which was handled so as not to wound it, and was dropped into the flower. It at once began to struggle to get out, but failed to make the slightest headway, its feet taking no effect whatever, so far as could be seen with a pocket-glass, upon the corolla wall. It was left in this situation but was found to have escaped some hours later—probably by climbing the style or by a well directed jump.

The next thing tried was a medium-sized bumble bee (probably Andrena), which I had knocked off a flower and slightly stunned, but which had recovered sufficiently to crawl freely and even to use its wings. The most that this bee could do towards getting out when put into the flower was to turn about and raise its head, and so standing on end, its back to the style, clawed impotently against the corolla tube until wearied out. It was then left alone for an hour, when being touched with a straw it began again its struggles, with no better success than at first. After that it was turned around so as to face the style, when it easily climbed up and escaped.

A spider was the next subject and proved itself just as unable to climb the corolla as the others preceeding. It succeeded in getting out at last by resting one of its long legs against the style and working another one over the rim of the corolla and so drawing itself to the top of the cup.

I next made use of a small grasshopper, which also entirely failed to take any hold upon the corolla wall, and after imprisonment for some minutes succeeded in making its escape by jumping out.

Finally a house-fly was caught, and having had both wings carefully clipped with scissors was dropped into the flower. The result in this case was beyond expectation of those who witnessed the experiment, notwithstanding what had gone before. The aerobatic, glass-walking fly was just as impotent in its attempts to walk up the wall of the flower as had been the other insects experimented with. In a very short time, however, the fly discovered the easy exit by the style, and after a few lessons would turn to this means of escape without loss of time. Six times in quick succession did it come up by the style and was then allowed to crawl away.

During the performance of these experiments a number of small ants were running over these same smooth walls as if they had been sanded, and also several visitors in the shape of small diptera flew in and out and crawled wherever fancy led them without difficulty. But at no time did I see one of these ants or flies ascend the style. The ants were evidently in search of nectar, and from the caravan lines which had been established in and out of some of the flowers there is little doubt but that they were getting a fair supply.

In the books are to be found the following references to the cross-fertilization of Campanula Medium. Sir John Lubbock says "Insects visiting the flower for the sake of honey do not so far as I have observed generally walk on the petals, being deterred by the stiff hairs which are scattered on their inner surface. In any case, however, they are almost sure sooner or later to clasp the style when they necessarily dust themselves with pollen." Herman Müller has nothing bearing directly upon Campanula Medium. Delpino remarks that "In the large flowers of Campanula Medium I have almost always found some species of Cetonia, which probably is the insect best adapted to fertilize this plant."

The first large insect seen in the flower was clearly unable to fly out, the space between the style and corolla wall not being sufficient to allow for the spread of the wings; still more would this difficulty hold for one of the Cetonias mentioned by Delpino. But by climbing the style and on to the stigma the place of vantage would be reached from which the wing covers could be raised and flight made easy.

As regards the visits of the ants it was noticed that very soon after fertilization of the flowers a certain relaxation of the parts followed, and the ants could then without much trouble work their way into the chamber under the expanded filaments, in which is secreted the nectar. But in the newly opened flower this chamber is effectively closed against any small insects. To test the efficiency of the roof made by these filaments against rain the experiment was made of shaving off the ovary with a razor, leaving the upper wall so as not to disturb the relations of the base of the corolla and the filaments. Then with a small, sharp blade cut out from below the remaining upper wall of the ovary, taking care to clip off the style and leave it in place to fill the angular space which would otherwise be left. Having done this nothing is left to stop the lumen of the corolla tube but these filaments. If water be now dropped into the corolla it will be found to hold perfectly.

How any considerable quantity of rain which might fall into these upright flowers could get out again remains to be found out. But it is not unlikely that it will be found that when a certain quantity of water does collect, either by its weight it will bend the flower over and escape or by its presence may excite some auxotonic movement causing the flower to nod and dump it out.

A repetition of these experiments should of course be made upon newly opened flowers and upon the particular variety here described.

Botanizing in Texas.* II.

J. REVERCHON.

In this locality (House Mts.) two entirely new plants were discovered, and both have been decorated with the name of Reverchoni, a Diplachne and a Campanula. The latter is a little annual, making long ribbons of the finest blue in the cracks of the rocks, with here and there a large tuft of Cereus pectinatus all ablaze with its beautiful pink blossoms, or a picturesque cluster of Cereus paucispinus covered with brick-red flowers. The more noted plants collected here were: on the side of the mountain, Metastelma Palmeri, Zexmenia hispida, Cyclanthera dissecta, Ipomœa Lindheimeri; on the banks of a sandy creek, Astragalus leptocaulis, and a variety of Mentzelia Wrightii with very small flowers.

From House Mt. to Mason is a region mostly sandy or rocky, in which three rare plants were collected: Panicum ciliatissimum, Brazoria truncata, and Polypteris Hookeriana. Juglans rupestris began to appear along the rocky banks of streams.

At Mason, a little German town, we resumed our westward march. The soil is generally poor, sandy or gravelly, up the Llano valley, the plain being covered with mesquit brush. At a

* Continued from March, 1886, p. 59.

distance and on both sides of the valley is a continuous line of bold bluffs overlooking the plain. Excepting near the river, and an occasional grove of post-oak, the ligneous vegetation is scant and dwarf. The last sign of granitic formation was left in Mason county, and in reaching Kimball all the rocks are limestone. Here for the first time we met the Sophora speciosa, already in fruit, the red beans of which are considered very poisonous. In fact these beans, scattered over the rocks, seem to be respected by every kind of animal. Near our camp on the Little Saline creek we made a good collection: in the valley, Tetrodes Coulteri, Berlandiera lyrata, Parthenium lyratum, Gaura macrocarpa, Aristolochia brevipes, Coldenia canescens, and Croton Neo-Mexicanum; on the neighboring bluffs, Schœnocaulon Drummondii, Lepidium lasiocarpum, Abutilon parvulum, Styrax platanifolia. Perezia runcinata, Chrysactinia Mexicana, Hymenatherum tenuilobum, Atriplex canescens, and Leucæna setosa, the last being a remarkably fine shrub. There also occurred two Yuccas, Y. canaliculata, growing to the height of 9 or 10 feet and giving to the landscape a tropical appearance, the other, referred to Y. rupicola, though I think it is different.

Along the Big Saline creek we noticed for the first time since we left Dallas the Quercus Muhlenbergii; but afterwards we find this species quite abundant in the mountainous region of S. W. Texas.

The 16th of May we reached Junction City, where the two forks of the Llano river unite. We pitched our tent on the north fork, in a beautiful spot, and if we were not botanizing I would have much to say about the delicious fish, the squirrels, the beavers, etc. The river is full of Nuphar advena, and near a picturesque fall I collected Lythrum ovalifolium and Agrostis verticillata. In the thicket covered valley I notice the following species: Callirrhoe pedata, Antirrhinum maurandioides, Vesicaria Gordoni, Stillingia Torreyana; on the rocky bluffs, Specularia Lindheimeri, Allionia incarnata, Nicotiana trigonophylla, Nothlæna sinuata, and a beautiful Cereus unknown to me. At the foot of a perpendicular rock near the river I found Euphorbia chamesula, and a grass new to science, Festuca Texana.

The north fork of the Llano is fringed with a growth of fine timber, but the high bluffs, which come closer to the river as we ascend the valley, are covered with bushes or stunted trees, Quercus Durandii making most of the thickets. Very often these bluffs are covered with high walls of hard limestone of dazzling whiteness.

On the 21st we arrived at old Fort Terrett, which is situated at the headwaters of the North Llano. All the neigboring hills are densely covered with mountain cedars (Juniperus occidentalis, var. conjungens). A few plants were collected along the roads, such as Rivina lævis, Pentstemon Jamesii, and Nama Jamaicense, but nothing different from what we had found below.

West of Fort Terrett we found ourselves on a vast table land, the divide between Devil's river to the west and the Nueces to the south. This country is a perfect desert, with only temporary supplies of water in holes, plenty of grasses though not properly a prairie, being covered with mesquit bush, clumps of post-oak, and thickets of cedars and live oaks, the home of the peccary, or Mexican hog. The cretaceous rocks crop out in every direction, and traveling in a wagon through such a country is nothing but punishment. Here the curly mesquit grass (Hilaria cenchroides) abounds, and low and rich spots were perfect masses of the orange colored flowers of Coreopsis cardaminæfolia. We also observed for the first time Hoffmanseggia brachycarpa, Thelypodium linearifolium, Actinella odorata, one of the commonest plants on the plains of W. Texas, and Erodium cicutarium, but this last I am satisfied was introduced through the agency of transient sheep.

We were detained a whole week at Mackenzie Well, on the head of South Llano. The country is the same as the divide, but I had more leisure for collecting. The following are some of the most interesting plants: on the rocky knolls, Erythræa calycosa, Abutilon holosericeum, Encelia calva, Zexmenia hispida, and two ferns, Pellæa flexuosa and Notholæna sinuata; in lower places, Chamæsaracha coronopus, Aristolochia brevipes, Dalea rubescens, Abutilon Wrightii and parvula, Argythamnia Neo-Mexicana, and a new variety of Sporobolus asperifolius, called brevifolius by Dr. Vasey. On the banks of Mackenzie Lake was found Zapania cuneifolia, var. angustissima.

I collected there many other plants that occur in other western localities, such as Siphonoglossa pillosella, Aristida Reverchoni, Passiflora tenuiloba, and Boerhaavia viscosa.

At Mackenzie Well we were convinced of the futility of trying to reach the San Pedro, or Devil's river, or even the Nueces, by the divide, for the trails were nothing but piles of rocks, over which our wagon would not have lived three days. Reluctantly, therefore, we took a trail going back to Junction City by the South Llano. We found along this river about the same vegetation as before, but two remarkable plants of this region deserve mention. One is Nolina Texana, whose long leaves are used for thatching Mexican huts, the other the Sotol (Dasylirion Texanum), of which I will speak more hereafter.

At Junction City we took the Bandera road, going up Johnson's creek, where I had the pleasure of collecting for the first time the beautiful Macrosiphonia Berlandieri, and Galphimia angustifolia. A grass, Hilaria mutica, quite abundant on the plains of W. Texas, was found there, being the only locality where I observed it in all our trip. I must not fail to mention the aljorita bush (Berberis trifoliata), very abundant in these regions, and whose berries, either raw or cooked, are really good. The Mexicans and settlers use them extensively.

From the headwaters of Johnson's creek to the head of Guadalupe river, there is a mesa or table land of about 20 miles, where the vegetation is similar to that of the divide, and on which the only new plant found was the magnificent Ipomœa leptophylla. I noticed in a common Texan plant (Œnothera serrulata, var. spinulosa), whose flowers in the north and west are uniformly yellow, that here the stigmas were jet black, while a little further south the throat of the corolla also shared in this striking color.

The 3d of June we reached the Guadalupe, and the vegetation began to change. In the valley, Tetragonotheca Texana, Berlandiera Texana, Pentstemon Wrightii (mostly in seed); on the rocky bluffs, Eupatorium ageratifolium and Ptelea angustifolia (in fruit); on the banks of the river, Aspidium patens, and, in rocky shades, Asplenium parvulum.

The next day there appeared along the river the beautiful Sabine (Taxodium distichum). Afterwards we observed this tree along most of the rivers in the mountainous region north-west of San Antonio. Between Kerrville and Bandera the country is mountainous, covered with good grasses but not very interesting to the botanist, the only plants collected being Euphorbia angusta and Psoralea cyphocalyx. It is well to notice that the Psoralea bearing that name in Curtis's distribution is a new species, *P. Reverchoni* Watson.

The 6th we camped at Bandera's Pass, a very interesting place to the botanist. On both sides of the road are two high and very steep hills, up whose rocky sides I undertook to climb. My time and labor were not lost, for I found, first at the foot, a very coarse grass, Epicampes distichophylla; next in the rocks, Nolina Lindheimeriana; higher up, Prunus copallina, Fendlera rupicola, Rhus cotinoides (all in fruit); in the cedar breaks at the top, Onosmodium Bejariense (in seed), Streptanthus bracteatus, Verbesina Wrightii; and on exposed flat rocks, the graceful Erythrea calycosa, var. nana.

In nearing Bandera the live oaks grow to an enormous size, and were covered with Tillandsia recurvata. We crossed the Medina at Bandera, where our only discovery was Amorpha lævigata, and took a westerly direction over what was called by the inhabitants a "good mountain road." Afterwards we understood the meaning of "mountain road." Soon we were in a very rough country, which we have good reason to believe no botanist ever visited. In fact, no one will ever visit it, who has any care for his limbs or neck. Of course in such a country progress was slow, and the 10th of April finds us camped on the banks of a fine stream, whose clear waters were dashing madly among the rocks. All around were hills clad with shrubbery and covered with overhanging rocks. We were in the wilderness and enjoyed it. It would be more than ungrateful not to pay a tribute to the great pile of dainty perch and fine trout lying before our camp fire. Beginning along the rivers, in swampy places are found several northern plants, such as Schoenus nigricans, Eleocharis rostellata, and Selaginella apus, mixed with Dichronema leucocephala and Reverchoni, Buchnera elongata, a variety of Samolus ebracteatus, and Epipactis gigantea; among the rocks, at the foot-hills, Asclepias perennis, Aspidocarpa hyssopifolia, Keerlia effusa, Cassia Lindheimeriana; on the top rocks, abundance of Laphamia Lindheimeri. A good many interesting shrubs are found here, Salvia ballotæflora, Budleia racemosa, Philadelphus serpyllifolia, Garrya Lindheimeri, Arbustus Xalapense, var. Texense, the last three in fruit. The last named species is called *Madrona* by the Indians, a small tree, very peculiar and picturesque in appearance. As for the ferns, near the water were Adiantum Capillus-Veneris, and Aspidium patens; amidst the rocky shades, Pellæa flexuosa, Cheilanthes Alabamensis, and Asplenium parvulum. But what made me forget all my falls and bruises was the discovery of the rare Aneima Mexicana, growing everywhere in the shade, and the rarest Pellæa aspera, found on exposed rocks!

At last we were out, emerging from the Sabinal cañon, and camped on that beautiful stream. Our principal finds are Capsicum baccatum, Salvia Rœmeriana, Acalypha hederacea, Russellia tuberosa, var. occidentalis (or, as I think, a good species), Bernardina myricæfolia, Cordia podocephola, Polygala ovalifolia, Indigofera Lindheimeriana, Euphorbia villifera and acuta, Melochia pyramidata, Triodia eragrostoidea, Muhlenbergia calamagrostoides, Setaria setosa, Chaptalia nutans, a new Petalostemon (P. luteolus Wats.), and a fern, Notholæna candida, the only one found on the rocky banks of the Sabinal. One plant deserves special mention, the beautiful Amoreuxia Wrightii. The peccaries are very fond of its roots. On the sandy plains below the cañon we find Dalea pogonathera, Cevallia sinuata, Menodora longiflora, Leucophyllum Texanum, Mimosa Berlandieri, and Lindheimeri; in the richest part of the prairie, Eupatorium Greggii and Desmanthus reticulatus.

Near the Sabinal cañon is the small cañon of Blanco, in which a curious cave has recently been discovered. Of course this new wonder had to be visited, and on our way we admired the gigantic *sotol* (Dasylirion Texanum) in all its glory. It is used in Mexico, as the Agave, to make an intoxicating liquor, and the bases of the leaves, that look like monstrous artichokes, are considered delicious vegetables, but we did not touch them. Here we added to our collection such plants as Heteropogon contortus, Fallugia paradoxa, Jatropha spathulata, and Mirabilis Jalapa.

Thus far we had had a tolerably pleasant time, in spite of gnats, mosquitoes, and other insects, but the dry weather had now set in, the heat was increasing alarmingly, the water was sinking very fast into the sandy beds of the rivers, and, what was more important to me, the vegetation was beginning to shrivel up and disappear. Our team was jaded, our provisions consumed, our clothes in tatters, our finances exhausted. We had either to refit our expedition or retreat, hence after consultation, the march on Mexico was postponed and a retreat ordered.

Uvalde was the most south-western point visited by our expedition, where we found Malvastrum tricuspidatum. Along the Frio, nearly dry all the way, were found Aristolochia longifolia and Oxalis dichondræfolia, and two fine shrubs, Anisacanthus Wrightii and Chilopsis saligna.

The homeward journey began the 20th of June. Between Uvalde and Castroville is an extensive plain, covered with thickets of mesquit, Acacia Rœmeriana, A. Wrightii, but the most common is certainly A. Berlandieri. There was also Condalia obovata, Celtis nitida, Scheifferia cuneifolia, Diospyros Texana. Among the herbaceous plants were Dianthera parvifolia, Perezia Wrightii, Sanvitalia ocymoides, Helianthus ciliaris, and Jatropha Berlandieri. On the banks of the Seco we gathered Marsilia macropoda, Neptunia pubescens, and Synedrella vialis. We noticed also, climbing on the mesquit, the singular Ephedra pedunculata, but with neither flower nor fruit.

For the most part the vegetation along the return route was similar to that we had met earlier in coming out, and towards the last of July we reached home.

BRIEFER ARTICLES.

Notes on Arisæma triphyllum.—Last year I called attention in the GAZETTE to some striking variations in Arisæma triphyllum, and knowing that I should have the opportunity of being where the two kinds might be found, I hoped that some other observer would be drawn to examine whether the differences were associated with its sexual characteristics, or were really such as to mark a distinct variety. It so happened that I found myself where they were abundantly in bloom, and the notes seem worth recording. In the one case are leaves pale green above and glaucous beneath. In the other the leaves are thin and look green on both sides. On this occasion I found them in large numbers, and both forms growing together. Many of them seemed intermediate, and it was difficult to decide to which section they belonged. A large bundle was collected, taking care to gather them pretty much as they ran. There was no trouble in selecting the two extremes, and these, when selected, looked very distinct. These, and the intermediates, made the three sets. Then it was seen that the wholly green-leaved ones were mostly very vigorous, the stems in some instances being half an inch thick, and they had rarely any but female flowers—an occasional male flower only among the hundreds of females. Those with the gray under surface were mostly males, and the plants small—the stems rarely thicker than a lead pencil. Only in rare instances were females present, and these but very few in the spathes, where they were found at all. In the intermediates only were the monœcious forms found, and in all these females preponderated,—indeed, the male flowers in these cases were always largely in the minority. The species is, in fact, so far as this locality, near Philadelphia, is concerned, almost wholly diœcious. I think the pollen in these technically monœcious flowers can be of little service, and the plants must be practically uni-sexual. In a half day of wandering through the wood, no insect was seen among the flowers, nor could any trace be found indicating their visits. The structure of the spathe is not favorable to the reception of much pollen through the aid of the wind, though the pollen structure would indicate an anemophilous class. What the plant gains by this division of the sexes, in any effort to secure cross-fertilization, is difficult to determine. Indeed, fertilization of any kind must be rare, for seldom have I been able to find specimens with fruit in this district. But the species has been well able to distribute itself, for it is found over a wide area. The spathes vary from a pale green to a brown purple. The stems also show a diversity of color. This has no sexual significance—the same varying shades being found in the three separate sets. Indeed, in the strong plants with the wholly female flowers, the capitate stigma, with its innumerable minute capillaries, would sometimes be of a beautiful rose, while in other spathes they would be wholly white. The texture and shades of the leaves seem to have relation to sex—but not so with color.—THOMAS MEEHAN.

CURRENT LITERATURE.

Contributions to American Botany. By Sereno Watson. Proc. Amer. Acad. xxi. 414-468. Issued June 2, 1886.

This is Dr. Watson's thirteenth contribution and, as usual, is full of new species. The first part contains a list of plants collected by Dr. Palmer in Mexico, in 1885. The second part is devoted to the descriptions of new species, chiefly from the Pacific States and Northern Mexico. We specially note a new Canbya, from Oregon; Silene Hallii, a new Rocky Mountain species, distinguished from S. Scouleri, and about 20 new Leguminosæ.

The third part begins a series of notes upon a collection made by Dr. Watson himself, in Guatemala, in the spring of 1885. The fourth and last part contains some notes upon a few palms of Guatemala, most of the 25 species collected being still undetermined. A new species, Bactris Cohune, is described. It is a palm six to fifteen feet high, is abundant in the Chocon forests, and is called by the natives "Warree Cohune." Mr. Watson always adds to the convenience of his papers by appending a complete index.

Flora of the Yellowstone National Park. By Frank Tweedy. Washington, D. C. 1886. pp. 78.

This is an excellent catalogue of the vascular plants of one of our most interesting regions, and visited as it is by so many hundreds of tourists each year, this catalogue must be in considerable demand as a guide to the location of plants. The author has brought together all the plants reported, and from this small area, 55×65 miles, 657 species are listed. It is noticeable that while the Compositæ (108) and Gramineæ (72) are, as usual, the ranking families, the Cyperaceæ drop to the sixth place with but 26 species. Before them come Scrophulariaceæ (32), Leguminosæ (28), and Ranunculaceæ (27). The very interesting collection of grasses, made by Mr. Tweedy, is being described in this journal.

Contributions to American Botany. By Asa Gray. Proc. Amer. Acad., xxi. 363-413. Issued May 4, 1886.

This is the twenty-third number of these contributions, and by far its most important part is the revision of North American Ranunculi. This genus was hastily compiled nearly half a century ago for Torrey & Gray's Flora, with very little knowledge of original material, and has now come up again for study in preparation for Gray's Synoptical Flora. Naturally the work has been a difficult one, and we now have this genus really for the first time thoroughly presented to American botanists. Including Greenland, we have 59 species, grouped under six sections, the last of which (*Euranunculus* Gray) contains 49 species. The first section is the old *Batrachium* DC., with four species; the fourth is *Cyrtorhyncha* Gray, while the others are established for the first time. A section, *Oxygraphis*, is made of the Asiatic genus Oxygraphis, of Bunge, and introduced after Batrachium, but it is yet uncertain that it contains any American forms. *Pseudaphanostemma* and *Crymodes* are other sections, while *Halodes* is represented in our flora by the widely diffused R. Cymbalaria. Some three or four new species are included, and many new varieties. The polymorphous *R. occidentalis* Nutt., is made to include *R. Nelsonii* Gray, and five of its extreme forms are described as varieties. *R. hispidus* Michx., partly, DC., Hook, is disentangled from R. Pennsylvanicus, etc., and set up as a good species, with the somewhat composite authority quoted above.

The botany of Northern Mexico, cultivated by Mr. Pringle, continues to yield an astonishing harvest of rare and new species, many of which are described in this contribution, and among them are to be found a new genus of Compositæ (Piptothrix), near to Eupatorium, and a revision of the North American species of Metastelma.

Contributions to the history of certain species of Conifers. By Dr. Maxwell T. Masters. From Linnean Society's Journal, vol. xxii. pp. 169-212. plates II-X.

This is a collection of notes and plates, and is meant to furnish the basis of a fuller sketch of the family. Coming from such hands, however, it would be strange if it did not contain valuable material. The American species discussed are *Abies amabilis* Forbes, *A. grandis* Lindl. (with vars. Lowiana and pallida, the latter equaling *A. concolor* Engelm., partly), *A. concolor* Lindl., *A. subalpina* Engelm., and *A. nobilis* Lindl. (with new vars. glauca and magnifica, the latter equaling *A. magnifica* Murray). There has arisen much confusion concerning some of our species, and anything that can be said to bring us to a clearer understanding of them will be welcomed. It is refreshing to see the variety of characters used, and also the reliance that is being placed in the anatomical structure of the leaf. When gross and minute anatomy join forces in descriptive botany some good work will be the result.

A Manual of Structural Botany. By M. C. Cook, M. A., LL. D. W. H. Allen & Co., London. J. H. Vail & Co., New York. 1884. 16mo. pp. iv, 123.

Twenty-five years ago this little volume was prepared to meet the demand for a cheap manual. For one shilling it gave all the salient facts belonging to structural botany, not professing to round out the periods or popularize the dry details. It was to be considered more as a reminder than as an instructor. Now at this late date a new edition has been issued, said to be thoroughly revised. The growing need for cheap books in all departments of science should be recognized and we turned hopefully to this to represent botany. We are sorry to find that while it may have done very well a quarter of a century ago it is no nearer than that to the present status of botany. The last twenty-five years in botany means a good deal, and to say that a botany is published which takes no account of that interval, is to say that it is about worthless. The book before us deals in the most antiquated ideas and terms. Scores of words are used which have been long ago banished to the limbo of useless nomenclature. Besides this, mistakes are more numerous than they should be. On p. 18 is the description and figure of "raphides," the former of which applies to crystals in general, and the latter represents the compound crystals of Begonia. Parenchyma is said to be cellular tissue with cells hexagonal in cross-section. "When a spiral line is coiled up in the interior of cells, it is called *Fibro-cellular* tissue." It furthermore states that this spiral is sometimes broken up into bars and forms elongated dots. "Pleurenchyma" is said to be "glandular woody tissue," all of which seems to refer to the discigerous tissue of conifers. One of the cell contents is the "*primordial utricle* or *protoplasm.*" The pith of a stem is said to be composed of "cellular tissue" as opposed to the woody parts, while the "bark" is treated in the style of long ago. The pollen tubes are said to "penetrate the ovules and discharge into them the contents of the pollen grains, and thus a union is effected between the fovilla, or fertilizing principle of the pollen, and the semi-fluid contents of the ovule." But enough of such illustrations. In many parts the definition of the fixed anatomical terms would serve the purpose of a glossary. The real truth is, the book is untimely. If one understands botany, this book is not needed; if he wants to learn it, this is very far from being the book he wants.

NOTES AND NEWS.

LACTUCA SCARIOLA has been found this season by Mr. Rose, in Union county, Indiana.

THE GLUTINOUS RICE of Siam (Oryza glutinosa) has starch which gives a red or red-brown coloration with iodine, instead of blue. It does not appear to differ otherwise from ordinary starch.

REV. KARL KALCHBRENNER, a prominent mycologist, died June 5, at Wallendorf, Upper Hungary, 80 years old.

IN THE JULY *American Journal of Science* Dr. Gray gives a memorial sketch of the late Professor Edward Tuckerman.

M. ED. BORNET, the eminent algologist, has been elected member of the French Academy of Sciences as successor to M. Tulasne.

THE FOURTH FASICLE of Millspaugh's American Medicinal Plants has just appeared. For its purpose, it is a very elaborate and complete work.

DR. A. GRAVIS has been appointed professor in the University and director of the Botanic Garden at Liége in place of the late Professor Morren.

IT IS REPORTED that Dr. Bowdeswell, of England, has discovered the germ of hydrophobia to be a micrococcus found in the nerve tissues. His paper upon the subject is looked forward to with interest.

PROFESSOR TRELEASE has discovered Eurotium Aspergillus-glaucus upon opium. The announcement, with description and plate, appears as a Contrib. Dep. Pharmacy of the University of Wisconsin for 1886, II, 5–9.

IN THE *West American Scientist* for June, two new cactuses are described, one of them being figured. They are published from the manuscript notes of Dr. Engelmann. One is an Echinocactus and the other a Cereus, both from Lower California.

IN THE JULY *Journal of Botany* some Japanese desmids are described and figured, while W. B. Grove continues his papers upon new or noteworthy fungi. Mr. C. C. Babington begins a paper upon the British Rubi, a very large and most puzzling group.

IN THE JULY NUMBER of the *Journal of Microscopy* (London) Mr. R. H. Moore describes the structure of Anagallis arvensis, with the aid of three plates. In the same number Mr. H. W. S. Worsley-Benison presents a very interesting *resume* of the subject of plant movement.

IN THE *American Naturalist* for July, Dr. Byron D. Halsted describes and figures some curious pollen-tubes of Lobelia syphilitica. They were distorted and misshapen in a strange way, but the cause could not be discovered. The tubes were naturally formed, artificial cultures not having been tried.

WE LEARN from *Nature* that the Swedish Academy of Sciences has issued a work entitled "The Correspondence of Carl von Linnaeus," containing a record of all the correspondents of this famous naturalist, Swedish as well as foreign, with their addresses, date of birth and death, etc., as well as the date of each letter to and from.

PROF. S. M. TRACY, of the Missouri State University, has published a catalogue of the vascular plants of that state. It is the first attempt at a complete catalogue, but it contains 1,785 species. The state is said to be divided into four well defined botanical regions, viz: (1) bottom lands; (2) swamp lands; (3) Ozark region; (4) prairie region.

DR. T. MILLMAN, of Kingston, Canada, writes of finding specimens of Taraxacum officinale with two scapes blended into one and bearing two complete heads of flowers. He also finds the same thing in Chrysanthemum leucanthemum. Last year dandelions were found in Crawfordsville with three scapes blended into one and bearing three heads of flowers.

THE SOCIETY for the Promotion of Agricultural Science, holds its seventh annual meeting in Buffalo, August 16 and 17, the two days preceding the meeting of the A. A. A. S. The meeting promises to be a full one and rich in papers. Several of our best botanists have forwarded the titles of papers to be read. Dr. B. D. Halsted, of Ames, Iowa, is the Secretary.

TO DR. GRAY'S note upon the arillus in Asimina (BOTANICAL GAZETTE, July, p. 190), should be appended the following, received too late for insertion in its proper place: Asimina angustifolia, of which Mr. Curtiss has now sent both *flowering* and fruiting specimens collected in July, has the ovate-subglobose seeds of A. pygmæa and an equally well-developed arillus.

DR. C. C. PARRY has published in the Proc. Davenport Acad. Sci., Vol. v, p. 26, the description of a new genus of Eriogoneæ, from Lower California. It is founded upon Bentham's Pterostegia macroptera and Greene's P. fruticosa. The name, *Harfordia*, commemorates a well-known Californian botanist. The genus is remarakable among Eriogoneæ for its diœcious flowers, and differs from Pterostegia in its perennial habit.

STRASBURGER has been experimenting upon intergrafting and has reached some remarkable results. Among herbaceous Solanaceæ, Datura, Tobacco, Henbane, etc., were grafted successfully upon the common potato. In the case of the Datura graft the potatoes were impregnated with atropine. It is said that Tschudy long ago grafted tomato upon a potato stock, and "gathered potatoes from the bottom and tomatoes from the tops of the same plant."

Botany at the American Association.

The botanical papers presented to the association at the Buffalo meeting were about the same in number and quality as last year. Those which may be classed as strictly botanical are six, as follows:

Asa Gray, Memoranda of a revision of the North American violets.

J. M. Coulter and J. N. Rose, Synopsis of North American pines, based upon leaf anatomy.

C. R. Barnes, A revision of the North American species of the genus Fissidens.

Lillie J. Martin, Plan for laboratory work in chemical botany.

W. J. Beal, The bulliform or hygroscopic cells of grasses and sedges compared.

W. G. Farlow, The development of the Gymnosporangia of the United States.

The several papers will eventually appear in the pages of the GAZETTE, and in this place it is only necessary to say a few words about them, and to summarize the discussions that followed the reading of them.

In the absence of the author, the paper on violets was read by Prof. Coulter. This paper and the two next mentioned, being so fully systematic, gave little occasion for discussion. One feature of Prof. Coulter's paper, the use of histological characters as the basis of arrangement, aroused much interest. Mr. Arthur commended the movement to bring such characters into use in classification, when found specially serviceable, and mentioned the success of Hackel, who used the tissue characters of the leaves to distinguish some of the difficult species and forms of the Festucas of Europe. Prof. Barnes alluded to the labors of Constantin and Vesque in discriminating plants by the characters of the leaves; they have taken up this work with the idea of making a complete key to the families. Mr. Morong desired to add testimony to the value of this method. He had recently been paying much attention to Naias, and finds that it is necessary to consider the cellular structure of the leaf and stem in order to decide between the species. He also said: "I am very glad to hear this paper, running somewhat in the same direction as my own studies. I wish botanists generally would feel more interest in the matter, for we have a large field open to us for new methods of systematizing."

Miss Martin's paper suggested the change which has come to

American botany in the last few years, and Mr. Arthur summarized this as starting with the collecting and classifying of flowering plants, afterwards embracing the lower orders of plants, reaching at the present time the stage when histology and morphology are receiving marked attention, with some notice given to physiology. "The chemistry of plants," he added, "is now investigated almost entirely by the chemists. If this paper does something to call attention to the fact that the chemistry of plants should be studied by botanists as well as by chemists, it will have served a most excellent purpose."

Prof. Beal's paper was illustrated with a large number of diagrams showing the position of the hygroscopic cells. A desire was expressed to know more regarding their function, a point not specially dealt with by the paper. This was explained; whereupon Prof. Burrill raised the query of how it happened that they so frequently occurred upon the upper surface of the leaf, if their office was to roll the leaf up in order to decrease evaporation and prevent the drying up of the leaves. When the leaves were rolled upon the upper surface, it exposed the under part, which usually has more stomata and softer tissues. Prof. Beal mentioned the fact, as a partial explanation, that many grasses habitually twist their leaves and present the lower surface to the sky. Prof. Pillsbury suggested a possible connection between the distribution of the hygroscopic cells and the folding of the leaf before vernation.

Dr. Farlow's paper was supplemented by numerous specimens of the different species of fungi that the paper dwelt upon, and some of the results of the cultures which furnished the principal data. Prof. Burrill spoke of the value of the paper as a basis of systematic study, and desired to learn the methods of conducting the experiments. Upon being assured that the details will shortly be published, he added that the results are of much economic importance. Upon the prairies of Illinois these fungi are doing serious harm. He had received a letter from an orchardist since coming to the meeting, in which he complains earnestly of acres of orchard being destroyed as the result of planting a cedar hedge around it.

Several other papers, which are in some measure botanical, should be spoken of in this connection. They are the following:

J. S. Newberry, On the cretaceous flora of North America.

E. W. Claypole, On some carboniferous wood from Ohio.

B. E. Fernow, Biology of timber trees with special reference to the requirements of forestry.

E. Lewis Sturtevant, Atavism the result of cross breeding lettuce; also A study in agricultural botany.

C. Richardson and C. A. Crampton, On the presence of cane sugar and allantoin in ungerminated embryo of wheat.

Lillie J. Martin, Preliminary analysis of leaves of Juglans nigra.

Helen C. DeS. Abbott, Certain chemical constituents of plants considered in relation to their morphology and evolution; also Preliminary analysis of a Honduras plant named 'Chichipate'.

V. C. Vaughan, Tyrotoxicon (cheese poison); its occurrence in milk.

W. McMurtrie, Blue milk and ropy cream.

D. E. Salmon and Theobald Smith, The bacterium of swine plague.

Theobald Smith, On the variability of pathogenic organisms as illustrated by the bacterium of swine plague.

D. E. Salmon, The theory of immunity from contagious diseases.

It is not possible for us to give more than a slight account of a part of these papers, except of two or three which will appear in our columns in the form of abstracts prepared by the authors.

Dr. Sturtevant's first paper described several lettuce plants grown from seed obtained from crossing two dissimilar varieties. One plant in particular much resembled the wild type, and the conclusion is reached that atavism has been one of the determining influences. The study in agricultural botany by the same author went to show that plants under cultivation have circumscribed limits of variation, and that the present type varieties, particularly of scorzonera, parsnip and carrot, probably originated from natural prototypes, and not by human selection.

The paper by Miss Martin and the second one by Miss Abbott were excellent examples of careful and valuable analytical work. Miss Abbott isolated a new camphor and a yellow coloring matter, specimens of which were exhibited. Miss Abbott's first paper, an abstract of which is to appear in the GAZETTE, excited very favorable comment. The subject is worthy the careful attention of botanists.

Prof. Vaughan's paper is of special economic interest. He traces the poisonous effects occasionally experienced from eating cheese and ice cream to the presence of a ptomaine, which he has called tyrotoxicon, and which from its nature and the circumstances attending its occurrence is believed to be due to a micro-organism. He also points out that cholera infantum may be due to the same or a similar cause.

Prof. McMurtrie has studied the phenomenon of ropy cream from a chemical standpoint and finds no grounds for the opinion that it is due to a simple physical or chemical change, but concludes that the evidence points to the presence of some form of bacteria. Prof. Burrill in discussing the paper stated that he had also given attention to the subject, and that while he did not doubt it was due to germs yet he had been unable to decide upon the particular kind. The blue milk spoken of in the title is an incidental accompaniment of the ropy cream, and is not the blue milk mentioned in works on bacteria.

Mr. Smith's paper is based upon observations of microbes obtained from three separate outbreaks of swine plague—one in the District of Columbia, one in Nebraska and one in Illinois. The microbes were identical in morphological, but different in biological characters. This variation is all the more interesting because not before admitted with any of the pathogenic organisms heretofore studied.

A considerable discussion followed the reading of Dr. Salmon's paper on the theory of immunity from contagious diseases, participated in by Drs. Minot, Arthur, Burrill, Bowditch and the author. Dr. Minot objected to the use of heated bouillon for testing the exhaustion theory. Dr. Arthur suggested that sterilization in such a case might properly be effected by filtration through porcelain; he also spoke of his own studies on pear blight as in some measure supporting the theory. Dr. Bowditch asked if the theory might not be extended to the lessened effects experienced from the continued bites of insects. The author thought it could.

Botanical Club of A. A. A. S.

The meetings of the Botanical Club have increased in attendance and interest from its organization, three years ago, at Minneapolis. The fourth meeting, just held at Buffalo, brought together more botanists than ever before, and still further compacted an organization which has in it the promise of great usefulness. Ninety-one names were entered upon the register slips, but the knowledge that several botanists neglected to register makes it more than probable that over one hundred were in attendance. This gives a very large percentage of botanists in the general association, and also adds weight to the thought expressed by some that there should be a section of botany.

The term botanist, of course, includes a great variety of persons, from those merely interested to those professionally engaged in botanical work, but as one of the objects of the club is to stimulate a general interest in the subject, all such persons are legitimately included. It is not easy to classify the departments entered upon the registration blanks, but the expressed preference of the ninety-one botanists entered may be summed up as follows: General botany, 11; flowering plants and ferns, 17; cryptogams, 15; minute anatomy, 4; chemical botany, 2; agricultural botany, 1; medical botany, 1; physiology, 3; morphology, 2; no preference stated, 35.

Four meetings were held, at 9 o'clock A. M., and the attendance was always large. As these meetings were supplemented by excursions and receptions given by the local club, it may be said that the botanists saw a great deal of each other. The social feature was especially prominent and a general feeling of good fellowship was always present. The papers presented to the club, as a rule, were more substantial and more carefully prepared than ever before. As most of them will be published in full or by abstract in this and subsequent numbers of the GAZETTE, they will not be referred to at any length in this account. Following is a brief summary of the proceedings and discussions of the club:

Prof. J. M. Coulter was chairman for the year, but in his absence on Tuesday, Prof. W. J. Beal presided. Dr. J. C. Arthur, the secretary-elect, was compelled to resign his position, owing to his duties as secretary of the section of biology, and Dr. N. L. Britton served in his place.

THURSDAY, August 19, 9 A. M. After a few introductory remarks by the chairman, a letter from Dr. Asa Gray was read to the club, followed by his paper entitled "Essay toward a revision of Dodecatheon," both of which are published elsewhere in this issue. Prof. E. W. Claypole then read a paper upon the potato rot. During the fall of 1885 this parasite was very abundant in some parts of the country, and the author undertook to study it in his own locality (Akron, Ohio). After describing the structure of a potato tuber, he observed that the parasite attacked the eyes and affected the fibro-vascular region of the tuber, leaving the interior starch cells intact.

Mr. F. V. Coville read a paper upon *Aconitum Noveboracense* Gray, n. sp., as occurring at Oxford, New York.

Prof. F. L. Scribner displayed an apparatus he had been using for making microscopic drawings. It was a device for using the camera lucida with simple lenses, and thus obtaining an amplification of a few diameters. Questions were asked and suggestions made by Professors Burrill and Beal.

Dr. W. J. Beal displayed a contrivance for facilitating laboratory work. It consisted of a device for holding all the ordinary laboratory accessories used by the student, thus enabling him to get them out and put them away speedily, and to have them always convenient while at work. The box was arranged to hold everything, from sandpaper to objectives. In the discussion that followed Prof. Pillsbury thought that holes bored in a block would be less expensive for holding reagent bottles than box-like compartments. Dr. Farlow thought it rather dangerous to have reagent bottles placed so near objectives.

A communication from Dr. A. Gattinger was read, in which was described Hypericum lobocarpum, a new species from the mountains of Tennessee.

W. H. Seaman, of Washington, read a paper on Marsilia quadrifolia. Plants of this species had been procured from Germany by the Fish Commission and cultivated as a fish food. Proving to be rather injurious to fish than otherwise, an attempt was made to destroy it. But the plant has spread and is likely to become permanently introduced.

Dr. Beal stated that Marsilia had become a thriving plant in central Michigan.

FRIDAY, August 20, 9 A. M. Rev. Thomas Morong had a few words to say concerning Marsilia. He said that it would take possession and drive out everything else, even witch grass. He had seen a small patch take possession of a pond and drive out every other aquatic. The first put out was twenty years ago, at Bantam Lake, Litchfield, Conn. "I find it has gone along the shore for half a mile and has taken complete possession of the ground."

Professor L. M. Underwood, in continuing the discussion, said that Marsilia was originally found at Bantam Lake and also at another widely separated locality. When first found it was in small quantities. He would ask Mr. Morong how he would account for that fact.

Mr. Morong replied by stating that Dr. Gray had recently sent him a specimen of Potamogeton crispus from Arizona, and he would like to ask how it had skipped from the Atlantic seaboard to Arizona.

The discussion was further continued by Professor Underwood with reference to other species.

Professor T. J. Burrill next described simple and inexpensive ways of making apparatus for fluid cultures and sterilizing. The author will fully describe these devices in the next number of the GAZETTE. It is sufficient to say that they exactly meet the demands of many workers who are unable either to purchase or devise such appliances.

Mr. Morong exhibited some Potamogeton fluitans from Niagara river.

Miss Lillie J. Martin read a paper in which she recommended the use of petroleum spirit (boiling 25°–45° C.) for the preservation of plant tissues. The subject was discussed by Mr. Seaman, Professor Barnes and Miss Martin.

Professor B. E. Fernow exhibited a branch from a chestnut which bore spikes of small burrs, and at a distance looked like a chinquapin. The tree grew wild in a wood-lot, in Lehigh Co., Pennsylvania. All the other trees have the same condition of development, and no cause for this freak could be discovered. He was inclined to think that it was self-fertilizing, but no male flowers were discovered.

Professor Underwood asked if there was any evidence of an injury, as he had often observed that injuries in certain plants tend to produce abnormal development, but Mr. Fernow had discovered none.

Professor Burrill called attention to the fact of the side shoots of Indian corn, near the base, bearing both sorts of flowers, the tassels coming out in the ordinary way, and in the tassels more or less female flowers. In husk corn this is a common thing.

The discussion was continued by Messrs. Beal, Farquhar and Fernow, and Mrs. Walcott.

Dr. W. J. Beal spoke of the escape of the seeds of Sporobolus cryptandrus.

MONDAY, August 23, 9 A. M. The time for the election of officers for the ensuing year having arrived a committee on nominations was appointed, and their report as follows unanimously adopted: For chairman, M. S. Bebb, of Rockford, Illinois; for secretary, Mrs. E. L. Britton, of New York city.

F. L. Scribner read a paper upon the occurrence of the orange scab in Florida, a disease which is comparatively new and which threatens to destroy nursery stock.

Prof. J. H. Pillsbury described a method of making lantern slides for micro-photographs, which is really very simple and ingenious. He obtains some tracing gelatin (which comes in very fine sheets), taking care to select sheets that are not much scratched. They can be obtained of every color and form. The piece of gelatin is put over any desired diagram, and with a very fine steel point (such as lithographers use) the diagram can be traced upon the gelatin. Slipping the gelatin between two pieces of glass a lantern slide is the result, which is convenient for all kinds of illustrations. These slips of gelatin can be purchased at almost any lithographic establishment. In this way a teacher can reproduce accurately for class illustration any published figure, and with great economy of time and money.

Professor Burrill stated that he had made lantern slides from blackboard drawings. By making the chalk lines even and dense a photograph can be taken with very good effect.

Professor Barnes upon inquiry brought out the fact that the scratches upon the gelatin appear as black as ink lines against a white surface.

Dr. N. L. Britton read a paper upon the herbaria of Columbia College. The description of the herbarium cases caused considerable discussion, by Professors Pillsbury, Britton, Beal, Barnes, Sargent, etc.

Prof. Barnes thought that the most commendatory convenience spoken of was the tightly fitting glass doors.

In the discussion with reference to dust-proof devices, it was generally the opinion that a working herbarium can not be made dust proof, as the doors are of necessity open so much of the time, and the only way to keep the specimens in proper condition is to exercise "eternal vigilance."

Dr. N. L. Britton read a paper upon Anychia dichotoma, of which he discriminated two forms, which might possibly merit specific rank.

TUESDAY, August 24, 9 A. M. Professor E. W. Claypole read a paper upon the appearance of immigrant plants in the neighborhood of Akron, Ohio, which was discussed by Messrs. Morong and Coville.

Professor F. L. Scribner then presented a paper upon the botanical character of the black rot of the grape.

The following resolutions were then adopted:

Resolved, That the members of the Botanical Club of the A. A. A. S. heartily thank the U. S. Commissioner of Agriculture for his promptness and energy shown in appointing an able investigator to prosecute the mycological work recently inaugurated in the Department of Agriculture, and in giving him opportunities to study the fungi which are injurious to cultivated plants. While they are gratified with the beginning made, they express the hope that this work will be still further supported. The botanists here assembled hereby renew their promise to render the U. S. Commissioner of Agriculture any assistance in their power toward making investigations in any department of botany.

Resolved, That the hearty thanks of the Botanical Club of the A. A. A. S. be tendered to the Botanical Club of Buffalo for the bountiful hospitality which they have shown to their brethren from abroad, and not less for the graceful and courteous manner in which this hospitality has been extended, with the promise that wherever our meetings may be held in the future every visiting Buffalo botanist will find a warm reception in our hearts and homes.

The presiding officer tendered the thanks of the club to Dr.

Arthur for his efficient work in arranging for their meetings, and the club adjourned to meet next year at 9 A. M. on the second day of the meeting of the A. A. A. S.

Entertainment of the Botanists at Buffalo.

Fortunately for the Botanical Club of the Association, Buffalo possesses a very active Botanical Club, and the members of this company vied with each other in devising and executing plans for the entertainment of the visiting botanists. Time did not allow the placing on the program of a tithe of the generous ideas their hearts suggested, but their spirit was shown by the numberless little things which were done to make pleasant the meetings. Three special rooms were set apart for the accommodation of the club, and the unavoidable school-room bareness was relieved by the easy chairs, pictures and statuary which thoughtfulness had provided.

The special reception announced upon the program was held on Thursday evening, from 8 to 11, at the residence of Hon. David F. Day, on Cottage street. With a view to making strangers feel personally welcome, the local club took the trouble to issue special cards of invitation, supplementing thus the general invitation, and in response to these two hundred and fifty cards fully as many people assembled at Mr. Day's hospitable home. Thursday had found the ladies of the club busy in decorating the four spacious rooms given to the reception. The mantels were banked with native flowers, and vases, bowls and dishes held a profusion of wild blossoms, some of which puzzled those not acquainted with the Buffalo flora to name. Of all these, most honored was Epipactis Helleborine, the rare orchid of Syracuse and Buffalo. Many of the native flowers were supplied by Mr. Day's grounds—which constitute, by the way, a botanical garden of no mean proportions—while others represented much active collecting by the members of the club. Beside all these, every available place was filled with exotics, whose graceful foliage or peculiar forms added much to the beauty of the rooms. The blooming of a Cereus was awaited with interest, but in vain, as it did not open until the following night. The center piece on the well-laden table was a huge block of ice hollowed out and filled with wide-open water lilies.

As everything possible in the way of decoration was done to make the rooms beautiful, so was everything possible done to made the guests feel at ease and to relieve the too common stiffness of a formal reception. So admirably did these plans succeed that every one spent a most delightful evening, and many pleasant acquaintances sprang up between the guests and their entertainers, which will not soon be forgotten.

The prompt and efficient service in the bountiful supper-room added not a little to the pleasure of a charming evening. Certainly the thanks of the botanists present were due to the local club, and especially to the distinguished botanist who placed his house at the disposal of the club.

The majority of the botanists went on the excursion to Niagara Falls on Saturday, and thoroughly enjoyed the grand scenery and varied flora which surrounds the Falls, especially that of Goat Island. The rare Hypericum Kalmianum, Gymnostomum curvirostrum and Fissidens grandifrons were the chief finds.

On Monday afternoon at 1:30 the club embarked on the steamer *Huntress* for the hour's ride to Point Abino, on the Canada shore. The day was cloudy and promised to be delightful for water travel, but half an hour out a hard rain set in, which kept the passengers busy avoiding the rills of water which coursed over the deck in various directions with the roll of the boat. Cruising off shore for half an hour until the rain ceased gave pleasant time for social enjoyment and improving the acquaintances begun at the reception. As soon as practicable the boat drew up to the long pier, built for loading sand-barges, and the merry crowd disembarked. Point Abino is a sandy cape backed by a range of low dunes, so that as soon as the rain ceased the surface was dry and comfortable for walking. At the end of the pier the party divided, some going under the leadership of Prof. Kellicott to a sphagnum swamp near by, while others under the guidance of Mr. Day walked along the shore towards the point. Here Hypericum Kalmianum and Calamintha glabella were the rarities, while a magnificent growth of Junipers attracted much attention.

After a ramble of an hour and a half, the warning blast from the boat's whistle brought in the stragglers. Scarcely were the last ones aboard when down came the considerate rain. But little cared we who had had our full time ashore, and still less cared we when sandwiches (assorted styles), cake and lemonade in lavish abundance were served. The discussion of deep botanical problems mingled with jest and laughter in consonance with the varying moods of the knots about the deck. No witness of the scene could doubt the thorough enjoyment of it by all. By dusk the boat touched her wharf (again the rain ceased) and we bade our hosts good night and good-bye, with many assurances of our pleasure in the excursion so admirably planned and so happily executed.

As the Botanical Club of the Association has never before been so well attended, so also has it never before been so hospitably cared for and so happily entertained as at Buffalo. What more can they do for it in 1896?

Essay toward a revision of Dodecatheon.*

ASA GRAY.

Probably every botanist who has turned his attention to this genus has suspected it to be of more than one species. But those who have attempted to deal with the numerous now extant forms have been baffled in their endeavors to distinguish and define them. In the Synoptical Flora of North America I could do no better than to arrange the forms loosely under seven varieties. If I have now done better in the attempted discrimination of five species the credit is largely due to indications and specimens supplied to me by two western correspondents, Mr. Suksdorf, of Washington Territory, and Prof. L. F. Henderson, of Oregon, to the latter especially in pointing out to me the anomalous character of the form which I have accordingly designated by his name.

If the assigned characters hold out it will be in good part by their fruits that we shall know them; and fruit is rare in our specimens, so that many of them can only be guessed at, and the value of the present scheme is still to be tested. But present indications point to five species, the principal characters of which are exhibited in the subjoined

Clavis Dodecatheorum.

A. Short filaments manifest, being inserted at the very orifice of the short corolla-tube, and distinctly monadelphous: leaves with tapering base.

1. Capsule acute, coriaceous, opening at apex by valves: Eastern. — D. MEADIA.
2. Capsule obtuse, coriaceous, opening at or from the apex by valves: Western.
   - Leaves from narrowly or elongated to obovate-spatulate: capsule oblong to cylindraceous, usually much surpassing the calyx. — D. JEFFREYI.
   - Leaves obovate or oval with cuneate base, short: capsule globular, hardly surpassing the calyx. — D. ELLIPTICUM.

* Read before the Botanical Club of the A. A. A. S., Buffalo meeting, 1886.

3. Capsule obtuse, thin, cylindraceous, or suburceolate, surpassing the calyx, truncately dehiscent by circumscission of the apex: leaves obovate. D. HENDERSONI.

B. Anthers seemingly sessile, the very short and distinct filaments being inserted below the orifice of the corolla and included in its throat[1]: leaves ovate or obovate, often abruptly contracted into the margined petiole. D. FRIGIDUM.

1. D. MEADIA L., the original species, and the only one of the Atlantic region, has an acute capsule, of coriaceo-crustaceous texture; the narrow and obtusely acute apex, of slightly different color from the rest, but of same texture, opens into five dentiform valves, which hardly ever dehisce further down. There are plentiful Rocky Mountain specimens (such as are represented by the *D. integrifolium* Hook. Bot. Mag. t. 3622, from the north, and by Fendler's no. 549 from New Mexico) which probably go with this; but fruit is wanting.

2. D. JEFFREYI Moore, in Van Houtte, Fl. des Serres, xvi. (1867) 99, t. 1662. The figure represents a large and robust form of a common Pacific coast Dodecatheon, the firm and erect leaves of which are said to be at least a foot long, and the scapes and peduncles are correspondingly grandiose. But it is added that in dry soil the plants are small and weak. It is said to have come from the Rocky Mountains, but it represents a form which we have only from the Pacific coast, where it is probable that Jeffrey gathered the seed. It is just the *D. integrifolium* of Bongard, and var. *vegetius* of Ledebour Fl. Ross. from Sitka, etc., the *D. Meadia*, var. *macrocarpum* of the Synop. Flora, also the var. *lancifolium* of the same, a form with usually shorter capsules. As var. ALPINUM we may for the present include the *D. Meadia* var. *alpinum* of the Synoptical Flora; but fruit of those small and narrow-leaved mountain forms is still little known. As far as seen it is fusiform, cylindrical and narrow, but whether blunt or pointed is not so clear. With little doubt the *D. Meadia*, var. *frigidum* Hook. f. Bot. Mag. t. 5871 belongs to *D. Jeffreyi*. The stamens as well as the leaves are not those of *D. frigidum*. As at present received the species ranges from Sitka to the Guadalupe Islands off Lower California.

3. D. ELLIPTICUM Nutt. ex Durand in Jour. Acad. Philad., ser. 2, iii. 94. *D. Meadia*, var. *brevifolium* Gray, Syn. Fl. ii. 57. *D. integrifolium* Benth. Fl. Hartw. t. 322. This is rather common in California, from San Diego county, and San Bernardino, ap-

[1] I can not agree to the statement of the late Mr. Durand (in Jour. Acad. Philad. ser. 2, iii, 95)—excellent observer though he was—that the filaments are unconnected in D. Meadia and its near allies: they are certainly monadelphous into a ring or short tube in the flower-bud and in anthesis in all the species except D. frigidum, separating only as the gravid ovary enlarges.

parently not on the mountains, and northward to the Columbia river. From the latter I have unusually large specimens, coll. by Suksdorf, in springy places on rocks, Columbia river, with flowers collected in April and fruit in May. I presume this to be Nuttall's species, taken up by Durand, who well describes it though without the fruit, which I have well formed only from Suksdorf. If I mistake not it extends to St. Lawrence Bay on the Asiatic Coast; for to this (though without fruit) I incline to refer some specimens there collected by Eschscholtz (unless there has been confusion of localities) and which have entered into Chamisso and Schlechtendal's description of D. frigidum. For the two taller out of four small plants from the herbarium of the St. Petersburg garden, ticketed by Herder, have the well-exserted stamen-tube of the present group. If not D. ellipticum they must belong to a depauperate D. Jeffreyi, which extends well northward. D. ellipticum should be distinguished by its globular or short-ovoid capsule, barely equaling or slightly surpassing the calyx (if this character holds out); also by the shorter and blunter anthers.

4. D. Hendersoni. Prof. Henderson, in sending me excellent specimens of this peculiar species (collected in Tualatin plains, Oregon), called my attention to its character. The broad and short leaves are like those of *D. ellipticum*, and the flowers are similar. But the capsule is chartaceous in texture, when well grown nearly twice the length of the calyx, cylindraceous-oblong, becoming urceolate as the placenta enlarges and the open summit broadens: the short more or less hemispherical apex becomes more distinctly circumscribed than in other species and at length falls away (along with the style) *as a lid*, and the truncate orifice seems indisposed to split up at all into valves. Upon searching among my specimens which had been referred to *D. Meadia*, var. *brevifolium*, I detect this species from Clear Water, Idaho, in the old collection of the late Mr. Spalding; from W. Klikitat county, Washington Terr., April, 1883, coll. Suksdorf, on mountain sides; also, but less marked, from the south side of Tamalpais, California, at the elevation of 2000 feet, coll. Brewer (1862), who notices it as quite unlike the form in the valleys below. This is the only species which in this revision demands a new name; and it may properly bear that of the acute observer who indicated its peculiarity.

5. D. frigidum Cham. & Schlecht. in Linn. i. 222, at least partly; Hook. Fl. i. 119; Seem. Bot. Herald, 38. t. 9. *D. Meadia*, var. *frigidum* Gray, Syn. Fl. l. c. The very short filaments in this species I find to be distinct down to the insertion in the

throat of the corolla, manifestly below the orifice: in anthesis they do not show at all; later they may slightly project. According to Seemann's figure the "not quite ripe" capsule is ovoid and slightly longer than the calyx. This figure accords well with the specimens from coll. Wright, of Arakamtchetchene Island, Behring Strait; from Arctic Alaska, Muir; and Lake Lindeman at the head of the Yukon, Lieut. Schwatka. Originals from Chamisso, and part of those from St. Lawrence Bay, Eschscholtz, are similar but smaller.

Var. DENTATUM. Larger: leaves with blade from one or two to three or nearly four inches long (in the dried specimens thin), oval or ovate to oblong, commonly repand or sparingly dentate, at base abruptly or truncately contracted into long and wing-margined petioles: scapes a span to a foot high, 2-7-flowered: corolla so far as known white: capsule globular- to oblong-ovoid, moderately surpassing the ovate or triangular-acuminate calyx-lobes, half-5-valved.—*D. dentatum* Hook. Fl. i. 119. *D. Meadia*, var. *frigidum* Watson, Bot. King Exp. partly. *D. Meadia*, var. *latilobum* Gray, Syn. Fl. l. c. The "N. W. Interior, Douglas" is probably interior of Oregon. Lyall collected it in 1850 on the east sides of the Cascade Mountains in Washington Terr.; Brandegee in the same region in open woods in 1883; Suksdorf in 1885, at the foot of a waterfall near Bridal Veil in N. E. Oregon; Henderson in 1884 and 1885 on wet rocks, along bluffs of the Willamette; Howell near the Cascades in 1886. The most southern and remote station is that of Watson in the Wahsatch Mountains, Utah, at the head of Cottonwood Cañon. It has all the essential characters of *D. frigidum*, but is much larger.

The Development of the Gymnosporangia of the United States.*

W. G. FARLOW.

The study of the connection between the different forms of Gymnosporangium and Roestelia known in the United States has not been by any means as simple as the similar study in Europe. This is owing, perhaps, to the fact that we have about double the number of species found in Europe, and it has not always been easy to determine exactly which of our forms were the same as those of Europe, or even clearly to define our own species. Before one could begin to study the connection between the Gymnosporangia and Roesteliæ, it was necessary to have a compara-

*Read before the A. A. A. S., Buffalo meeting, 1886.

tively clear notion of the species as distinguishable by their gross and microscopic appearances, for, until that was the case, any account of cultures made would be quite unintelligible. Nor could we hastily assume that those of our Gymnosporangia, which appear to be very much like European species, must have the same Roestelia form as in Europe. Practical experiment by cultures is the only method of settling the question effectually. If the anatomical characters are the same, and if the sowings of the spores are followed by the same Roestelia in both cases, then our form and the European belong to the same species, otherwise not.

In a paper published in 1880, I attempted to take the first step by collating what had been written about our species and supplementing it by observations on a large amount of living and herbarium material, so as to be able to form an estimate of the comparative distribution of both our Gymnosporangia and Roesteliæ, and, as far as our knowledge then allowed, to learn something of the probabilities of the connection between different forms; for we must naturally assume that, if there is any natural connection between Gymnosporangia and Roesteliæ, the connected forms will be found growing near together rather than separated by long distances.

In the paper mentioned I also gave an account of some cultures of Gymnosporangium spores on different hosts for the purpose of finding out what Roesteliæ followed the sowings. Although spermogonia in abundance followed some of the sowings, the æcidia themselves did not develop, and hence it was impossible to be sure of the species, although one could perhaps infer something. In northern and central Europe where the species of Roestelia are by no means as numerous as with us, some botanists who, on sowing Gymnosporangium spores, have obtained only spermogonia have at once assumed that they belonged to the Roestelia growing on the same host in nature.

This assumption, somewhat dangerous it must be admitted, might perhaps be allowed in Europe where the species are few, but would be quite unwarranted in this country where not only do most of our Roesteliæ grow on several different hosts but, in several cases, the same host is known to support several different forms of Roestelia. Although my cultures were not conclusive at all, taken in connection with what was known of the comparative natural distribution of the forms in question, they afforded, in a measure, some guide to the direction in which we might expect more definite information in the future.

Since 1880 my cultures have been continued at intervals, without, however, the production of æcidia, and in the meanwhile our knowledge of the natural distribution of the species has been enlarged and emended in several respects. In the present connection I wish to speak only of the forms found east of the Rocky Mountains, of which the enumeration given in 1880 is still correct with one exception. There is to be added one species from the Rocky Mts., but it can not enter into the present discussion. Of the different notices on the subject which have appeared since 1880, I need refer only to a paper in the Proceedings of the Am. Academy of Arts and Sciences, issued in Feb., 1885, in which, after summing up all the evidence to be obtained from my numerous cultures and what was known of the distribution, I came to the conclusion that: first, *Gymn. biseptatum* Ellis, and *Roestelia botryapites* Schweinitz were probably connected; secondly, that *Gymn. globosum* Farlow might possibly be connected with *R. aurantiaca* Peck; thirdly, that *Gymn. macropus* Lk. has as its Roestelia a form growing on apples and Amelanchier.

Last spring cultures of several species of Gymnosporangium were made by Mr. Roland Thaxter, a student in the cryptogamic laboratory at Harvard, and the results which he has obtained are of great interest. The details will be given in a paper by Mr. Thaxter and I should like, in this connection, to call attention to some of the principal results reached. To start with the simplest case. The cultures of the spores of Gymn. biseptatum on two plants of Amelanchier were followed by spermogonia in ten days and later the æcidia began to form on the under surface of the leaves. Although the peridia are not yet ripe there can be no doubt that the species is R. botryapites, as the tubercular swellings produced can not be mistaken for those of any other species known in this country. Furthermore, in the cultures as in nature this Roestelia has developed very slowly, and it is highly probable that the æcidia will ripen as, when growing wild, the tubercles appear in July and August, but the ripe peridia are not found until some time in September, in Massachusetts. This case affords then a confirmation of the first statement mentioned above.

My second supposition has been proved by Mr. Thaxter's cultures to be incorrect. The spores of Gymn. clavipes growing on Juniperus Virginiana were followed by spermogonia in ten days when sown on Amelanchier and apples, and in about a month were followed by ripe æcidia on the stems of Amelanchier. This culture was the most striking of any. The æcidia were luxuriantly developed and the species was seen to be without doubt R. aurantiaca. In this culture furthermore the spermogonia appeared principally on the leaves while the æcidia were on the stems, and this is known to be the case when the species grows wild. On apple only spermogonia appeared, but it is well known that the species not unfrequently grows on apples. It might be asked whether the result of this culture is not at variance with what is known of the distribution of Gym. clavipes and R. aurantiaca? The last named species is known to have a wide range but it has been believed that the Gymnosporangium was confined to the eastern parts of the country where it is not so common as some other species. That it is more common in the East than has been supposed is shown by the fact that it was found on Juniperus communis at Weymouth, Mass., by Mr. J. E. Humphrey last spring, and abundantly on the same host at Kittery, Me., by Mr. Thaxter. On J. communis the fungus is more easily recognized than on J. Virginiana. On both hosts it is generally found on the stems and is recognized by the reddish color, rather than the brown or yellow found in other species. The pedicels are much inflated at the top and the spores quickly fall from the pedicels and germinate almost invariably at both extremities. With this I had confounded a foliicolous form very common on J. Virginiana near Cambridge, which produces the birds-nest distortions. The fungus as in this case is rather brown than red, but the pedicels are often much swollen at the tip, and the spores in some cases germinate at the two extremities. If in this form the pedicels are sometimes quite as much swollen as in Gym. clavipes, it should be said that sometimes they are not much swollen and while in Gym. clavipes the germination is almost invariably at both extremities in the foliicolous form under consideration the germination is only occasionally so, as I find by repeated experiments. The near relationship of G. clavipes to G. conicum was pointed out in my first paper. I now think that the true G. clavipes is specifically distinct from the foliicolous form which produces the birds-nests, and the latter form, together with a stem form, should be referred to Gymn. conicum. But to return to the true Gymn. clavipes as it grows on stems. It must be admitted that, so far as we yet know, the Roestelia aurantiaca extends much farther west and south than the Gymnosporangium with which from Mr. Thaxter's cultures it appears to be connected. It should not be forgotten, however, that the Roestelia is the most striking of the genus and is found on common cultivated plants, whereas the Gymnosporangium usually grows in company with the much more conspicuous G. macropus and G. globosum, and is much more likely to escape observation. Now that we know that it occurs on J. communis as well as J. Virginiana botanists may, perhaps, discover the species in regions where it is not now known.

Taking next the form which grows on Juniperus Virginiana and produces the well known birds-nest distortions, sowings were made on Pyrus Americana, apple, Amelanchier, and Pyrus arbutifolia and spermogonia appeared in great abundance on Amelanchier in seven days and on one apple in eight days and in a month æcidia developed on Amelanchier. The species was R. cornuta which is considered in Europe to belong to Gymn. conicum. Why the æcidia did not also develop on Pyrus Americana, the host on which R. cornuta occurs in its most marked form in this country, is a question. The failure in the present case may be merely an accident and future cultures may succeed. At any rate, the experiments should be repeated several times before we conclude that the spores of the birds-nest form will not grow on Pyrus Americana. Considering the distribution, the result of the cultures, and in general the anatomical structure, I think that it is most probable that the species is Gymn. conicum which Oersted concluded from his cultures to be connected with Roestelia cornuta. We must, however, ask one question. In Europe this species grows on Juniperus communis and, if our form on J. Virginiana is really the same, how does it happen that in this country the species is entirely unknown on J. communis which frequently grows in fields with J. Virginiana? I know one small field in which the two junipers grow mixed together, and although I have watched for years I have never found any Gymnosporangium on the J. communis there although the Gym. conicum so-called is abundant on the J. Virginiana.

Cultures were also made of the spores of Gym. clavariæforme, a species which grows on J. communis, and has apparently been more abundant this year than usual. Although sown on Pyrus Americana, apples, and Cratægus they only grew on the Cratægus where they produced Roestelia lacerata, the æcidium which in Europe is believed to be connected with the same species. In general the distribution of the Gymnosporangium and the Roestelia is about the same in the north and west, although the latter is much more common and is found in places not very near juniper trees.

Gymnosporangium Ellisii is, for some reason or other, less easily cultivated than the other species. In my cultures no results were obtained. In Mr. Thaxter's cultures when sown on Pyrus arbutifolia the spores seemed to cause spots on the leaves but no spermogonia or æcidia developed. It may be possible that the species is connected with Roestelia transformans which occurs on the Pyrus.

There remains to be considered two species, Gymn. macropus and Gymn. globosum, sometimes considered a form of Gymn. fuscum. The two species occur on J. Virginiana, often together, and are the most striking as well as probably the most common species east of the Mississippi. One would naturally expect that the study of their development would not be difficult. Unfortunately, however, Gymn. globosum is as great a puzzle as ever. In all my cultures this species was the one which always produced the greatest crops of spermogonia. Sometimes they were so abundant as nearly to cover the young plants used for experiments which in some cases soon died, apparently killed by the excessive growth of the fungus. Although spermogonia appeared on several species of Cratægus and on apples, in no case was there the least sign of æcidia. The fungus flourished for a few weeks and then the leaves either dropped off or recovered their normal appearance. Mr. Thaxter has had precisely the same experience except that he also found spermogonia on Pyrus Americana, a host which I had not tried in this case. He had the same luxuriant growth of spermogonia on Cratægus but no trace of æcidia. No explanation can be offered for the failure to obtain æcidia for, at first sight, the conditions seem more favorable than in any other species. Nor is it possible from the distribution to guess with what Roestelia it is connected if we exclude R. aurantiaca which, as we have seen, followed the sowings of the spores of Gymn. clavipes. It is out of the question to consider Gymn. globosum and Gymn. clavipes as forms of one species both from their habit, microscopic structure, and the distortions produced. The species to which it appears to be most closely related and with which it is even identified by some writers is Gymn. fuscum, a species which is considered by European botanists to have for its æcidium Roestelia cancellata which grows on Pyrus communis. Now although in this country one often finds pear trees growing close to red cedars attacked by Gymn. globosum there is not a single undoubted instance of the occurrence of Roestelia cancellata in this country and the few herbarium specimens bearing that name are more than doubtful. R. cancellata is one of the most easily recognized forms and it is hardly credible that it has escaped the observation of our botanists unless it is very rare indeed while Gymn. globosum is very common.

With regard to Gymn. macropus we have more definite information, although here, unfortunately, the case is not quite clear. This species has been studied more than any other, not only on account of its great size and abundance, but also on account of its supposed relation to diseases of apple trees. My cultures seemed to point to a connection with some common Roestelia on apples, and, I suspected, judging by what I had seen in orchards near infected cedars, that it might be the minute form generally considered a variety of R. lacerata, which is very common in the east. In my cultures I found only spermogonia. During the past spring cultures were made by Prof. B. D. Halsted, at Ames, Iowa, and by Mr. Thaxter, at Cambridge, and I found an instructive case at New London, Ct., to which I will refer later. Many have probably read the account of Prof. Halsted's experiment, in a recent number of the BOTANICAL GAZETTE, and, with the author's consent, I will state briefly the result. Early in the season, specimens of Gymn. macropus were gathered and allowed to develop under cover, so that there need be no danger of mixture with spores from outside. The germinating spores were then sown on the young leaves of a wild crab apple, Pyrus coronaria. The leaves and tips of the branches sown were then covered with small bags, and about three weeks later there appeared an abundance of spermogonia. The experiment was repeated on other twigs with a similar result later, and in both cases the fungus had developed to a marked degree before there was any trace of spots caused by natural infection on parts of the tree which had not been covered. In time the æcidia appeared and proved to be what has usually been called Roestelia penicillata.

To turn for a moment to Mr. Thaxter's cultures. The spores of Gymn. macropus were sown on Pyrus Americana, Cratægus coccinea, apples, Amelanchier, and Pyrus arbutifolia, but spermogonia appeared only on the apples. The cultures were continued and on July 14 a small number of æcidia appeared and grew slowly. Unfortunately, the æcidia have remained small, and the determination can not be made with certainty, but it must be admitted that they give one the impression rather of the small form of lacerata than of penicillata. It may be added that the wild specimens of R. penicillata had already developed at this time, and it is not probable that the æcidia in Mr. Thaxter's cultures were any later in developing than the wild form.

In the latter part of June I noticed at New London what might be called a natural culture of Gymn. macropus on a wild apple. A small J. Virginiana and a small apple had grown together in such a way that they seemed to form but one tree. My attention was first attracted by the immense number of bulbs of the Gymn. macropus on the cedar. They were so numerous as to make it look like a decorated Christmas tree. I had never seen a cedar so covered with the Gymnosporangium and at the same time the apple was yellow with the spermogonia of a Roestelia, at the time immature, but which afterward developed into a form of R. penicillata. It might be asked why, judging from Prof. Halsted's culture and the New London specimens, we should not consider the R. penicillata to be the æcidium of Gymn. macropus, for Mr. Thaxter's culture, while it seems to point to a different conclusion, is not sufficient in itself. If we look at the opinions of European botanists we find that they differ very much with regard to R. penicillata. On anatomical grounds alone, some regard it as merely a form of R. lacerata. Others, like Winter, think it distinct. From their cultures, also, they have not reached a definite conclusion; for, while Oersted thinks that R. penicillata is the æcidium of G. clavariæforme, Rathay maintains that it is a form of Gym. conicum. Oersted considered that he obtained both R. lacerata and R. penicillata from sowing the spores of Gymn. clavariæforme on Cratægus and apples respectively, but it is claimed that he never really obtained the æcidia on apples but inferred that the spermogonia on apples must belong to R. penicillata. But such an inference is not strictly logical. In American cultures Gymn. clavariæforme was followed only by R. lacerata not by R. penicillata which is in confirmation of the views of those who are opposed to Oersted's conclusion. In other words, the undoubted Gymn. clavariæforme on J. communis in this country acts when sown just as that species is said by the opponents of Oersted's view to act in Europe. If we accept Oersted's view we must accept the view that Gymn. macropus of this country is only a form of Gym. clavariæforme which grows on J. Virginiana. This is the view of Schroeter, but it is difficult for botanists in this country, who have seen both species growing, to regard them as forms of a single species. It may be true, however, and the important point for our botanists to settle is, can the spores of R. penicillata be made to grow on both J. communis and J. Virginiana and produce on the former what we now call Gymn. clavariæforme, and on the latter what we call Gymn. macropus.

The Theory of Immunity from Contagious Diseases.*

D. E. SALMON.

The immunity which an individual acquires from the effects of a contagion, by passing through one attack of the disease which it causes, has never been completely and satisfactorily ex-

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plained. Various conjectures have been offered, but no one of these to my knowledge has been based upon sufficient direct and positive evidence to warrant its acceptance as a well established theory of immunity. Since the demonstration of the germ theory of contagion, it has been evident that there were, in a general way, three possible explanations of acquired immunity, viz: a substance might be formed in the body during the course of the disease which is unfavorable to the microbes; or a substance essential to the growth of these microbes might be excreted or in some way lost or destroyed during this period; or, finally, the living matter of the body might acquire the power to resist or prevent the growth of the microbes.

It is well known that Pasteur has adopted the second or exhaustion theory, and sustains it by his observations on the growth of microbes in culture liquids contained in flasks. If we sow chicken bouillon, he says, with the microbe of fowl cholera and after three or four days filter the liquid in order to remove all traces of the microbe, and afterwards sow this parasite again in the filtered liquid, it will be found powerless to resume the most feeble development. He assumes that there are but two hypotheses by which this fact can be explained: either the microbe has exhausted something from the culture liquid essential to its multiplication or it has added some substance which is unfavorable to it. To decide between these two possibilities a culture of the microbe was evaporated *in vacuo* without heat, and then brought back to its original volume by the addition of fresh culture liquid. He reasoned that if the growth of the microbe had been arrested in the culture by the formation of a substance which acted as a poison upon it, then the activity of the microbe would not be renewed after the addition of the fresh liquid since the volume had not been increased and all of the chemical principles were retained. As a matter of fact the multiplication of the microbe was renewed, and consequently the antidote theory was rejected and the exhaustion theory adopted.

Doubtless M. Pasteur's conclusion is correct as applied to the growth of microbes in flasks, but when we take into consideration the conditions under which such organisms multiply in the animal body, we find the elements of the problem very materially changed. The body is very different from a culture flask to which nothing gains entrance and from which nothing is eliminated. The insusceptible fowl is continually taking into its system fresh food which contains principles suited to the growth of the microbe in question. If the body is to be compared to a culture flask we should expect the immunity to be at the most of but a few days' duration, since the fresh nutriment should increase the capacity for growth in the one as well as in the other. Immunity from contagious diseases, when once acquired, however, does not terminate so soon, and generally persists for years.

The exhaustion theory is susceptible of being tested by direct experiment. If a fowl is insusceptible to cholera because it lacks some element essential to the growth of the microbe, then bouillon made by infusing the muscles of this fowl in distilled water should also lack this same element and would therefore be equally incapable of nourishing the germ. In February, 1881, the writer was investigating the subject of fowl cholera, and made this experiment; and he found that the proliferation of the microbe was just as vigorous in bouillon made from insusceptible fowls as in that made from susceptible ones (Rep. U. S. Dep. Ag., 1881 and 1882, p. 292).

Both the antidote and the exhaustion theory, consequently, fail when tested by direct experiment; indeed when we consider that there must be a different chemical substance exhausted from the body for each contagious disease against which immunity is acquired in the one case, or a different product for each disease added in the other case, the theories become at once improbable.

If we direct our attention now to the third or vital resistance theory, such discrepancies in regard to well established facts will not be found. Immunity is probably never absolute, but simply relative. Chauveau found that the Algerian sheep, supposed to be insusceptible to charbon, would succumb to that disease if a sufficiently large dose of virus was administered, and the writer found that fowls insusceptible to ordinary doses of cholera virus would contract the disease if the dose was sufficiently increased (*loc. cit.* p. 289). By turning these experiments in the opposite direction, I found that the effect of virus upon susceptible fowls varied to a certain extent with the dose, and a point was finally reached at which no symptoms of disease were produced, although some of the most virulent germs were introduced into the body (Rep. U. S. Dep. Ag., 1883, p. 48)

These facts indicate that the tissues of the most susceptible individuals are not suited to the growth of microbes when the functions of the cells are normally performed; because, if favorable, one germ introduced into the interior of the body would multiply just as it does in a culture flask and finally produce the disease with the same certainty as would a million. This not being the case, it is evident that by increasing the dose the resistance of the tissues is in some way overcome, the microbes multiply and the disease is produced. If the germs failed to multiply when a small number were introduced, because there was something lacking in the constituents of the body which is essential to their growth, it is difficult to understand how this unfavorable condition can be overcome by increasing the dose of virus; or if the failure to multiply was due to the existence of some substance which acts as a poison to the microbe, it is equally difficult to conceive how a large dose of virus would insure proliferation when a small one fails.

That the influence which prevents the multiplication of the microbes is connected with the vital activity becomes more probable from the fact that the bacteria of putrefaction, organisms closely related to the pathogenic microbes, are unable to reproduce themselves when introduced into the tissues; but they find favorable conditions for growth there as soon as the life of the tissue is destroyed.

With these various facts in mind, we are prepared to understand how immunity results from one attack of a contagious disease. The cells of the body are at first depressed in their activity or narcotized by the poison of the microbes, but after being subjected to its influence for a certain length of time they acquire a tolerance for it just as people begin a tolerance for tobacco and are able to smoke and chew it without inconvenience, although the first attempt made them deathly sick. Of course as this tolerance is gained the tissues resume their vital functions as before, the liquids of the body become unfavorable to the existence of the microbe and it perishes. From that time forward for a considerable, though indefinite and variable, period the animal enjoys an immunity from that particular microbe when introduced in limited doses; but just as almost any one can be made sick by sufficiently increasing the dose of tobacco, so the immunity of most individuals may be overcome by administering a very large dose of virus.

[The discussion of observations and theories made by Metschnikopf, Chauveau, Zülger, Riemschneider, Hiller, Pasteur, and the author, which bear upon the elucidation of the subject, but do not affect its general statement, have been omitted for lack of space.—Eds.]

If these conclusions are correct, then we should be able to develop immunity by introducing into the body the poisonous products of bacterial growth which have been freed from all living organisms. This result would be a most decided advance in the preventive treatment of contagious diseases. Investigations of this question have not been as numerous or thorough as is desirable. Pasteur found that his fowls which had been treated with the narcotic above referred to were still susceptible. The writer made many experiments with the same poison, which were also negative in their results. Law has published experiments with swine plague from which he claims positive results, but the number of animals operated upon is too limited to be at all conclusive, even if the details of the experiments were satisfactory, which is not the case. Quite recently in our experiments pigeons have been granted a very complete immunity from the effects of swine plague virus by treating them with cultures of the microbe in which all living organisms had been previously destroyed by heat. Up to this time, however, our experiments with pigs have only given negative results.

Although there are still some points in connection with this subject which greatly need experimental elucidation, it is believed that the theory developed in this paper is in accordance with the facts so far demonstrated. The problems of immunity have long been considered impenetrable mysteries, and if this theory does not prove in all respects correct it is hoped that it may at least be of some service to other investigators.

BRIEFER ARTICLES.

Dr. Gray's letter to the Botanical Club.—*To the Botanical Club of the A. A. A. S., at Buffalo:* I am unable to attend the ensuing meeting of the Association. But wishing to manifest my interest in the Botanical Club, and to show that I am not altogether an idler in the camp, I send herewith two small papers,* containing the result of some recent systematic work upon two familiar genera.

They are not readable papers, and therefore should not be doled out at your sessions, which will naturally be occupied with more interesting and discussable communications. I can not even make an abstract of them, which would be much more readable than the papers themselves. But the few lines prefatory to the essay on Dodecatheon will sufficiently explain that undertaking, and the result, which has given me no small satisfaction. For we have always felt confident that there were distinct western species, although I have never till now found a clew to lead toward the extrication of the various forms.

I am glad to find that only one really new name will be needed in the nomenclature of the five species which we have presented.

As to Violets, I make out thirty-three wild North American species, of which only eight are represented in the Old World. In two instances, namely, in the *Palmata* and *Blanda* groups, I have kept up recognized species, which almost every botanist believes to be confluent, but is yet not disposed to suppress.

* The paper on Dodecatheon published in this issue, and that on Violets in the next

I have arranged our species in a series of natural groups, which are pretty clearly defined by means of a combination of characters. There are one or two changes in nomenclature; but the only notable ones are in the second group, where *V. pedatifida* replaces the much later name of *V. delphinifolia*, and the Linnæan name of *V. palmata* asserts its right of priority over *V. cucullata* of Aiton. If we did not fall back upon this name we should have to take up *V. obliqua* of Hill, which is much earlier than *V. cucullata*, and is clearly of that species, as Hill's figure shows.

I crave the opinion of the club as to whether our Pansy-Violet, *V. tricolor*, var. *arvensis*, is indigenous to this country. In deference to those who have more knowledge of the matter than I have, this is here included among the wild species, yet with misgiving.—ASA GRAY.

Orange-leaf scab.*—During the past two seasons the Department of Agriculture has been receiving orange leaves that were diseased in some way. Mr. Charles W. Campbell, of Ocala, Florida, writes that the disease appeared first last summer and is rapidly increasing, especially attacking young and vigorous trees. It is very destructive to the growth of the trees and ruinous to young nursery stock, so that it is feared it will seriously affect the orange interest. There seems to be no literature upon the subject, and there is a probability that the disease is new, at least it is of very recent appearance in Florida. The entomologists affirm that there is no evidence of its being caused by insects.

The first appearance is that of small, light-colored, wart-like excrescences upon the leaf surfaces and young shoots. These develop, often become confluent, and finally destroy the vitality of the leaf. The top of the older warts is dark brown or nearly black, due to the presence of a dense fungous growth, made up of a multitude of irregularly developed conidiophores, bearing oblong one-celled conidia. Whether this particular fungus is the caase of the disease it accompanies I can not at present say.

Upon some specimens recently received Mr. J. B. Ellis discovered a species of Fusarium which he believes to be *F. sarcochroum* Desm., and expresses the opinion that the warts are caused by the mycelium of this fungus. After careful examination, however, I am inclined to think that the disease is caused by the first fungus referred to above.

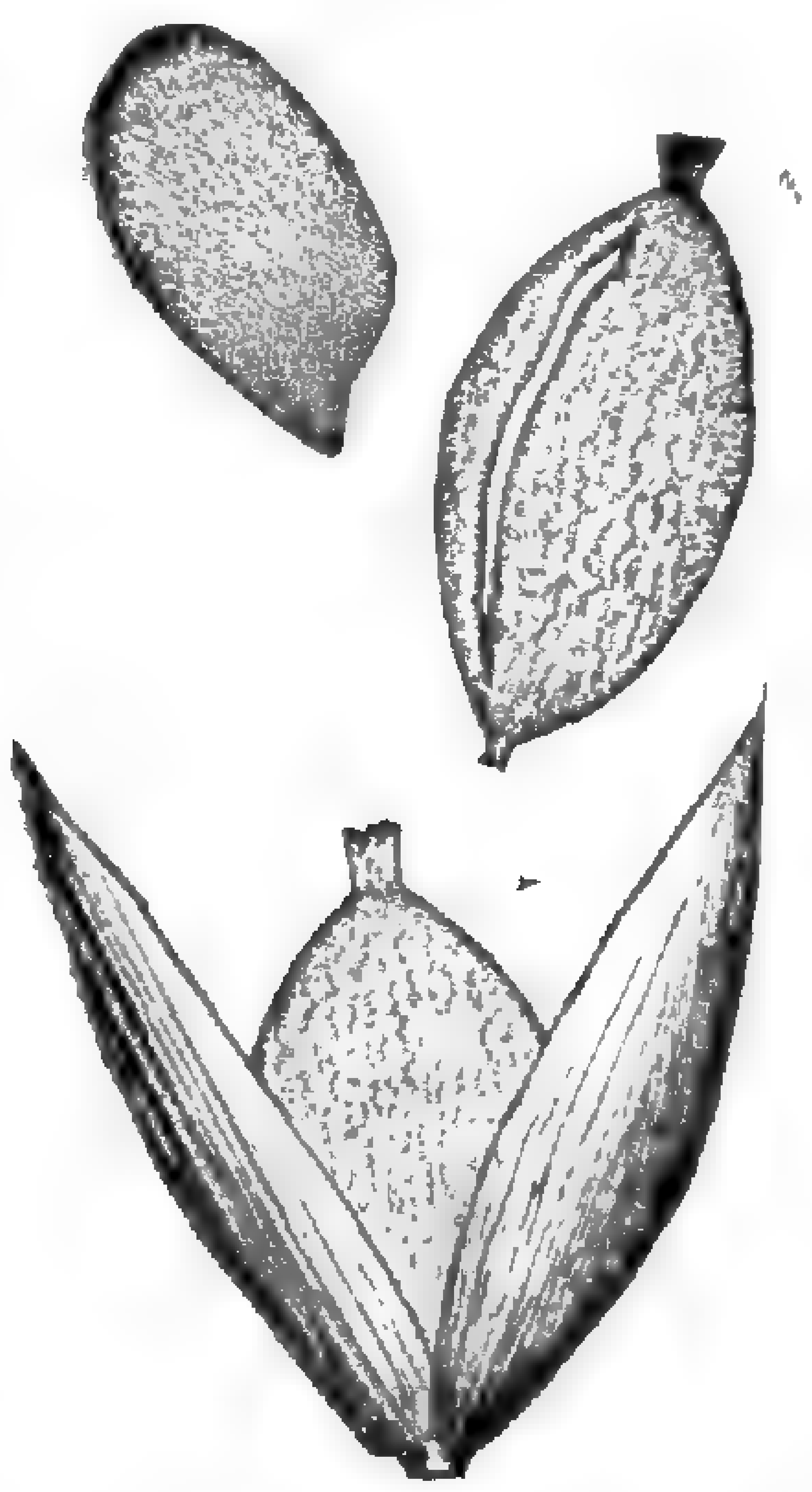
From letters received from De Land, Florida, we learn that (1) trees affected last season were the first attacked this spring; (2) sour trees alone are affected; (3) soil and surroundings have no influence on the disease; (4) vigorous and "sickly" trees are alike attacked; (5) the disease tends to spread throughout the whole tree; (6) the disease does not spread in the grove, but appears at several points simultaneously.

It is recommended that the following fungicides be tried: (1) a solution of potassium bisulphide; (2) liquid grison†; (3) strong soap suds containing glycerine and carbolic acid. Of course all these solutions should be applied in the form of fine spray.—F. LAMSON SCRIBNER.

*Abstract of a paper read before the Botanical Club of the A. A. A. S., Buffalo meeting, 1886.

†Prepared by boiling three pounds each of the flour of sulphur and lime in six gallons of water until reduced to two gallons. When settled pour off the clear liquor and bottle for use. In use this liquid should be much diluted with water (1 to 12).

Expulsion of the seeds of Sporobolus cryptandrus.* —The caryopsis of most Gramineæ contains a seed which firmly adheres to the pericarp. Sporobolus and some others have long been known as exceptions to this rule. The ovary of Sporobolus is very thin and tender. Free seeds may often be seen still adhering to various portions of the glumes and branches of the panicle. One of my special students, at my suggestion, has made a few experiments to determine the mode in which the seed escapes. Inside the ovary and about the seed there is a gummy secretion. When about ready to escape or at a certain stage of maturity, if water be applied to the panicle, in a short time the seeds come forth. A part of a panicle was wet and in 30 minutes 27 seeds escaped; in 37 minutes 40 seeds had escaped. In another case the seeds began to escape in ten minutes after the water was applied. After drying six days in a room seeds started out twenty minutes after wetting. In other cases seeds were seen to escape in six minutes, and in one case in four and one-half minutes. If the ovary is carefully removed from the floral glume and palea, and water is applied, the seed usually escapes a little quicker than when left in the floret.



On applying water the ovary may be seen to slowly enlarge till it bursts and the seed pops out in a hurry. If a little water is applied, it moves more slowly, and if the glumes are still near the ovary the seed moves upward and usually adheres to some part of the panicle. A slight sprinkling or a heavy dew would bring the seeds out, but a heavy rain would wash them down at a time when the condition would be favorable for germination. Several other species, as I judge from herbarium specimens, expell and hold their seeds in a similar manner. The action of the water on the ovary seems to be purely mechanical and is explained in well known works on physics. The water enters the ovary faster than the gum can escape. The ovary is flattened and splits on the side next the palea.—W. J. BEAL.

The Biology of timber trees with special reference to the requirements of forestry †—It is most necessary for forestry purposes to thoroughly understand the biology of the timber tress to be propagated, as injudicious methods of propagation, selection of unsuitable species and improper after-treatment may occasion heavy financial loss, the results being visible only after many years of investment. The selection of the material for forestry purposes out of the 420 arborescent species is made difficult by the absence of knowledge as to the true value not only of the timber, but the growing capacities of our trees.

A classification may be made into dominant species, which are capable of

*Read before the Botanical Club of the A. A. A. S., Buffalo meeting, 1886.

† Portion of an abstract, by the author, of a paper read before the A. A. A. S., Buffalo meeting, 1886.

forming extensive forests, co-ordinates, which may be occasionally grown in extensive plantations for their economic value, though properly not desirable for dominant forest growth, and subordinates which are useful to fill up the forest stand.

The most important qualities for the consideration of the forester, possessed by different timbers in a different degree, are the relation of their development to the influence of light, shade, and rate of growth. A classification into shade-enduring and light-needing species in a general series is possible. The relative requirements as to light must be studied in the dense forest, where no side light changes the habit of forest growth. The capacity of trees to endure shade is manifested by the density of their foliage and by the tenacity in sustaining life of lower branches and overshadowed individuals. Conditions of site modify the requirements for light. Alpine floras become light-needing floras; cloudy climes increase requirement of light and southern skies diminish it, so do humid atmospheres.

As the preservation of soil humidity becomes a necessity all over the world only such species as are capable of shading the soil against undue evaporation should be chosen for the dominant forest. These are the shade-enduring ones.

A study of the form-development must precede consideration of rates of growth. Trees may be classified according to their greater tendency to develop the bole or the crown. Their true habitus must be studied in the open; the dense forest influences the development especially of the latter class, it stimulates height-growth. Soil, situation and age influence form-development, the energy of height-growth being increased in fresh and deep soils, while shallow and compact soils, altitude, cold winds reduce this energy.—B. E. FERNOW.

EDITORIAL.

IT IS PROBABLY safe to say that the botanists form the best compacted organization of scientific workers in the country. Their work demands the most widespread exchange of facts, and this has led to correspondence which has often ripened into friendship. This can be plainly seen at such meetings as the one just held at Buffalo, and the Botanical Club is doing a great thing in fostering these friendships and binding together still more firmly widely scattered workers. A spirit of courtesy is prevalent, the spirit which prompts to render every possible service, and respects the rights of one who is already occupying some special field. The whole field of botany is so large that there is an abundance of room for every one without jostling. The stimulus of these annual meetings in directing botanical activity can hardly be overestimated. Never before has there been such botanical activity in this country, and no small part of the cause is due to the botanical journals which supply the means of speedy publication, and the meetings of the Botanical Club, which bring all workers into more sympathetic relationship. We would urge upon botanists who have not already mapped out their work that they select at once some convenient subject for investigation during the coming year, so that at their next meeting they may have something of interest to present which will be a real contribution to science. The thing to be criticized in many of our botanists is the aimlessness of their work. One year is much like another, and consists in the collection of specimens, the finding of new stations, or the observation of a few unimportant deviations from published descriptions. It is true that the days of announcing albinos is past, but there ought to be a more decided settling down to some special work. On the other hand, the mistake should not be made of selecting some subject far too difficult, which is beyond the range of the worker both in experience and material. The commonest materials and the easiest subjects are the best to work, for they imply a sufficiency of ability and material. The young collegian thinks of stopping nothing short of reorganizing the universe, and the ambitious young botanist is something like him. The work that is nearest at hand is the work to be done, and no subject, however unpromising at first, will fail to open up to patient work all the opportunities desired. In the selection of a subject advice should be asked of those more experienced, else a perfectly useless work may be undertaken, or one that has already been done in a much better way. Collecting and exchanging are all good enough in their way and necessary, but they simply furnish material for work, and that they are to represent the height of a botanist's ambition can not be too strongly decried. Every botanist should become an original observer and not simply lead a tread-mill existence. All this is not by way of saying that the botanists of this country are not at work, for there is an abundance of good work being done, but simply to stimulate the many who are not at work as they should be.

Some mention is made elsewhere in this issue of the present status of botany in the Department of Agriculture at Washington. It is evident there has been expansion, which has resulted in leaving the original botanical division as strong as before, and in some respects stronger, while there has been a distinct gain in establishing the study of plant diseases as a separate and clearly recognized portion of the Department. It remains to be seen if this good beginning can be maintained, and made the fulcrum for higher and broader work. An institution which depends upon annual appropriations for its income, and which must rise step by step from small beginnings to its full measure of usefulness, needs the support of a strong public opinion to save it from the numerous pitfalls that annually beset its progress or possibly its existence in legislative halls. The botanists of the country should constitute one of the important forces in sustaining this new enterprise. The committee of the A. A. A. S., which has heretofore lent assistance, is now disbanded, and botanists should consequently feel that such responsibility as may exist lies with them individually.

At the time the August number should have been prepared for press the editors were taking their vacation—the senior editor with a party in Indiana, one of the others in the mountains of West Virginia, and the third on the shores of Vermilion lake, in Northern Minnesota. If any short-comings are observed in that number our subscribers will have no difficulty in surmising the cause.

OPEN LETTERS.

Drying Plants.

On reading the Herbarium number of the GAZETTE I noticed that none of the writers on specimen making had mentioned a plan adopted by myself a few years ago, while botanizing in Nova Scotia. Though not to be recommended for common use as the specimens fall short of those obtained by the ordinary methods, yet, if so situated that an abundance of driers is not obtainable, or, if the climate be so foggy and wet that they can not be properly dried, I think it will be found of practical value. On the trip referred to a large number of specimens had been collected, but so bad was the weather from rain and sea fogs that there was great danger of losing them all. Under these circumstances advantage was taken of occasional glimpses of sunshine in the following way: each sheet of specimens was placed between two driers and these were spread in a single layer on the floor of an open balcony. Pieces of board placed in the sun, logs or bark, would of course answer the same purpose. Small stones laid on the corners of the sheets prevented the wind disturbing them, and no pressure was used except the weight of the single drier covering the specimens. An hour of good sunshine served to fully cure most plants. This plan is only applicable to specimens previously somewhat wilted in the press, as the leaves of fresh or insufficiently wilted ones curled up from the absence of pressure.

London, Ontario, Canada. T. J. W. BURGESS, M. D.

A Collection of Exotics.

In reply to the suggestion of Prof. W. W. Bailey concerning exotics in the herbarium, I may state that in the herbarium of the United States National Museum we have undertaken to form precisely the kind of a collection he mentions.

It is the policy of the National Museum to publish, in the form of bulletins, investigations upon the natural history of various interesting localities. With this in view Prof. Baird issued a circular bearing date of March 1, 1883, requesting information and lists of the cultivated plants of the District of Columbia. A committee of botanists was also appointed by the Biological Society of Washington to assist in the collection and preparation of this material. For several years but little was accomplished, but on the formal establishment of an herbarium in the museum the matter was taken up with energy. A competent collector, who is also a practical gardener, was employed, and several thousand specimens have been collected from the public parks and greenhouses.

As many of these plants are being cultivated without scientific names the first work will be their proper scientific determination. This will often be a matter of great difficulty, as their native country will be unknown, and moreover exotics that have long been cultivated are generally burdened with an extensive synonomy, but with a good named herbarium of foreign plants for comparison much may be accomplished.

When finally mounted for exhibition or study each specimen will be labeled with its accepted scientific name, the common name under which it is cultivated, its native country, and such other data as will be likely to be of interest. As for keeping these specimens separate from the general herbarium, we shall probably not be able to do so on account of limited space, although the suggestion of Prof. Bailey to this effect may be a good one. At any rate a collection of this character will furnish a source of popular information of undoubted value.

United States National Museum. F. H. KNOWLTON.

Sinteni's Puerto-Rico Plants.

[Translation.]

The distribution of the first installment of plants collected by T. Sinteni at Puerto-Rico has just taken place. The determinations have been made by the undersigned in company with several monographers. As but a few sets are yet to be disposed of (at 30 marks per hundred) intending purchasers must send in their names speedily. The species lacking in this issue will be supplied (possibly completely) from shortly to be expected collections.

Schöneberg bie Berlin, Grünewald. DR. IGN. URBAN.

NOTES AND NEWS.

DR. H. F. HANCE, British Consul at Amoy, China, died on June 22. He has been an earnest student of the plants of the East, having described a large number of new species, mostly in English periodicals.

MR. ROMYN HITCHCOCK, editor of the *American Microscopical Journal*, has sailed for Osaka, Japan, which will be his address for some time to come. The business management of the *Journal* is placed in the hands of Rufus W. Deering, of Washington, D. C.

A NEW monthly botanical journal, to bear the name *Malpighia*, wil lsoon be started at Messina, Italy, to be edited by Professors Borzi, Penzig, and Pirotta. It will contain original articles, bibliography, critiques, notes and queries. The subscription is placed at twenty-five francs per annum.

PROFESSOR F. L. HARVEY, of the Arkansas Industrial University, has accepted the position of professor of natural history in the State College, Orono, Me., made vacant by the resignation of Professor C. H. Fernald, who takes the chair of zoology in the Massachusetts Agricultural College.

A CRITICAL SYNOPSIS of the North American species of the genus Carex by Prof. L. H. Bailey, Jr., will shortly appear in the proceedings of the American Academy. Contrary to the usual custom of American botanists the territory covered includes Greenland, Mexico and Central America, *i. e.*, all of North America. Prof. Bailey has been engaged upon the work for three years, and the results of his study will be heartily welcomed.

THE BUFFALO MEETING of the Society for the promotion of Agricultural Science listened to the following papers pertaining to botany: Parasitic fungi as affecting plant distribution, by W. J. Beal, Ph. D.; On some diseases of cultivated plants, by W. G. Farlow, M. D.; The sources of nitrogen of plants, by R. C. Kedzie, M. D.; Vitality and germination of fruit tree seeds, and Comparative growth of young timber trees, by W. R. Lazenby, M. Sc.; Hybridity in nature and its effects, by T. V. Munson, M. Sc.; A study in agricultural botany, by E. L. Sturtevant, M. D.; The agricultural grasses of Arizona, and The mildews of the grape, by F. L. Scribner, B. Sc.

A PLANT of Yucca filamentosa of remarkable size and habit bloomed last year in the Botanic Garden at Adelaide, South Australia, and is figured and described by Dr. Schomburgk, the director, in his last report. It is about twenty-five years old, is 18 feet high and 7 feet 4 four in circumference one foot above the ground. It bloomed for the first time in 1873, producing an upright flower-stalk. When this was cut away, a number of short branches were produced, forming a globular head of foliage. Last year when it bloomed for the second time, it threw out eight flower-stalks, three feet long and bearing three hundred flowers each, but instead of being upright, they were fully pendulous. It is said to have been a magnificent sight, as can well be imagined.

THE COMMITTEE of the A. A. A. S. for securing more favorable ruling regarding the transmission through the mails of herbarium specimens with written labels reported that much attention had been given toward securing the desired object but no result had been reached. The committee were met with the objection that it was asking legislation for too small a class to be worth while. To overcome this obstacle the name of the committee is now changed by the substitution of the words "natural history specimens" for "botanical specimens," and the committee is strengthened by adding Prof. S. F. Baird, of the Smithsonian Institution as Chairman. The other members are Profs. L. F. Ward, J. W. Chickering, Jr., and Dr. Geo. Vasey. The committee on the health and diseases of plants reported that it had accomplished the chief objects in view and was discontinued.

REFERENCE WAS MADE in the May issue to the condition of the botanical part of the Department of Agriculture, and the efforts to secure a suitable appropriation for the present year. For awhile after that was written the prospect was gloomy, and fears were entertained that recent advancement might be lost if appropriations were cut off. At this juncture the committee of the American Association on the health and diseases of plants addressed a memorial to Congress setting forth the desirability of investigations upon the fungous foes of the cultivator and the necessity for an appropriation of fully $5,000 with which to carry on the work. This was effectively presented by Prof. Riley, to whose exertions and those of Commissioner Colman the credit of finally securing the favorable action of Congress is largely due. The result has been, that the work on the diseases of plants has been separated from the botanical part of the Department, now raised to the dignity of a Division, and has been placed in full charge of Mr. Scribner, who reports directly to the Commissioner. This leaves the position of assistant botanist vacant. An appropriation of $5,000 was obtained, of which $840 goes to the Botanical Division to be expended chiefly in studying the agricultural grasses of the West, and the balance, $4,160, is to be used for the investigation of the diseases of plants, and for the salaries of those employed. Although this is much less than originally contemplated, yet it is an excellent beginning.

LATHRÆA SQUAMARIA, a common Orobanch of Europe, has been studied by Mr. George Massee and described, with a plate, in the September *Journal of Botany*. It has for a long time been considered a true parasite upon the roots of elm, ash, hazel, and beech. After germination, a full season is devoted to the development of vegetative organs and the accumulation of reserve material. The second year's work is confined to the production of reproductive parts. After fully describing the structure of the haustoria, leaves, etc., and also the results of chemical tests, the author concludes: "Although Lathræa has up to the present been described as a parasite, which to a certain extent is correct, more especially while young, yet we consider it much more of a Saprophyte than a parasite, scale-leaves never being absent; whereas the discs, upon which its parasitism depends, are, as the plant becomes old, frequently very rare, or apparently altogether absent, while in other instances roots and discs are very numerous on old plants; their presence or absence depends entirely on the position in which the plant finds itself; if small living roots of a suitable host-plant are present they are developed, whereas, if the plant has migrated to a locality from which they are absent, it possesses the power of supportin; itself by means of its scale-leaves." It may be interes'ing to mention that the roots are sometimes covered with the mycelium of a fungus, such as described by Kamienski as about the roots of Monotropa, but not with sufficient constancy to admit of the theory of symbiosis.

VOL. XI, NO. 10.—BOTANICAL GAZETTE.—OCT., 1886.

Memoranda of a revision of the North American Violets.[1] I.

ASA GRAY.

It seems most natural to throw all the Candollian groups into one, except the section *Melanium*, which includes the pansies; in this, following the late M. Boissier; and to arrange our violets in six primary sections, upon characters of vegetation taken along with differences in the stigma.

GROUP I. Strictly acaulescent; the dissected leaves and scapes all directly from an erect and short thick caudex rather than rootstock, never stoloniferous: corolla beardless: large antrorse-terminal stigma wholly beakless and naked.

V. pedata L., with var. **bicolor** Pursh, fide Raf.

GROUP II. Acaulescent; the leaves and scapes springing directly from the summit of a rootstock, or later more or less from runners: style with inflexed or truncate and beardless summit and an antrorsely beaked or short pointed small stigma.

* Rootstocks thick and short, multicipital, ascending or little creeping, never filiform nor stoloniferous, often fleshy-dentate: corolla only saccate-spurred, blue or violet, occasionally varying to white; at least lateral petals bearded. Species connected by transitions.

V. pedatifida Don. Syst. i. 320 (1831). *V. delphinifolia* Nutt. in Torr. & Gray, Fl. i. 136 (1838). This earlier name clearly belongs here and must be adopted. It is the *V. pinnata* of Richardson (not the Linnæan species, which has longer and narrower spurs), the *V. pedata* of Hooker's Flora as to the plant of Saskatchewan, etc. It has often been confounded with that species; but its affinities are with *V. palmata*, indeed is probably only a marked geographical variety of that species, with all the leaves finely dissected. It might take the much earlier name of *V. digitata* Pursh, except that Pursh founded it on a Virginian specimen, which he had seen in Major Le Conte's herbarium. The latter, however, makes no mention of it in his monograph; but we suppose it to be his *V. septemloba*, the variety of *V. palmata* which comes nearest to the present species. Indeed, the late Professor Tuckerman long ago collected at Concord, Massachusetts, specimens which would surely pass for *V. pedatifida* if from the valley of the Mississippi.

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[1]Read before the A. A. A. S., Buffalo meeting, 1886.

V. palmata L. In the year 1856, in the second edition of my Manual, this was combined with *V. cucullata*, following the general conviction of our botanists; repeated studies during thirty years confirm the opinion. But *V. cucullata* Ait. ought to have been referred, as an entire-leaved variety, to the Linnæan *V. palmata*. I am the more constrained to do so now by the fact that the name *cucullata* would have to give way to the much earlier-published *V. obliqua* Hill, well figured and unmistakable in his Hortus Kewensis. To the various synonyms already adduced to the more or less cut-leaved forms of this multifarious and widely diffused species, I have only to add that of *V. digitata* Pursh, as suggested above.

Var. **cucullata**, the *V. cucullata* of Aiton (1789) and *V. obliqua* Hill (1769), with abundant synonymy, is characterized only negatively by the absence of cut leaves, and every one of its many forms is liable to have them, most so those which affect dry or sandy soil. Yet they have not been found at either the most northern or the farthest western limits of the species.

V. sagittata Ait. Generally well-marked as this is, yet it appears to be confluent on one hand into typical *V. palmata*, on the other into the var. *cucullata*.

* * Rootstocks thickish and creeping, stoloniferous, comparatively large-flowered: corolla blue or violet, with white varieties; lateral petals usually bearded; spur short and saccate: leaves cordate and merely crenulate.

V. Langsdorffii Fischer in DC. Arctic Alaska to Brit. Columbia, extending, I believe, to the Sierra Nevada in the state of Nevada. Quite distinct, as Maximowicz insists, from the more caulescent *V. mirabilis*.

V. odorata L., the Sweet Violet of the Old World, beginning to be naturalized.

* * * Rootstocks long and filiform (not thickened nor scaly except at base of old flowering growths), extensively creeping underground, sometimes in summer along the surface in shade, leaf-mould, etc.

+ Corolla blue or purple, large-spurred, beardless.

V. Selkirkii Pursh, fide Goldie. Our identification of this northern species with *V. Kamtschatica* of Gingius in DC., and with *V. umbrosa* of Fries, appears to be confirmed. Few botanists are aware that *John Goldie*, the first describer of this marked species, and of several other Canadian plants, lived down to the present summer, dying at a great age, at Ayr, Ontario, June 1886.*

+ + Corolla blue or purple, short-spurred, smaller.

*See sketch of Goldie's life, p. 272, this number.

V. palustris L. In this country only alpine or subalpine. Labrador to Saskatchewan and Rocky Mountains, south to those of Colorado, and the higher parts of those of New England.

+ + + Corolla white, mostly with brown-purple lines on lower or also on lateral petals or a blotch, these bearded or beardless in the same species; spur short and saccate: stigma as if truncate and margined, antrorsely short-pointed. The three species run together.

V. blanda Willd. Geographical range fully as large as that of *V. palmata*. To this I refer two forms, which in their extremes would seem specifically distinct, viz.:

Var. **palustriformis**. Comparatively large, growing in shady or mossy and loose soil or leaf-mould, where it is freely and extensively stoloniferous: upper face of the leaves commonly hirsutulous in the way of *V. Selkirkii*, but less so: scapes often reddish: flowers rather larger; lower petal less lineate or picturate. This is *V. obliqua* Pursh (not Hill nor Ait.), and may also be his *V. clandestina* (in the summer state it is abundantly cleistogamous, and is the *V. amœna* of Le Conte). It ranges from Canada to Delaware, and to the mountains of Utah, but passes freely into the ordinary type. In the dried specimens it so much resembles *V. palustris* that Sir Joseph Hooker not unnaturally referred the whole of *V. blanda* to that species.

Var. **renifolia**. *V. renifolia* Gray, Proc. Am. Acad. viii. 288, which seems quite different from the ordinary state of *V. blanda* by its round reniform and beneath soft-pubescent leaves, is so connected with the preceding variety that it can not be kept distinct. It also grows in wet mossy woods and swamps, from Nova Scotia to the district north of Lake Superior, and south to Massachusetts and central New York.

V. primulifolia L., including *V. acuta* Bigelow, in its various forms, as is well known, fills up the interval between *V. blanda* and *V. lanceolata*. It is an Atlantic coast species, except as to

Var. **occidentalis**. A form with ovate- or spatulate-oblong leaves, all tapering at base, coll. by T. Howell, much out of the ordinary range, at Waldo, S. Oregon, along streamlets.

V. lanceolata L. has a rather larger range, from Nova Scotia to Lake Superior, Florida, and Texas.

+ + + + Corolla yellow; lateral petals usually bearded.

V. rotundifolia Michx. Our only truly acaulescent yellow violet, well marked in its summer state by the unusually accrescent leaves lying flat on the ground. From the character and habitat this should be, in its cleistogamous-flowering summer state, the *V. clandestina* of Pursh.

GROUP III. Subcaulescent by leafy stolons, or caulescent, with ascending 2-3-leaved stems, slender, almost glabrous, multiplying by long filiform rootstocks: leaves all reniform or cordate, undivided: corolla a bright yellow, with saccate spur: stigma terminal, beardless and beakless.

V. sarmentosa Dougl. To this belongs *V. rotundifolia* Hook. in Lond. Jour. Bot. vi. 73, in Geyer's collection, a species which it considerably resembles at first, flowering direct from the rootstock.

V. biflora L. Always caulescent, no leafy stolons; stigma margined on two sides. In this country known only from the Colorado Rocky Mountains; in the Old World ranges from Kamtschatka and Japan to Europe.

Synopsis of North American Pines, based upon leaf-anatomy.[1] I.

JOHN M. COULTER AND J. N. ROSE.

(WITH PLATE VIII.[2])

The genus Pinus is very naturally circumscribed, but its species have always been notably difficult of discrimination. This has arisen partly from the real difficulty of the subject, partly from the imperfect material found in our collections, and mostly from the insufficiency of the characters used. The oldest division of the genus was based upon the number of leaves in the bundles, and this must still be considered a supplementary character of considerable importance. In late years, however, it has been discovered that most valuable characters are to be found in the internal structure of the leaves, meaning, of course, the secondary or foliage leaves. The great diversity in the structure of these leaves is in marked contrast with the uniformity found in leaves of higher plants, and of itself is no mean argument in defense of the position of gymnosperms as the lowest of phanerogams.

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[1]Read before the A. A. A. S., Buffalo meeting, 1886.

[2]EXPLANATION OF FIGURES.—1. *P. Strobus*, 2 dorsal peripheral ducts, stomata on ventral faces, and single fibro-vascular bundle, ×54; 2. *P. clausa*, 2 parenchymatous ducts, stomata on all faces, and 2 fibro-vascular bundles, ×54; 3. *P. Cubensis*, internal duct, ×54; 4. *P. Arizonica*, 3 cells of the bundle-sheath with thick outer walls, ×250; 5. *P. monophylla*, thin-walled bundle-sheath, ×250; 6. *P. aristata*, strengthening cells next the epidermis, ×250: 7. *P. flexilis*, thin-walled layer (pitted) next the epidermis, ×250; 8. *P. tuberculata*, thin-walled layer between epidermis and strengthening cells, ×250.

In 1865 F. Thomas, in Pringsheim's *Jahrbucher*, iv. pp. 23-63, first called attention to these leaf characters as means of classification. The other authors upon this subject have been C. E. Bertrand, *Bull. Soc. Bot. France*, xviii. pp. 376–381, 1871, and *Ann. Sci. Nat. Bot.*, xx. pp. 5–153, 1874; W. R. McNab, *Proc. Irish Acad.*, ii. pp. 209–213, 1875, and in the same journal, pp. 673–704, 1877; E. Purkinje, of Austria, has also made studies, but his results have not been learned. Probably the most diligent and successful investigator of this subject was the late Dr. Geo. Engelmann, whose name in connection with this group of plants is the most familiar in this country. Some of his conclusions have been published in his "Synopsis of American Firs," published in 1878 in the *Trans. St. Louis Acad.*, iii. pp. 593–602, and particularly in his "Revision of the genus Pinus," published in 1880 in the same journal, iv. pp. 161–189. It is upon this last contribution that the work recorded in the present paper was based. Dr. Engelmann made use of the characters obtained from leaf-structure to define many of his subdivisions of the genus, but did not carry them on into the species. Our object has been, in the first place, to verify his work; in the second, to make use of these characters in the discrimination of species.

No reference will be made to any other than leaf characters, but it is far from the intention to claim that other characters are to be discarded. The leaf characters are rather given as confirmatory and supplemental, and in some doubtful cases decisive. The permanency of these internal structural characters, as compared with those which are external, is evident, but even with this, care should be taken not to place too implicit confidence in them. They should be used in connection with the ordinary external characters, though it is claimed here that almost all species of pines can be determined by a single leaf. The value of such characters is thus seen, not only in confirming those obtained from scales and cones, but in deciding upon our too numerous herbarium specimens which lack complete material, or in fossil botany in the determination of species or relationships. In several cases it will also be noted these characters serve to separate forms which have been doubtfully placed together, and more frequently to bring together certain forms which have been kept apart as doubtful species.

It will be observed that Dr. Engelmann's arrangement, in the main, has been confirmed, trifling modifications here and there being made to better express what is conceived to be true relationships. The necessity of a lineal arrangement, of course, distorts many of the facts, but we believe it to be the most natural yet suggested.

The number of species of American pines, exclusive of Mexico, as given by Prof. C. S. Sargent, in the tenth census report, is thirty-five. These have all been examined, as well as eight or ten Mexican species, which are also included. The material has been obtained from the Harvard herbarium, from other well known herbaria, and also from the very instructive slides prepared by the Rev. J. D. King, whose material was obtained from Prof. Sargent. Effort was made to obtain material from as wide a range as possible, and repeated studies of the same forms were constantly made.

Transverse sections of the leaf are used, and these should always be made well away from either its base or apex. Neglect of this precaution has led to confusion, as a leaf with two distinct fibro-vascular bundles, may be thought to have but one if the section is made near the extremities. The bundles usually separate above the base of the leaf, and blend again near its apex, and in poorly developed leaves may never appear separate at all. This led Dr. Engelmann to say that the single or double bundle "is of very little diagnostic importance, as we find occasionally single or double bundles in the same species,"[1] while, with the precaution mentioned, we have known it to fail but once.

The outline of a transverse section, in the main, depends upon the number of leaves in a fascicle, but this can not be pressed too far. In P. monophylla the outline is nearly circular, in 2-leaved species it is semicircular, in 3-leaved species triangular, but in 5-leaved species it is also triangular. It is thus usually possible to determine approximately the number of leaves in a fasicle by the transverse section of a single one, and hence the number of leaves will also be legitimately included among our anatomical characters.

The leaf-structure is separable into three regions, the cortical, the mesophyll and the fibro-vascular.

I. *The cortical region.* This is composed of one layer of epidermal cells, with very thick walls, interrupted here and there by stomata. The position and number of rows of stomata are valuable characters. In some species, as P. Strobus, they are found only on the ventral side; in others, as in P. Coulteri, they occur both dorsally and ventrally. The rest of the cortical region is made up of the so-called "hypoderma," being mostly very thick-walled cells, aptly called by Engelmann "strengthening cells" Engelmann rejected the term "hypoderma," because cells of the same nature often occur about the resin ducts and in the fibro-vascular region. The term "strengthening cells," therefore refers to this thick-walled tissue wherever found, and they may be cortical, about the

[1] Trans. St. Louis Acad., iv. 165.

ducts, or central. The term "hypoderma" still has its use, however, as it contains another group of cells which we have called "thin-walled cells," to distinguish them from the strengthening cells. This thin-walled layer frequently occurs between the epidermis and the cortical strengthening cells, and its presence or absence is a character of considerable importance. Seven of our species have an hypoderma composed only of these thin-walled cells, with no cortical strengthening cells; eight or nine species have no thin-walled layer between the epidermis and the cortical strengthening cells; while the remainder have the thin-walled layer between the epidermis and strengthening cells. By "thin-walled cells" it must be understood that we are speaking comparatively, as they are by no means thin-walled in fact, but contrasted with the epidermal and strengthening cells are decidedly so. Rarely is there any difficulty in distinguishing this layer, but occasionally, as in P. monticola, the thin-walled layer shades into the strengthening cells.

II. *The mesophyll region.* This is chiefly composed of large chlorophyll-bearing parenchyma cells, with very characteristic infoldings, which are of no diagnostic value. In this region, however, are found the resin ducts, and their position and size furnish very important characters They are found in three positions, viz.: *peripheral,* when they lie next to the cortical region; *parenchymatous,* when completely surrounded by the mesophyll; *internal,* when next to the bundle-sheath. The terms "external," "medial," and "internal" would better express their relation to the mesophyll region, but the former terms were given by Dr. Engelmann, and there is no good reason for changing them. A little confusion in these terms also arises from the fact that in two species resin ducts have been occasionally discovered in the fibro-vascular region, viz.: P. sylvestris,[2] to which we add P. serotina. Dr. Engelmann considers the positions of these ducts in the mesophyll region as the most useful diagnostic character obtained from the leaf-structure. However, even this character can not be relied upon exclusively, as variations from the normal position are apt to occur. This variation does not consist in changing the normal position, but in the development of accessory ducts in some other position, or in the change in position of a single one of the normal ducts. To Dr. Engelmann's list of these variations we have added ten or twelve species, showing that such variation is not unlikely in the whole genus. All the resin-ducts are lined with a layer of thin-walled secreting cells, outside of

[2]Arthur, Barnes and Coulter, Hand-book of plant dissection, p. 167.

which, in many cases, are thick-walled strengthening cells, either scattered about the duct or forming a compact sheath.

III. *The fibro-vascular region.* A very distinct bundle-sheath invests this region, the cells of which are either comparatively thin-walled, or with the outer wall excessively thickened. This has been a useful character in some of our subdivisions, but is not always constant. P. Sabiniana, P. Coulteri, and a few others may or may not have the bundle-sheath with thickened outer walls. In the center of this region occur the fibro-vascular bundles, either one or two. This character we have used as one of the best for separating the genus into two sections. As has been mentioned, Dr. Engelmann considered it of but slight diagnostic importance, but we have found no character less likely to fail. In the examination of many hundreds of sections but one was different from the expectation in this regard. The bundles are always together at the base and apex of the leaf, and may be widely separated during the remainder of their course, but even when they are in contact they can easily be distinguished as two. In the use of the terms "dorsal" and "ventral", when speaking of the leaf surfaces, the former is applied to the phloem side, the latter to the xylem. Strengthening cells may or may not be found about the fibro-vascular bundles, and this is such a constant character as to be of good service in classification. The rest of the fibro-vascular region is filled with parenchyma cells and tracheids, neither of which are of any diagnostic value.

Using the structural characters described the following synoptical arrangement of our pines, including some Mexican species, is presented, for the purpose of supplementing other characters, for use in the absence of other characters, and to indicate relationships.

§1. **Fibro-vascular bundle one: leaves mostly in fives.**

*A thin-walled layer next the epidermis (somewhat thickened in P. monticola): no strengthening cells next the epidermis nor about the ducts: leaves always in fives.

† Stomata on dorsal side of leaf.[3]

1. **P. albicaulis** Engelm. Epidermis mostly very thick-walled: one to three rows of dorsal stomata: two dorsal ducts (.050–.070 mm.); often a ventral duct, sometimes one or more smaller accessory ones: thin-walled cells about ducts larger than those next the epidermis: leaves 2 in. long.

Along the Coast Range, from California to British Columbia.

[3] This does not mean that there are no ventral stomata.

First described by Engelmann in *Trans. St. Louis Acad.*, ii. 209; then reduced by him to a variety of the next species in *Bot. Calif.*, ii. 225; finally restored to specific rank by the same author in BOT. GAZETTE, vii. 4. Several specimens labeled P. aristata in herbaria belong here.

2. **P. flexilis** James. Epidermis not so thick-walled: one to four rows of dorsal stomata: two dorsal ducts (.030–.045 mm.); rarely a ventral one: thin-walled cells about ducts equalling those next the epidermis: leaves 2–4 in. long.

Western slope of Rocky Mountains to California.

The extreme forms of these two species stand well apart, but there are intermediate forms which are hard to determine.

† † No stomata on dorsal side of leaf (often present in P. monticola).

3. **P. reflexa** Engelm. Three or four rows of stomata on ventral faces: two dorsal ducts (.025–.040 mm.): number of cells in bundle-sheath 16–20: fibro-vascular bundle often quite large, almost filling the fibro-vascular region, which often has strengthening cells, differing in this respect from the other species of the group and resembling P. cembroides: leaves 1–2 in. long.

High mountains of New Mexico and Arizona.

First described as a variety of P. flexilis by Engelmann in *Bot. Wheeler's Report;* then raised to specific rank in BOT. GAZETTE, vii. 4.

4. **P. Strobus** L. Three to five rows of stomata on ventral faces: one to three ducts (.035–.040 mm.), mostly two and situated half way between the middle and edge of the dorsal face: when three the odd one is on one of the ventral faces: number of cells in bundle-sheath 15–19, mostly 16: leaves 3–4 in. long.

Along the Alleghanies and in the northern states east of the Mississippi.

5. **P. Ayacahuite** Ehrenberg. Much like the last, but with a few more cells in the bundle-sheath (18–21), and always two dorsal ducts, which are much smaller (.015–.025 mm.).

Mountains of Mexico.

6. **P. monticola** Doug. Two to six rows of ventral stomata, often one or two dorsal rows: mostly two dorsal ducts (.025–.050 mm.), sometimes but one; often a few ventral ducts: number of cells in bundle-sheath 20–25: leaves 2–4 in. long.

Mountains of the Pacific slope.

The thin-walled layer next the epidermis, which is characteristic of this group, is not so evident as in the other species, but can be distinguished from the strengthening cells. It marks well a transition phase to the next group.

* * No thin-walled layer next the epidermis: strengthening cells next the epidermis and generally about the ducts: leaves one to five.

† Stomata on dorsal side of leaf.

7. **P. Lambertiana** Doug. Two to six rows of stomata on each face of the triangular section: always two dorsal ducts, often one between, occasionally some ventral ducts which are sometimes parenchymatous, no strengthening cells in fibro-vascular region: leaves 3–4 in. long.

In the Sierra Nevada and Coast Range.

Notes on the mode of pollination of Asclepias.

CHARLES ROBERTSON.

(WITH PLATE VIII)

In regard to the visitors of Asclepias Cornuti, Dr. Hermann Müller observes that they "slip upon the smooth parts of the flower until a foot enters the wide inferior part of the slit, in which it at last gets a firm hold".[1] Mr. T. H. Corry[2] describes the insect as grasping the back of a nectary, and plunging its proboscis into its cavity, "endeavoring at the same time to get a firm and sure foothold on the unstable flowers", until the insect at length places one of its feet into the wider part of an alar fissure.

Having collected insects on the flowers of six species of Asclepias, I regard the normal action of the most common and most efficient to be that they hold on to a flower, or several flowers, in such a way that their feet go down below the angles of the alæ, and when the legs are drawn upwards they are caught between the strongly projecting hoods and guided by them over the entrance of the stigmatic chamber, which occupies the narrow interval between their bases. Of native insects, the most common visitors I have observed on A. Sullivantii, are humble bees (Bombus separatus, B. Pennsylvanicus, and B. scutellaris) and Danais Archippus. The feet of humble bees reach down as far as the bases of the petals, and I have often found the pollinia fastened upon their tibial spurs as well as on their claws. I have also found pollinia of this species on the spurs and claws of Danais Archippus, and high up on tarsal hairs of Priononyx

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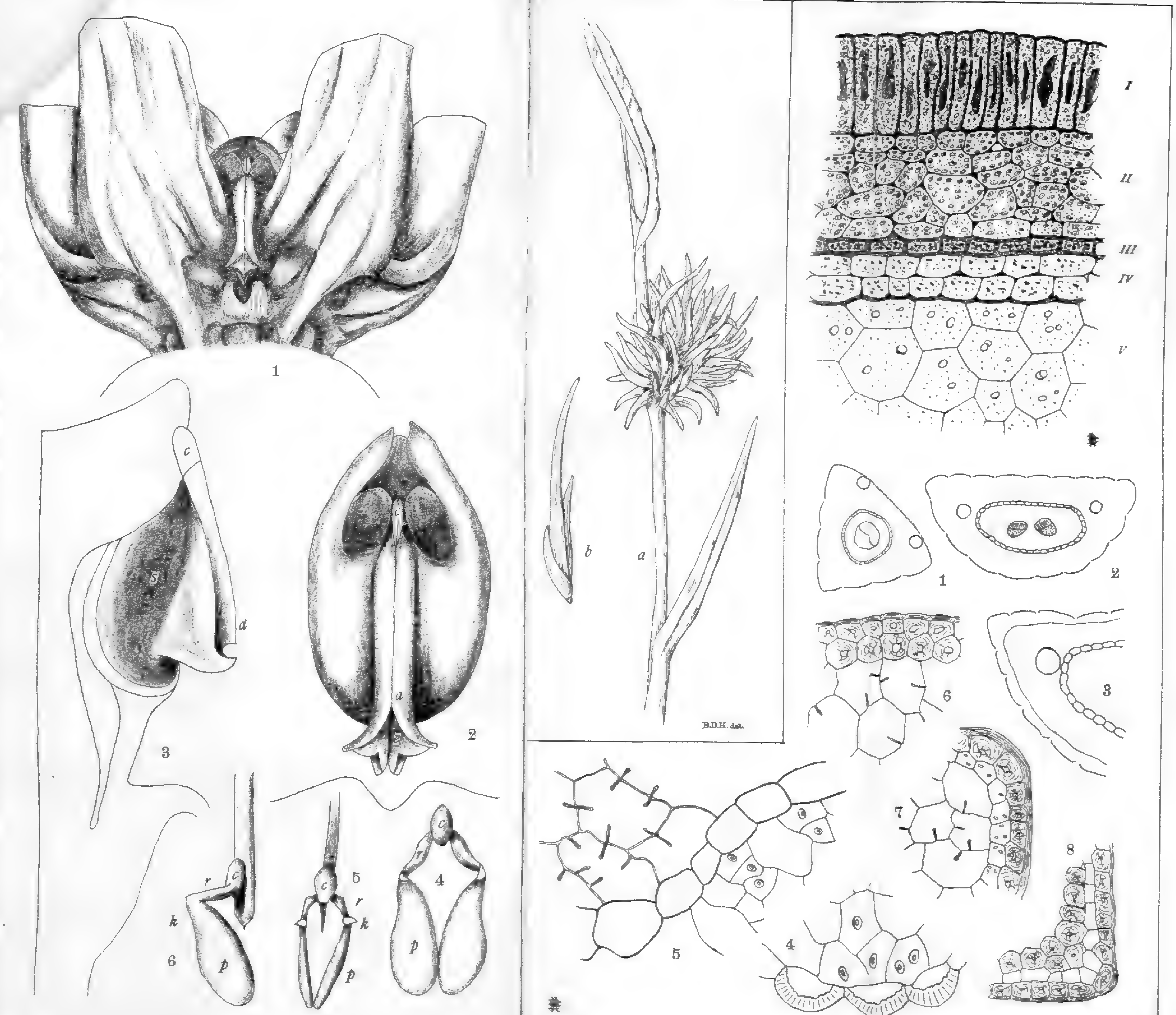
[1] "Befruchtung der Blumen", 1873, p. 336. "The Fertilization of Flowers", translated by D'Arcy W. Thompson, B. A., 1883, p. 398.

[2] "Structure and Development of the Gynostegium and on the Mode of Fertilization in Asclepias Cornuti, Dec.," Trans. Linn. Soc. Lond. Bot. 2d Ser. Vol. II., part 8. 1883, pp. 186, 187.

PLATE VIII.



Thomæ[3]. In a similar way, a specimen of Scolia bicincta shows pollinia of A. Cornuti on the tarsal hairs. However, the gynostegia of these species are so large that the feet of many visitors will not reach far below the angles of the wings, and, when this occurs, the claws are the only parts which are readily caught. The importance of the hoods in guiding the legs of insects over the angles of the wings, is more apparent in the smaller flowered species, since the more delicate wings catch hairs which are not only very fine and short, but which are also situated much higher up on the legs. Thus, hive bees caught on A. Sullivantii and A. Cornuti, show pollinia only on their claws and pulvilli, but they have the pollinia of A. tuberosa, A. incarnata, and A. verticillata scattered upon the hairs of the tarsi. A specimen of Argynnis Cybele, which I caught on A. Cornuti has pollinia of this plant on its claws and pollinia of A. tuberosa on the tarsal hairs. Again, a specimen of Papilio Asterias caught on A. tuberosa has pollinia of A. tuberosa on the hairs of the tarsi and of A. Sullivantii on the claws. Although the pollinia are fastened to different parts, I see no reason for supposing that the action of the insect differs on the different plants. To show how high the pollinia are fastened upon the legs of insects, I may mention that I have found the pollinia of A. incarnata on the hairs of the tibiæ of humble bees 7mm. above the claws, and on Papilio Cresphontes and P. Turnus as high as 9mm. H. Müller gives a figure of the leg of a butterfly showing eleven corpuscula, seven of which are fastened above the claws, four forming a combination on a tibial spur. [4]Dr. A. S. Packard, Jr., figures a Tachytes (?)[5] showing pollinia much as they appear on visitors of the smaller flowered species. In addition to those mentioned above, I have found, among the visitors of A. incarnata, A. verticillata and A. tuberosa, insects of the following genera with pollinia upon the hairs of the tarsi above the claws: Apathus, Melissodes, Ceratina, Magachile, Epeolus, Halictus, Vespa, Polistes, Odynerus, Cerceris, Crabro, Pelopoeus, Ammophila, Stizus, Bembex, Astata, Tachytes, Pompilus, Priocnemis, Myzine, Pieris, Colias, Libythea, Conops, Midas, Trichius, and Euphoria. A theory of pollination can not, therefore, be limited to an account of the insertion of pollinia which are attached to the claws; and it is

[3]A specimen of Sphex Pennsylvanica in the collection of Prof. S. A. Forbes at Champaign, Ill., has pollinia which I refer to A. Sullivantii similarly situated on its legs.

[4]"Fertilization of Flowers", fig. 133.

[5]Am. Nat., vol. I., p. 105, and "Guide to the Study of Insects", p. 165. Dr. Packard regards the tarsus as that "of a wasp belonging probably" to Tachytes. Mr. W. H. Patton, in Proc. Bost. Soc. Nat. Hist., XX., p. 397, says, "Indeed, that figure bears a resemblance to the tarsus of Tachytes, but represents tolerably well the tarsus of Sphex, an insect of a different family".

claimed for the view maintained in this paper, that it will account for pollination as readily in the one case as in the other and by the same mode.

H. Müller, who supposes that the whole foot enters the stigmatic chamber, says: "When the insect tries to draw its foot out in order to proceed further, the diverging claws are caught by the apposed edges of the anther-wings, and guided upwards in the slit, so that one or other of the two claws is brought without fail into the notch in the lower border of the corpusculum and there held fast[6]." On the same subject Mr. Corry observes: "When the foot reaches the superior end of the alar chamber in which it has been guided, one at least of the two hooked claws upon it, or some part of the foot in the case of Diptera, must easily enter the hollow cavity of the corpusculum, which lies in such a position that this result is inevitable[7]." The importance which these authors attach to the view that the whole foot enters the chamber, in my opinion, rests on a misunderstanding of the mode of insertion of the pollinia, and has led them to overlook the precision with which a corpusculum comes to be fastened to a hair or claw. The corpusculum is placed so nicely at the top of the wings that its cleft is fairly continuous with the slit between them (fig. 2 *c*.), and I can not conceive that the contrivance works normally unless the particular part, *i. e.*, a single claw, hair, or pulvillus to which the corpusculum becomes attached, is caught between the wings and guided by them into the cleft. Believing that all processes are caught as the leg of the insect passes over the angle of the wing, I suppose that only a single process is caught and that a claw is caught in exactly the same manner as a hair or spur. In a careful examination of the feet of 116 hive-bees which were killed by being caught on the flowers of A. Sullivantii, I have found that, with but two exceptions, when a foot was held by the wings, only one claw was between them, the other being free, or less often the pulvillus was held between the wings and both claws were outside.

When first withdrawn the pollinia lie in the same plane (fig. 4.) In a few minutes the twisting of the retinacula brings the pollinia into nearly parallel planes, but the upper ends are still separated by quite an interval (fig. 5.) According to the authors to whom reference has been made, the pollinia are inserted by the corpusculum. From the analogy of observations made on the movements of the pollinia of some Orchidaceæ some ad-

[6] Ibid, p. 398.

[7] Ibid, p. 188.

vantage might be looked for in the slow movement of the pollinia of Asclepias. Indeed, Mr. Corry, who has observed this phenomenon in A. Cornuti, states that it is of advantage, although he fails to show it; and I think it impossible so to do on the supposition that the pollinia are introduced by the corpuscula. He says: "Some considerable time, moreover, must elapse after the pollinia are extracted before the corpuscular appendages are so far dried that both pollinia of the same corpusculum can be introduced through the fissure into the alar chamber, and in the meantime the insect has had time to reach another flower or plant[8]." On another page he observes: "If the movement did not occur on the part of the pollinia their broad surfaces would lie at right angles to the alar fissure, and their insertion into it in this position through the notch would in consequence be rendered a much more difficult, if not an altogether impossible operation; or else the pollinia in being slipped in would become folded in the opposite direction, and the less curved border which emits no pollen tubes would be first inserted into the fissure[9]." But what is to prevent this consequence before the movement takes place? Whatever might happen there is obviously nothing to render the introduction of the corpusculum itself more difficult before the movement occurs than afterwards, so that the slowness of the movement is hardly an advantage under this view. If the corpusculum were very slender or flattened so that a thin edge could be presented to the slits, there would be no difficulty in understanding how it could readily slip into the stigmatic chamber; but it is a rounded body, and is relatively large in comparison with the entrance to the cavity. Of course, if the whole foot of an insect commonly enters the stigmatic chamber it is not hard to understand how the corpusculum should go in with it. But when the corpusculum is fastened to a hair which is directed outward and downward from the leg of the insect, and which is often so short that the corpusculum is fairly in contact with the leg, the difficulty increases. In the examination of the feet of hive bees killed on the flowers, I have failed to find a single case in which a corpusculum was attached to that part of the foot which was held between the anther wings. In my opinion, therefore, the structure of the corpusculum is so far from facilitating the introduction of the pollinia that it prevents the part to which it is attached from being again caught in the slits; and, until the

[8] Ibid. p. 195.
[9] Ibid, p. 190.

movement occurs, the corpusculum with its two pollinia will pass over the entrance to the stigmatic chamber without being injured.

After the movement occurs, if the corpusculum be examined from one side (fig. 6), it will be observed that the retinacula project outward and downward. Since the parts to which the corpuscula are attached themselves project outward and downward, the retinacula finally stand nearly at right angles to the leg of the insect. The retinaculum, near the point where it joins the pollinium, is bent rather suddenly, so that the pollinium appears to be flexed upon it. This flexure, which Mr. W. H. Leggett[10] has called the knee, is very prominent. There is quite an interval between the knees, and the membrane of the retinaculum at the knee is expanded transversly to the plane of the pollinium (fig. 5 *k.*) Robert Brown[11] has observed in A. purpurascens, that the part of the retinaculum extending between the knee and the pollinium remains attached to the latter when it is found in the stigmatic chamber. This expansion of the membrane serves to prevent the withdrawal of the pollinium after it has been inserted into the cavity, and, when drawn against the closely apposed edges of the alæ in the upper part of the stigmatic chamber, facilitates the rupture of the retinaculum. Judging from the structure of parts which are readily caught between the anther-wings, nothing could be more natural than for one of the knees to slip into the entrance to the stigmatic chamber, and the movement is intended to turn them into such a position that this will occur. When, therefore, the movement has taken place and the insect draws its leg over the angle of the wings, the corpusculum with the claw or hair to which it is attached passes on without being caught, while one of the knees of the pollinia readily enters the stigmatic chamber and the pollinium enters with it. When the knee has reached the upper part of the cavity and will go no further, the retinaculum is torn across and escapes, leaving the pollinium in position to effect fertilization.

In repeated trials at artificial pollination of the flowers of A. Cornuti, A. Sullivantii, and A. incarnata, I succeeded three times, in the case of A. Sullivantii, in separating the pollinium from the retinaculum without withdrawing the latter from the slit, and thus was enabled to insert a pollinium and to draw out a corpusculum at the top of the alæ with its two pollinia by the same movement. But in all other cases a pull that seemed sufficient to break the rectinaculum freed it from the slit so that the corpusculum at the top remained intact. Accordingly, I have seen

[10] Bull Torr. Bot. Club, Vol. III, p. 35.

[11] Trans. Linn. Soc. Lond., Vol. XVI, p. 724.

no difficulty, on the supposition that the pollinia are introduced by the knees, in the observation of H. Müller, who says: "In several flowers which I dissected the corpuscula and pollen masses were still in their places, though pollinia, which must have come from other flowers, had been inserted into the stigmatic chambers[12]."

In a number of cases observed by me on A. Sullivantii the movement which turns the knees toward the flower is completed in about seven minutes, though it has proceeded sufficiently in five minutes to turn the flexure far enough to render its insertion quite likely. With the view of pollination stated in this paper, the slow movement is plainly of advantage, because a knee can hardly be caught by the wings until it has occurred.

Now, since only one pollinium is inserted into the stigmatic chamber, there is an economic disposal of the pollinia. The interval between the flexures is so great that only one of them can be caught, while the other passes by the slit uninjured. There are, therefore, two chances of a pollinium being transferred to another plant. If both pollinia were left at each act of pollination, there would be but one chance of cross fertilization. Moreover, the chances of cross fertilization would be reduced from the fact that the stigmatic chambers would be more nearly filled by pollinia from the same source, while if they are introduced singly, there are more chances of a chamber receiving a pollinium from a distinct plant.

As two pollinia are fastened together, there would be but one chance of pollination occurring if the pollinia were inserted by the corpuscula, while there are two chances of a knee being caught. When a pollinium has been removed, the broken retinaculum may be caught in a slit and remove a second corpusculum with its two pollinia. When this combination of two corpuscula and three pollinia is drawn over the angle of the wings, there are three chances of a pollinium being caught. Whenever a pollinium is removed, two new pollinia may be substituted for it and a large combination of pollinia may result, arranged either in a unilateral series or dichotomously. In either case, the chances of the insertion of a pollinium equals the number of pollinia in the combination. If the foot to which the first corpusculum of the combination is attached must enter the stigmatic chamber, of course, there would be but one chance of pollination taking place without regard to the number of pollinia. Such an accident would be likely to destroy the whole combination. As already observed, on the large flowers of A. Sullivantii and A.

[12] Ibid, p. 400.

Cornuti the shorter hairs on the legs of insects are not readily caught, so that the number of parts to which the corpuscula may be attached are reduced to a minimum. For instance, the only parts on the leg of a hive bee which can remove the corpuscula of these species are the two claws and the pulvillus. The leg will thus remove three corpuscula, and since these bodies render useless the parts to which they are attached, the broken retinacula not only take the place of the parts disqualified, but increase the number of parts to which the corpuscula can be attached. By means of these combinations, therefore, the leg of an insect has its capacity for carrying pollinia greatly increased.

Mr. Corry, referring to the simplest form of combination, viz., two corpuscula and three pollinia, says: "This combination being inserted into the alar fissure, as the single corpusculum was previously, one of the two lower pollinia is left detached in the lower part of the chamber, while its appendage, becoming caught at the upper part in the fissure of the corpusculum which lies there, carries it away, forming a combination of three corpuscula and four pollinia[13]." This suggests a most serious objection to the view that the pollinia are introduced by the corpuscula. It makes a mystery of the mode of retention of the pollinia, for how are we to understand how one pollinium is retained after the foot with two corpuscula and two pollinia have escaped. However, so long as the combination remains uniserial, Mr. Corry finds no difficulty in its passage through the stigmatic chamber; but when it becomes dichotomous the difficulty becomes insurmountable, and, to account for this form, he makes use of the theory which I have applied throughout. He says: "These corpuscular combinations are, however, frequently more or less regularly dichotomous in their arrangement, and this can only occur by one of the projecting corpuscular appendages, either with or without a pollinium attached to it, becoming caught in the open lower extremity of an alar chamber; it is then drawn upwards in the cavity, its pollinium, if it has one, is usually detached in the lower part, and then in any case the appendage simply passes upwards as the insect raises its leg and lifts out the corpusculum situated at the apex of the chamber, along with its pair of appended pollinia. I am unable to conceive that this dichotomous form can be brought about in any other way, since the alar chamber is in all cases of much too contracted dimensions to admit of the passage of any form of combination except a unilateral series such as that previously mentioned, *i. e.*, a combination with a single pollinium directly attached to each corpusculum save the last,

[13] Ibid. 191.

which has two pollinia[14]." This is a plain admission that the view that the pollinia are inserted by the corpuscula will not account for the formation of dichotomous combinations of pollinia, and involves the whole theory of the insertion of pollinia by the corpuscula. For if a pollinium in a dichotomous combination can be inserted by the knee, any other pollinium may be inserted in the same way, and the theory of insertion by the knee may be applied throughout without meeting any difficulty. The supposition that the pollinia are inserted by the knees explains the formation of these as well as of unilateral ones, and shows the value of both forms; for the combination becomes the equivalent of a leg provided with a number of pollinia, each one of which may be inserted separately.

Finally, I have seen the pollinia of A. Sullivantii introduced into the stigmatic chambers in the manner above described. The pollinia and the entrance to the chamber in this species are very large and are easily seen, and hive bees move so slowly in effecting pollination that, after a knee is caught, one can see the pollinium slowly disappear between the wings, so that there can be no doubt as to the manner of insertion. Commonly, however, the insertion of pollinia occurs so rapidly that it is impossible to see how it really happens. After a pollinium has been introduced into the chamber, hive bees always have difficulty in breaking the retinaculum, and they lose their lives on account of this as well as on account of the difficulty in drawing their claws through the slit. When a foot is held by a retinaculum the pollinium is found in the chamber, with every indication that it was introduced by the knee.

Explanation of Figures on Plate VIII.—1. Flower of *A. Sullivantii* Engelm (sepals and petals removed). 2. Anther wings of same. 3. Stigmatic chamber. 4. Pollinia when first withdrawn. 5. Same after twisting of retinacula. 6. Same, seen from the side.

a. anther wing. *c.* corpusculum. *e.* entrance to stigmatic chamber. *k.* knee. *r.* retinaculum. *s.* stigmatic chamber. *p.* pollinium.

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[14] Ibid. pp. 191, 192.

Certain chemical constituents of plants considered in relation to their morphology and evolution.*

HELEN C. DE S. ABBOTT.

The writer has been engaged for some time upon the study of plants by means of proximate qualitative and quantitative chemical analysis, in which the latest methods advanced by Dragendorff were followed. The facts obtained from these studies tend to show a chemical progression in plants, and a mutual dependence between chemical constituents and change of vegetable form.

All plants which were known to contain *saponin* were examined to determine the correlation between this constituent and the accompanying morphological forms. It was found that these saponin plants occupied the great middle plane of M. Edouard Heckel's scheme of plant evolution.[1] M. Heckel arranges all plants within three divisions: 1. Simplicity of floral elements; 2. Multiplicity of floral elements; 3. Condensation of floral elements, and in addition he bases his theories upon three characters: Filiation, adaptation, and progression. These laws as well as the three divisions of development, are not only elements of test for the great divisions, but are to be found in orders, sub-orders and classes. It is a significant fact that all the saponin groups belong to this middle division, or multiplicity of floral elements. Saponin is thus a constructive element in developing the plant from the multiplicity of floral elements to the cephalisation of those organs. It is an indispensable principle in the progression of certain lines of plants, passing from their lower to their higher stages. Saponin is invariably absent where the floral elements are simple; it is invariably absent where the floral elements are condensed to their greatest extent. Its position is plainly that of a factor in the great middle realm of plant life when the elements of the individual are striving to condense and thus increase their physiological action and the economy of parts. All the great groups which contain saponin are closely allied and possess other properties in common, as fibrous or bulbous roots, rootstocks, tubular character of some part of the flower, and a climbing tendency in *Smilaceæ* and some of the *Sapotaceæ*.

Numerous analogous examples of a correspondence between morphology and chemical constituents were advanced, and the following conclusions reached:

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* Abstract, by the author, of a paper read before the A. A. A. S., Buffalo meeting, 1886. Evolution used in the sense of progression.

[1]Les plantes et la théorie de l'evolution, *Revue Scientifique*, 13 Mars. 1886.

1. A similarity of one or more chemical constituents is to be found in all plants which are equally developed, and on the same evolutionary plane.

2. The evolution of chemical constituents in which they follow parallel lines with the evolutionary course of plant forms, the one being intimately connected with the other, and consequently that chemical constituents are indicative of the height of the scale of progression, and are essentially appropriate for a basis of botanical classification. In other words, that the theory of evolution in plant life is best illustrated by the chemical constituents of vegetable form.

The reasons offered in favor of a chemical basis of classification are:

1. The disagreement among botanists themselves, depending upon the insufficiency of the present methods of classification.

2. Chemical constituents, or the constructive elements of form are intimately associated with the origin and progression of plant life, and are consequently better adapted for classification than organs and tissues because as component parts less complex.

3. By the invariable composition and structure of given determinate chemical constituents.

4. The percentage of any given compound in a plant would gauge the progression or retrogression of a plant, species or genus, and would accentuate the characters of progression, adaption, and filiation.

5. Variations in chemical constituents would be detected by analysis earlier than consequent variations of organs or tissues.

6. It is a law of internal influences controlling function and modifying forms rather than of external forces, hence a study of the elements of the innermost structure of plant life is a study of that law and of life itself.

All chemical constituents will not answer as means of classification for the same great evolutionary plane, though any compound might be found to furnish a basis for the division of plants into classes, orders, sub-orders, genera and species.

Albuminous compounds and chlorophyll are less likely to be serviceable as compounds of classification. They are intimately associated with the manifestation and continuance of the conditions of life though they are not regarded as the essential factors in development.

The chemical study of plants is meant to include microchemistry in its application to histology and physiology, in determining the position in the cell of any chemical compound, and qualitative and quantitative analysis to be practiced in accordance with the schemes of Dragendorff and others. I should suggest that analysis be made of each part of the plant, as of the root, stem, bark, wood, leaf, flower, and seeds; also of the separate organs of plants, *i. e.*, in the flower, of the stamens, pistils, petals, calyx, and of various plants under various conditions of age, climate, soil and seasons. Under these conditions a comparison of chemical constituents with plant structure would lead to a comprehension of the correlation between morphology and chemistry.

BRIEFER ARTICLES.

An interesting Peronospora.—The *Peronospora graminicola* Schr. is abundant here this season on Setaria viridis. Dr. Farlow gives a description of the species in the BOTANICAL GAZETTE, March, 1884, p. 39, after which he says: "This curious species, for which Schroeter has created the sub-genus *Sclerospora*, has been found in several European countries, but is at present only known at La Crosse (~~Minn.~~) in this country." The specimens gathered here are more vigorous, seemingly, than those from which the description of the species was made. For example, the conidiophores, instead of being solitary or sparingly branched, are clustered and much branched. But that which will most interest all lovers of the Peronosporæ is the fact that this mildew attacks the spikes of the Setaria and frequently distorts the floral parts beyond all recognition. Herewith is shown[1] a "head" of the foxtail flowers, drawn natural size. Instead of the apparently cylindrical spike, three or more inches long, with its many long bristles, there is a smooth head, or short spike of floral parts, as shown at *a* in the engraving. Rarely more than one head in the same plant is thus deformed. With few exceptions, the essential parts of the affected flowers are either abortive or wanting. At *b* is shown a spikelet double its natural size. The affected floral parts are usually of a purplish color, and abound in the oöspores of the Peronospora. In many of the palets and flowering glumes the thick-walled, dark brown or chestnut oöspores are so numerous as to occupy nearly all the space within the epidermis.

On other culms without flowers the upper leaves are frequently very stiff, upright and colored dark brown. In such the oöspores have formed in countless numbers.—BYRON D. HALSTED, *Agricultural College, Ames, Iowa.*

John Goldie, gardener and botanist.—John Goldie was born near Maybole, in the district of Carrick, Ayrshire, on the 21st March, 1793. Having selected gardening as an occupation, he was for a time under instructions in the art in the gardens of Kilkenam, a residence of the Fergusons, an Ayrshire county family, situated on the Girvan river in Carrick. At an early period of his career he became associated with Mr. James Smith, well known in his day

[1]See plate VIII.

as a botanist and horticulturist, and to whom is credited the introduction into cultivation of what is now known as the Kilmarnock weeping willow, which, it is said, he discovered amongst some of the hedges of Ayrshire.

When Hen Ainslie, the well known American naturalized poet, was a young man making the tour, the fanciful account of which he afterwards published under the title of "A Pilgrimage to the Land of Burns," he visited, amongst other places worthy of note, Mr. Smith's residence and gardens, known by the name of Monkwood Grove, situated on the banks of the classic Doon, and puts on record a very pleasing picture of the place and its occupant and its botanical treasures.

In the year 1815 Mr. Goldie married Margaret Ballantyne Smith, daughter of his preceptor. An incident of his early youth was his appointment as botanist on an exploring party being sent out to Africa by the British government. When preparing himself and in full expectation of going, he was, from some unexplained cause, superseded at the last moment, which he had no cause afterwards to regret, as the expedition turned out abortive, nearly all the members succumbing to the terrible African climate.

For the purpose of more thoroughly studying botany, he became connected with the botanic gardens at Glasgow, and in company with the lamented botanist and traveler Douglas studied botany under Sir William Hooker, who was at that time curator of the gardens, and whose lifelong friendship he afterwards enjoyed.

He paid his first visit to America in 1817–18, and at Montreal made the acquaintance of Frederick Pursh, one of the pioneer botanists of this continent, and at that time residing at Montreal; congeniality of tastes resulting in Mr. Pursh furnishing him with useful letters of introduction to people throughout the country likely to aid him in his researches. Returning home in 1818, he revisited America in 1819–22. His diary, still preserved in manuscript, records his starting on foot from Montreal on the 4th June, 1819, and in this way making the journey up the St. Lawrence, with a divergence to the Lake Simcoe neighborhood, passing through the city of Toronto, at that time called Little York, and along the beach near Hamilton, without observing or being made aware of any nucleus of a city where Hamilton now stands. The Niagara Falls were, of course, a point of special interest, and the diary is illustrated with a pen and ink plan of it. From the falls his course lay through parts of New York and Pennsylvania and through that part of the latter which has since become known as the oil regions. Footing it away out from Pittsburg, the diary dates his arrival at what was called in the locality Oil creek, so named from an oil that was seen to rise to the surface in many places, thick, dark-colored, and having a strong bituminous smell. Some soldiers, marching from Pittsburg to Detroit, were said to be the first to report the discovery of this oil, the virtue of which as a cure for rheumatism they also found out, the march in the wet having made many of them victims to it.

The diary, of course, makes many references to the plants noted in the different localities, and his services to the science were recognized by English botanists in annexing his name to a fern, Aspidium Goldianum, which he was the first to describe and procure specimens of.

On returning to Scotland, after this second American tour, he was in the year 1824 recommended by Mr. McNab, of the Edinburgh Botanical Gardens, to collect and take charge of a vessel load of plants to be taken to St. Petersburg for the starting of a botanical garden there, in which mission he acquitted himself to the satisfaction of his employers. On his return from this expedition he settled down with his family in the nursery business, but returned to Russia again in 1830 and made a collecting excursion through the country, amongst some of the fruits of which was the introduction to the English horticultural world of such plants as the Picea pictita, Pavenia tenuifolia plena, etc. From this time till the year 1844 he followed the business of nurseryman and florist at the old home near by to the birthplace of the poet Burns, a few miles from the town of Ayr.

In 1844, having formed a favorable opinion of Canada West as a place of emigration, in which he might have a chance to better the circumstances of himself and family, he took ship with his entire household, for Montreal, and from there journeyed westward and chose as a resting-place a spot near some of his old-world neighbors, about a mile from Ayr, in the county of Waterloo, where he died, surrounded by children, grandchildren and great-grandchildren, last June, in his ninety-fourth year.

Desmodium molle DC.—This species, heretofore accredited to Florida, seems to be no nearer to us than St. Thomas of West Indies, Panama, and tropical South America. It should be dropped from our catalogues. The plant described under that name with doubt by Chapman, and on that authority entered in Watson's Index, is *D. tortuosum* DC. To it are to be referred *No. 30 Garber's South Florida Fl.*, and *No. 623 Curtiss' N. Am. Pl.* Its more distant verticels of filiform, recurved, thrice longer (9′′) pedicels, and its pendulous loments of 4-6 equal, twisted, 2′′ long, fertile joints, sufficiently distinguish *D. tortuosum* from the following:

D. molle DC.; *? Macf. Fl. Jam.; Benth. in Fl. Brasil.; Griseb. Fl. Brit. W. Ind.; not Chapm.* (*No. 361 Eggers' Fl. Ind. Occ.*)—Probably distinct from every other known species by its loment. This is 2- or occasionally 3-jointed; upper joint only perfecting seed, flat, oval, enlarged (3′′ long) and detaching itself at maturity, suture notched at insertion of seed; lower joints minute, undulate-twisted, sterile, persistent.—JOHN DONNELL SMITH.

Testa of the seeds of Phytolacca[1].—Being engaged in a study of Phytolacca, and noticing the paper of Mr. L. H. Pammel on the structure of the testa of several leguminous seeds, published in the *Bulletin of the Torrey Botanical Club*, February, 1886, at Dr. Coulter's suggestion I made an examination of the testa of the seeds of Phytolacca, with the following results: There are four distinct regions: 1. The palisade layer (I). This layer consists of flat very thick-walled cells, each containing a very irregular cell cavity, completely filled with a large granular mass and numerous small granules. The thick walls contain a brown pigment, and are roughened all over by small projec-

[1] See plate VIII.

tions. These cells vary in shape, some being almost wedge-shaped. 2. The next region (II) contains four or five layers of thin-walled cells, which are somewhat irregular, sometimes five or six-sided in section, separated by a few intercellular spaces, and containing a small amount of coloring substance. 3. The third region (III) is decidedly a pigment layer. The cells are small, regular and thick-walled. 4. The innermost region (IV) contains two layers of nearly empty cells. They are thin-walled, with the exception of the wall next the nucellus (V), and somewhat rectangular. It will be noticed that the "crystal layer" found in many of the harder seeds is entirely wanting.—CHAS. U. STOCKBARGER, *Wabash College, Indiana.*

Some notes on Hypericum.—Since the publication of my revision of North American Hypericaceæ in the BOTANICAL GAZETTE for April and May, 1886, I have received some very interesting material from Dr. A. Gattinger, of Nashville, Tenn., who has for many years been making a careful study of the state flora. Tennessee seems to be a center for this group, where northern and southern forms mingle. Eighteen species of Hypericum are found within its borders, and it is not wonderful that in some of its almost inaccessible regions a new species has been discovered.

A very interesting discovery is that of *H. Kalmianum* L. in the oakbarrens of Tullahoma, Middle Tennessee, July 10, 1882. Heretofore thought to be restricted to the region of the great lakes, its occurrence in this widely separated locality is very unexpected. As a rule the specimens seem more robust than their northern representatives, but not more so than some specimens I collected last August at Point Abino, near Buffalo. It would be interesting to learn more of the surroundings, but "oakbarrens" give us probably the same conditions of soil as are found to favor the northern forms.

In the revision referred to a separation is made between H. Kalmianum and the group containing H. prolificum and H. densiflorum upon the basis of five- and three-celled capsule. Undoubtedly this distinction occasionally breaks down, as H. Kalmianum is found with capsules four- to six-celled, and the capsule of H. densiflorum is often four-celled, while the new species described below combines characters of both groups, and forms a complete transition from H. Kalmianum to the species that follow. While these exceptions show that the division is not an absolute one, it still is the rule, and furnishes as good a distinguishing character as can be expected in species so closely allied. For the present, then, the new species, while it is undoubtedly most closely related to H. densiflorum and H. prolificum, will be grouped most conveniently with H. Kalmianum, on the basis of a five celled capsule, as follows:

3.* **H. lobocarpum** Gattinger, n. sp.[1] Shrub, five to seven feet high, with upright branches: leaves as in *H. prolificum*: flowers as in *H. densiflorum*: sepals not foliaceous, linear-lanceolate: capsule two or three lines long, lanceolate and tapering to the long strong beak, completely five-celled and deeply five-lobed, in most cases the five carpels almost distinct, and at maturity falling away from a central axis.—Low swampy lands, in the Orange sand formation, near Hol-

[1]Announced to the Botanical Club of the A. A. A. S., Buffalo meeting, 1886.

low-rock, Carroll Co., West Tennessee, collected first in fruit, September, 1867 in flower, July, 1886, *Gattinger;* also, "W. Mississippi or E. Tennessee," *Dr. J. T. Stewart*, 1863. Dr. Gattinger describes it as "growing in a swampy region difficult to penetrate, amidst Rosa Caroliniana and Nyssa aquatica." He found two shrubs, and no more. The Stewart specimen is in the Harvard herbarium, and is simply a fragment of a fruiting specimen which has remained undetermined, but it is undoubtedly this species. The great peculiarity consists in the deeply five-lobed capsule, which is more differentiated than in any other member of the genus and serves well to distinguish the species. Some species are slightly lobed, but in this case the carpels seem almost distinct and are simply held together by their attachment to a central axis, from which they fall away at maturity. The size and general habit of the plant are like H. densiflorum, with perhaps even denser flower clusters, while the broad leaves are exactly those of H. prolificum. Mr. Canby has collected New Jersey forms of H. densiflorum bearing the leaves of H. prolificum, which closely resemble H. lobocarpum, except in the capsule characters. Dr. Gattinger is to be commended for the persistence with which he urged the claims of this species to recognition.—JOHN M. COULTER.

How the humble-bee obtains nectar from Physostegia Virginana.—While passing through a patch of the "False Dragon-head," I noticed that a goodly number of a large species of humble-bee were alighting *on* the flowers and darting their heads deep in between the calyx and corolla, at the upper side of the latter. At first I thought they were collecting nectar from between the calyx and corolla, and commenced to look for the glands. But on inspection, I found that on the upper side of many of the corollas, near the base, was a longitudinal slit, usually near one-third inch long. This was the case in nearly all the older flowers examined, while in those just opened, or still opening, the slit was usually absent. On gently pressing down on the outer portion of the slitted flowers, I found that the sides of the opening were thrown apart, thus exposing the upper portion of the four-lobed ovary and lower parts of the pistil and stamens, and making access easy to the nectary glands at the base of the ovary. In addition to the humble-bee there were a number of other insects visiting the flowers, but they entered in the usual way, through the corolla. It is not unusual to find tubular flowers, especially the closed gentians and Tecoma radicans, with holes eaten through them near the base, through which insects pass in and out, which holes are nearly always made by ants. But I do not remember to have seen any record of instances where an insect made a slit, through which to collect the sweets of a flower.—J. SCHNECK, *Mt. Carmel, Ill.*

Home-made bacteria apparatus.—For the cultivation of bacteria and other microscopic organisms certain utensils are essential, others are very serviceable without being indispensible. The German investigators have given much attention to the construction of incubators, sterilizers, culture vessels of various kinds, implements and accessories in great numbers, and of convenient utility. If it is desired to fit up a complete laboratory for the study of these low organisms, and the means are at command, it is doubtless best to send to Berlin[1] for the equipment. But for many who have not large bank accounts, and who are still desirous of learning or teaching something concerning bacteria, a few lines about inexpensive, home-made apparatus may prove acceptable.

The necessities are: (*a*) A good microscope, of which nothing further need be said, (*b*) a dry sterilizer, (*c*) a steam sterilizer, (*d*) a water oven or incubator, (*e*) moist chambers, (*f*) test-tubes, (*g*) inoculating needles, (*h*) soft glass tubing, (*j*) pincers.

The dry sterilizer may be made of sheet-iron ("Russia" preferable), and if the walls are double all the better; but the common ovens sold with "oil" stoves may be easiest procured, and answer every purpose. The side door is in

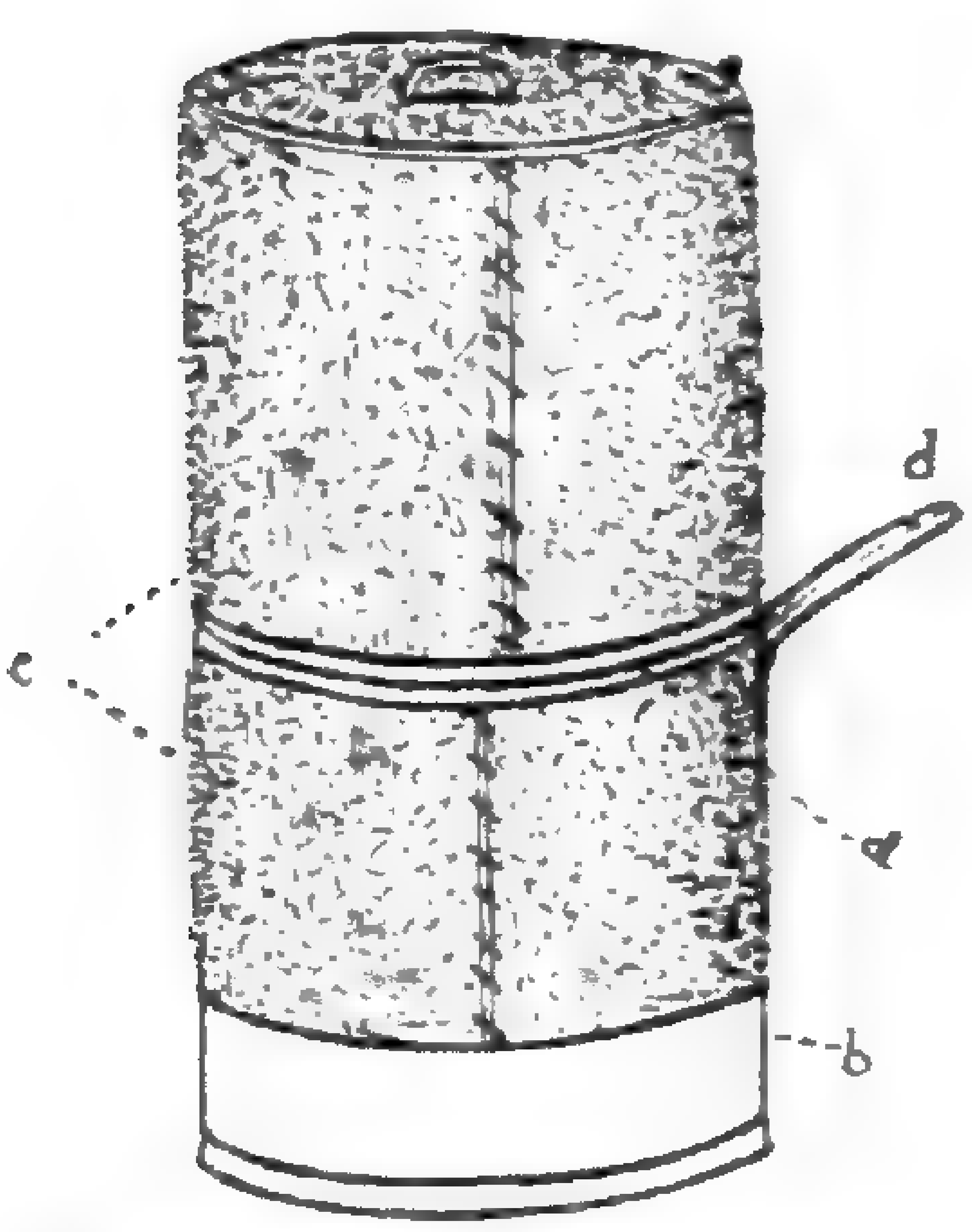

Fig. 1. Steam Sterilizer. *a*, place of division; *b*, protecting ring of tin outside the felt cover; *c*, felt covering; *d*, handle at extreme top of lower division.

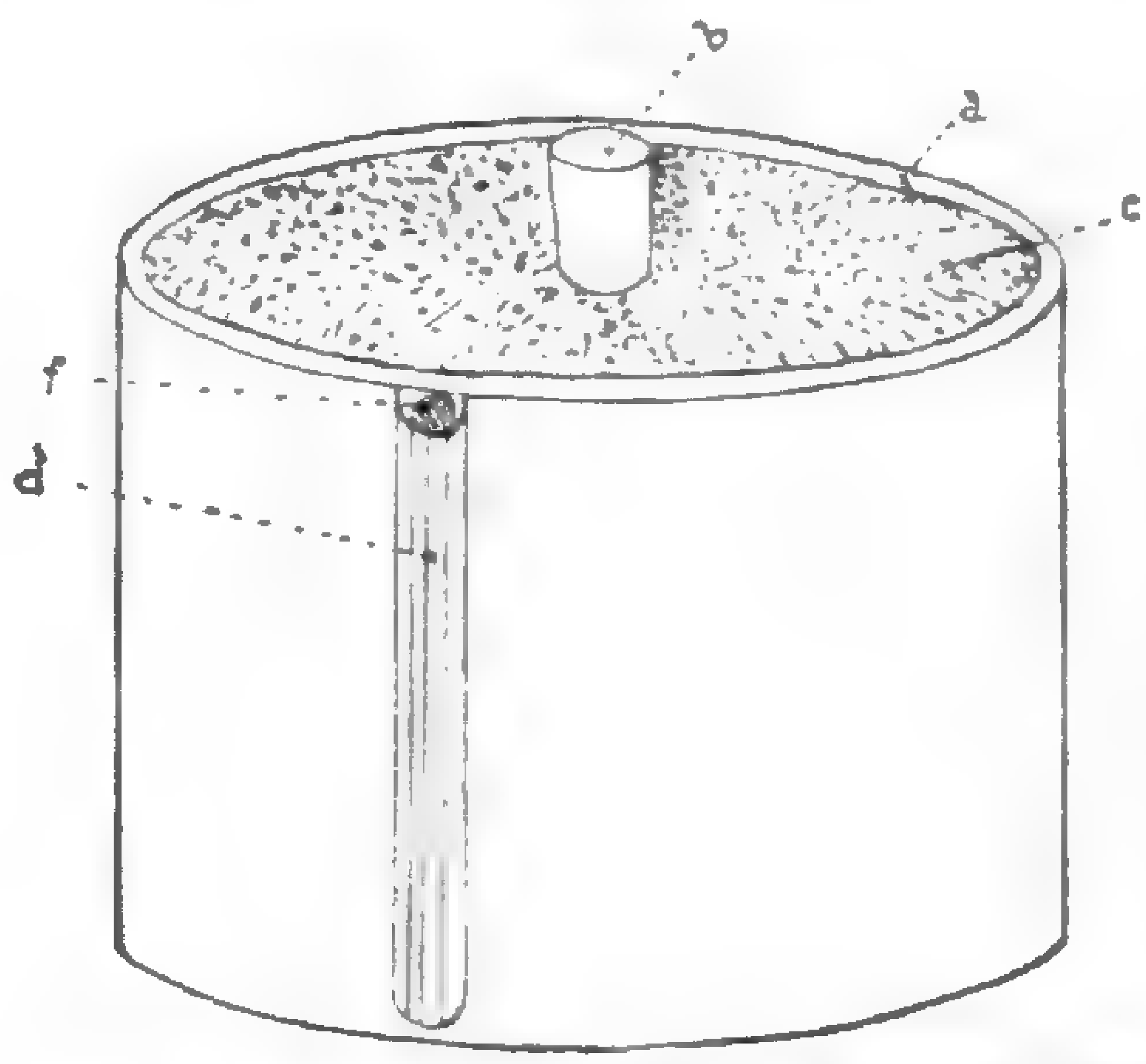

Fig. 2. Incubator. *a*, Double wall for water space; *b*, opening with collar to serve for the insertion of thermometer and for handle; *c*, felt covering on cover; *d*, nose piece for filling water space, observing height of water and for thermometer or gas-regulator; *f*, opening in outer wall of vessel for exit of air and steam.

every way preferable to a cover at the top. The bottom should be perforated to admit the flame and a false bottom pierced with small holes, except near the central area, placed an inch above. Several moveable shelves are required. The size must depend upon the amount of work to be done, but in any case one square foot for the base is little enough, and a greater height is preferable. In this all vessels and utensils which will stand a high temperature, as well as a quantity of cotton-wool for plugs, are to be sterilized by heating to 150° C., or more. It is a good place to keep a supply of test-tubes, etc., ready for use. Keep a quantity of cotton in the upper space. Let this be separated into pellets big enough for plugs before sterilizing.

The steam sterilizer (fig. 1) is a very useful vessel for sterilizing fluids in flasks, test-tubes, etc., and anything else that will not permit a high dry heat. It is used for filtering gelatine, etc., for making meat broth, cooking potatoes and the like. It should be cylindrical in shape, not less than six inches in diameter of base and one foot in height. It should be divided into two equal parts,

[1] Or to Eimer and Amend, 205–211, Third Ave., N. Y. City.—Eds.

so that the upper part may be lifted off and the lower half used by itself. A cover like that of an ordinary tin pail is used. A perforated false bottom (readily removable) is fitted on suitable supports one and a half inches from bottom. When in use this space is to be filled with water. This vessel may be made of tin, but copper is better. Over the outer surface thick felt (to be obtained at the saddler's) may be sewed by bringing the ends snugly together after placing the piece around each cylindrical portion of the vessel. The felt on the cover may be held in place by three or four little "tongues" soldered to the upper surface, passed through the felt and bent down. To protect the felt from the flame a band of tin two and a half inches wide should be fastened around and allowed to project a half inch below the bottom, the lower edge being turned in and up against the vessel.

I can not help but feel that the sterilizer is much simpler than this description. The figure may help to a comprehension of the latter. If tin is used the cost need not be over one dollar and a half, and a dollar more for copper.

The incubator (fig. 2) ought to be made of zinc or copper, preferably the latter. The cheapest (though not the best) form is cylindrical with circular cover. The bottom and side walls must be double so as to leave a three-fourths inch water space. The side walls are closed at the top. Two half-inch holes are to be cut through the outer vessel, one at the *extreme* top vertically over the other near the bottom. At this place a vertical nose-piece three-fourths of an inch in diameter extends the entire height of the vessel covering the holes just mentioned. This is for filling the water space, and for the insertion of a thermometer or gas regulator, as well as to indicate the height of the water within. The cover may be single tin covered with felt, or better (in service, but more inconvenient to handle), of copper, and double for water. In the latter case a side projection containing water connected with that inside will be necessary for heating by a special lamp. An inch hole fitted with an upright collar is to be provided in the cover for the insertion of a thermometer. With the double cover a second hole leading to the enclosed water is desirable for a second thermometer. It is surprising what difference in temperature there is between top and bottom of the space in such a water oven when the cover is single tin unprotected by felt or some such substance—by far too much for the results required. No doubt a thick pine-wood cover, lined with tin beneath, would answer well the requirements. The difficulty which one finds in any such incubator is to keep the temperature uniform and not *too high*. With gas, the simplest way is to have an ordinary lava-tipped burner (instead of a Bunsen burner as commonly used) turned low enough to make the flame nearly or quite blue, and then regulate the amount of heat required by the distance from the vessel to the flame. A small kerosene lamp, "night lamp," may be utilized to good purpose. An incubator as described, of copper with felted tin cover, can be made for four to six dollars.

Moist growing chambers can be satisfactorily secured by the use of a small plate or saucer and the largest goblets or tumblers procurable. A simple circle made of a strip of zinc an inch wide will serve as a support for the glass culture plate. The latter can be cut from good window glass the size of the moist chamber, or less, if desired. In moist chambers it is usually wise to use a one-per cent. aqueous solution of corrosive sublimate instead of pure water. In this case the support for the culture plate should be glass or porcelain. Individual butter plates or saltcellars may be utilized.

Test-tubes five inches long by three-fourths of an inch wide are the most convenient. Instead of these, half-ounce bottles of elongate form and with wide mouths may be used with equally good results.

For inoculating or transferring needles for cultures, platinum is the best. When this is not attainable use brass wire. Heat the end of a slender glass rod five inches long until soft and thrust the wire into the glass for a handle. The wire may be three inches long. One of these should be hooked at the end.

Small sized glass tubing, suitable for drawing out into capillary pipettes, is indispensible for the inoculation of culture liquids through the cotton-wool stopper. This tubing can be found at any chemical laboratory, or may be had of any dealer in chemist's supplies. The same may be said of suitable pincers for handling the sterilized cotton. The latter should not of course be taken in the fingers when corking the test-tubes. The rubber cloth called by dentists "rubber dam," and to be had of them, is serviceable for capping cotton-stoppered tubes or bottles to prevent evaporation. Cut the rubber into suitable squares, and hold in place with a common elastic band. If test-tubes are used a beaker with a little cotton in the bottom serves well for holding, or a little basket can readily be made of screen wire cloth.—T. J. BURRILL.

EDITORIAL.

THE BOTANICAL SPIRIT has been so rampant and the botanists so numerous at the recent meetings of the American Association that there have been frequent suggestions of breaking up the biological section into its constituent parts, or at least of making a section of botany. It is urged that the interests of the present section are so diverse that it is already found convenient to group its papers by subjects for the convenience of those who have no desire to listen to the discussion of all biological subjects, and that botany and zoology have no more relation to each other than certain other distinct sections, and not so much as both to geology. There are several objections to making the proposed change that might be profitable to consider. In the first place, after botany and zoology have been separated they no more embrace single interests than the whole subject of biology, and what is to be the fate of the great field of physiology, so ably represented at the Buffalo meeting? In the second place, such a division, so far as botany is concerned, would simply convert the Botanical Club into a section of botany. This would change a pleasant, informal, social affair into a stiff, business-like, and somewhat heavy body; the small notes, the personal suggestions, the hundred things which are often far more personally beneficial than weighty papers, would be eliminated, and we would predict for the section of botany not a tithe of the attendance, interest, or enthusiasm enjoyed by the Botanical Club. In the third place, the very fact that there is great diversity of interest in a section makes it a far more comfortable one to be associated with, as it does not compel a burdensome attendance, and gives chance to learn something of the other work of the Association, as well as to cultivate friendships. As it is, the section of biology burdens no one, excepting its officers, and yet one can hear everything he desires. Botanical papers are good things, but botanical papers morning, noon and night for days in succession would become tiresome even to botanists. Then there is great objection to excessive subdivisions in the matter of machinery and reference of papers. The machinery is already cumbersome enough, and even now papers are often doubtfully referred. For instance, such papers as that of Dr. Salmon, on immunity from contagious diseases, would be almost impossible to refer properly in the proposed division. Large in attendance and diverse in interest as the section of biology is, we believe it as yet gives the most convenient and complete arrangement of subjects and opportunities that can be made.

THE TIME being nearly at hand for putting together and summing up the results of the year's work, suggests the consideration of a class of public institutions, having more or less to do with botany, whose annual reports may properly be the subject of criticism: we have in mind the experiment stations dealing with agricultural and allied subjects. Their work is two-fold in character, and may accordingly be separated into the popular and the scientific. This distinction has been admirably defined and elucidated by Dr. Bessey, who points out the need of fostering both these branches of research. The former appeals to the man who desires to apply the knowledge toward securing increased commercial value for his labors, and the latter to the man who desires to apply it toward the establishment of some new principle or fact of universal accuracy. Experimental work is likely to furnish data for both purposes. But, as observed by Lord Rayleigh, in his Montreal address, "detached and ill-assorted facts are only raw material, and, in the absence of a theoretical solvent, have but little nutritive value." It is this want of digestion which does much toward rendering the majority of experiment station reports a conglomeration of details, explanations, facts, deductions, illustrations and hypotheses, which neither the commercial nor scientific man is disposed to work over into useable shape. A decided advantage might be gained by placing the undigested facts and other separable data by themselves, which would bring the directly applicable part of the report into readable compass. A division of the latter into the commercial and the scientific could then be made. The commercial part should be non-technical, and be a clear statement of the results of the year, in so far as they may be of value to the farmer, gardener, stock-raiser, etc. The scientific part should state with equal clearness and brevity the facts and deductions of permanent and universal value, and point out their relation to what has been previously established. Some such plan of making the material of these reports more available would add to the good reputation of the institutions and to their usefulness.

OPEN LETTERS.

Spores of Pilobolus.

At the Buffalo meeting of the Botanical Club of A. A. A. S., Dr. Farlow spoke of an instance in which *Pilobolus* threw its spore cases a distance of eight feet. I have just observed in a dark stable, not often used, where there is a dirt floor, that these black "specks" are very thick and some of them rise to a perpendicular height of six feet, certainly, and very likely a little higher. I examined some of them and they are not "fly-specks." W. J. BEAL.

Agricultural College, Michigan.

Viola tricolar, var. arvensis.

Seeing by the GAZETTE for September that Dr. Gray wishes to know whether Viola tricolar, var. arvensis is established as a wild plant or not I might say that the above plant has been firmly established in one of our fields for at least ten years, and is steadily spreading itself over the whole farm.

Woodstock, Ontario. THOMAS P. HART.

Vegetable substance within animal tissues.

A case of the organization of a vegetable substance within animal tissues reported in the *Revue de Chirrugie*, August, 1886, may be of interest to your readers.

Prof. C. Vaulair, of Liège, was experimenting on the tubo-suture of nerves, using rubber drainage tubes, as decalcified bone was too speedily absorbed.

A tube of gray vulcanized caoutchouc was used, $1\frac{1}{4}$ metres long, $\frac{1}{5}$ inch thick, walls $\frac{3}{50}$ inch thick.

The experiment was successful as regards the regeneration of the nerve. But in $7\frac{1}{2}$ months it was found the tube was being absorbed, and finally it disappeared. Under the microscope the tube showed a more or less homogeneous parenchyma, and a large number of blood vessels. The stroma formed a compact resisting mass of fine interlaced connective tissue fibers, and cells occupying the interfascicular spaces.

The cells averaged twenty micro-millimeters; some were polygonal, others elongated. The cells had large nuclei. The connective tissue took a bright rose stain in boracic carmine.

The vessels were numerous and of the capillary type; in some the walls were of a continuous layer of elements, flattened and resembling normal vascular endothelium; there were also other types.

The outer surface of the tube was irregular and fungous; the inner surface smooth, and showed no distinct line of demarcation from the subjacent tissues. At its lower part the tube had become assimilated to the surrounding connective tissues, and had finally disappeared.

Your readers will observe that this absorption or rather organization of a structureless vegetable exudate is different from the revivification of catgut, bone sponge, etc., where we have the conversion of one animal tissue into another. But heretofore vegetable substances have not become animalized, as far as known, save through the laboratory of the alimentary system.

Your readers will find a more extensive abstract in the *Medical Record*, October 2, 1886. A. W. BRAYTON.

Indianapolis, Ind.

CURRENT LITERATURE.

The Cayuga Flora. Part I: A catalogue of the Phænogamia growing without cultivation in the Cayuga lake basin. Bulletin of the Cornell University. vol. ii. William R. Dudley. 8vo., pp. xxx. 133. v, with 2 maps. Ithaca, 1886.

Professor Dudley has given us one of the most complete and best prepared catalogues we have seen. It may be taken as an example of careful and conscientious work, and aided, as he has been, by specialists in their own groups, every part of it becomes authoritative. The introduction of 30 pages is devoted to the consideration of such subjects as the limits of the flora and its physical characters, the lesser floras which go to make up the larger range of the catalogue, the affinities of the Cayuga flora, the primitive flora, sketch of the explorations, statistics of the catalogue, and comparison with other floras. This region was first botanically explored by Bartram (1743), followed by Kalm (1750), Pursh (1807), Thomas, Aikin, Sartwell, Gray, and others. Since that time many young botanists have aided in the work, until probably no one has ever had more material or better work at his command in the preparation of a catalogue than the author. As for the statistics of the catalogue, it includes 1160 species, 963 of which are natives. Adding the well-marked varieties the number reaches 1278. Of these 381 are Polypetalæ, 350 Gamopetalæ, 133 Apetalæ, 403 Monocotyledons, and 11 Gymnosperms. The large number of monocotyledonous species is made by the two great orders Cyperaceæ (151 species) and Gramineæ (107), while monocotyledonous genera number but 101, as against 162 polypetalous and 146 gamopetalous genera. Compositæ stand between the two orders mentioned, with 125 species, followed by Rosaceæ (69), Leguminosæ (45), etc. The largest genera are Carex (112), Potamogeton (27), Aster (24), Salix (22), Polygonum (20), Solidago (18), Panicum (17), Juncus (15), etc. Rhexia, Hippuris, Castilleia, and Pogonia pendula are reported as having disappeared. New varieties of Cratægus coccinea and Naias marina are described by the author, and Eatonia Dudleyi, a new species, by Dr. Vasey. The nomenclature has all been brought up to date, accompanied by necessary synonymy, and that the last convenience, even in a catalogue, may not be wanting, an index to orders and genera is appended. It was a pleasant thought that suggested cuts of the pussy-willow for a head-piece and the witch-hazel for a tail-piece, and looking over these well-printed pages one can feel confident that from pussy-willow to witch-hazel all has been well done.

Flower-Talks at Elmridge. By Ella Rodman Church. Philadelphia: Presbyterian Board of Publication. 1885. 12°. pp. 320. Illustrated.

Among the Trees at Elmridge. By the same author and publishers. 1886. pp. 412. Illustrated.

The popularly most interesting phase of botany at the present time is that which looks at correspondences and differences of homologous parts, which discovers adaptations and the means of accomplishing ends, which takes into account the habits, growth and behavior of plants, in short, that which scrutinizes every detail of the plant's structure and appearance, and constantly inquires for the reason of it as looked at from the standard of the plant's needs. It is this form of the subject—the new botany, as it is sometimes inappropriately termed—as opposed to the routine learning of the names of organs and of their shapes and positions, upon which dependence must be placed to redeem the good name of botany from the popular misapprehension that looks upon the science as having as little to do with the verities of active life as do the stories of Greek mythology.

So far as children's books are concerned, the botany which is the most attractive and serviceable in them is the kind that sets the young mind to thinking and stimulates the observation. An incidental requirement is that technical terms should be kept as much in the background as possible, for children, and older persons as well, often gain the stultifying idea that the hard names are the chief part of the science. The first question must be, "how is it?" with the supplementary inquiry, "what advantage is it to the plant?" and the answer must be obtained directly from the plants themselves, and not through the medium of books.

Both of the books before us are designed for children, more particularly Sunday-school children, and in accordance with a too common custom, for it seems to us unwise, the characters are drawn unnaturally good and polite. Three small children and their governess talk in one book about flowers, and in the other about trees. The author assures us in the preface that the "Elmridge Series," of which the first two volumes are entitled *Birds and their Ways*, and *Flyers and Crawlers*, has been projected especially to open the eyes of the young to the natural objects about them. There is, therefore, no disagreement between the author and the critic in regard to the main objects to be accomplished; and it is a matter of interest to see how fully the aim has been attained. We quote a few lines from the middle of the first volume by way of illustration; the subject is the common blue flag or iris. The governess says:

"You will notice that while the leaves are perfectly straight the flower-stem bends this way and that, which is called *flexuous;* it is quite round, and about two feet long. The stem is also branching, and has several flowers, each with three thick *petals* that curl outward. Botanists call these thick lower petals *sepals*, or divisions of the calyx, while the three upright ones in the center are the real *petals*. The three *stamens* grow from the base of the sepals, and are concealed by the three *stigmas;* which are those three central divisions that resemble petals. The stigmas are cut in two parts at the top. Remove the petals and sepals, and you will see that these three gorgeous stigmas proceed from the same *style* and *germ*, which ripen into a three-celled *capsule*."

"I wish there weren't such hard things to remember about flowers," said Clara. "I like the flowers so much that I want to know all about them, but I mix up all the sepals and things."

"You need not, dear," replied her governess, laughing; "all that you need to remember at present is that sepals belong to the cup or bottom of a flower, and petals to the top or corolla. As Malcolm is the oldest of the party, I shall expect most of the remembering to be done by him."

Malcolm made a grimace, too, at the sepals and petals, but manfully said that he would do his best.

We fully side with the children, and see no reason why these technical terms should be used, as it seems unnecessary to introduce them just to point out the parts, and all the other information could have been as clearly expressed by the use of every-day words. We feel sure that the great botanist, Dr. Asa Gray, would agree with us, for in his account of the curious construction of this same flower, in his work *How Plants Behave*, he calls the parts "divisions, or leaves of the flower," instead of petals and sepals, as so strenuously urged in the quotation. The idea is not that technical terms should be entirely discarded, but that they should be used only where an obvious necessity exists, in reality very few being needed by the child-botanist. Fortunately for the little ones, the governess does not always feel it incumbent upon her to be so strictly "botanical," and many pleasant and instructive observations upon the history and habits of plants are scattered through the volumes.

It is pleasant to remark a noticeable freedom from scientific blunders, there being none worth mentioning, unless one takes account of a few like the loose use of the words "stigma" and "germ" in the quotation. The author is evidently upon familiar ground. What we have to regret is that she was not better acquainted with some of the features of botany referred to in the beginning of this notice, to which the juvenile work by Dr. Gray, already mentioned, may be cited as a stepping stone.

Guide to the recognition of the principal orders of Cryptogams and the commoner and more easily distinguished New England genera, with a glossary. By Frederick Leroy Sargent. Cambridge: Charles W. Sever, 1886. 12°. pp. 39, interleaved.

The author tells us in the preface that he has attempted "to bring together in systematic form and in a convenient shape such information as would enable a student to learn to recognize a number of the commoner conspicuous genera of cryptogams." The idea is an excellent one. Probably all who are conversant with the subject will agree that our text-books have been inadequate heretofore for the needs of the student who desires to readily provide himself with some knowledge of the names and relationships of the plants he sees about him, especially of the lower forms.

The printer and the binder have done their parts well, and the text has an attractive appearance, as if it deserved its excellent setting. But the value of a *guide* lies in its usefulness when put to the test. Here is the result of our trial. The first thing that came to hand was a thalloid liverwort. Turning to the key, we find two grand divisions, "Cormophyta" and "Thallophyta." The first includes "plants in which (with few exceptions) there is a well-marked differentiation into caulome and phyllome." Our plant evidently does not fit here, unless it be one of the exceptions, which unfortunately are not enumerated, but must go into the next division, where such differentiation is not well-marked. Under this are the groups, algæ, fungi, and lichenes, and with the characters of the first of these our plant does not conflict, but turning to the descriptions of the orders of algæ, we find ourselves quite astray. Going back to the beginning again, we conclude to assume that this may be one of the exceptions hinted at in the first line of the key. This gives a choice between Phanerogamia, Pteridophyta and Bryophyta, which are distinguished by the presence or absence of seeds and fibro-vascular bundles. As our plant appears to have neither of these structures, we place it under the last division, and turning to the description of the orders, have little doubt that it goes with Marchantiaceæ. But here are only two genera (Lunularia and Marchantia), distinguished by gemmæ, which our specimen does not have. As we are still as much in the dark about the true position of the plant as when we started, we take down Underwood's *N. Amer. Hepaticæ* and find that it is Conocephalus conicus, more commonly written Fegatella conica, everywhere a very common liverwort.

Fearing this may not be a fair test, we take the next thing at hand, and have a white mildew on lilac leaves. There is no trouble in placing this under the fungi, and running it into the Perisporiaceæ, but here we find "genera not given".

These examples will serve to make clear some of the limitations of the work. (*a*) No guard is provided for preventing the student being led astray by non-typical forms or misinterpretation of structures. Even plain "exceptions" are not always specified. (*b*) When a handbook is made to cover only the more common plants of a region, the user can rarely be certain that he has not stumbled upon a plant which is omitted, and this casts a doubt upon the correctness of his work with the key. Very few plants indeed, could be omitted if every one were included that is common at some locality or other over a large region. (*c*) The number of orders under which the genera are given is surprisingly small. The two genera of Characeæ are the only ones given among fresh-water algæ, and those of but three orders are given among marine algæ. Only four orders of fungi have the genera given, Gasteromycetes, Hymenomycetes, Tremellineæ, and Discomycetes, but these embrace the largest and most conspicuous of the fungi. The genera of lichens are enumerated as an independent group.

The above criticisms may be interpreted as meaning that the work does not meet the expectations raised by its title. But we may turn about and criticise the title, as too ambitious for the work it is attached to. A guide is for the use of those who do not know the way, and to serve its purpose must therefore be reliable in all cases. The present work can not be said to meet this requirement. But instead of calling this a "guide," suppose it be named an "abbreviated synopsis"—the criticisms we have made lose their force, and the work will still serve the same ends the author has apparently designed it to quite as well. We think that a serviceable guide is feasible and desirable, but it must be more elaborate than the present work, and as we have good manuals of the mosses and liverworts, it need not cover more than the thallophytes.

Professor Sargent's work will be an excellent one to place in the hands of students who are under the eye of a teacher. It will assist the student in many cases to learn something of the chief characters of the specimens he has found, and usually to learn enough for him to readily turn to some larger handbook and pursue his inquiries.

Lectures on the Physiology of Plants. By Sydney Howard Vines, M. A., D. Sc., F. R. S., Fellow and Lecturer of Christ's College, Cambridge, and Reader in Botany in the University. 8°. pp. x. 710. Cambridge: University Press. 1886. [New York: Macmillan & Co.]

In this delightful volume—delightful typographically and intellectually—Dr. Vines presents his lectures on physiology to a wider audience than can gather about his desk at Cambridge. The work of preparing these lectures for the press began in 1877, before there was "any text-book in the English language treating at all fully of the physiology of plants so as to meet the requirements of advanced students." Various delays prevented its appearance until more than six months after the publication of Dr. Goodale's admirable work with which American students are now familiar.

Assuming a previous knowledge of histology, Dr. Vines' book is purely physiological. It shows throughout its pages the influence of Michael Foster, to whom the author acknowledges his indebtedness. Undoubtedly this influence has had much to do with the excellence of the treatment. Certainly the author has given us a work on vegetable physiology which is a worthy companion to Dr. Foster's well known text-book on animal physiology.

The broad topics of the book are discussed in the following order: Structure and properties of the cell, absorption, movement of water, transpiration, food, metabolism, growth, irritability and reproduction. At first glance it would seem that too much space had been allotted to irritability, but when it is seen that under this head the author treats the relations of plants to external influences, such as light, heat and electricity, together with their movements in response to internal stimuli, of whose nature we are ignorant, the apparent disproportion vanishes. Warmly to be commended is the concluding portion of the last lecture on irritability, in which is discussed the biological significance of this property in plants.

Of the six lectures on metabolism (we are glad to substitute this well-founded physiological term for metastasis), two are specially devoted to a consideration of the "supply of energy" and the "expenditure of energy," and throughout the work the broad principles of the conservation of energy in their vital relations to the assimilative and metabolic activities of the plant are kept constantly before the mind of the reader. No one feature is more to be commended than this, for in no other work have these relations been so clearly set forth.

The last eighty-five pages contain a fine summary of the reproductive process, tracing these from their lowest terms in the protophytes to their most complicated form in the phanerogams, together with a condensed statement of the more prominent theories of reproduction.

The excellence of such a work disarms criticism. One could wish, however, that some topics had been treated in greater detail. A notable omission, for instance, is that of any account of the processes of nuclear division. The reversed use of the terms dorsal and ventral, as applied to leaves, is calculated to confuse, and is of doubtful utility.

If we compare Dr. Vines' work with its only English contemporary, it will be seen at once that Dr. Goodale's book is decidedly more comprehensive, treating with greater or less fullness almost every topic of vegetable physiology, and including innumerable things of less importance which the college student or general reader is sure to desire to know. While Dr. Vines' book lacks this somewhat encyclopedic character, it treats more elaborately the larger topics, and in a way suited only to advanced students. It therefore supplements its predecessor in such a way that no one can do without either.

NOTES AND NEWS.

PROFESSOR C. R. BARNES has returned from Cambridge to the duties of his professorship in Purdue University, Ind.

THREE NUMBERS of Cooke's British Desmids are now issued. This work forms a continuation of the author's British Fresh-water Algæ.

REV. J. M. CROMBIE begins an Index Lichenum Britannicorum in the last number of *Grevillea*, after the most recent Nylanderian arrangement.

DR. MAXWELL MASTER'S "Vegetable Teratology" has been translated into German by Mr. Udo Dammer, and published by Hässel, of Leipzig. Additional notes and wood cuts have been added.

MR. FREDERICK LEROY SARGENT has accepted the Chair of Botany in the University of Wisconsin, at Madison, which was resigned by Prof. A. B. Seymour. Mr. Sargent has already entered upon his duties.

MR. HARVEY THOMSON, for several years Professor Coulter's assistant, has accepted the professorship of botany in Hastings College, Hastings, Nebraska. His position at Wabash College has been filled by Mr. J. N. Rose.

THE ADDRESS of Mr. Carruthers, president of the biological section of the British Association at the recent Birmingham meeting, dealt with the past history of those plants which still form a portion of the existing flora.

PROF. C. S. SARGENT writes that there should be added to the published list of Dr. Engelmann's publications (BOTANICAL GAZETTE, May, 1884) his paper on "The Genus Euphorbia in DeCandolle's Prodromus", *Am. Jour. Sci.* II. xxxiv. 288–291.

THE COMMON stink horn (Phallus) sometimes becomes very obnoxious when growing near dwellings. W. G. Smith, in the *Gardeners' Chronicle*, recommends trying a strong solution of carbolic acid to destroy the fungus and prevent its starting again.

CYPRIPEDIUM ARIETINUM in the mountains of China is a notable addition to an already very considerable list of disjoined species, divided between E. North America and E. Asia. It is announced by M. Franchet in *Bull. Soc. Bot. de France*, xxxiii. 206.

THE SEASON of 1885 in Nebraska and Iowa gave a heavy crop of the cluster-cup on green ash, Æcidium Fraxini, but the trees are almost free from it the present year. A query as to the cause of this unexpected change is raised by Professor Bessey in the last *American Naturalist*.

THE NAVAJO names of plants are treated of in an entertaining article by Dr. W. Matthews in the September *American Naturalist*. The list comprises about one hundred species, including many small or inconspicuous kinds, which it is surprising the Indians should have names for.

MR. ERWIN F. SMITH, recently assistant in the botanical laboratory of the University of Michigan, has received the appointment as assistant in the mycological section of the U. S. Department of Agriculture. He will first take up the study of the Fusicladium and Morthiera of fruit trees.

DR. HENRY LESLIE OSBORN, professor of Zoölogy in Purdue University, has undertaken the editorship of the *American Monthly Microscopical Journal* during the absence of Mr. Hitchcock in Japan. Dr. Osborn is an expert in histological manipulation, and looks upon the microscope in the true light as a *means* and not the *end*. This means that the *Journal* will be ably edited, and with special reference to *useful* work with the microscope.

C. H. STOWELL has severed his connection with the *Microscope*. The August number contains his valedictory, and also a most uncalled for and ungentlemanly attack upon the *Am. Mo. Microscopical Journal*, and particularly its editor, Mr. Romyn Hitchcock. No private quarrel could justify such public insolence.

THE "HERBARIUM HEUFLERIANUM" of cryptogams is for sale, on account of the death of the owner. It contains 1,431 genera, 8,614 species, and about 30,400 specimens, including many type specimens. Further information can be obtained by addressing Paul Baron Hohenbühel, Innsbruck, Universitätsstr. No. 3, Tirol, Austro-Hungary.

MR. ERNEST FREUND, of Vienna, claims to have found cellulose in the human blood and organs in tuberculous disease, and concludes that cellulose is a typical constituent of tubercles and of the blood in tuberculosis. Heretofore the occurrence of cellulose in animal tissues was thought to be restricted to a few invertebrate families.

A REVISION of the Phalloids, or stink horn fungi, has recently been made by Dr. Fischer in which eleven genera and seventy-three species are recognized. The old genus Phallus is discarded. About a dozen species are recorded from North America, four from Europe, and seven from Asia. They are most numerous in the southern hemisphere.

IN THE LAST Bulletin of the Buffalo Society of Natural Sciences, Vol. V. No. 2, Mr. David F. Day gives a list of additions to his excellent catalogue of Buffalo plants. The Naturalists' Field Club of that city is an exceedingly active organization, and it would seem strange if any plants escaped them. About 125 species are included in these additions.

THE METHOD used by Dr. A. F. W. Schimper to study the distribution of starch in leaves is to first place them in alcohol from twelve to twenty-four hours, then transfer to an iodized solution of chloral hydrate, eight parts of chloral to five of water. By this means the leaves become very transparent, and the smallest grains of starch, stained blue by the iodine, are clearly visible under the microscope, even in the deepest-seated cells.

THE PRINCIPAL articles of the *Bulletin of the Torrey Club* for September are Naiadaceæ in the Torrey Herbarium, with plate, by Thomas Morong, Synopsis of the Genus Paspalum, by Geo. Vasey, Dehiscence of Fern Sporangia, by Joseph Schrenk, and Proceedings of the Botanical Club of the A. A. A. S. at Buffalo. The new species described are *Potamogeton Wrightii* Morong from the Loo Choo islands, and *Paspalum Buckleyanum* Vasey from Texas.

THE THIRD BULLETIN of the *Société Mycologique de France*, recently received, contains several papers on hymenomycetous fungi by MM. Quélet, Lucand, Forquignon, Gillot, Mougeot, Barla, and Brunaud. The other principal articles are the Role of ptomaines and leucomaines in mushroom poisoning, by Dr. L. Forquignon; Note on a case of poisoning by mushrooms, by Dr. Kuhn; and On the microscopical study of mushrooms, by M. Boudier.

MACLEOD AND MILLER have been investigating cholera during the past year in Shanghai. They found Koch's comma bacillus in twenty-five out of twenty-seven cases. The germ is destroyed by drying, but if kept moist is capable of growth after four months. The question as to whether it enters the body through inspired air or the alimentary canal finds upholders for the first position in Emmerich and Buchner, working in Sicily, for the second, Koch and the general opinion.

REMARKABLY REDUCED trichomes in some species of Campanula have been described by E. Heinricher in the *Berichte der deutsch. bot. Gesellschaft*. They form peculiar small plugs in about the middle of the outer walls of the epidermal cells on the upper surface of the leaves. They are covered with a thin cuticle, and often show divisions. The discovery was made in C. persicæfolia, but they also occur in C. grandis and C. patula, and presumably in other smooth, or nearly smooth, leaved species.

DR. MILLER, of Austria, finds that the germs of zymotic diseases are destroyed in the stomach when its reaction is acid. If, however, bacilli and bacteria are passed into the stomach before the hydrochloric acid of the gastric juice is poured out they pass on into the intestine uninjured. It has been observed that persons are more likely to be attacked by cholera when the stomach is diseased. As it is generally thought that the germs of these diseases are introduced by the alimentary canal, these observations of Dr. Miller are extremely valuable.

TWIN TREES are often recorded, and a recent account of one near Tunbridge Wells, England, brings them to mind. In the case referred to an oak and a beech have grown together so as to form a single trunk for five or six feet. In another case the old oak has a birch tree growing out of it, but the latter has evidently germinated where a branch of the oak had been broken off eight or nine feet from the ground. The birch is now six or eight inches in diameter, and its roots reach through the internally decayed oak to the ground.

A HYBRID ORCHID between Cattleya intermedia and Sophronitis grandiflora, produced by Veitch & Sons of England, has been referred by Prof. Reichenbach to the genus Lælia. It is quite remarkable that a hybrid should fall into a different genus from the parents, and the wonder is not much diminished, but takes on another form, when we learn that this has led Prof. Reichenbach to reexamine the characters of these genera, and with the result that he decides that all of the species but one of Sophronitis should be tranferred to Lælia, including S. grandiflora.

M. CORNU has found by culture experiments conducted the present season (*Compt. Rendu de l'Acad.*, 1886, p. 930) that the spores of Peridermium Pini, var. corticolum sown upon Vincetoxicum officinale produce in about four weeks Cronartium asclepiadeum. It has been known since 1873 that Coleosporium Senecionis and Peridermium Pini, var. acicolum are alternate forms of the same fungus. It is now apparent that these two forms of Peridermium are really specifically distinct. This gives further evidence that we shall be unable to fully classify the pleomorphic fungi until their life histories are known.

DAVIES' SMALL WORK on the "Preparation and mounting of microscopic objects", a 16mo. of some 200 pages recently sent us by the American publishers, J. H. Vail & Co., of New York, attests its substantial character by having reached the twelfth thousand. It is now in essentially the same form as left by Mr. Matthews of the Quekett Club, who edited the second edition about twelve years ago, Although it does not describe some valuable processes which have come into use since the author's time, and is not a work for the specialist, yet it is still almost as serviceable as at the time it was published, for that considerable class of microscopists who desire to prepare a cabinet of mounted specimens of curious and interesting objects, selected from the whole vegetable and animal kingdom. The author tells in a clear and trustworthy manner how to prepare, preserve and mount such objects.

THE BOTANY of the U. S. Department of Agriculture Report for 1885, which was distributed some time ago, is of all degrees of value and accuracy. The most important thing in bacteriology is the identification of the bacterium of swine-plague, and the discrimination between this disease and the rouget, or swine-plague of Europe, studied by Pasteur. The seed and forestry divisions require no notice. The report of the superintendent of grounds gives much space to mildews, peach-leaf blister, peach yellow, pear blight, cracking of pears, potato rot, etc. The most courteous thing we can say of this is, that it is "crude, owing to want of practical knowledge"—words which we find in the report. The microscopist has a short compilation regarding edible mushrooms, illustrated with a colored plate. The botanist's report gives a brief description of a score of foreign and native medicinal plants, with cuts, and a page of notes on grasses. The remainder of it is devoted to fungous diseases of plants, contributed by the assistant botanist, together with a short account of smut in timothy by Professor Trelease, and is worthy the careful attention of cultivators and students of fungi.

THE COMMITTEE of the British Bssociation on fossil plants made an interesting report at the recent Birmingham meeting. Attention was devoted last year exclusively to phanerogams. They find that many of the so-called monocotyledons have been disproved and that that group can not boast of as great antiquity as has been claimed. The oldest monocotyledons seem referable to the Pandanæ, a group now distributed in widely distant and remote oceanic islands, and whose fruits are still met with at sea in drifts of vegetable matter. Very likely the Aroideæ have been proved to be of high antiquity. In reference to the naming of fossil plants from fragmentary material, a habit which has in some cases reached an absurdity, the committee utters a wise protest. It does appear, they say, that it would have been wiser and more consistent to have taken the absence of fruit into account, when these were such as would naturally have been preserved. The large proportion of fossil dicotyledonous leaves, that have been referred without any hesitation to living genera, must strike every one, in comparison with the relatively few associated fruits that have been determined otherwise than as Carpolithes, a name which is a confession of failure.

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Memoranda of a revision of the North American Violets. II.[1]

ASA GRAY.

GROUP IV. Subcaulescent, first flowering from the ground, on slender mostly subterranean shoots from a deep thick rootstock or caudex, not stoloniferous nor creeping, later more caulescent, always low: corolla wholly or mainly yellow, except in last two species, the spur short-saccate: stigma beakless, sometimes with a short antrorse lip, concave, orbicular, antrorse-terminal or oblique at the large and gibbous-clavate summit of the style, bearded below its margin by a tuft or rarely a ring of stiff and reflexed or spreading bristles. Western species, but one cismontane.

* Leaves undivided, from roundish-ovate or cordate to lanceolate: lateral petals slightly bearded or beardless in the same species.

+ Ovary and oval capsule glabrous.

V. pedunculata Torr. & Gray. California and Arizona.

V. Nuttallii Pursh. Kansas to the Saskatchawan, British Columbia, and the northern borders of California. Although some forms of this come near to the next, the capsule should distinguish them. A good part of Sir Wm. Hooker's *V. præmorsa* belongs here, namely the specimens of Scouler's collection. Also *V. linguæfolia* Nutt in Torr. & Gray.

+ + Ovary and globular capsule pubescent.

V. præmorsa Dougl. in Lindl. Bot. Reg. t. 1254; Hook. Fl. as to pl. Dougl. only. *V. præmorsa* and *V. Nuttallii* Benth. Pl. Hartw. 298. This proves to be the species more commonly known as *V. aurea* Kellogg, and a form of it must be his *V. Brooksii.* It ranges from W. Idaho and drier parts of Washington Territory to Southern and Lower California, in a great variety of forms, among them the var. *venosa* (*V. aurea*, var. *venosa* Watson, *V. purpurea* Kellogg): there are larger-leaved and long-petioled forms which approach *V. pedunculata,* and narrow-leaved ones which are very like *V. Nuttallii.*

* * Leaves finely dissected: subterranean shoots commonly sending up their scapiform peduncles from under ground; the last species more caulescent.

+ Petals beardless, essentially yellow.

V. chrysantha Hook. Well marked by the bipinnately dissected leaves, beardless and deep orange-yellow petals, the upper slightly or largely brown-purple.

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[1] Concluded from page 256.

V. Sheltonii Torr. Known by the glabrous palmately dissected leaves of orbicular outline and light yellow petals. The stigma has the bearded tufts of the related species, but small.

+ + Lateral petals bearded; upper deep violet-purple or blue; lower pale or yellow.

V. Beckwithii Torr. & Gray, is pubescent or puberulent, its rounded leaves palmately about thrice 3-parted into linear or spatulate-linear acutish or obtuse lobes, the primary divisions petiolulate: upper petals deep violet-purple, the others light blue or bluish, with yellow base, lateral ones short-bearded.

V. Hallii Gray. Glabrous throughout: the leaves of ovate or oblong or irregular outline, subpinnately or pedately about twice parted into lanceolate or linear lobes, their tips obtuse or acutish and callous-apiculate, veins or ribs indistinct: upper stipules commonly foliaceous, often enlarged and laciniate or entire: upper petals deep blue, others yellow or cream-color.—From Salem, Oregon, to Humboldt county, California.

V. trinervata Howell, in printed distribution, and in Botanical Gazette, viii. 207, as a questionable variety of *V. Beckwithii.* This is *V. chrysantha,* var. *glaberrima* Torr. in Wilkes Exped., xvii. 238, where it is said (doubtless from Pickering's notes) that the upper petals are purplish and the others yellow. It is well distinguished from *V. Hallii* by the more pedately and less dissected leaves; the divisions from lanceolate to almost ovate, acute or apiculate, at maturity almost coriaceous, and *prominently 3-ribbed,* the lateral ribs intramarginal; also by the small and entire and nearly free stipules. It is known only in the eastern parts of Washington Territory, was rediscovered by Howell in 1874, and later by Suksdorf.

Group V. Caulescent; the few-several-leaved stems erect from short or creeping rootstocks; no stolons; no radical flowers: spur of corolla short and saccate; lateral petals commonly scantily papillose-bearded: stigma beakless, bearded or pubescent at the sides.

* Petals yellow: main stems usually naked at base and few-leaved above.

V. lobata Benth. Pl. Hartw. A species of the Pacific Coast, with very various and mostly digitately cleft or lobed leaves: with

Var. **integrifolia** Watson, with mostly deltoid- or rhombic-ovate often caudate-acuminate leaves, which is to the species what *V. hastata* is to *V. tripartita* Ell. Perhaps it passes to *V. glabella.*

V. hastata Michx., an Alleghany Mountain species, extending to Ohio and to the northwestern borders of Florida; generally well marked by its approximate and deltoid-hastate or subcordate leaves.

Var. **tripartita**, the *V. tripartita* Ell., a remarkable form with trifid or 3-parted or even trifoliolate leaves, evidently, as LeConte maintained, only an usual state of *V. hastata*.

V. glabella Nutt. in Torr. & Gray, Fl. A Pacific species, ranging from the middle parts of California to Alaska and to Japan; its northernmost forms coming too near the Asiatic *V. uniflora* L., while its most eastern in the northern Rocky Mountains are not readily distinguished from *V. pubescens*. With Maximowicz, I conclude that we should keep up these species.

V. pubescens Ait. This common and rather variable Atlantic American species, contrary to Maximowicz, I must keep entire. The capsule in all its forms varies from oblong to globular (even on the same stems), and from glabrous to densely tomentose; and the very pubescent plants are connected by transitions with

Var. **scabriuscula** Torr. & Gray, which should have been named *glabriuscula*, for it really is not scabrous.

* * Petals white, with violet or purple tinge, and some yellow or yellowish at base within: stems more leafy or more prolonged by successive leaf- and flower-bearing growths up to midsummer: stipules small, narrow, entire and nearly scarious: capsule oval, glabrous.

V. Canadensis L. This ranges from Newfoundland to Saskatchawan and the Rocky Mountains, to those of Utah and Arizona. In New Mexico and Colorado it passes into

Var. **scopulorum**, a diminutive and depressed form, of which the most characteristic form was collected in Clear Creek cañon, by Mr. Greene.

V. ocellata Torr. & Gray. Known only in California; seems well to hold its characters as a species.

V. cuneata Watson, Proc. Am. Acad. xiv. 290, and Bot. Calif. ii. 433. Mountain woods in the northern part of California and adjacent Oregon. Distinguished from the preceding by its smoothness and its rhombic-ovate or cuneate leaves, only the radical ones cordate.

Group VI. Caulescent from more or less creeping rootstocks, or at first flowering nearly acaulescent, erect or spreading: leaves cordate, undivided: stipules more or less herbaceous: corolla from blue to white, with *projecting* oblong to cylindrical spur: style moderately thickened upward, beardless.

* Spur of corolla not very long: lateral petals usually bearded: stigma inflexed, a short scarious beak. (*Caninæ.*)

+- Stipules from serrate to fimbriate-pinnatifid or pectinate.

V. striata Ait. Stems 3-4-angled, ascending and at length a foot or more long, producing normal petaliferous flowers until midsummer or later: corolla yellowish-white; lower petal striate with brown-purple lines; spur thick, rather shorter than the sepals: capsule ovoid.—An Atlantic and mostly northern species, extending along the mountains to Georgia, and westward only to Minnesota and Missouri. My *V. laciniosa* of Japan is the analogue of this rather than of any form of the next, with which Maximowicz would associate it.

V. canina L. Our forms of this collective species, none of them quite identical with European, may be grouped under the following varieties:

Var. **Muhlenbergii**, the common Atlantic American Dog Violet, nearest to the Old World *V. canina*, var. *sylvestris*, may as well retain the name under which Torrey published it (as *V. Muhlenbergii*) in 1824, the same year in which it was named *Muhlenbergiana* in the Prodromus. The alpine and arctic form of it, *V. Muhlenbergii*, var. *minor* Hook. Fl., has recently been illustrated under this name by Lange in the Flora Danica, from Greenland. Dr. Engelmann detected a summer form of it on the sand-beaches of Lake Superior, answering to *V. arenaria*. Our plant is only spring-flowering; in summer it sends off prostrate stems bearing cleistogamous flowers.

Var. **multicaulis**, the *V. Muhlenbergii*, var. *multicaulis* Torr. & Gray, Fl., and doubtless *V. radicans* DC. (though the summer runners, so far as seen, do not root), is a peculiar form of the Southern Atlantic States, in rocky or sandy ground, from Kentucky to Florida and Texas; there flowering from February to April, depressed-spreading, and with round leaves; later in the season producing prostrate leafy branches or runners, bearing cleistogamous flowers.

Var. **adunca** Gray. To this, the type of which is *V. adunca* of Smith in Rees' Cyclopœdia, I refer all the far western forms of the species, which differ from the eastern somewhat in habit, in less cordate leaves, and in the generally longer spur which is disposed to be curved or hooked. The more southern and larger forms, which prevail in California, answer to *V. longipes* Nutt. The smaller and higher northern form answers to Regel's *V. canina*, var. *rupestris*.

Var. **oxyceras** Watson, in the Botany of California, is remarkable for its acute as well as long spur. It has been collected, so far as I know, only by Dr. Torrey near Donner's Pass over the Sierra Nevada, and by Brewer and later by myself on very high ground between Clark's and the Yosemite.

+ + Stipules entire, or nearly so, linear: flowers on scapes from the rootstock and few on 1-3-leaved ascending stems, pretty large.

V. mirabilis L. A species allied on one hand to *V. Langsdorfii*, on the other to *V. canina*, ranging from the mountains of Europe to N. E. Asia; and I somewhat doubtfully refer to it a plant collected in Oregon, near Portland, in coniferous woods, by Mr. Howell. The species was so named by Linnaeus because the only one he knew having what are now called cleistogamous flowers.

* * Spur to corolla very long; petals beardless: style slender-fusiform, symmetrical; stigma erect and terminal, small: stipules laciniate-pectinate.

V. rostrata Muhl. A strongly marked species, of the Alleghany region, ranging from Upper Canada and Michigan, through the higher parts of the State of New York, to the mountains of Georgia. Mr. Dolph long ago sent me, from northern Pennsylvania, flowers having the spur 2-3-corniculate at tip.

The section *Melanium*, which includes the pansy and *V. cornuta*, now well known but not so common in our gardens, and which has the enlarged and globular apex of the style hollowed into a large and deep nectariferous and stigmatic cavity, is represented in America only by

V. tricolor L., var. **arvensis** DC. I had always taken this field form of the pansy for a mere escape from cultivation; but it occurs in rather numerous localities from Canada to Texas: and several botanists familiar with it insist that it is indigenous.

If we count this as indigenous, in deference to the weight of authority, we have thirty-three wild species of Violet in North America, all but eight of them endemic.

It is not out of place to remark that I persist in the opinion that *Solea concolor* of Gingius represents a genus quite distinct from *Ionidium*, and of course I should keep up *Hybanthus*.

The relative value of cultures in liquid and solid media in the diagnoses of bacteria.

THEOBALD SMITH.

The marked progress recently made in the study of microorganisms as the cause of certain diseases is without doubt due to the more thorough application of various solid culture media by Koch and his pupils. Today the microscope does not hold the chief place in the study of these minute organisms. It is their mode of growth upon gelatine, blood serum, agar-agar, potato, in meat infusions, milk, etc., or the absence of growth on one or more of these substances and in these fluids which aids in confirming the microscopic examination. For this frequently yields results so indefinite that without the media mentioned it is impossible to come to any satisfactory conclusions as to the kind of bacteria under consideration. Besides these various tests, inoculation experiments are of essential importance in the investigation of pathogenic forms.

In connection with the cultivation of bacteria for diagnostic purposes, it is again desirable to call attention to liquid media and their uses. The statements of Koch and others several years ago concerning the unreliability of liquids have almost driven them from the field in Germany and in our own country.

Pasteur, the founder of this new and brilliant branch of pathology, made cultures in meat broths or decoctions exclusively. That grave errors may arise in this way through contaminations which can not be easily detected is self-evident. When gelatine and other solid media were introduced by Koch he discarded cultures in liquids except for very special purposes. Since that time they have been looked upon with distrust, and results obtained with their aid suspected and questioned.

If there were some means of keeping liquids free from contamination, it is not unfair to say that they would be better adapted as a natural medium of bacterial life than any solid media ever suggested. This is self-evident for germs endowed with motility. One of the advantages of solid media is derived from the fact that any after-contaminations are quite easily detected with the unaided eye. This is not so readily done in the case of liquids. There are two ways of overcoming this difficulty: (1) by the use of a culture tube in which the parts are so adjusted that a momentary exposure for purposes of inoculation, etc., is practically without any danger whatever; (2) by frequently testing liquid cultures on solid media, preferably on gelatine. My experience with the culture tube devised by Dr. D. E. Salmon has been entirely satisfactory. Its efficiency may be considered quite perfect. As it has been fully described[1] I need not dwell upon it here. The testing of liquid cultures is very simple and quickly accomplished. Either a minute portion is shaken up with liquified gelatine and the mixture poured on glass plates, or a platinum wire frequently dipped into the culture liquid is drawn several times across a layer of gelatine not yet congealed. In either case the developing colonies will determine the purity or impurity of the liquid culture. I have almost invariably found the thirteenth or fourteenth generation as pure as the first, and I should be surprised to find one out of every hundred impure.

I will grant unreservedly that test tubes plugged with cotton wool are not fit for liquid cultures. For gelatine in such tubes, when frequently exposed, is invariably invaded after a time by fungi or bacteria. The plug being a nidus for dust, its removal is always attended with danger. Because a culture tube which eliminates the use of a large removable plug is more costly, it does not follow that it should not be used in scientific research. We know that in the department of physics, chemistry and physiology, the most advanced work is of necessity performed with the most complex apparatus That there are those who do not succeed in keeping liquid cultures pure, does not concern those who do. It behooves the former, in the interests of a true scientific spirit, to improve their apparatus and techinque instead of condemning the method.

Conceding then for the present that cultivations in liquids can be kept free from contamination, the point at issue is the employment of liquids for diagnostic purposes. Whoever has paid any attention to the multiplication of bacteria in nutritive fluids, has no doubt been surprised at the variety of features which present themselves, and at the regularity with which the same ones appear in cultures of the same microbe. To illustrate how many different characters may be used in determining the kind of bacteria and the purity of the cultivation, I will briefly outline a few of the more important ones as they have come under my own observation, referring the reader to Miquel[2] for characters of bacteria obtained from the air, soil and water.

Every cultivation made in a tube shaped like a test-tube presents three regions for observation—the liquid itself, its surface,

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[1] First Annual Rep. Bureau of Animal Industry, Dept. Agriculture, 1884, p. 229; American Monthly Microscopical Journal, 1884, p. 185.

[2] Annuaire de l' Observatoire de Montsouris pour l'an 1885, p. 577.

and the bottom of the tube. In other words, there may be a membrane covering the liquid and a deposit in the bottom. With reference to the liquid itself, it may remain clear or become clouded. In the former case the growth may appear as a membrane or a deposit, or it may be disseminated through the fluid in minute granules, flakes or cloud-like masses. The cloudiness may be very faint—a slight opalescence—or it may be dense, approaching a turbidity. When shaken the cloudiness may be, as it were, set in motion, and thus show itself composed of elements, indistinguishably minute, or as granular or flocculent masses; or it may be impossible by shaking to disturb the uniform opalescence. The liquid may become colored. There may or may not be a membrane present. It may vary from a mere iridescent pellicle to a thick creamy layer. Its formation and growth should be carefully noted, together with its color, consistency and structure when fully formed. The deposit may be absent, very scanty, or quite abundant and colored. When agitated it will rise from the bottom in coarse or fine flakes, as a viscid ropy mass, or as a fine powder. In connection with these characters it is necessary to take into consideration the composition and reaction of the culture liquid. The temperature to which the culture is exposed has a marked effect upon the rapidity with which these characters appear. The odor and reaction of the culture of a certain age are also valuable in many cases.

When these various features, and many others not given above, are taken alone and in combination, we have for most cultures an almost positive means of diagnosis as well as a ready method of detecting contaminations, for these features are as a rule constant. In order to illustrate this statement I will write down a few features of the growth of *Bacillus subtilis*[3] in a neutralized infusion of beef to which 1 % peptone has been added. In a temperature of about 35° C. the liquid becomes opalescent in from 6 to 8 hours. When agitated, rolling cloud-like masses are outlined by a condensation of the suspended bacteria. Within 24 hours an interlacing network, or islands of a whitish gelatinous deposit appear on the surface, which within another day are fused into a white papery membrane covering the entire surface. This membrane, which is not smooth, but puckered and pouched in a peculiar way, pushes its border up the sides of the tube, resembling at this stage the cup of an acorn. The liquid itself gradually clears up in the mean time until it is quite as limpid as before inoculation. This clearing up of the liquid, together with the pe-

[3] This bacillus can be obtained pure at any time by boiling in a water bath, for from ½ to ¾ hour, a filtered infusion of hay contained in a flask plugged with cotton wool.

SCRIBNER ON BLACK ROT.

culiar cup-shaped membrane, is very characteristic of this bacillus, certainly as reassuring to the observer as the stellate growth of its colonies on gelatine. For if another microbe be present, the liquid remains clouded and the membrane is modified. There are many other points of interest in connection with the membrane and the deposit formed later, which I forbear to mention here, as their value for diagnostic purposes is limited by their tardy appearance.

If we now turn our attention to solid media, we shall find that diagnosis often fails when the bacteria do not liquefy the substratum. The colonies then are apt to develop very much alike, and any modification may as well be credited to changes in the consistency of the gelatine, due to variations in temperature, to drying, etc. These same changes will modify the appearances of colonies of the same microbe. Tube cultures in gelatine of radically different bacteria are frequently almost identical in appearance, or else the slight differences are found not constant. In such cases cultures in fluids are frequently of great service. In a recent paper[4] before the American Association for the Advancement of Science, I called attention to two pathogenic forms identical microscopically and in their effects upon animals though found in widely separate sections of our country. One of the few differential characters was the presence of a membrane in the liquid cultures of one germ, its absence in the other.

The great importance of solid media in isolating bacteria and testing the purity of cultures is conceded by all engaged in this field of research. The advantage of starting cultures from a single germ by inoculating them from the colony, its progeny, is inestimable in obtaining accurate and reliable results. But that liquids have also a place, and a very important one, the facts above stated will, I hope, demonstrate without a doubt.

Botanical characters of the Black Rot, Physalospora Bidwellii Sacc.*

F. LAMSON SCRIBNER.

(WITH PLATE IX.)

The external characters of black rot of the grape are determined by the growth of the mycelium of *Phoma uvicola* B. & C., or, if we assume the mature form to be correctly determined, *Physalo-*

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[4] Medical News, 1886, Oct. 18.

* Read before Botanical Club, A. A. A. S., Buffalo meeting, 1886.

spora Bidwellii Sacc. As soon as the berry exhibits any signs of the malady, a thin section through the discolored part will show, under the microscope, the mycelium or vegetative portion of the fungus. This will be found near the surface of the berry and will be seen to consist of hyaline, colorless threads or hyphæ, of very irregular diameter (1–4μ), much branched and provided with more or less frequent septa. The very young branches remind one by their shape of the haustoria of *Peronospora*, but their position in respect to the cells of the host and their subsequent development reveal their true character. The presence of the septa is alone sufficient to distinguish the mycelium of the *Phoma* or *Physalospora* from that of *Peronospora*.

The mycelium traverses the tissues both between and through the cells and under its action the latter soon lose their turgescence and their contents turn brown; they gradually collapse and flatten, and the dried pulp remains only as a thin layer of tissue in which the vegetative part of the fungus occupies a large part.[1] During the earlier stages of the disease the mycelium is most abundant near the surface of the berry and here, at frequent points, just beneath the cuticle, it makes a condensed growth that results in the formation of the perithecia or conceptacles destined to contain the spores. At first colorless, the pseudo-parenchymatous tissue of these conceptacles soon become pale yellow, then brown and finally black. The conceptacles themselves are ovoid or globular bodies varying in size from 75μ to 140μ in diameter, and in their development they raise and finally burst through the cuticle, imparting to the surface of the berry a pimply or punctulous appearance. At the apex of the exposed part of each conceptacle there is a minute opening, or osteolum, through which the spores escape at maturity.

The microscope reveals the fact that the conceptacles are of two sorts—*pycnidia* and *spermagonia*—names determined by the character of their contents, otherwise they do not differ except in size, the pycnidia being the larger.

PYCNIDIA.—A cross-section of a pycnidium shows first a clear zone lining the cavity, consisting of very delicate tissue that gives rise to the short and thin walled threads, the *basidia*, upon which are borne the spores, in this case called *stylospores*, that completely fill the remaining portion of the cavity. These stylospores are one-celled, round or somewhat oblong, being in their longest diameter about 8μ. Under an amplification of 500 diameters the cell wall is clearly discernible, the contents having

[1] Viala and Ravaz, "Memoire sur une nouvelle maladie de la vigne, Le Black Rot," p 416.

a beaded appearance, or sometimes one or two nuclei in the othwise clear contents are seen. These spores escape, probably by the absorption of water through the osteolum or opening at the apex of the pycnidium. Under certain conditions they issue as a minute worm-like thread, which is composed of vast numbers of spores glued or held together by a kind of mucilage. These threads which are more or less twisted are easily seen with a pocket lens. This manner of protusion is probably not constant, but exists under certain favoring conditions.

The stylospores germinate freely in water within a space of three or four hours. They throw out a slender tube which soon provides itself with septa, branches and quickly developes into a mycelium in every way like that seen within the tissues of the berry. How long these stylospores may retain their germinative power is unknown, but it is not likely that they hold it through the winter season.

Spermagonia.—The spermagonia have exactly the appearance of the pycnidia but are usually smaller, they are also far less numerous. Within the outer wall there is a clear zone from which arise the very slender basidia that project radially toward the center of the cavity. The spores, or as they are termed, the spermatia, having been supposed to have a fertilizing power, are borne upon the summit of the basidia and when mature escape in vast number from the spermagonium through an opening at its apex. They are cylindrical, obtuse at each end, 5-8μ long and about 7μ in diameter. What may be the rôle of these spermatia in the economy of the fungus is a matter of speculation. In speaking of the nature of these bodies in general, in the order Pyrenomycetes, Cornu says they are true spores, since they germinate and give out filaments having all the appearance of mycelial threads. He regards them as very small conidia of a special form, borne upon particular arbuscles in protecting conceptacles. They do not in general germinate in pure water and they have a rather slow development; their physiological rôle appears to be determined by their very small size and the circumstances which their germination require.

It has been quite generally supposed that they constitute the male element in the process of reproduction, but there is no evidence to sustain this opinion. Their very small size and consequent lightness have suggested to the minds of some that their office is to more certainly effect the wide distribution of the fungus. It seems to have been conclusively shown that they are not the spores of a parasite on the Phoma.

The species of the genus Phoma are believed to represent merely one stage or condition of certain ascigerous or ascosporous fungi, yet to be determined. Professor W. G. Farlow has very carefully described and illustrated the various conditions or spore-bearing forms of the fungus that causes the Black Rot of the plum and cherry trees, *Sphaeria morbosa*. In this case there are shown pycnidia containing stylospores and spermagonia filled with spermatia, *conidia* produced externally on short stalks or *conidiophores*, and *sporidia*, which are spores formed in little sacs or asci within a perithecium. The last or ascigerous form is the mature or perfect state of the fungus. We have here four distinct varieties of supposed reproductive bodies, pycnidia, spermagonia, conidia and sporidia. In the black rot we have seen the first two upon the same mycelium and even associated in the same *stroma*, so that there is no possible doubt of their connection, and, reasoning from analogy, we would expect to find also the conidial and ascigerous forms.

Conidia.—I am confident that I have seen upon completely diseased berries gathered from the vine, but more particularly upon similarly diseased berries kept moist for a few days under a bell jar, the conidiophores of the Physalospora bearing imperfectly developed conidia. They certainly appeared to be growing from the exposed portion of the pycnidia, but whether from these or from specially formed sclerotia I am not prepared to say.

Messrs. Viala and Ravaz state that berries diseased with black rot, placed in the earth, have developed sclerotia; and, maintained in the soil at a temperature of 18° to 20° C., these sclerotia have produced conidioferous filaments. At Val Marie, upon the 17th of December, they observed sclerotia upon berries that had lain upon the ground for some time after being destroyed by this disease. These berries, placed in a moist atmosphere at a temperature of 20° to 22° C., produced the same conidioferous filaments.

The conidia serve to propagate the fungus, and consequently the rot which it occasions. If their development be delayed until spring, as perhaps it often is, a knowledge of their existence is particularly important, for by them the disease may be perpetuated from year to year.

Sporidia.—The discovery of the mature or ascigerous form of the so-called *Phoma uvicola*, or what it seems reasonable to assume to be such, is recorded by Mr. J. B. Ellis, of Newfield, New Jersey, in the Bulletin of the Torrey Botanical Club for August, 1880 (vol. vii, page 90). Mr. Ellis says that in the early part of May, 1880, Dr. E. C. Bidwell, of Vineland, New Jersey, informed him of having made this discovery on grapes which had been diseased with the rot the season previous and were still hanging dry and shriveled on the vines. By way of experiment some of these berries were placed in water, where they were allowed to soak for three or four days. At the expiration of this time many of the perithecia (that before only contained Phoma spores) were now filled with well developed asci containing immature sporidia. Following up this discovery, Mr. Ellis at once searched for similar developments in shriveled grapes from his own vicinity. His efforts were rewarded by finding some ascigerous perithecia, together with an abundance of Phoma, on grapes gathered from the ground where they had probably lain through the winter.

Messrs. Viala and Ravaz did not succeed in finding, nor were they able to induce the development of the ascosporous form, neither have my efforts to this end met with better success. Thanks to the kindness of Mr. Ellis, who has very generously supplied me with specimens, I have been enabled to study its appearance and illustrate it.

The perithecia containing the asci are in all respects like those that enclose the stylospores, and they have every appearance of being developed from the same mycelium. The walls of the asci are very transparent, and it is difficult to determine their outline except they be separated and examined singly. They are cylindrical or subclavate, abruptly contracted at the base, obtuse at the summit, straight, or occasionally somewhat curved. Except for the sporidia they are perfectly transparent. Each ascus contains eight sporidia.

Mr. Ellis named this fungus Spheria Bidwellii, in honor of its discoverer; by a more recent classification it becomes *Physalospora Bidwellii* Sacc.[2] If we are right in our conclusions, we see that this parasite has four kinds of reproductive bodies: first, the stylospores, enclosed in conceptacles, together constituting the *Phoma uvicola* of authors; second, the spermatia produced at the same time and enclosed in similar though smaller conceptacles; third, the conidia externally developed on short conidiophores; and fourth, the sporidia which are formed in asci that are enclosed in a protecting perithecium. The stylospores (and possibly also the spermatia) are undoubtedly designed for the immediate propagation of the fungus. The conidia probably serve the same purpose, and by their tardy development may help to continue the fungus from year to year. The sporidia are without doubt the special reproductive bodies for the latter purpose. The mycelium

[2] The description given by Ellis is as follows: "Peritheciis minutis globosis epidermidi tectis demum suberumpentibus, apice poro pertusis; ascis clavate-cylindraceis obtusis .0027 X.0005′, sporidias octo, irregulariter ellipticas vel oblongas (continuas?), .0005-.0007′ X.00015-.0002′ foventibus; paraphysibus nullis."

within the diseased berries retains its vitality during the winter months and through the agencies of warmth and moisture of early spring and summer the asci and sporidia are produced.

The germination of these sporidia has never been observed, but if by any system of culture they can be made to reproduce the Phoma of the Black Rot their real nature will be settled beyond dispute.

Explanation of Plate IX. Fig. 1. A fragment of epidermis of a diseased berry, showing five of the black "pustules" formed by the development of the pycnidia. From four of these slender, contorted, worm-like filaments are being extruded; these are the stylospores held together by a kind of mucilage.

Fig. 2. A section through a bit of the berry, including a pycnidium (P) and a spermagonium (S). At O is the osteolum of the pycnidium through which the spores escape at maturity.

Fig. 3. A section of a portion of a pycnidium, more highly magnified, showing the basidia.

Fig. 4. Three stylospo-es germinating.

Fig. 5. A section through the perithecium or conceptacle of the ascosporous form, showing the asci, etc.

Fig. 6. Two separate asci, showing the 8 sporidia in each.

Fig. 7. Four of the sporidia that have escaped from an ascus.

Fig. 8. An ascus, enclosing 8 sporidia, found June 2, 1886, in grape (destroyed in 1885 by "Black Rot") kept for a week in moist air. From camera lucida sketch made by Erwin F. Smith in the laboratory of the University of Michigan. Mr. Smith notes that the "receptacles containing the asci are numerous, and the asci themselves abundant."

Synopsis of North American Pines, based upon leaf-anatomy. II.*

JOHN M. COULTER AND J. N. ROSE.

8. **P. monophylla** Torr. & Frem. Section almost circular: stomata in 18–26 rows: number of ducts two[4] (.055–.115 mm.): number of cells in bundle-sheath 30–55: strengthening cells in fibro-vascular region: leaf 1 to 2 in. long.

In the Sierra Nevada and mountains of California.

The single leaf serves well to distinguish this species. It has been considered a single leaf or a connate pair, but its minute structure at once decides that it represents but one of the two leaves found in P. edulis, and the notion

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*Continued from page 262.

[4] Dr. Engelmann, in *Bot. Calif.* ii. 124, says that the ducts vary from 2 to 14, but we have found but two. Our specimens have included the type.

that the two leaves of the latter are the representatives of the one in P. monophylla can not be held for a moment. If, therefore, P. monophylla and P. edulis intergrade it can only be on the supposition that an entirely new leaf is formed. Dr. J.S. Newberry[5] states that he has observed the two species running together, and that in certain intermediate regions he has seen trees upon which both single and double leaves were found. This would surely indicate a very close relationship, borne out by their minute structure, but in the absence of specimens from these intermediate forms we would suspend judgment. Dr. Hooker[6] still claims, from his own observations, that they are distinct. If Dr. Newberry's testimony is confirmed by a study of the minute structure of these intermediate forms the question would seem to be settled.

9. **P. edulis** Engelm. Closely resembling the last, but the much smaller section semicircular (2-leaved) or rarely triangular (3-leaved): stomata in 5–15 rows: ducts .030–.060 mm.: number of cells in bundle-sheath 15–40: leaves somewhat shorter.

S. Colorado, New Mexico, and W. Texas.

The 3-leaved forms of P. edulis we have received raise the question whether they should not rather be referred to the next species, not so much on account of the 3-leaved character, but because it is accompanied by the absence of dorsal stomata.

+ + No stomata on dorsal side of leaf.

++ Dorsal side of leaf much broader than either ventral: cuticle not specially thickened: stomata not deeply set, the subsidiary cells even forming slight protuberances.

10. **P. cembroides** Zucc. No ventral furrows: stomata in 4–6 rows: dorsal ducts two, nearer the edge than the middle (.025–.040 mm.), completely surrounded by strengthening cells, which are also in fibro-vascular region: leaves (3) slender, 1–2 in. long.

Throughout the southwestern mountains and Mexico.

Occasional specimens of this species show stomata on dorsal side of leaf and hence a close relationship to the preceding group.

11. **P. latisquama** Engelm. Like the last, but with a broad furrow on each ventral face: ducts smaller (.020–.030 mm.), not always completely surrounded by strengthening cells: leaves more slender and longer.

Mexico.

12. **P. Parryana** Engelm. Resembling P. cembroides, but with section much (often twice) larger: stomata in 8–10 rows:

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[5] *Bulletin Torrey Bot. Club*, xii. 50; xiii. 183.

[6] *Gardener's Chronicle*, July 31, 1886.

ducts much larger (.050–.090 mm.): leaves (mostly 4) shorter and much thicker.

S. California and southward into Lower California.

In reference to this whole group of "nut pines" (the last five species) Dr. Engelmann[7] says "it is an open question whether these species may not properly be united into one, as the difference of flowers and fruit is very slight, and that of foliage is only relative." We have been able to separate them upon the characters given, but do not claim that they should be kept specifically distinct. It is evident that they are very closely related, and if the differences noted do not serve to make them specifically distinct they will all have to be included under one species. For the present it seems better to keep them separate.

++ ++ Dorsal side of leaf about as broad or narrower than either ventral: cuticle often much thickened, and stomata very deeply set: leaves in fives.

13. **P. Balfouriana** Murray. Strengthening cells about two layers, sometimes three in the angles, very few in fibro-vascular region: ducts dorsal, two (.040–.080 mm.), always completely surrounded by strengthening cells, position as in P. cembroides, or nearer the middle, sometimes parenchymatous: leaves 1–1½ in. long.

Mountains of California.

14. **P. aristata** Engelm. Resembling the last, but strengthening cells fewer, but one layer next the epidermis, sometimes two on the dorsal side or at the angles, and an incomplete sheath or none at all about the ducts: dorsal ducts one or two, smaller (.025–.050 mm.), near the middle of the dorsal face, often quite close together: leaves as in the last.

Mountains of Colorado, Arizona and westward.

In *Bot. Wheeler's Report*, p. 375, Dr. Engelmann reduces this species to a variety of P. Balfouriana. Judging from its leaf structure it should be restored to specific rank, for it is more distinct than many that are kept separate, and its superficial characters confirm this claim.

§ 2. Fibro-vascular bundles two: ducts mostly parenchymatous or internal.

* Ducts parenchymatous (mostly peripheral in P. resinosa).

+ Bundle-sheath thick-walled (except sometimes in P. Sabiniana)

++ A thin-walled layer next the epidermis.

= Leaves in pairs.

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[7] Trans. St. Louis Acad. IV. 178.

a. Strengthening cells about ducts, but none in the cortical region. Atlantic species.

15. **P. resinosa** Ait. Thin-walled cells small, tangentially oblong, not half as large as the epidermal cells: leaves 5-6 in. long.

Massachusetts to Minnesota.

The ducts are mostly peripheral, as in the first section, though parenchymatous ones are quite common. This species seems to form a sort of transition between the two sections, which are apparently quite widely separated here owing to the absence of about a dozen Old World species.

b. Strengthening cells in the cortical region, but none about ducts: Pacific coast species.

16. **P. contorta** Dougl. Thin-walled cells as in P. resinosa, and about half as large as the strengthening cells, which mostly form but one continuous row interrupted only by stomata: ducts one or two, often wanting, larger than in the next species (.050-.090mm.): leaves 1-1½ in. long.

All along the Pacific coast.

When old the leaf structure resembles that of P. Banksiana and P. inops.

17. **P. muricata** Don. Thin-walled cells larger than in the preceding, only a little smaller than the epidermal and larger than the strengthening cells: ducts 2-9, very small (.025-.040 mm.): leaves 4-6 in. long.

Along the coast of California.

This species has been confounded with forms of P. contorta, but they are well distinguished by the characters given above.

= = Leaves in threes (sometimes fours or fives): ducts 2-10.

18. **P. Engelmanni** Carr. Strengthening cells abundant in cortical region, extending half way to the ducts; rarely any about the ducts; abundant in fibro-vascular region: ducts 8-10, very small (.020-.030 mm.): leaves 13-15 in. long.

Mountains of Mexico.

Our description of this little known species is taken from specimens obtained from the Harvard herbarium. Dr. Engelmann describes the single spectimen obtained by Wislizenus, in 1846, as having "strongly developed strengthening cells around the ducts," a character which our specimens do not show. The strengthening cells are unusually developed and are often larger than the epidermal cells. Parlatore considered this species a form of P. Montezumæ, but its leaf structure is very distinct from what is found even in that polymorphous species.

19. **P. Coulteri** Don. Strengthening cells larger than the epidermal cells, in the cortical region broken into heavy bundles by the frequent rows of stomata; sometimes about the ducts; very numerous in fibro-vascular region on both sides: ducts 4-10, quite variable in size (.025-.100 mm.), sometimes internal: leaves 6-12 in. long.

Along the Pacific coast.

20. **P. ponderosa** Dougl. Strengthening cells smaller than epidermal cells, in 1 to 3 rather regular rows in the cortical region; also about the ducts: ducts mostly two, often five or more, quite variable in size (.030-.070 mm.): leaves 5-11 in. long.

Generally distributed throughout the Rocky Mountains and westward.

31. **P. tuberculata** Gordon, may be looked for in this group.

= = = **Leaves in fives: ducts always 3, one in each angle.**

21. **P. Arizonica** Engelm. of S. Arizona, and

22. **P. Montezumæ** Lamb. of Mexico, can not be separated by leaf characters. The latter species has a wide range of forms, and is but poorly circumscribed. It is quite possible that further knowledge of external characters may require these two species to be reduced to one. All the forms have well developed strengthening cells.

++ ++ **No thin-walled layer next the epidermis: strengthening cells about ducts and in fibro-vascular region.**

= **Leaves in fives: stomata deeply set.**

19. **P. Coulteri** Don. may be looked for in this group.

23. **P. Torreyana** Parry. Outline of section mostly triangular: stomata numerous, 8–13 rows on each face: 3–5 rows of strengthening cells in cortical region: ducts mostly 3 (.040-.060 mm.), sometimes with accessory internal ones: leaves 8–11 in. long.

Coast of Southern California.

= = **Leaves in threes: stomata not deeply set.**

24. **P. Jeffreyi** Murray. Strengthening cells in 2 or 3 rows in cortical region; one complete row about ducts: ducts two or more (.040–.060 mm.): leaves 4–9 in. long.

Eastern slope of the Sierras and ranging into Oregon.

The leaf structure is much like that of P. ponderosa, to which species it is often referred as a variety, but is very distinct in the absence of the sub-epidermal thin-walled layer.

25. **P. Sabiniana** Dougl. Strengthening cells in bundles in cortical region, and usually about ducts; which are mostly two (.020–.050 mm.): the cells of the bundle-sheath are often thin-walled, and the species may be looked for under the next group: leaves 8–12 in. long; the section considerably smaller than in P. Coulteri, with which it may be confused.

Mountains of California.

+ + Bundle-sheath thin-walled: a thin-walled layer next the epidermis.

++ Strengthening cells in fibro-vascular region; few, if any, about ducts.

= Leaves in threes.

26. **P. Tæda** L. Strengthening cells in the angles much larger than epidermal cells, in the rest of the cortical region only about half as large; also on dorsal side in fibro-vascular region: ducts quite large for the section (.037–.075 mm): leaves 5–6 in long.

Delaware to Florida and westward to Arkansas.

27. **P. serotina** Michx. Strengthening cells equalling the epidermal cells, or smaller, numerous in the angles, elsewhere in the cortical region in bundles or single layers; generally absent from the ducts; in the fibro-vascular region on either or both sides of the fibro-vascular bundles: cells of the thin-walled layer quite small: ducts mostly 5–7, often half of them internal (.025–.050 mm.): leaves 6–8 in. long.

From N. Carolina to Florida.

28. **P. rigida** Miller. Like the last, but strengthening cells not so numerous in the cortical region, in two or three rows, about the size of the epidermal cells, or larger in the angles: ducts 3–7: leaves 3–5 in. long.

From New Brunswick to Kentucky.

29. **P. insignis** Dougl. Epidermal cells forming an arch next the stomata, making an oval cavity which opens below: strengthening cells (as well as thin-walled layer) mostly larger than epidermal cells, in one or two rows in the cortical region; sometimes found in the fibro-vascular region: leaves 4–6 in. long.

Coast of California.

19. **P. Coulteri** Don., and
31. **P. tuberculata** Gordon, may be looked for in this group.

= = Leaves in pairs.

30. **P. pungens** Michx. Thin-walled cells quite small:

strengthening cells in small bundles separated by the rows of stomata, much more numerous and larger in the angles; generally present in the fibro-vascular region: leaves 1–2½ in. long.

In the mountains from Pennsylvania to Tennessee.

++ ++ No strengthening cells in fibro-vascular region, nor about the ducts.

= Leaves in threes.

31. **P. tuberculata** Gordon. Thin-walled cells smaller than epidermal: strengthening cells in one or two rows, larger than the epidermal cells; rarely some about ducts and on dorsal side of fibro-vascular region: ducts 2 to 5, small (.020–.030 mm.), often with several internal.

Throughout the western mountain systems.

23. **P. Tæda** L., and
26. **P. insignis** Dougl. may be looked for here.

= = Leaves in pairs.

32. **P. inops** Ait. Epidermal and strengthening cells about the same size and quite small, the latter in a single layer: lines of stomata quite numerous: ducts occasionally internal: fibro-vascular bundles often widely separated: leaves 1½-3 in. long.

Along the coast from New York to S. Carolina, westward through Kentucky to Indiana.

33. **P. clausa** Vasey. Lines of stomata 10-20: strengthening cells often entirely wanting, or with a few scattered peripheral ones: ducts mostly two, one of which is occasionally internal, varying but little in size (.030-.035 mm.): leaves but half as wide (1 mm.) and longer than the last.

Florida.

34. **P. mitis** Michx. But one layer of strengthening cells, which are little smaller than the epidermal: ducts small (.020-.030 mm.), often as many as six: leaves 3-5 in. long, not twice as wide as thick.

New York to Florida, westward to Texas and Kansas.

35. **P. glabra** Walt. Ducts rather large (.050-.060 mm.) for the group, fewer than in the last, mostly 2 or 3, sometimes with one of them internal: leaves 3-4 in. long, twice as wide as thick.

South Carolina to Florida and through the Gulf States to Louisiana.

36. **P. Banksiana** Lamb. Cells of thin-walled layer smaller

than strengthening cells: ducts (.030-.060 mm.) sometimes wanting: leaves 1 in. long.

In the northern States.

30. **P. pungens** Michx. may be looked for here.

* * Ducts always internal: bundle-sheath thin-walled.

37. **P. palustris** Miller. Cells of thin-walled layer generally much smaller than those of the epidermis: strengthening cells mostly on ventral side of fibro-vascular region: ducts variable in size (.040-.050 mm.), with few strengthening cells: leaves 10-15 in. long.

P. australis Mx.

Virginia to Texas.

38. **P. Cubensis** Griseb. Cells of thin-walled layer large, often equalling those of the epidermis: strengthening cells about as large as epidermal, mostly but one layer; sometimes more in the angles, and even extending to the ducts; none about the ducts nor in fibro-vascular region: ducts variable in size (.050-.080 mm.), often with accessory parenchymatous ones: fibro-vascular bundles but little separated, often blended: leaves 7-12 in. long.

P. Elliottii Engelm.

South Carolina and Florida.

NOTE.—We would be pleased to receive from our friends specimens for identification, as doubtless a wider range of forms will lead to some modifications.

BRIEFER ARTICLES.

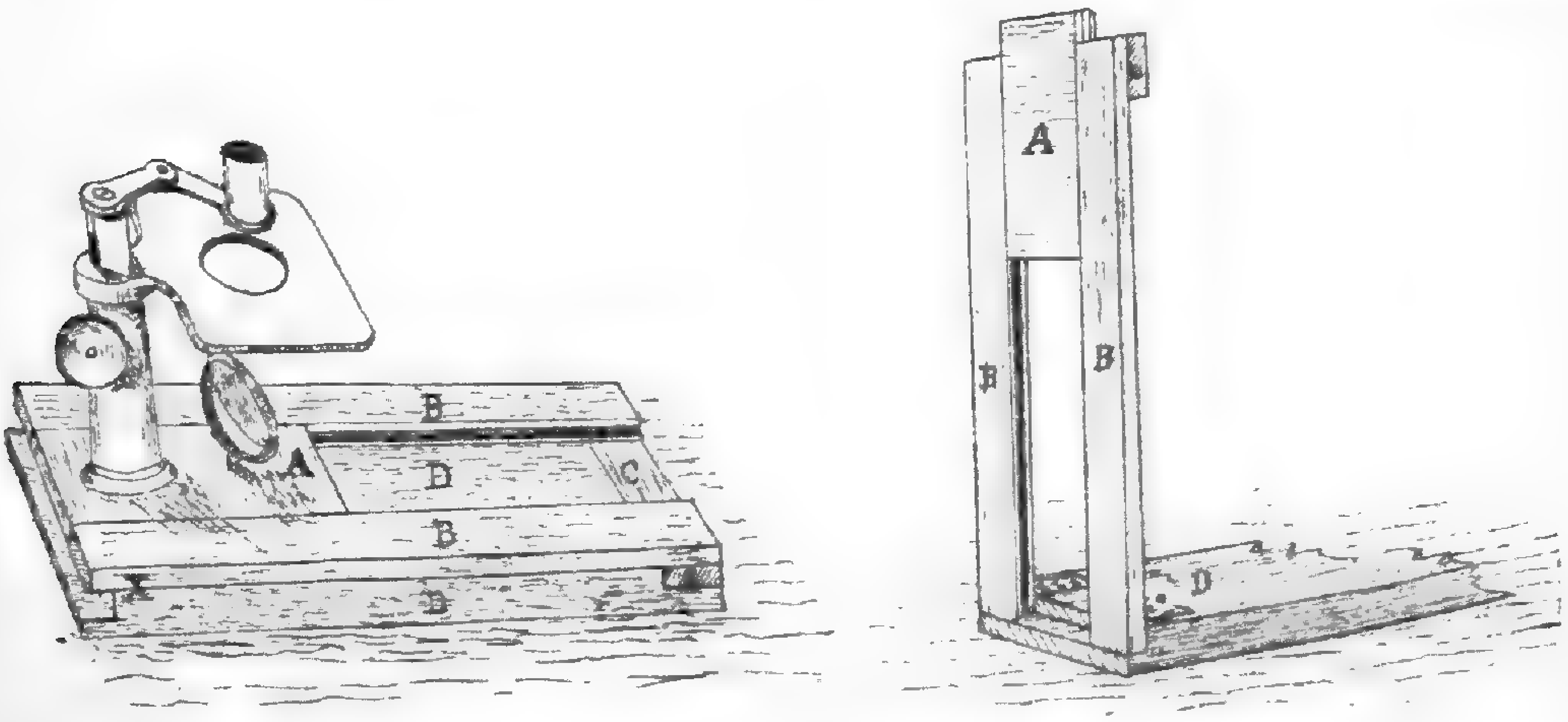
A case of teratology.—It is not always that the continuity of the leaf-spiral can be readily demonstrated with opposite or whorled leaves. Teratology sometimes helps us out. A stem of the garden valerian, Valeriana officinalis, was lately found which had grown to several times the usual diameter and become much shortened and spirally twisted. Where the tissues of the stem were nearly horizontal the leaf-spiral was nearly vertical and the leaves were inserted vertically with their buds at the side. The twisting, as is common with monstrous formations of the stem, was confined to the single axis.

A. A. CROZIER.

Puccinia Malvacearum Mont. in Massachusetts.—I have recently received some leaves of hollyhock from the garden of Prof. C. L. Jackson, at Beverly, Mass., which were attacked by the true Puccinia Malvacearum common in many parts of Europe. In all respects the leaves attacked resemble those which I have examined from Europe, and differ from those which I found in California, of which a notice was published in the BOTANICAL GAZETTE of September, 1885, in having isolated, light yellow sori instead of the aggregated, or somewhat concentric, and dark brown, almost black sori found in the affected hollyhocks of Santa Barbara. The fungus from Beverly is of interest not only because very little is known of the occurrence of P. Malvacearum in the Eastern States, but also because in this case we have an accurate record of the advent of the fungus. The disease was unknown at Beverly until the present year, and was imported with some seeds of Malope from Europe last season. At present the disease is confined to the Malope and hollyhocks of Prof. Jackson's garden and that of one of his neighbors, other gardens being free from the disease.

W. G. FARLOW.

Making drawings with a dissecting microscope.—The apparatus consists of a Zentmayer's dissecting microscope, the Rothrock model, the round metal base being replaced by a wooden one, which is made as follows: A heavy board (D in figure) 6 × 12 inches, having a shoulder cut at each end, forms the ground work; to this are hinged on either side at X, the two strips B B, each $1\frac{1}{2} \times 12$ in. and grooved on their inner edges; these are bound together by the strip C; between the strips B B is placed the piece marked A, which is tongued to fit the groves. Two holes are made in A, one to receive the screw at the base of the microscope, the other for the attachment of the mirror. When the object is prepared for drawing, A is carried forward to C, and then raised with B B into a position at right angles with D, the weight of the microscope and the shoulder at the end of D keep this portion in position.



A Wollaston's camera lucida is now placed over or rather back of the lens and the object drawn in the usual way.

The lenses used are a one inch and a one-half inch achromatic triplets having special adapters for fitting into the arms of the microscope stand and for receiving the camera lucida. Mr. Zentmayer has made these fittings or adapters under my direction, and modified the mounting of the camera slightly, making it more convenient for use than in its usual form.

The piece A can be raised or lowered and fixed at any point so that various degrees of enlargement in the drawing are secured. Upon the stage I have a piece of plate glass $1\frac{1}{2} \times 3$ in. upon which my dissections are usually made. A space in the center of this glass slip is ruled to millimeters, twenty-five millimeters each way. This ruling, as made for me by J. W. Queen & Co., does not interfere at all with the work of dissecting, while it enables one to measure in the easiest possible way any object on the plate, and in making the drawings the scale of enlargement is always before you and can be noted in a moment. The slip of glass is held to the stage by spring clips which are attached to the stage but are not shown in the figure.

In making drawings for photo engraving it is essential that the lines be black. For this purpose Higgins' American drawing ink is very good. An excellent pen for very fine work is No. 1459 of Keuffel & Esser.

F. LAMSON SCRIBNER.

Plan for laboratory work in Chemical Botany.*—Chemistry furnishes the means for investigating plants. The chemical study of a plant includes not only macro- and micro-chemical work, but also gross and minute anatomy study Two years ago when I saw Prof. Goodale repeat Pfeffer's experiment of putting together certain constituents and building up a cell, I also saw that cell form was not fundamental, but that construction lay back of form and determined it Form is a property of a substance, so to speak. If this is so, even the study of anatomy falls under chemistry and it determines how a plant shall be investigated.

Organic chemistry has two departments. As a special and not an inclusive subject, it investigates elements and compounds in themselves and in their relation to each other apart from their place of occurence. When a study is made of the combination and relation of these substances under what is generally termed life, botany has been entered upon. That is to say, that department of organic chemistry termed the proximate analysis of plants is divisible. One of its subdivisions really belongs to botany and should be relegated to it.

Whatever may be true in other countries, the chemical plant study now being done in America is not alone imperfect in results but *methods*. The chemist extracts the various compounds from the plants and examines them without regard to their relation to the plant. The botanist does little better. With the highest power of his microscope, he entirely misses many of the constituents of the plant. It would seem as if there ought to be a combination of these two modes of investigation, that is, that macro-chemical study of the plant should be accompanied by a micro-chemical study. One who has ascertained the presence and quantity of the more important constituents is prepared to trace these substances in its various tissues. The comparative study that is then possible needs no emphasis.

On page 179 of the July number of the BOTANICAL GAZETTE I gave a scheme of analysis in which macro- and micro-chemical work are combined. I shall not repeat it here, but an examination of that scheme will be necessary

*Read before the A. A. A. S., Buffalo meeting, 1886.

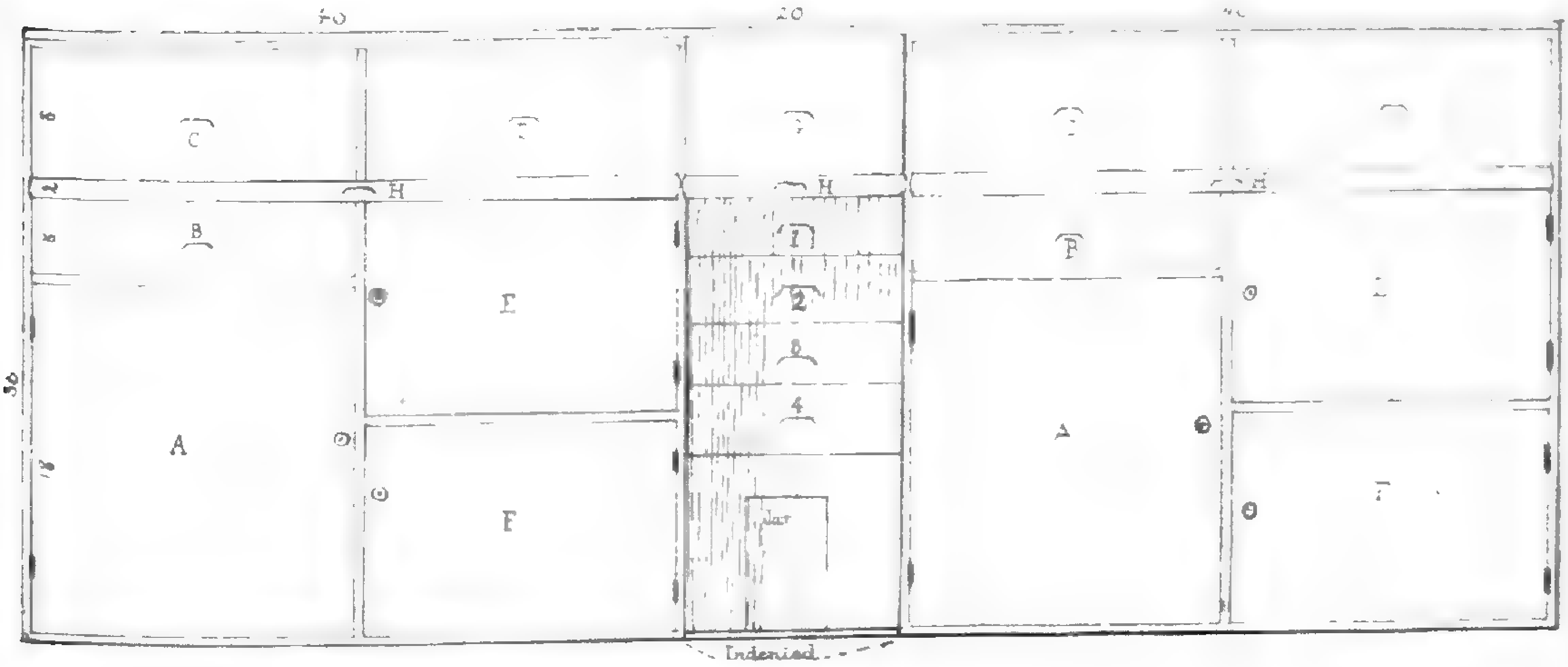
before, not only the laboratory arrangement I am about to describe, but the whole bearing of the paper can be really understood.

That scheme includes the more important plant products, and by studying any plant as indicated the student is acquainted with a good number of them. In spite of time required, the qualitive value of the quantitative work makes its omission impossible. It frequently tells where the individuality or active principle of the plant lies. Of course this is the real end of botanical proximate analysis.

The books needed in carrying out this analysis are easily obtained. Prof. Goodale and Bessey's botanies and Prof. Trelease's translation of Poulsen's Botanical Micro-Chemistry give directions for the micro-chemical work, and Dragendorff's Plant Analysis for the macro chemical. Dragendorff's book is rather difficult for beginners, but can be supplemented by the investigations of some one who has followed his general plan. Miss Helen Abbott read a paper, entitled "A chemical study of Yucca Angustifolia," before the Association last year that seems to me particularly suited to this purpose. It is something more than an intelligent following of Dragendorff. It is a model as regards the use of the five senses and in its deductions from what is observed. This last alone would be sufficient reason for placing it before students.

The plant to be taken depends upon the end in view. If investigators in botany are to be trained a fresh plant will be chosen each time for the purpose of stimulating observation and generalization. If botanical information is to be given in a short period of time some plant whose anatomy is familiar will be selected, though it may be remarked in passing that it is believed, if form depends on composition, the time will come when anatomy study will accompany the macro- and micro-chemical study. Fortunately a valuable laboratory guide for anatomy study has just appeared. For botanical information the plant richest in products and showing its chemical characteristics most readily on the application of proper tests will, of course, answer best. If this plant was one, one or more of whose constituents were sold on the market, these could then be obtained in sufficient quanties to allow that fuller study that is not possible with the amounts obtained in the above analysis

If the introductory remark that chemistry lies at the bottom of all botanical work is accepted, then a botanical laboratory will be a chemical laboratory with convenient arrangements for plant study. I have here a plan of a laboratory desk that I have arranged for the work. While a modified chemical laboratory desk it seems to me not unsuited to all work now generally done in botanical laboratories. The desk is 40 in. long, 36 in. high, and 31 in. deep. It has three drawers and three cupboards. Cupboard *A* is for the compound microscope, drawer *B* for the apparatus generally used with it, and *C* for mounting materials. *D* is for the simple microscope and other apparatus used in analyzing flowers, *E* is for holding bottles of material undergoing maceration, and *F* for fresh plants. *H'* can be drawn out and used for holding mounted specimens from the herbarium near by. *HH* are pieces that form a table for the compound or simple microscope when drawn out. The desks are set in groups of four, as a whole having the shape of a truncated triangle. Book-shelves for ordinary working books are placed at one end of the group. The other ends are placed against the wall, between two windows, so that the drawn out tables will be in front of windows and receive plenty of light. Drawer *G*, between the two desks, is for the smaller pieces of chemical apparatus. Drawers 1, 2, 3, 4 are for students' use. They are set back, leaving a space in front for refuse solids, in the sides of which are nails for holding rags, apron, etc. Each desk has two gas jets, a faucet, the water falling into the sink below, and tin hood for assisting in ventilation. I have found these tin hoods of great use for



PLAN OF LABORATORY DESK.

this purpose. I think that with these, and a gas chamber for generating hydrogen-sulphide, chlorine and one or two other gases, the microscope would not be injured by being kept in the laboratory if shut up in close box when not in use.

It is intended that one desk will be furnished with the reagents ordinarily employed in inorganic chemistry. The next with those of organic chemistry. Of these petroleum spirit, ether and absolute alcohol will constitute the chief expense. Petroleum spirit and ether can be readily recovered by using the condenser, so that absolute alcohol might be said to be the only great expense. Even if recovered it could only be employed as a weaker alcohol.

The individual desks are to be furnished only with the simpler pieces of apparatus as measuring flasks, pieces of platinum, porcelain crucible, etc., etc The balance, polariscope, spectroscope, condenser, platinum dish, etc., will be used in common. It is thought that the additional expense of carrying on the work as laid down will be slight in those places where botanical laboratories are properly equipped for the study of plant anatomy.—LILLIE J. MARTIN.

Some additions to the Sylva of North America.—During the month of April of this year I was able, in company with Messrs. C. G. Faxon and A. H. Curtiss, to make a somewhat detailed examination of the trees of the semi-tropical Florida region, among which should now be included:

Myginda integrifolia Lam. (M ? latifolia Chapman, Flora, not Swartz), a peculiar plant, not rare in the West Indies, and, although early collected upon Key West in a shrubby state, often confounded in American collections with M. latifolia and M. pallens; referred to Ilex by Kunth, and on account of its diœcious flowers and suspended ovules made by Grisebach (*Cat. Plant.* Cub. p. 15) the type of his section *Gyminda* of the genus Myginda. Myginda integrifolia is truly arborescent upon Key West, reaching a height of 20 to 25 feet, with a straight slender trunk, not rarely six inches in diameter. It may be distinguished from the other North American species of the genus by its entire obovate leaves, rounded or often deeply emarginate at the apex, revolute, pale yellow-green in color; its wide-spreading axillary and terminal cymes, diœcious flowers, the staminate with long erect filaments (those of M. palleus become reflexed between the petals upon the expansion of the flowers) surrounding a deeply-cleft pistillate process, the pistillate flower with two-lobed sessile stigmas with a single suspended anatropous ovule in each cell, and by its small dark blue or black ovoid drupe, the large embryo surrounded with a thin covering of albumen.

Terminalis Buceras Bentham & Hooker (Bucida Buceras L.). This well-known West Indian tree was first seen in the U. S. by Mr. Curtiss. It is common in the hummocks, near a Mr. Farley's house, towards the east end of Elliott's Key, where we found it in full bloom on the 19th of April. It is here a fine tree, sometimes 50 feet in height, with a trunk 12 to 18 inches in diameter, these tall, upright stems often springing from stout, short, prostrate trunks two to three feet in diameter. The wood is heavy, hard and moderately close-grained, but probably of little value except for fuel.

Pseudophœnix Sargentii H. Wendland (in lit.) Dr. Wendland proposes provisionally to establish a new genus in Chamedoriæ, to receive an arborescent Palm, also detected by us near the eastern end of Elliott's Key, with abruptly pinnate leaves four to five feet long, the pinnæ lanceolate acuminate 12 to 16 inches long, bright green above, glaucous beneath; branching interfoliaceus spadix 36 inches long by 30 inches wide, the main and secondary branches very light yellow-green, flattened and the latter thickened at the base, especially on the upper side, with an ear-shaped process, and with three-lobed three-seeded fruit or often one or two-lobed by abortion, one-half to three-fourths of an inch in diameter, in April bright orange or red, fleshy and very conspicuous. Unfortunately neither flowers nor mature fruit could be found, so that Dr. Wendland, to whom specimens were submitted, is unable to characterize the interesting addition to the North American sylva.

The Pseudophœnix is a tree with the general habit and appearance of Oreodoxa, 20 to 25 feet in height, with a trunk 10 to 12 inches in diameter. Six individuals only, in two localities, two or three miles apart, were found.

It is perhaps worthy of remark that upon the island of Key West, which is less than four miles long by about three-quarters of a mile wide, there are growing at the sea level 41 indigenous arborescent species, a greater number no doubt than can be found in any other area of similar extent in the United States. Lysiloma latisiliqua, Colubrina reclinata, now the rarest of the Florida trees, and Clusia flava, not rediscovered in Florida during the last 40 years, and probably not now growing naturally in the United States, although found on Key West, according to Nuttall, in Dr. Blodgett's time, have now disappeared from the island; and it is not improbable that other species, which now flourish upon the adjacent islands, have been exterminated from Key West in the general cutting of the woods which is continually going on there.—C. S. SARGENT.

EDITORIAL.

IN REFERRING to the botanical papers at the recent Buffalo meeting of the American Association the *American Naturalist* takes occasion to remark that "it is noticeable that they include no physiological subjects, and that the tendency is strongly toward the systematic side of botany, which may be taken as indicating the prominent position which this phase of botanical science still maintains with the leaders." In regard to this conclusion we beg to differ, as not necessarily following from the fact stated, and as being contradicted by our own information. The GAZETTE has a wide acquaintance among our most active young botanists, and has had frequent consultations with them as to the most promising field for an energetic young worker to cultivate. A few years, often too few, perhaps, are spent in special and costly preparation of a general kind, and then every spirited student desires to enter some special line of work, in which he proposes to become an authority. The easiest advice to give is that he should follow the bent of his desires, but the average young botanist is compelled rather to follow the bent of his opportunities. Physiological botany is a great department, an exceedingly important and attractive one, and should be cultivated by all who can do so, and we know more than one keen American botanist who would willingly exchange all his chances in systematic work for a good opportunity to follow out his physiological bent. But the appliances for good physiological work are costly and entirely beyond the reach of the average American botanist. Of course any amount of physiological work can be conducted in ordinary laboratories, but such work is purely elementary and only serves for class illustration. What our young botanist wants is to become an authority in some department of physiological botany, and how is he to do it with the means at his command? Systematic botany, on the other hand, requires no such unattainable appliances, and what information is needed from unattainable books or specimens can be had by correspondence or an occasional visit to some herbarium where they are to be found. All that is necessary is the selection of some group that needs work (and there are plenty such), the accumulation of all books and specimens possible, and then a settling down to study. As being a thing that can be done, it naturally becomes the thing that is done. We must guard against a too hasty conclusion from these remarks that in our opinion most of our young systematists would be physiologists if they could. There are some among them who would be systematists from choice were the whole field of physiology open to them. We simply make the claim that our young botanists are fully alive to all the interests of their science, physiological as well as systematic, and were equal opportunities offered would be fairly distributed among the different departments.

Botanical activity is manifesting itself by contributions and bulletins from the laboratories and science departments of our various institutions of learning and research. In comparing these one finds that they are of very uneven value as permanent additions to the world's knowledge. They all show ability to deal with new problems, but the worker often leaves the reader to find out for himself just where he stands, and what relation this contribution holds to what other workers have already recorded. We venture to say that the difference in the value of results is mainly referable to the equipment in libraries, specimens and indexes, possessed by the several institutions. Many workers, possibly the majority, are inadequately supplied with these requisites for determining and recording the relation which their results bear to the present record of facts, or for directing their attention to the most profitable part of the field of research. Of these helps, the last is especially important, for unless all available literature and material is fully indexed, by means of a card catalogue or some similar system, it is hopeless to expect the student to thoroughly compass his subject, and to exert his powers to the best purpose.

OPEN LETTERS.

Letter from Commissioner Colman.

To the Members of the Botanical Club of the American Association for the Advancement of Science:

Ladies and Gentlemen:—I have noted with extreme gratification the interest you have taken in the work established by me in this Department, relative to the investigation of the fungus diseases of plants; and the resolutions you have passed commending my action and assuring me of your support and aid in securing the necessary means for the continued and successful prosecution of this most important undertaking, are fully appreciated, and I wish to thank you on behalf of the farmers and fruit growers of the country, in whose interest and for whose direct benefit this work is designed.

As you are well aware, only a few of the more important plant diseases have been thoroughly worked out by scientists, and the little that has been done—little when compared with what there is to do, but a great deal when considered by itself—has been the result of private effort on the part of some of your own well known members. Such obscure diseases as the peach-yellows, the cotton rust and the "foot rot" of the orange tree, demand immediate attention, and, for their proper elucidation, we need to command the services of our most skillful investigators, giving them opportunities to make special studies in the field until the knowledge desired is gained. As you have well suggested a liberal supply of funds is required for this work.

In addition to the assistance in this particular, to which you have so generously pledged yourselves, I beg leave to call your attention to the fact that you, as botanists, knowing our cultivated and native plants and the fungus parasites infesting them, may do much valuable service as *observers*, in your respective localities, by recording such facts as may come to your notice relating to this subject and by collecting and transmitting to the Department material useful in the investigations, or that may serve to record the distribution of the injurious species of fungi.

Facilities for this work and a free use of the mails will be accorded those who may have such notes or materials to transmit, and the source of all matter that may be used for publication will be properly credited.

Again thanking you for your hearty commendations of my course in relation to this subject, and assuring you that I shall continue to do all in my power to further the work, I remain Yours respectfuly,

NORMAN J. COLMAN, *Commissioner.*

Department of Agriculture, Washington, D. C., Oct. 20, 1886.

Second blooming of Salix humilis.

On the 25th of last September, while collecting the leaves of some willows, I came across a bush of S. humilis which was full of partially developed staminate catkins and three fully developed ones. I visited the place two weeks later and about one-half of the catkins had bloomed. The other half had dried up and withered. OLIVER A. FARWELL.

Phœnix, Mich.

CURRENT LITERATURE.

Plant Analysis: qualitative and quantitative. By G. Dragendorff, Ph. D. Translated from the German by Henry G. Greenish, F. I. C. J. H. Vail & Co., New York, 1884. 8vo. pp. 280.

The study of plant constituents, a most important part of a full knowledge of plants, received a great impetus from the publication of this work. Both in its original form and its English version it at once attracted attention for its completeness, compactness and adaptability to the requirements of the student. The translation is exceptionably accurate and satisfactory, and has all the value of an original work.

The study of chemical botany is now receiving more attention than heretofore, and merits, and is likely to obtain, a larger place yet in the curriculum of botanical science, being especially appropriate as a part of the course in vegetable physiology, and even more so in medical and pharmaceutical botany. This change can be chiefly traced to the influence of Dr. Dragendorff's work, for although it has been before the public but a short time, it has nevertheless come to be looked upon as the standard and necessary guide in such study.

A certain amount of knowledge of chemistry, chemical manipulation, and of the microscope, is presupposed in the pupil, but having this, the work will be found as clear and simple as the complex nature of the subject permits. Its arrangement is such that it can not fail to stimulate the pupil to original investigation, for while the limits of the work would only permit the introduction of the more important constituents of plants, yet he is kept upon the alert for less usual or unknown compounds, which are to be worked out from information gathered elsewhere, the copious references to literature aiding him in his research.

The fact that the work is specially adapted for the investigation of chemical problems from a botanical point of view, makes the notice of it at this time peculiarly fitting, as Miss Martin's recent articles on the subject have undoubtedly turned the thoughts of our readers in this direction.

General Biology. By William T. Sedgwick, Ph. D., and Edmund B. Wilson, Ph. D. Part I. 8° pp. vii. 193. Henry Holt & Co., New York, 1886. American Science Series.

A new book on biology is always welcome, especially when it deals with methods of laboratory work. Every respectable teacher believes in laboratory methods, but every good teacher follows no guide blindly, and has notions of his own as to the order and details of presentation. The very fact that a constant succession of laboratory guides is appearing shows that teachers differ as to these matters of detail, and the wise teacher will use his own methods and cull out from all these laboratory guides the things that are adapted to his wants. We believe in general biology, and think it should be more generally taught, and the book before us serves well as an introduction to the more detailed study of either plants or animals. The method proposed is to state the general principles of biology, illustrate them so far as possible by laboratory work, and then make a detailed study of a single plant and animal. For this reason a fern (Pteris aquilina) and an earth-worm are selected. Four chapters are devoted to the preliminary statement and illustration of principles, six to the study of the two types mentioned, and one to a discussion of classification. It is very true that an ordinary laboratory guide often leads to the accumulation of an undigested mass of facts, and the student has in the end no clear conception of the relations of things, but this simply results from the wrong use of such a guide. It is not expected in these days that a student is to get all his knowledge of a subject from a single book, and he who uses a laboratory guide, either in the absence of a living teacher or without some good general text-book, can not expect to obtain the best results. Our only criticism of this book is that while it dispenses with the necessity of both text-book and teacher in the general statement of biological principles, it creates a greater necessity for both in following the laboratory directions than any guide we have yet seen. The book is to be an introductory one, so introductory that the student is to be taught the use of the microscope, but the laboratory directions are so condensed, many of the operations are so difficult, and, more than all, the material is so varied that it would tax our best equipped laboratories and our best trained teachers to have a beginning class follow them. To save a constant supervision on the part of the teacher, and the almost impossible attempt to get together such varied material, we prefer explicit directions in laboratory work, a few types, and to leave to the teacher the task of enunciating principles. It must not be understood for a moment that we disapprove of the laboratory directions, for they are excellent, very desirable to follow, and well illustrate the principles of biology. The criticism only raises the question as to their adaptability to introductory work and the average American laboratory. The figures of the book are numerous, well executed, and refreshingly new, and it would be well if they could be an incentive to more numerous and better drawings in our laboratories. We commend this book to the careful attention of teachers, and feel confident that it is one that they can not afford to be without.

British Fungi (*Hymenomycetes*). By the Rev. John Stevenson. Vol. II, Cortinarius-Dacrymyces. Edinburgh: Wm. Blackwood & Sons, 1886. pp. 336. Large 12mo. Illustrated.

The second and concluding volume of this work, completing the order Hymenomycetes, follows the first with remarkable and commendable promptness. That they should both be issued within one year was unexpected, but will give great satisfaction to collectors.

The first volume was noticed and commended in the July number of this journal (where a typographical error made the date read 1866 instead of 1886), and only a few words need be added here. The second volume contains over fifty genera, of which the largest, with the number of species of each, are as follows: Marasmius 36, Boletus 41, Russula 42, Clavaria, Hydnum and Lactarius 46 each, Cœticium 48, Hygrophorus 54, Polyporus 124, and Cortinarius 130. The descriptions are equally complete and satisfactory with those of the first part. A convenient glossary is added, which also illustrates the care that has been exercised in excluding dispensable terms, and in simplifying the technical nomenclature as much as possible. Each volume possesses its own index.

Both the author and publishers are to be congratulated upon the satisfactory completion of so valuable a handbook. While being an aid to the American student, the need of such a work for our own country will yet make itself the more keenly felt.

NOTES AND NEWS.

SOME SEVENTY SPECIES of lichens from Florida collected by W. W. Calkins, and mostly determined by H. Willey, are enumerated in the *Journal of Mycology* for October.

DR. BYRON D. HALSTED will spend the winter months in the neighborhood of Los Angeles, California. He will remain there from the middle of November to the middle of February.

A CRITICAL STUDY and revision of the Hysterineæ in the Duby Herbarium, by Dr. Rehm, is begun in the fourth heft of *Hedwigia*, and will prove of interest to systematic mycologists.

IN THE *Bulletin of the Torrey Botanical Club* for October, Dr. N. L. Britton distinguishes two forms of what has been called Anychia dichotoma, and restores Decandolle's A. capillacea to specific rank.

A HANDBOOK of the cryptogamia is being prepared by Alfred W. Bennett (6 Park Village East, London, N. W., England), who desires that authors will send him copies of their recent articles pertaining to this subject.

CARL OSCAR HAMNSTRÖM died at Hessleholm, Sweden, on July 5 of this year, at the age of 70. We learn from the *Botaniska Notiser* that his chief botanical works comprise studies of parts of the Swedish flora, published between 1842 and 1851.

IN THE OCTOBER *Journal of Botany* Baron F. von Mueller describes a new genus of Vacciniaceæ from New Guinea, naming it Catanthera. Its salient characters are petals perfectly separated and anthers continuously completely bent downward.

AN ERINEUM on the flowers of cultivated grapes is recorded by J. E. Planchon in the last *Revue Mycologique*, as being found in two localities in France. Erineum usually appears on the upper surface of leaves, and has probably never before been found on the flowers.

IN *Nature*, for September 30, is printed a charming lecture by H. Marshall Ward, on the subject of roots. In popular language he gives an idea of the activities of the root, and shows what complex conditions are at work, influencing the life of the whole plant. Special attention is paid to the oxygen supply.

NOTES ON TOMATOES, by Prof. L. H. Bailey, Jr., occupy Michigan Agricultural College Bulletin No. 19. Seventy-six seedsman's varieties were grown the past year, and a critical synopsis prepared in which the number of names is reduced nearly one half. Remarks upon their earliness, productiveness, amount of rot, and germination are given.

THE COMMON YARROW (Achillea Millefolium) is observed by Rev. G. Henslow, before the Royal Horticultural Society of England, to be gyno-diœcious. The female florets have abortive anthers without pollen. They also differ from the hermaphrodite florets by sometimes having fewer petals and stamens, slightly longer ovaries, and the corresponding tubes slightly shorter.

THE ANATOMY and development of Agarum Turneri, the sea colander, by Mr. J. E. Humphrey, forms the fifth contribution from the cryptogamic laboratory of Harvard University. The frond was the part studied. It agrees closely in structure with that of other Laminariaceæ. The interest centers in the manner of forming the perforations, which is well described and illustrated.

MR. G. H. PARKER furnishes the sixth contribution from the cryptogamic laboratory of Harvard University, on the morphology of Ravenelia glandulæformis. Our knowledge of this odd member of the Uredineæ has been very incomplete. The paper shows that each head of teleutospores, from its earliest development, is a group of adnate pedicelled spores. The other species and the literature of the genus are reviewed.

A SKETCH of the life of C. C. Frost of Vermont, who died in 1880, is given in the October *Journal of Mycology*. It is from the pen of Prof. Wm. R. Dudley, after a visit to Mr. Frost's late residence, and is an interesting account of a modest and retiring botanist. Mr. Frost's chief work, done conjointly with Prof. Tuckermann, was a Catalogue of Plants of Amherst, in which he described sixty species of fungi, mostly of the fleshy sorts.

PROF. CHARLES R. BARNES has published, as one of the bulletins of Purdue University, an analytic key to the genera of mosses, recognized in Lesquereux and James's manual of the mosses of North America. As is well known to those attempting to use the manual referred to the analytical key to genera is anything but satisfactory. Professor Barnes has attempted to supply this need and to lessen the difficulties in the way of students of mosses. Copies can be had on application to Purdue University.

THE VERY INTERESTING presidential address of Professor Carruthers, before the biological section of the British Association, on the age of some existing species of plants, is published in full in the *Journal of Botany* for October. Comparing the species of mummy plants and those of recent geological deposits with their living representatives the conclusion reached is that the data given must be considered "as confirming the long-established axiom that by us, at least, as workers, species must be dealt with as fixed quantities."

IN COLLECTING marine algæ for microscopic study, members of the Quekett Microscopical Club have found it convenient and satisfactory to carry a bottle of good glycerine, and as the material is gathered wash well in sea water and drop it into the bottle. Enough specimens must not be put into a bottle to thin the glycerine too much with sea water. Such material can afterward be mounted in glycerine jelly. Some kinds, like Polysiphonia and its allies, are not well preserved in this manner, and for such a saturated salt solution should be used.

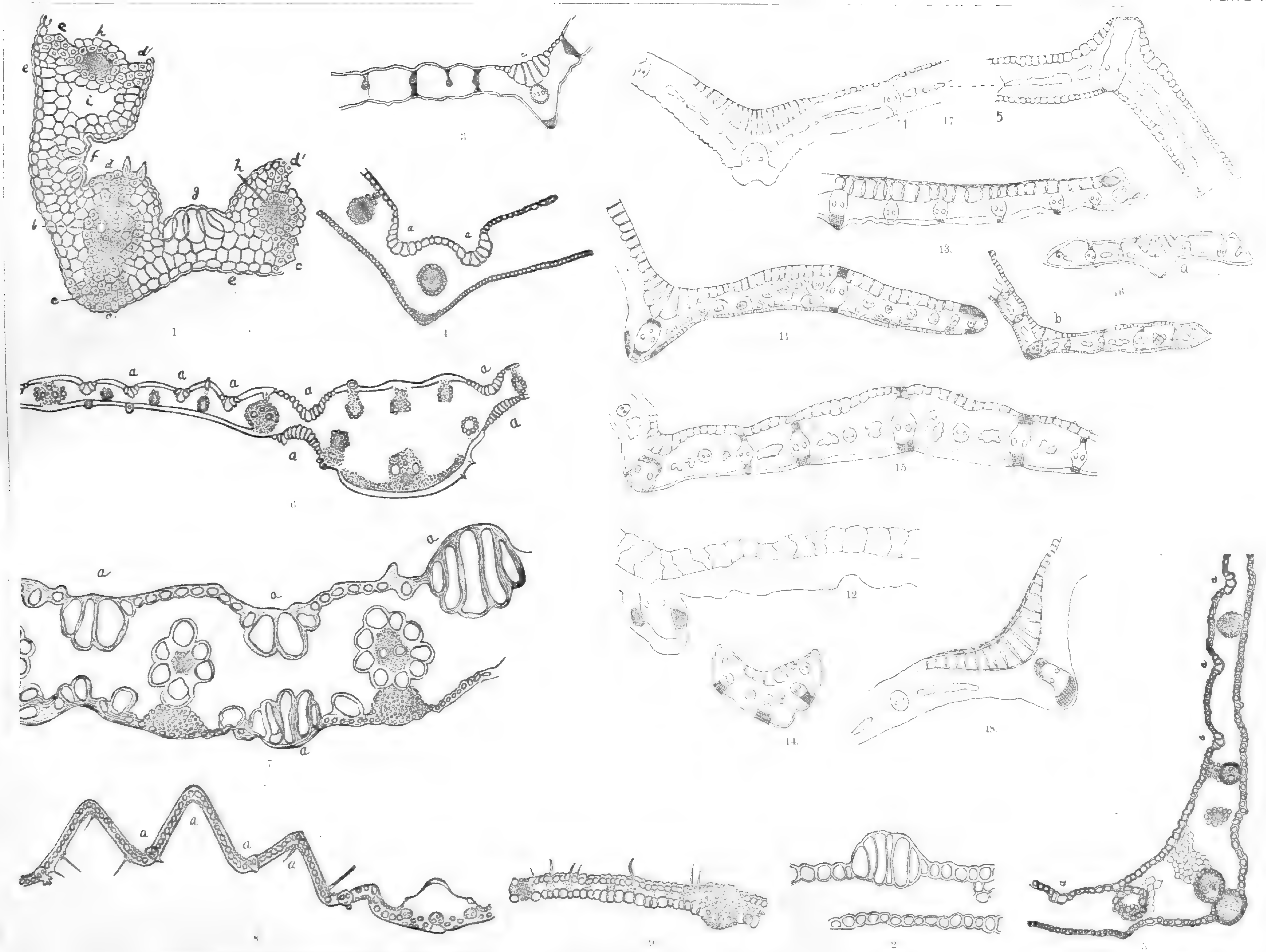
MR. JAMES BRITTEN is doing some good work in the matter of raising questions concerning the priority of certain generic names. He has given in the last *Journal of Botany* a paper on the nomenclature of some Proteaceæ, in which the rights of Salisbury are put forward and rather severe strictures passed upon some distinguished botanists. As to the merits of the case we have nothing to say, but if priority is to be a law at all, and if its sole object is to be fixity of names, the sooner all questions of priority are settled the better: and they must be settled in spite of sentiment, or fitness, or universality, for short of absolute priority there is no fixity.

THE BOTANICAL PAPERS read before the Birmingham meeting of the British Association are as follows: Initiation of a discussion upon the value of the "type-system" in the teaching of botany, Prof. Bayley Balfour; On the germination of the spores of Phytophthora infestans, Prof. Marshall Ward; On the flora of Ceylon, especially as affected by climate, Henry Trimen; On Humboldtia laurifolia as a myrmecophilous plant, Prof. Bower; Note on the floral symmetry of the genus Cypripedium, Dr. Maxwell T. Masters; Bugio, the biological relations of an Atlantic rock, Michael C. Grabham; The multiplication and vitality of certain micro organisms, Percy F. Frankland.

SOME INTERESTING FUNGI from phosphate caverns of Quercy, France, 500 feet below the surface, collected by M. Marty, are described by M. Roumeguère in the last *Revue Mycologique*. These include two species of Agaricus, one of Coprinus, two of Stereum, two of Telephora, and a diminutive Genea. The most interesting one is the Coprinus, C. subterraneus, n. sp., which hung pendent from the ceiling of the cave by thousands. The filiform stipes, a foot or more long, much twisted and often branched, were inflated to an inch in diameter at the base while the other end was recurved, and supported the grayish brown pileus in an upright position. When lighted by the lamps of the explorers the roof scintillated with the reflections from the moist pilei.

THE STRUCTURE of the diatom valve is the chief subject considered in the last number of the *Journal of the Quekett Micr. Society*. The paper by Mr. Deby is of special interest as the author has based his conclusions upon a study of untreated valves from living diatoms, supplemented by those treated with reagents, and by fossil forms. He finds that the valve may for convenience of elucidation be said to consist of three layers, an outer continuous one, which is thin, rarely silicified, and readily dissolved by acids, a thicker inner one, also continuous, but silicified, and an intermediate wall of silica completely perforated, giving the valve its appearance of areolation. This view, as elaborated by the author, seems more in accord with our knowledge of the structure of other vegetable cells than those of the well known diatomists, Müller, Van Ermengem, Flogel, Cox and Van Heurck.

A. ERNST, of Caracas, in *Nature* of October 7, gives an account of what he considers to be a new case of parthenogenesis in the vegetable kingdom. It is a menispermaceous plant, described by Eichler as *Disciphania Ernstii*, a very rare genus, containing but one other species. Strictly diœcious, Ernst has cultivated it carefully and found that his female plants "produced in three successive years an increasing number of fertile fruits without the operation of any fertilizing pollen from a male flower." He also attempted to discover whether, as in the case of Cœlebogyne, the embryo is developed as an outgrowth from a cell of the nucellus, but discarded the idea on the ground that that process is connected with polyembryony, and there is no such thing in Disciphania, a conclusion which, by the way, may be somewhat hasty. Hence the claim is that this furnishes a case of the development of an unfertilized oosphere. Of course the strength of food supply is considered in this connection, and altogether it is a matter well worth looking into.



BEAL ON BULLIFORM CELLS

VOL. XI. NO. 12.—BOTANICAL GAZETTE.—DEC., 1886.

The Bulliform or Hygroscopic Cells of Grasses and Sedges compared.*

W. J. BEAL.

(WITH PLATE X.)

As so little attention has been given to this topic, it will be necessary first to describe briefly the leaf of a grass. In general, it consists of a *sheath* encircling the stem, and a *lamina* spreading from the upper part of the sheath. The blade is traversed longitudinally by fibro-vascular bundles which vary much in size and degree of perfection. In viewing a magnified transverse section of a mature leaf of Sesleria (fig. 1), we see: *e*, an outer envelope of cells, the epidermis; *b*, the median fibro-vascular bundle; *h*, *h*, lateral bundles; *a*, the lower median strand of hypodermal fibers; *d*, the upper median strand; *c*, *d'*, the lateral strands. The other cells are parenchymatous, most of them containing granules of chlorophyll. The vacancy, *i*, is the lacuna, caused by the rupture of some cells. In aquatic grasses the lacunæ are very large. The epidermal system consists of: *a*, epidermis proper: *f*, *g*, bulliform (blister) cells; *c*, stomata; *d*, trichomes.

Of the bulliform cells I speak more particularly. They are in longitudinal parallel lines, are larger, extend further into the leaf, and have thinner walls than ordinary epidermal cells. They are usually more or less wedge-shaped, with the point of the wedge towards the outside of the leaf. When dry, these cells contract and aid in closing the leaf in two or three ways; when moist the leaf expands again. In Zea Mays (fig. 2) these cells are raised above the others and puff out like a blister. When viewed on the surface of the leaf the bulliform cells are usually seen to have the proportions of length and width much like those next to them.

The number of rows in a species appears to be always uniform, but the number varies with the species from three to twelve in a band. If there are many rows the cells are shallow: if few, the cells are deep; if three only, those at the side are small, and the middle one is very large. The arrangement or plan of these cells is quite constant in a species, but in a genus they often vary widely.

The following examples will give some notion of the variety, the sections being made in the widest part of the leaf:

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*Read before the A. A. A. S. Buffalo meeting, 1886.

1. The leaves of Dactylis glomerata have one median band (fig. 3).

2. In Chloris petræa there is one middle band, and one or more on each side.

3. The leaves of Poa pratensis have two bands, one on each side of the middle (fig. 4).

4. Andropogon squarrosus has one band each side of the middle and a small one at each edge.

5. The leaf of Phleum pratense has one band of several shallow cells each side of the middle and others between the veins (fig. 5).

6. The leaves of Zea Mays have a band between each two primary bundles and above each third class bundle (fig. 2.)

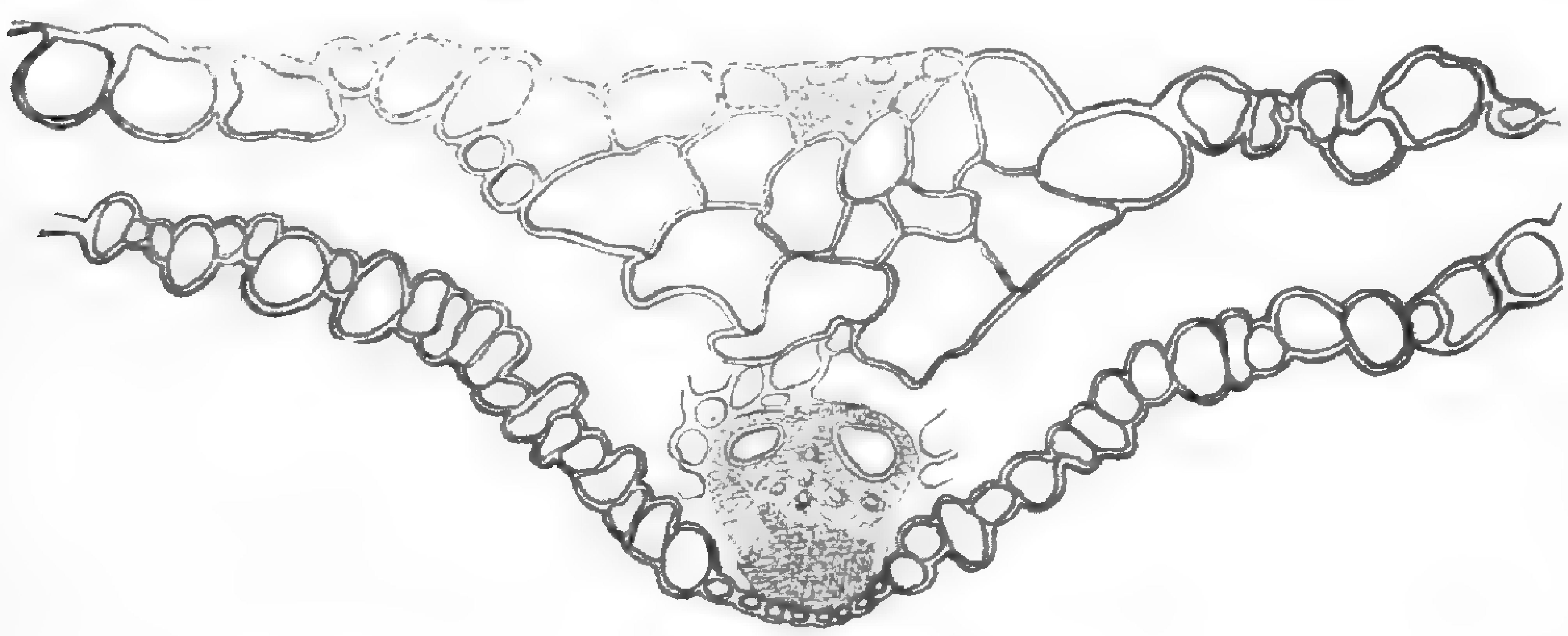

FIG. 10.

7. The leaf of Leersia oryzoides has numerous bands on the upper surface each side of the middle, and one band each side of the keel on the lower side (fig. 6).

8. The leaf of Amphicarpum Purshii has opposite bands of bulliform cells on both surfaces, though those above are most prominent (fig. 7).

9. In case of the leaves of Panicum plicatum the bands of bulliform cells are first on the upper side and then on the lower, and are found in grooves (fig. 8).

10. The leaf of Andropogon prinoides has large epidermal cells of nearly uniform size distributed all along the surface, excepting over the veins (fig. 9).

11. The leaf of Paspalum plicatum has a very irregular epidermis, with groups of cells in the center of the leaf, several above each other, as well as side by side, all acting as bulliform cells (fig. 10, text).

In vernation the leaves take the same positions as when full grown and dried, though the bulliform cells at that time are very small. The leaves of Dactylis and Poa pratensis are conduplicate when slowly dried, while those of Phleum are convolute. The leaves of Panicum plicatum, when dry, close in a zigzag manner like a fan. The object accomplished by the closing or rolling of the leaves is to cover one surface and assist in preventing excessive evaporation in dry weather.

The examples here cited belong to various genera and tribes of grasses, and give a fair idea of the varied forms of bulliform cells, though these are by no means all the varieties that might be shown.

In a similar manner let us now glance at some of our common species of Cyperaceæ, and compare them with some leaves of grasses.

1. The leaf of Cyperus rotundus, var. Hydra, is narrow and thin, having a single deep band of bulliform cells above the midvein (fig. 11). The epidermal cells are rather large and nearly uniform in size. The bulliform cells are much like those of Dactylis glomerata. The epidermal cells on the upper side are much larger.

2. In case of Kyllingia pumila the upper epidermis occupies nearly half the thickness of the leaf, the cells above the midvein being scarcely larger than those on either side (fig. 12). This leaf may be compared with Andropogon prinoides, though in the latter case the epidermal cells over the veins are small.

3. The leaves of Heleocharis, so far as seen, have leaf-blades which are very small or rudimentary.

4. The leaves of Scirpus sylvestris are wide, with many veins, opposite each one of which, above and below, there is a depression. There is one band of about eight cells above the midvein and these have only a moderate depth. The epidermal cells are rather small and can scarcely act as bulliform cells. The leaf much resembles that of Dactylis glomerata, but the bulliform cells are not so deep.

5. The blades of Scirpus validus, the great bulrush, are very short, almost rudimentary. The lacunæ are large and near the upper surface of the leaf. The cells of the upper epidermis, as well as several layers below, are rather small, thin-walled, not varying much in size. All of these small cells act as bulliform cells and the leaf becomes convolute or involute when drying.

6. The leaves of Fimbristylis autumnalis (fig. 13) have a thick epidermis of one layer of thin-walled cells, which extend nearly to the lower side of the leaf. This much resembles the leaf of Andropogon prinoides, though in the latter the cells over the veins are small.

7. On examining a leaf of Eriophorum Virginicum we see that it is very thick, with many veins and lacunæ. The epidermis is composed of small cells; the single band of bulliform cells over the midvein consists of about eight rows of considerable depth. The epidermal and bulliform cells are much like those of Dactylis glomerata.

8. In Fuirena squarrosa the cells of the upper epidermis extend about one-third the depth of the leaf and are somewhat uniform in size. There is no special enlargement of these cells above the midvein. The epidermis is much like that of Fimbristylis autumnalis and Kyllingia pumila among sedges, and Andropogon prinoides among grasses, except the cells above the leading veins are as large as any, while in the grass they are very small over the veins.

So far the examples of leaves of sedges noticed belong to one tribe, Scirpeæ.

9. The leaves of Rhynchospora capillacea (fig. 14) are very narrow, with a few veins, small epidermal cells, and a band of bulliform cells reaching more than half way across and extending nearly one-third the depth of the leaf. This may be compared to a very narrow leaf or the apex of a leaf of Dactylis.

10. The leaf of Cladium mariscoides is rather thick, becoming thinner at the margins and toward the midvein. The epidermal cells are small and have thin walls; there are many layers of similar thin-walled parenchyma cells below the epidermis; but no distinct band of bulliform cells. The leaf reminds us very much of the leaf-blade of Scirpus validus.

The last two examples belong to the Rhynchosporeæ.

11. The bulliform cells of Scleria triglomerata are much like those of Carex vulpinoidea (fig. 15).

The following eight examples are selected from the large and difficult genus Carex:

12. The blade of C. vulpinoidea (fig. 15) is of medium thickness, having about six bulliform cells extending one-third the way to the lower side of the broad shallow midvein. Between the veins there is a noticeable enlargement of about six epidermal cells, the other epidermal cells being rather large. These side bands approach in appearance the side bands in Phleum pratense, only they are less distinct.

13. C. lagopodioides has a leaf much resembling the last, but the epidermal cells do not show a resemblance to bulliform cells.

14. C. Grayii is a coarse species found in low and wet places. The epidermal cells are of moderate size; the lacunæ are large.

There is one band of bulliform cells of about twelve rows, extending one-half the depth of the leaf, if the deep narrow midvein is not taken into account. So far as bulliform cells are concerned this reminds us of a leaf of Dactylis glomerata.

15. C. Pennsylvanica is an early upland sedge with narrow leaves. The epidermis (fig. 16) is composed of small cells. There are six rows in each bulliform band, and these extend about two-fifths of the way down to the lower side of the midvein. The epidermal and bulliform cells remind us again of a leaf of Dactylis glomerata.

16. The blade of C. utriculata is very thick, narrowing to the margin and in the center. The epidermal cells are of moderate size; the single band of bulliform cells number about ten and are over the midvein. This leaf reminds us very much of that of Eriophorum Virginicum, but in the former the vessels of the fibro-vascular bundles are near the upper surface, while in the latter they are near the lower side.

17. In the wide coarse leaf of C. Careyana (fig. 17) the upper epidermal cells are rather prominent, varying considerably in size. There is one very wide band of about twenty bulliform cells over the midvein. In the center of the leaf they extend two-fifths of the distance to the base of the vein. About half way from the midvein to the margin of each side of the blade there is a longitudinal crest or ridge on the upper side. The prominent vein at this place has small epidermal cells and hypodermal fibers. On the upper surface on either side of this vein and ridge the epidermal cells resemble a wide shallow band of bulliform cells.

18. The leaf of C. Hitchcockiana is much like the last one named, and there are many leaves of Carex proper of like structure.

19. The leaf of C. laxiflora, var. latifolia (fig. 18) is about an inch wide and rather thin. The epidermal cells are somewhat prominent. There is one band in the middle of about ten bulliform cells, which cause this wide leaf to be conduplicate when dry.

In the leaves of Carex the pitted vessels of the fibro-vascular bundles are near the lower side of the leaf.

It will be seen that all the leaves of sedges have been compared with some one of five genera of grasses. In the sedges, so far as studied (many genera of four tribes), I find nothing in the middle of the leaf to compare with that of Poa pratensis, Phleum pratense, Leersia oryzoides, Amphicarpum Purshii, or Panicum plicatum. The bulliform cells and other epidermal cells, the hypodermal fibres, and the lacunæ vary more in grasses than in sedges, or in other words, we find a greater variety of forms of these cells or groups of cells in grasses than in sedges. Perhaps we should expect this as most of the sedges thrive in wet places, where the conditions are uniform, while the grasses thrive in a much greater variety of places. Still we find a greater differentiation of parts in the leaves of marsh grasses than in the sedges growing near them.

Some of these characters in the leaves of grasses and sedges may be useful in description and classification.

EXPLANATION OF PLATE X.—The drawings are all diagrammatic and represent portions of the tranverse sections of the leaf. Fig. 1, Sesleria cærulea; *a*, median strand of hypodermal fibres; *b*, median fibro-vascular bundle; *c d'*, lateral strands of hypodermal fibres; *e*, epidermis; *f*, bulliform cells when leaf is closed; *g*, same when leaf is open; *h h*, lateral fibro-vascular bundles; *i*, lacuna, ×120 (Douval-Jouvé). Fig. 2, Zea Mays, ×17 (Sudworth, in Beal's Grasses). Fig. 3, Dactylis glomerata, ×38 (Sudworth, l. c). Fig. 4, Poa pratensis, ×75 (Sudworth, l. c). Fig. 5, Phleum pratense, ×20 (Sudworth, l. c). Fig. 6, Leersia oryzoides, ×350 (Douval Jouvé). Fig. 7, Amphicarpum Purshii, ×25 (Sudworth, l. c). Fig. 8, Panicum plicatum, ×10 (Douval-Jouvé). Fig. 9, Andropogon prinoides, ×50 (Douval-Jouvé). Fig. 11, Cyperus rotundus, var. Hydra, ×55. Fig. 12, Kyllingia pumila, ×55. Fig. 13, Fimbristylis autumnalis, ×55. Fig. 14, Rhynchospora capillacea, ×55. Fig. 15, Carex vulpinoidea, ×46. Fig. 16, C. Pennsylvanica, ×55. Fig. 17, C. Careyana, ×55. Fig. 18, C. laxiflora, var. latifolia, ×55.

Hierochloa borealis.

WALTER DEANE.

A visit at Rye Beach, N. H., during the month of August, 1886, and an acquaintance with an Indian named Sabbatis Dana, who camps in the town every summer and sells baskets and other articles, have given me some interesting facts in regard to the Hierochloa borealis, or Holy Grass. It is one of our widely distributed grasses, ranging over the northern half of the United States and northward. In this section of the country, eastern New England, it is generally found near the sea shore, and is one of our earliest flowering grasses. I have collected it in the middle of May and, at that time, only the culm, rising from the creeping root-stocks, is visible. Later in the season, from the same root-stocks, at intervals of two or three inches, there grow radical leaves in tufts. In the months of July and August these leaves reach their full height. The length of the grass much surprised me, as I can find no mention made of it. I saw it three feet in height, and I was assured that it grew much higher. In a salt marsh near by there was a patch of half an acre covered with this grass, its delicate green leaves, a quarter of an inch in width, contrasting sharply with the dark and wiry Spartina juncea, which covered the rest of the marsh. I can find no mention of these radical leaves, growing later from different parts of the original root-stocks, and I do not think that the fact can be generally known. At least it may be interesting to call it to mind. The dead culm and flowers remain standing erect during the season, hardly seeming to belong to the fresh over-topping leaves.

This grass, as is well known, becomes very fragrant when dried, whence its name, Vanilla Grass. Bigelow says, "This is one of our earliest grasses and is distinguished by the delightfully fragrant odor while drying." In Germany, on festival days, it is strewn before the doors of churches on account of its fragrance and is called, as the generic name implies, Holy Grass. These radical leaves are used very largely by the Penobscot Indians in the manufacture of their baskets, etc. Sabbatis Dana is one of the remnant of the Penobscot tribe, from 400 to 500 in number, who live at Old Town Island, Me., on the Penobscot river. In the summer time large numbers of them visit the various fashionable resorts and ply their profitable trade. Sabbatis has been at Rye Beach for twenty-six consecutive summers. The Hierochloa borealis is known among the Indians as Sweet Grass. There is no Indian name for it, even those Indians who know no other English using this name. They pick it in large quantities and hang it up in small bunches from the ridgepole of their tents to dry, the fragrance being much stronger if dried away from the sun. In this way, I was told, that the scent would last for years. The leaves, in drying, become strongly involute, making a fine pliable thread, very different in appearance and color from the fresh state.

The Indians do not know the plant in flower. Indeed, I was positively assured that it never flowered at all, the reason for this statement being obvious. For when the grass is gathered the flowers have long gone by. I showed Sabbatis the dead culms but, looking wisely at them, he shook his head and said, "That is not Sweet Grass." He had seen those amongst the leaves, but they did not belong to the grass, and he refused to be convinced until I produced a specimen with the old culm and fresh radical leaves rising from the same root-stock. Then he was much surprised and interested. Of course, in pulling up the leaves as they do, but little, if any, of the root-stock remains attached. The Indians know the grass by experience, the base of each tuft, in the fresh plant, being quite red in color after the outermost leaves are removed. They always carefully pick over the grass when brought home, stripping off the older, outer leaves which, they say, have no fragrance.

In using the grass it is generally braided into strips as fine or as coarse as they require, and of any desired length, and is then woven into baskets and other fancy work. As it takes a good deal of time to pick the grass, dry and braid it, the Indians often buy it of those who gather and prepare it for sale, paying for it so much a pound. The wood used, which forms the main part of these articles, is white ash, Fraxinus Americana, and red maple, Acer rubrum, called in Maine white maple. These woods they prepare at home, splitting the ash into strips of the requisite thinness and width by means of a machine. The maple is used for the heavier parts, such as the frame work and handles. The pieces are stained with some coloring material and are then ready for use. Baskets and articles of that sort are always made over a block to preserve the shape, and I was told that it would be impossible to make a basket, with Sweet Grass in it, without a block, as the grass would draw the basket out of shape. I saw some very delicate specimens of weaving. They frequently use horse hair in making very small baskets for charms, being less than half an inch in width; the frame work is of ash and the weaving is almost microscopic. I noticed among the articles for sale in the Indian tent, some small boats, beautifully cut out of white cedar or arbor vitae, Thuja occidentalis, while the bark of the paper birch, Betula papyracea, was made into baskets, music rolls, etc.

Notes on Carex. VIII.—Hybrids.

L. H. BAILEY, JR.

(WITH PLATE XI.)

CAREX ARCTATA × FLEXILIS.

C. Knieskernii Dewey, Sill. Journ. 2d ser. ii. 247. *C. arctata × formosa?* Bailey, Proc. Amer. Acad. Arts and Sci. xxii. 104.

In a recent trip to the northern boundary of Minnesota, I found a quantity of this rare Carex and growing in such intimate association with Carex arctata and Carex flexilis that all doubt was at once removed as to its parentage. I had long been confident that the plant is a hybrid, and that Carex arctata is one of

BAILEY ON CAREX.

its parents, but it had not occurred to me that the rare Carex flexilis is the other parent. In the Synopsis of North American Carices I guessed at Carex formosa as being the other parent, although that plant had not been found in the vicinity of Lake Superior, where Professor Macoun had found the hybrid. Dr. Vasey has loaned me the original specimens of Carex Knieskernii, together with Carex flexilis from the same source, and adds this note: "The original Carex Knieskernii was collected by myself, in company with Dr. Knieskern, on the ground of old Fort Bull, somewhere west or northwest of Rome, N. Y., near a small stream which, if I remember correctly, was called Fish Creek, and empties into Oneida Lake. The specimens of Carex flexilis are from the same locality." This first collection was made in 1841. In 1869 Professor Macoun collected it at Kakabeka Falls, on the Canadian side of Lake Superior. The third finding was that of the present summer, a few miles this side of the international boundary. I obtained about a hundred specimens from two or three contiguous localities. Judging from its comparative frequency in these localities, I should expect to find the hybrid wherever Carex arctata and Carex flexilis grow near each other. Some of my specimens are almost indistinguishable from one parent, some from the other. They appear to have been the products of reciprocal crosses. The hybrid may be distinguished in general as follows:

Culm one and a half to two feet high, longer than the flat leaves, all usually somewhat hairy as in C. flexilis; spikes one to two inches long, drooping or spreading on very slender peduncles, mostly sparsely alternately flowered at the base, rusty, or whitish in color; perigynium empty, rusty, mostly lance-ovate and in at least the northern specimens very conspicuously beaked, lightly nerved, thin in texture, mostly surpassing the whitish, pointed scale (Fig. A).

It is singular that a genus possessing imperfect flowers and so many species should present so few hybrids. I enumerate all the remaining hybrid Carices which have been clearly made out in this country:

Carex debilis × virescens Bailey, Proc. Amer. Acad. Arts and Sci., xxii. 105.—Plant slender and lax, very green, appearing as if immature; culm flattish, rough on the angles; leaves flat, rough, mostly longer than the culm; bracts narrow, usually much exceeding the culm; spikes two or three, two inches long, thin and slender, erect or nearly so, the terminal one bearing a few pistillate flowers at the top; perigynium, which is nearly an exact medium between the two species, lance-ovate, nerved and slightly hairy, short beaked, thin in texture, empty, twice longer than the white-hyaline scale.—Revere, near Boston, Mass. C. E. Faxon. (Fig. B.)

CAREX GRACILLIMA × PUBESCENS Bailey, l. c. 107.
C. Sullivantii Boott, Sill. Journ. xlii. 29.

CAREX STRICTA × SALINA Bailey, l. c. 85.
C. spiculosa? W. Boott, Bot. Gaz. ix. 88.
"*Forma sterilis salinæ*" Christ, Cat. Car. Eur. 7.

CAREX TENTACULATA × LURIDA Bailey, l. c. 69.
C. tentaculata, var.? *altior* Boott, Ill. 94.

CAREX BULLATA × UTRICULATA Bailey, l. c. 68.
C. Olneyi Boott, Ill. 15, t. 42.

EXPLANATION OF PLATE XI.—*A*, Carex arctata × flexilis, ×½; *a*, perigynium; *a′*, scale of same, ×7.
B, Carex gracillima × virescens, ×½; *b*, perigynium; *b′*, scale of same, ×7.

The Flora of our Southwestern Archipelago. II.[1]

WM. S. LYON.

The absence of the great genus Astragalus from Guadalupe struck Mr. Watson as somewhat remarkable.[2] It seems to the writer, however, phenomenal that the genus should have any representation not only upon that island, but upon any of those under our consideration.

The "Rattleweeds" take as kindly as does the horned toad to the dry, arid basins of the interior, and of the vast number known but few are reported from the immediate sea-board. Only four species I know of approach anywhere near the coast-line adjacent to the Santa Barbara group.[3] The papery texture of the pods of most species unfits them for transportation by water, while the pernicious nature of some species makes them avoided by animals, and an inherent antipathy to the moisture-laden atmosphere of the seas keeps them mainly retired from the coast. Nevertheless three species manage to reach Catalina, two get to Cedros, one to Clemente, and the genus does not fail altogether till far out at sea on Guadalupe.

[1] Continued from page 205.
[2] Proc. Am. Acad. l. c. p. iii.
[3] A. leucopsis, A. Antiselli, A. didymocarpus, A. pycnostachyus.

Of the three species reaching Catalina, two are common to the immediate coast, and their migration is less a matter of wonderment than the development of an entirely new and interesting species (A. Nevinii) upon Clemente, which can only be accounted for by assuming that the potency of insular influences in the elaboration of new types have succeeded in overcoming what I believe to be the natural antagonism of the genus to the tide line.[4]

Localization of species is the next feature which arrests our attention. Hemizonia Streetsii is not infrequent on the east end of Catalina, extending quite down to (and there in greater abundance than elsewhere) the narrow isthmus which connects the east and west sections of the island. A strong current of wind at nearly all times sucks through this narrow causeway, across which one might almost throw a stone; otherwise all conditions of soil and climate seem identical on both sides. Diligent search during two seasons failed to reward me with a sight of this species from the west end. The current of wind seems insufficient to account for this peculiarity, as all other species pass and repass freely. Paucity of species is worthy of mention, more striking in Catalina than in Clemente or Guadalupe, since the former island possesses in an eminent degree all the physical requirements of a large and varied flora: great size, low fertile valleys, swamp lands, river bottoms (in miniature), rolling hills, sub-alpine elevations, densely wooded and naked exposures, and is not even wanting on the south side our so-called "desert" country. Excepting only the region of perpetual snow in the upper Sierras, the whole of southern California, with upwards of 2,000 species, presents no greater variety of physical conditions than exist here, yet only a total of 153 species are reported from this island. Collections from Guadalupe and Clemente having been made only in the spring, will probably be augmented by future exploration, yet those so far reported are meager in the extreme.

A summary of Mr. Greene's list, and that subjoined, shows a total of only 287 Phanerogams and ferns from these three islands. Of these, 46, or 16 per cent. of the whole number, are strictly insular. Of the 287, 23, or 8 per cent., are limited to Guadalupe; 10, or about $3\frac{1}{2}$ per cent., restricted to Catalina; and 5, or about $1\frac{3}{4}$ per cent., peculiar to Clemente. The 23 Guadalupe species constitute 17 per cent. of the whole 133 species reported from that island. The 10 Catalina species form $6\frac{1}{2}$ per cent of the 153 species listed from thence; and the 5 from Clemente are about 6

[4] This peculiarity has been noted of the genus Astragalus more strongly than of any other of the great genera characteristic of California flora: among which may be cited Hosackia, Lupinus, Krynitzkia, Mimulus and Eriogonum, all of which are abundantly represented in closest proximity to the sea shore.

per cent. of the 81 species collected on that island. Lastly, 31, or 38 per cent. of the whole flora of Clemente is reported also from Guadalupe; and 35, or only 23 per cent., of that of Catalina is common to itself and Guadalupe. More significance attaches to this latter analysis than to the others, as it seems to indicate a closer relationship between the floras of Clemente and the distant Guadalupe than obtains on the two nearer islands.[5]

At this point it is proper to refer back to the statement made in relation to the antiquity of Clemente, that the geology and present flora of that island were not in apparent harmony. This hypothesis, determined by the scantiness of peculiar species, is far from conclusive. Greater antiquity would afford opportunity for the extension landward of many perhaps original species whose local identification would thus be absorbed and lost forever; and if the faintest value be attached to the common methods of seed dispersal, facilities have occurred for the distribution of a score of distinctive floras; and while strongly disparaging those very methods in general, their specific force and application is readily conceded where the barrier to isolation becomes contemptible, in view of the stupendous lapses of time since the seas first swept the uppermost terraces of Clemente.

From all the foregoing we briefly suggest:

1st. Present variation and constant modifications in matter of size point to the mutability of species upon these islands.

2d. The large percentage (16) of the whole flora being characteristic, tends strongly to indicate insular genesis.

3d. That there are no barriers which some species can not overcome; while the close restriction of others to local habitats and seeming to enjoy greater facilities for expansion than the first named, would indicate that the latter species were too short-lived to acquire the adaptability and availability for extension possessed by the former.

4th. That the material available for investigation is of too conflicting a nature to formulate even a scientific "guess" as to primative origin of the floras of these islands.

The discovery of a new genus on Catalina and Santa Cruz[6], whose definite characters and relationship is not yet wholly settled, but whose nearest apparent affiliation is native of northern Mexico, might lead us to inquire for some such derivation; but Mr. Watson has shown how unlikely is this to be the case with

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[5] Since making the above analysis, the publication of some new species and extension of the limits of others by Dr. Gray in his recent revised supplement to the Syn. Flora of N. America affects the exactitude of the enumerations given, but not enough to vitiate the general conclusions.

[6] Proc. Am. Acad., vol. 20.

Guadalupe, hence with our northern group. From the presence of a few sporadic South American forms it would be as unsatisfactory to attempt in any way to connect their floras as to deduce anything European from the presence of Lavatera.

Have these islands ever formed part of a continuous territory? Have they ever been united to the adjacent continent? Is their antiquity greater or less than that of the main land?

These, and a host of correlated questions, must first be answered authoritatively by the geologist who undertakes their careful exploration; until then the botanist must relegate the history of the past to the field of idle speculation, and from the pregnant material at hand confine himself to defining the present—anticipating the future.

LIST OF FLOWERING PLANTS AND FERNS OF SANTA CATALINA ISLAND.

1. Clematis ligusticifolia Nutt.
2. Eschscholtzia peninsularis Greene
3. Crossosoma Californicum Nutt.
4. Dendromecon rigidum Benth.
5. Isomeris arborea Nutt.
6. Capsella Bursa-pastoris Mœnch.
7. Oligomeris subulata Boiss.
8. Helianthemum scoparium Nutt.
9. Frankenia grandifolia C. & S.
10. Silene Gallica Linn.
11. Stellaria media Linn.
12. Lepigonum macrotheeum F.& M.
13. Sagina occidentalis Wats.
14. Malvastrum Thurberi Gray.
15. Erodium cicutarium L'Her.
† 16. Rhamnus crocea Nutt.
* 17. Ceanothus sorediatus H. & A.
18. Rhus diversiloba Hook. & Arn.
19. Rhus ovata Wats.
20. Rhus integrifolia Benth. & Hook.
20ª. Rhus integrifolia (a remarkable ternate-leaved form).
21. Rhus laurina Nutt.
22. Trifolium microcephalum Pursh.
23. Melilotus parviflora Desf.
24. Medicago denticulata Willd.
25. Hosackia glabra Torr.
26. Hosackia micrantha Nutt.
27. Hosackia maritima Nutt.
28. Hosackia ornithopus Greene.
29. Astragalus leucopsis T. & G.
30. Astragalus trichopodus Gray.
31. Astragalus Antiselli Gray.
32. Lathyrus vestitus Nutt.
33. Prunus occidentalis Nutt.
34. Prunus ilicifolia Walp.
35. Spiræa discolor Pursh.
36. Rubus ursinus Cham. & Schlecht.
37. Cercocarpus parvifolius Nutt.
38. Adenostoma fasciculatum Hook. & Arn.
39. Alchemilla arvensis Scopoli.
40. Rosa Californica Cham. & Schlecht.
41. Heteromeles arbutifolia Rœm.
42. Lyonothamnus floribundus Gray.
43. Ribes viburnifolia Gray.
44. Tillæa minima Miers.
45. Cotyledon cæspitosa Haworth.
46. Zauschneria Californica Presl.
47. Œnothera micrantha Hornem.
48. Œnothera bistorta Nutt.
49. Godetia tenella Wats.
50. Megarrhiza Californica Torr.
51. Megarrhiza Marah, reported by Baker, not collected since.
52. Opuntia Engelmanni Salm.
53. Mesembryanthemum crystallinum Linn.
54. Caucalis microcarpa Hook & Arn
55. Sambucus glauca Nutt.
56. Symphoricarpos mollis Nutt.
57. Lonicera hispidula, var. vacillans Dougl.
58. Galium angustifolium Nutt.
59. Galium Aparine, var. Vaillanti Gray.
60. Galium Catalinense Gray, *ined.*
61. Brickellia Californica Gray.
62. Pentachæta Lyoni Gray.
63. Bigelovia veneta Gray.
64. Erigeron foliosus Nutt.
65. Baccharis pilularis DC.
66. Stylocline gnaphalioides Nutt.

* = C. arboreus, Greene, [illegible]

† Greene says for This is a [illegible]

67. Filago Arizonica Gray.
68. Encelia Californica Nutt.
69. Leptosyne gigantea Kellogg.
70. Madia sativa Molina.
71. Madia filipes Gray.
72. Hemizonia Streetsii Gray.
73. Hemizonia fasciculata T. & G.
74. Layia platyglossa, var. breviseta Gray.
75. Bæria Palmeri, var. Clementina Gray.
76. Amblyopappus pusillus Hook & Arn.
77. Achillea Millefolium Linn.
78. Cotula coronopifolia Linn.
79. Artemisia Californica Less.
80. Cnicus occidentalis Gray.
81. Centaurea Melitensis Linn.
82. Perezia microcephala Gray.
83. Stephanomeria paniculata Nutt.
84. Malacothrix saxatilis T. & G.
85. Arctostaphylos tomentosa, Dougl.
86. Arctostaphylos bicolor Gray.
87. Erythræa venusta Gray.
88. Gilia atractyloides Steudel.
89. Gilia multicaulis Benth.
90. Eucrypta (Ellisia) chrysanthemifolia Greene.
91. Phacelia hispida Gray.
92. Phacelia Lyoni Gray.
93. Emmenanthe penduliflora Benth.
94. Eriodictyon tomentosum Benth.
95. Heliotropium Curassavicum Linn.
96. Krynitzkia ambigua Gray.
97. Krynitzkia ramosissima Gray.
98. Plagiobothrys Arizonicus, var. Catalinense Gray, *ined.*
99. Convolvulus Soldanella Linn.
100. Convolvulus macrostegius Greene
101. Convolvulus Californicus Choisy.
102. Cressa Cretica Linn.
103. Solanum nigrum Linn.
104. Solanum Xanti, var. Wallacei Gray.
105. Lycium Californicum Nutt.
106. Scrophularia Californica Cham.
107. Pentstemon cordifolius Benth.
108. Antirrhinum Nuttaliianum Benth.
109. Antirrhinum speciosum Gray—coll. by Gambel.
110. Mimulus glutinosus, var. puniceus Wendl.
111. Mimulus cardinalis Dougl.
112. Mimulus luteus Linn.
113. Mimulus floribundus Dougl.
114. Castilleia foliolosa Hook. & Arn.
115. Castilleia parviflora Boug.
116. Monardella lanceolata Gray.
117. Micromeria Douglasii Benth.
118. Audibertia Palmeri Gray.
119. Audibertia polystachya Benth.
120. Verbena prostrata R. Br.
121. Plantago Patagonica Jacq.
122. Mirabilis Californica Gray.
123. Rumex salicifolius Weinmann.
124. Eriogonum nudum, var. pauciflorum Wats.
125. Eriogonum giganteum Wats.
126. Chorizanthe staticoides Benth.
127. Pterostegia drymarioides Fisch. & Meyer.
128. Atriplex Coulteri Dietrich.
129. Urtica holosericea Nutt.
130. Urtica urens Linn.
131. Parietaria debilis Forster.
132. Eremocarpus setigerus Benth.
133. Salix lævigata Bebb.
134. Populus trichocarpa T. & G.
135. Quercus Douglasii Hook. & Arn.
136. Quercus dumosa Nutt.
137. Quercus tomentella Engl.
138. Calochortus Kennedyi Porter.
139. Calochortus Catalinæ Wats.—coll. by P. Schumacher.
140. Juncus bufonius Linn.
141. Stipa setigera Presl.
142. Avena fatua Linn.
143. Melica imperfecta Trin.
144. Hordeum murinum Linn.
145. Elymus condensatus Presl.
146. Gymnogramme triangularis Kaulf.
147. Gymnogramme triangularis, var. viscosa Eaton.
148. Pellæa ornithopus Hook.
149. Adiantum emarginatum Hook.
150. Aspidium aculeatum Swartz.
151. Selaginella rupestris Spring.

LIST OF FLOWERING PLANTS AND FERNS OF SAN CLEMENTE ISLAND.

1. Eschscholtzia elegans, var. ramosa Greene.
2. Delphinium variegatum Torr. & Gray.
3. Meconopsis heterophylla Benth.
4. Sisymbrium reflexum Nutt.
5. Lepidium nitidum Nutt.
6. Oligomeris subulata Boiss.
7. Lepigonum macrothecum Fisch. & Meyer.
8. Claytonia perfoliata Donn.
9. Lavatera assurgentiflora Kellogg.

10. Malva borealis Wallman.
11. Erodium cicutarium L'Her.
12. Erodium moschatum L'Her.
13. Rhus integrifolia Benth. & Hook.
14. Rhus ovata Watson.
15. Lupinus affinis Agardh.
16. Trifolium microcephalum Pursh.
17. Trifolium Palmeri Watson.
18. Medicago denticulata Willd.
19. Hosackia ornithopus Greene.
20. Astragalus Nevinii Gray, *ined.*
21. Vicia exigua Nutt.
22. Cotyledon?
23. Mentzelia gracilenta T. & G.
24. Megarhiza Californica Torr.
25. Cereus Emoryi Engl.
26. Opuntia prolifera Engl.
27. Mesembryanthemum nodiflorum.
28. Mesembryanthemum crystallinum Linn.
29. Bowlesia lobata Ruiz. & Pavon.
30. Sanicula bipinnatifida Dougl.
31. Daucus pusillus Michx.
32. Galium Aparine Linn.
33. Gnaphalium decurrens Ives.
34. Hemizonia Streetsii Gray.
35. Perityle Fitchii Torr.
36. Bæria Palmeri Gray, var. Clementina.
37. Eriophyllum Nevinii Gray, *ined.*
38. Achillea Millefolium Linn.
39. Senecio Lyoni Gray, *ined.*
40. Microseris Lindleyi Gray, *ined.*
41. Malacothrix foliosa Gray, *ined.*
42. Sonchus oleraceus Linn.
43. Gilia Nevinii Gray, *ined.*
44. Gilia micrantha Steudel.
45. Nemophila racemosa Nutt.
46. Phacelia floribunda Greene.
47. Phacelia phyllomanica Gray.
48. Phacelia distans Benth.
49. Krynitzkia ambigua Gray.
50. Convolvulus macrostegius Greene.
51. Lycium Californicum Nutt.
52. Antirrhinum Nuttallianum Benth.
53. Antirrhinum speciosum Gray.
54. Collinsia bicolor Benth.
55. Plantago Patagonica Jacq.
56. Mirabilis Californica Gray.
57. Abronia umbellata Lam.
58. Rumex salicifolius Wein.
59. Eriogonum nudum, var. pauciflorum Wats.
60. Erigonum (n. sp.) unfit for determination.
61. Pterostegia drymarioides Fisch. & Meyer.
62. Aphanisma blitoides Nutt.
63. Chenopodium Californicum Wats.
64. Chenopodium album Linn.
65. Atriplex microcarpa Dietrich.
66. Atriplex leucophylla Dietrich.
67. Atriplex Californica Moquin.
68. Hesperocnide tenella Torr.
69. Parietaria debilis Forster.
70. Allium serratum Watson.
71. Brodiæa capitata Benth.
72. Phalaris Canariensis Linn.
73. Stipa setigera Presl.
74. Melica imperfecta Trin.
75. Ceratochloa grandiflora Hook.
76. Hordeum nodosum Linn.
77. Polypodium Californicum Kaulf.
78. Gymnogramme triangularis Kaulf.
79. Notholæna Newberryi Eaton.
80. Layia glandulosa H. & A.
81. Amsinckia intermedia Fisch. & Meyer.

Additional Notes.—In the very nature of things all islands, and these in a superlative degree, being largely exempted from the disturbing external influences affecting organic life upon the mainland, present to the naturalist an inviting field of exploration and research.

To the enthusiastic lover of the beautiful in nature, they offer as well a wealth of picturesque attractions. The southern coast of San Clemente once seen can never be forgotten. Against vertical cliffs of over two hundred feet the great seas dash with thunderous noise and appalling force, whilst far above, the rocky terraces, all softened with tender creamy lichens and whose darkling caves each carry a drooping portière of lovely snow-white morning glories, forms in all a combination of rare grandeur and dainty prettiness seldom seen in one picture.

Catalina is a miniature world in itself. The landward coast is indented with little pockets rather than harbors, whose waters are marvels of tranquillity and pellucidity. From his boat the fisherman can look down and at a depth of fifty feet see the brilliant anemones and sea urchins starring the rocks below.

From the middle of the island two not inconsiderable streams (in California we call them rivers) take their source and flow in opposite directions, one through a sandy valley with here and there a fertile oasis of cottonwoods, anon a desert of prickly pear or tuñas within whose cruel environment lurks the dainty edible fruit of Solanum Xanti, var. Wallacei. The other "river" takes its way southerly through cañons of the loftiest mountains of the island until it plunges into Silver cañon; and thence to follow its precipitous course to the sea will try the nerves of the trained mountaineer. Down into the very bowels of the earth one seems to go, into ravines whose walls are vertical battlements of rock that not even a goat could scale, and into whose chilling and darkening depths the sun never looks; it is then that when a "break off" or falls occurs in the descent that the situation becomes interesting—critical, perhaps, for him who will not or can not retreat.

But Catalina is not all made up of dangerous cañons; its endless diversity constitutes its chiefest charm; teeming pastoral valleys where the track of the waterways fairly dazzle the eye with its splendor of Mimulus cardinalis, or enchanting nooks carpeted with gold fern or Aspidium aculeatum, else rolling hills or grim castellated mountains, constitute an aggregation of beauties and attractions to the traveler and explorer unequalled anywhere in Southern California.

Though I have spoken of my work upon these islands as "gleanings" the *harvest* on most of them as yet is virtually untouched, and offers a fruitful field to the zealous collector. If my remarks should stimulate any to their thorough and comprehensive exploration, my labor shall not have been in vain.

BRIEFER ARTICLES.

New grasses.—SPOROBOLUS BOLANDERI. Culms slender, about a foot high decumbent below, smooth: leaves narrowly linear, flaccid; radical ones about 6 inches long; cauline ones similar, 1 to 2 inches long; ligule short and obtuse; upper half of stem naked: panicle 2 to 3 inches long, sparsely flowered, open, lax, lower branches in twos or threes, filiform, 1 to 1½ inches long, flowering above the middle: spikelets about 2 inches long; empty glumes unequal, 1-nerved, upper one ovate-lanceolate, 1 line long or more, lower one ¼ shorter; flowering glume nearly 2 lines long, oblong-lanceolate, 5-nerved, softly pubescent on the nerves below; palet equaling its glume, finely ciliate on the nerves; sterile pedicel prominent, ⅓ to ½ as long as the flower.—Collected at Multinomah Falls, Oregon, by Dr. H. N. Bolander.

AGROSTIS ATTENUATA. Culms slender, smooth, erect, attenuated, 2 to 3 feet long: radical leaves narrowly linear, 2 to 4 inches long; culm leaves 3, distant, sheaths shorter than the internodes, smooth; ligule membranaceous, conspicuous, 2 to 3 lines long; blade 2 to 3 inches long, narrow, acuminate: panicle 3 to 4 inches long, pyramidal, lower branches in threes or fives, somewhat unequal, 1 to 2 inches long, capillary, few-flowered, pedicels mostly longer than the spikelets, which are about 1½ lines long: empty glumes equal, oblong-lanceolate, acute, scabrous on the keel; flowering glume nearly as long; palet wanting.—Found by Mr. Thomas Howell, near Mt. Hood, Oregon. It belongs to the *scabra* group, but is well distinguished as a species.

AGROSTIS FOLIOSA. Culms stoloniferous, erect, 1½ feet high, leafy nearly to the summit: leaves 3 to 5 inches long, 2 to 3 lines wide, acuminate, somewhat scabrous; sheaths smooth; ligule short, obtuse: panicle lanceolate, 4 to 6 inches long, 1½ inches wide below, open, branches mostly in fives, uneven, ½ to 1½ inches long, flowering near the extremities, subdivided mostly below the middle, pedicels longer than the spikelets, which are about 1½ lines long: empty glumes lanceolate, acute; flowering glumes a little shorter, about 5-nerved, the lateral nerves excurrent at the apex, the midnerve usually terminating in a short awn near the middle; palet wanting.—Collected in Oregon by Thomas Howell and by Dr. H. N. Bolander.

MUHLENBERGIA NEO-MEXICANA. Perennial: culms mostly branched near the base from thickened nodes, wiry, erect, 1 to 2 feet high, scabrous: cauline leaves about 5, setaceous, erect, about 3 inches long, the upper one near the panicle; ligule short, lacerate: panicle narrow, linear to lanceolate, 4 to 6 inches long, the branches unequal, mostly in twos, appressed, the longer 1 to 2 inches long, flowering to the base, the branchlets sessile and closely flowered: spikelets sessile or nearly so, about 2 lines long without the awn; empty glumes equal, more than half as long as the spikelet, lanceolate, acuminate or awl-pointed, 1-nerved; flowering glume short stalked, 3-nerved, narrow, acuminate and terminating in a straight, slender awn 4 to 6 lines long.—Rocky hills and mountain sides, New Mexico and Arizona.

MUHLENBERGIA ACUMINATA. Culms erect, 3 to 4 feet high, smooth: radical leaves involute, 6 to 12 inches long; cauline ones 3 or 4, distant, narrow, becoming involute, acuminate, lower 6 to 8 inches long, upper 1 to 2 inches, scabrous; ligule 3 to 4 lines long, lacerate: panicle linear, 6 to 10 inches long, branches in twos or threes, closely appressed, the lower 1 or 2 inches long, flowering to the base, branchlets short and erect; pedicels and rhachis scabrous: spikelets 2 lines long; empty glumes half as long, nearly equal, obtuse and denticulate at the apex, membranaceous; flowering glume 2 lines long, rigid, 3-nerved, acuminate, and terminating in a minute awn, about a line long; palet as long as its glume, acute.—Number 1993, C. Wright's collection in New Mexico. A well marked species.—Dr. George Vasey.

Ambrosia bidentata $\times$**trifida.**—A hybrid from these parents has been sent to us by Mr. Eggert, of St. Louis. That district is famous for hybrids, Dr. Engelmann having detected so many there, but this one, we believe, is new. A. Gray.

Selinum Canadense in Indiana.—The discovery of this northern species in middle Indiana is a very interesting fact. Known to students of Gray's Manual as Conioselinum Canadense, or Hemlock-Parsley, its range is entirely north of Indiana, except as it finds its way southward along the higher summits of the Alleghanies, and is usually found in swamps. I found it a little over a mile north of Crawfordsville, clinging to an almost inaccessible bluff wall, in surroundings kept constantly cold and wet by springs. It was in both flower and fruit October 15.—J. N. Rose.

Dr. George Martin.—Those interested in mycology will be pained to learn of the recent death of Dr. George Martin. The study of our American fungi was with the deceased a thing of recent years, and was taken up mainly because he saw in it an opening for good work in its relation to practical medicine. However it was not long before he became so interested in these plants that almost his whole leisure and strength were given to them. When one remembers how many of the specimens in Ellis' Centuries of North American Fungi were collected, and how many more were critically studied by Dr. Martin, there will be a surprise to know that he had been for years an invalid whose life hung upon the slenderest thread. The deceased left behind him a manuscript volume which might well be published as a memorial of his labors. It contains a large number of colored illustrations, with spore measurements, and descriptions of the fungi he had studied. Such a volume would be a real boon to American mycologists. During his life, when urged by his friends to publish it, his modesty always led him to evade the question or to depreciate the real value of what he had done. He was distinguished as a physician, high-toned and honorable as a man, public-spirited as a citizen, and warm-hearted as a friend. None can regret his death more than his neighbors in West Chester, Pa., who knew and loved him well.—J. T. Rothrock.

Two new Californian plants.—On making for the first time a botanical excursion to Monte Diablo I found upon its very summit the little *Campanula* here described which has heretofore been overlooked, probably on account of its diminutive size and ephemeral duration, rather than from its absolute rarity. It may have been passed over as a *Githopsis*, as it has somewhat the aspect of a depauperate form of this common plant.

The following species of *Gilia* was also found in a district supposed to be pretty thoroughly explored. Professor Gray informs me that I may regard it as a new species, quite as good as some other of the troublesome forms which have come to light, and which almost efface the distinction between the sections *Dactylophyllum* and *Leptosiphon*. I have had Professor Gray's kind and needful help in shaping the characters of these two species so as to render them more diagnostic than they would have been in my inexperienced hands.

CAMPANULA EXIGUA. Annual, 2 to 5 inches high, with spreading branches, hirsute below, puberulent or almost glabrous above: leaves very small (1 to 3 lines long), sessile, lowest lanceolate or obovate, entire or with a few coarse teeth, upper subulate: flowers solitary at end of the slender divergent branches or short peduncles, erect: calyx-lobes subulate-linear, usually twice the length of the campanulate or somewhat turbinate tube, erect, connivent after flowering: corolla oblong-campanulate, light blue; tube about the length of the calyx-lobes, longer than its oblong acute lobes; filaments abruptly dilated below the middle into a broad ciliolate base: style not surpassing the corolla: capsule somewhat urceolate, opening by three valves above the middle.—Summit of Monte Diablo, June 14, 1886. Also collected, July 3, on Tamalpais, by Mrs. Curran, in full fruit and in a larger and coarser form. The species will rank along with *C. Reverchoni* of Texas, in a separate subdivision.

GILIA AMBIGUA. Habit and foliage of *G. Bolanderi*, but more erect and stouter: corolla much larger, over half-inch long, nearly thrice the length of the calyx, its proper tube equalling the latter or somewhat exserted, the obconical brown-purple throat of nearly same length and hardly exceeded by the rotately expanding bluish purple lobes: ovules 2 in each cell.—Very abundant at Oak Hill, four miles south of San Jose, May 15, in flower and fruit. The only other *Gilia* seen near it was *G. dichotoma*.—VOLNEY RATTAN.

A pleasing experiment in laboratory practice.—The following experiment has proved very satisfactory with classes in vegetable anatomy while upon the subject of mucilaginous modification of the cell wall. The student makes a thin section of a flaxseed and places it dry under the ⅛ objective so that the outer layer of the external coat is in the field. Pass a drop of water under the cover-glass and watch the section. As soon as the liquid strikes the mucilaginous layer the cells composing it at once enlarge and their dissolved contents float out upon the slide. That which before was a hyaline line, seemingly amorphous, becomes a series of cells nearly uniform in size. The thinness of the section and the unusual exposure of the mucilage permits of the quick outward movement of the cells much to the delight of the student. For a time it was quite a puzzle how the side walls of the rapidly expanding cells could accommodate themselves to the sudden expansion. A quantity of flaxseed was soaked in water, the liquid being changed frequently during a day or more, and the seeds afterwards dried with blotting paper. Upon making thin sections of these seeds, and treating the outer layer as above described, the side walls were well defined, and their method of expanding became plain. These walls are folded or plaited right and left like the sides of the bellows of an accordeon, the plaits being widest at the bottom, or attached ends, and diminish outward toward the exposed surface. These cells are somewhat irregular, but are usually six sided. If a superficial or thin tangential section of the seed-coat is carefully experimented upon, the mucilaginous cells may be expanded and contracted several times before their contents so far disappear as to arrest further action.

If the student attempts to study the mucilaginous covering without making a section the expansion of the cells and the outward flow of their contents are so slow as to be disappointing. When the thin section has been brought into the field of the high power lens it is well for a neighboring student or an assistant to add the drop of water, thus giving the experimenter the entire use of his time for making the observation.—BYRON D. HALSTED.

Alaskan plants.—List of plants collected during the summer of 1885, at Ounalashka, by Mr. S. Applegate, the United States Signal Observer at that station. The list, although small, contains several species of great rarity and interest:

Cardamine pratensis L.
Draba hirta L.
Leptarrhena pyrolifolia R. Br.
Epilobium angustifolium L ? Fragments only.
Oxyria digyna Camp.
Luzula campestris DC.
Luzula spadicea DC., var. parviflora Led.
Juncus arcticus Willd.
Juncus Scheuchzeri Hoppe.
Carex decidua Boott. Very rare: the third station in North America. (Fide Bailey in litt. Oct. 22, 1886.)
Carex podocarpa R. Br.
Carex limosa L., var. stygia Bailey.
Festuca rubra L.
Bromus Aleutensis Trin.
Poa pratensis L.
Deschampsia atropurpurea Scheele.
Deschampsia cæspitosa P. Br., var. longiflora Trin.
Trisetum subspicatum P. Br., var. molle Gray.
Deyeuxia Aleutica Vasey.
Deyeuxia Langsdorfii Kunth.
Agrostis canina L.
Agrostis exarata Trin.
Equisetum variegatum Schl.
Cryptogramme acrostichoides R. Br.

I am indebted to Dr. Vasey and Prof. L. H. Bailey, Jr., for assistance in determining the sedges and grasses.—F. H. KNOWLTON, *U. S. Nat. Museum.*

EDITORIAL.

WITH THIS number the GAZETTE for 1886 is complete. The 350 pages that we have given to our readers represent the best botanical activity of the country, and the fact that several important papers presented this year cannot appear until next, on account of the pressure upon our pages, goes to show that this activity has been unusually great. It is very evident that botanists are working now as never before in this country. Perhaps there is no more interest in the general subject of botany, but there is more independent and valuable work. Our friends have said that the GAZETTE has been no small influence in encouraging this activity. Whether this is true or not, the botanical signs for 1887 are most encouraging. American botanists are fully awake, and the next year gives promise of much good work. Every botanist should feel called upon to help along this progress, both by making some contribution to botanical knowledge himself, and by warmly supporting a botanical journal that gives expression to these activities. That the GAZETTE has been better than its promise is the record of the year just closing, and as we clear our decks for another year it is with the determination to surpass anything we have yet done. With this promise to our friends we wish them a happy and successful new year.

THERE IS some feeling among American botanists that their labors are not fully recognized in Europe, being passed by when credit is really due them. We desire to point out one reason for this apparent neglect, a reason that our opportunities of knowing enable us to assert is a very important one, and which points to partial remedy within the control of each author. We refer to the distribution of separately printed copies of important articles contained in journals and society publications. We venture to say that the number of copies now sent by most authors to German and other foreign investigators is very small and wholly inadequate. A satisfactory distribution would require that a copy of every important research should be sent to other workers in the same line, to the prominent botanical periodicals, and to the chief libraries. If it can also be placed on sale, so much the better. If authors will take this small trouble and expense, the knowledge and recognition of American botany abroad will be advantageously improved.

OPEN LETTERS.

Orientation of Cassia leaflets.

The region about me is literally clothed with a growth of the two species of Cassia, C. nictitans and C. Chamæcrista. I notice this summer what I never happened to have observed before, that, in the afternoon especially, all the leaflets are so disposed as to present their surfaces to the declining sun. In thousands of specimens I can find no exception. This presentation of necessity gives something of a north and south trend to the edge of the leaflets, so here we have compass plants of a certain kind. W. W. BAILEY.

Brown University, Providence, R. I.

Eupatorium perfoliatum.

In August last I collected a stout specimen of this plant, nearly four feet high, having a whorl of three leaves at each node. The leaves of each whorl were united around the stem much as in the usual form, except that there was a superfluity of tissue at the points of cohesion, thus making the bases of the leaves crispate. J. FRANKLIN COLLINS.

Providence, R. I.

CURRENT LITERATURE.

Life Histories of Plants. By Professor D. McAlpine. pp. 296. Illustrated. Swan Sonnenschein, Lowrey & Co., London. 1886. sq. 12°.

This is a successful attempt to put the latest phases of botany in such a popular way that any intelligent person can understand them. Such attempts can not be too warmly commended, for they are important and difficult. As the intelligent popular mind becomes acquainted with these facts the chances for foundations for original investigation multiply, but the difficulty lies in popularizing without misstating. Professor McAlpine has accomplished this task as well as we have yet seen it done. The book was not written for botanists, but it should be able to stand the fire of their criticism. At the same time botanists must not criticize technical points or omitted facts It is simply a question as to whether what has been stated is clear enough to be understood or is not misleading. The book begins with a chapter upon the comparative study of plants and animals on a physiological basis, and another upon the living cell. The remaining pages take up types, beginning with the lowest, and give a condensed account of their structure and life history, over forty being considered. The book is not only a capital one for the general reader, but would be very helpful in the hands of the young laboratory worker. The figures are the same that have done such long and efficient service in botanical works, and a few changes in that direction would have been both easy and valuable. There are some things that might be criticised. In referring to the function of chlorophyll, p. 69, Pringsheim's "screen" theory is given without any mention of there being a diversity of opinion upon the subject. The use of the terms "root" and "shoot" are carried down to the lowest plants on physiological grounds, but the average reader will not distinguish between root-function and root-structure, and so we would class the use of these terms as misleading. The terms "microspore" and "macrospore" are carried through to the highest plants, a thing proper enough perhaps for the technical botanist, but the audience for whom the book is written had better know what the pollen-grain and embryo-sac mean. On p. 229, in speaking of the germination of the teleutospores of wheat-rust, the statement that they "*only* continue their course of development on the Barberry-leaf," should be modified in accordance with the fact. But these are mostly matters of judgment, and we would commend the book as being very readable and serviceable.

Preliminary Synopsis of North American Carices, including those of Mexico, Central America and Greenland, with the American bibliography of the genus. By L. H. Bailey, jr. pp. 99, v. Reprinted from Proc. Amer. Acad., April 14, 1886.

That the genus Carex needs elucidation all botanists will agree, and Professor Bailey has done us good service in thus recording the results of his study. A proper judgment upon such work can be passed only after using it, and whatever is said now is based upon the author's known ability. Such a vast genus is, of necessity, a most bewildering tangle, and if Professor Bailey has straightened it all out he has done far more than he claims. Of course it will be found faulty in parts, and the author will probably be quicker to recognize that than any one else, but it must surely advance our knowledge of carices and lighten the labor of naming them. Changes in nomenclature are quite numerous and radical, and the author deserves commendation for his attempt to observe the law of priority. The paper gives distinguishing characters for all species not described in Gray's Manual, Chapman's Flora and Coulter's Manual. The breaking away from the old artificial groupings, and the attempt to distribute species in natural groups, is noteworthy. Professor Bailey has put us under an obligation which should be repaid by the careful use and criticism of his paper.

NOTES AND NEWS.

THE HERBARIUM of Lamarck has been acquired by the French government and placed in the Jardin des Plantes.

PROF. W. W. BAILEY finds that the stamens of Parnassia mature one at a time, and asks if this has been observed before.

THÉODOR G. ORPHANIDÈS, emeritus professor of botany at the university of Athens, died in August last at 69 years of age.

DR. EMILY L. GREGORY presents the first part of a paper on the distribution and function of the pores of libriform tissue, in the *Bulletin of the Torrey Club* for November.

PROF. O. NORDSTEDT has critical notes on the marine Vaucheria litorea, V. sphærospora, V. Thuretii and V. Synandra, illustrated with a plate, in the October *Scottish Naturalist.*

A WELL WRITTEN and readable notice of Lubbock's "Flowers, Fruits and Leaves," covering over a page, is given in No. 1115 of the *Nation*, under the title of "Vegetal æsthetics."

A. A. CROZIER, graduate of Michigan Agricultural College and of the botanical department of the State University, has been appointed assistant to Dr. Vasey in the Department of Agriculture.

SPIRANTHES ROMANZOVIANA has been a very rare orchid in Ireland for fifty years or more, and is now thought to be entirely exterminated. A systematic search for it is talked of for next year.

PROF. DR. LEIMBACH, editor of *Irmischia* and of the *Deutsche botanische Monatsschrift*, has removed from Sondershausen to Arnstadt, where he has accepted the position of director of the Realschul

BARON F. VON MUELLER will next June resign his position as director of the Botanical Garden of Melbourne, Australia.

MISS LILLIE J. MARTIN'S paper on the preliminary analysis of the leaves of Juglans nigra, read before the A. A. A. S., Buffalo meeting, has been issued as a reprint from the *Amer. Jour. of Phar.*, October, 1886.

DR. THEOBALD SMITH expresses some thoughts on recent investigations concerning bacteria in drinking water, in the *Medical News* of October 9, which are especially valuable to those engaged in such researches.

DR. J. W. A. WIGAND, the renowned professor of botany at the University of Marburg, is dead, at the age of sixty-five years.

FOUR FRENCH BOTANISTS have recently died: L. D. A. F. M. Marcilly, conservator of forests; Guillaume Sicard, mycologist; Ed. Lamy de la Chapelle, lichenologist; and Jean Baptiste Pierre Letendre, cryptogamist.

ON PAGE 260, October *Gazette*, is an omission which should be corrected. To the characters of ⸹ 1 should be added "ducts peripheral."

DESCRIPTIVE NOTES on Papuan plants, by Baron F. v. Mueller, cover 120 octavo pages, and include many new species. The descriptions are in English.

ERRATA.—Page 263, for Epeclus, Pelopoeus, Stizua and Trichina, read *Epeolus, Pelopœus, Stizus* and *Trichius*. In foot-note 5 for "bears a resemblance" read bears *no* resemblance.

MR. JOHN H. REDFIELD continues his notes in the November *Bulletin of the Torrey Club*, upon localities for Corema, with an account of explorations for 1886.

THE SOCIEDADE BROTERIANA, of Coimbra, publishes an annual bulletin, issued in parts, which has now reached its fourth volume. It is devoted to the study of the flora of Portugal, and has already brought to light quite a number of new species.

BARON VON MUELLER'S activity in making known the flora of Australia and adjacent regions is shown in his almost monthly publication of new species of flowering plants in the *Victorian Naturalist, Australasian Journal of Pharmacy*, and other journals.

THE MYXOMYCETES are noticed in the August and November numbers of the *Journal of Mycology* by critical notes on the banded-spore Trichias by Dr. George A. Rex, and by the description of a new genus and species, Orthotrichia microcephala, by Harold Wingate.

PROF. A. N. PRENTISS has written in the *Am. Horticulturist* (reprinted in the *Am. Naturalist* for November) upon how botany shall be taught in agricultural colleges. What he suggests finds its application not only in agricultural colleges, but wherever botany is taught.

TWO NEW WORKS of much interest are announced from the press of Swan Sonnenschein, Lowrey & Co., London. The first is a "Text book of practical botany," edited from the work of Strasburger by Prof. W. Hillhouse, and the other is "The microscope, in theory and practice," edited from the work of Nägeli and Schwendener by J. Mayall. A new edition, entirely re-written, of Prantl and Vines' "Text book of botany," is also announced by the same firm.

MICROSPORES in Sphagnum were described by Schimper in 1858. They were found in separate capsules, and also intermixed with the macrospores. They do not appear to have been seen again, however, until a few months ago. The subject is discussed by C. Warnstorf in *Hedwigia*.

THE COMPLETE life history of Gnomonia erythrostoma has been traced by Dr. Frank (*Berichte d. deutsch. bot. Gesellschaft*, iv, p. 200), making the second Pyrenomycetous fungus in which the sexual reproduction is known. It attacks the leaves of the cherry tree, enfeebling the tree, and finally killing it.

A LIST of the Diatomaceæ of Lake Michigan, by B. W. Thomas and H. H. Chase, is the result of collections from the Chicago water supply, made chiefly by Mr. Thomas during the last sixteen years. Two hundred and fifteen species and varieties are enumerated, six of which are marked *n. sp.*, and one *n. var.*

MR. J. H. HART, superintendent of the government cinchona plantations, Jamaica, has issued from the press of Mortimer C. DeSouza, Kingston, a very interesting account of "A Botanist's Rambles" in Central America. It gives a sketchy account of the plants of that interesting region and is well worth reading. It can be had from the author for a sixpence.

MR. D. H. CAMPBELL is at present at Bonn, studying in Strasburger's laboratory. He reports but two or three working there during the winter semester, but that during the summer the number will reach 30 or 40. Dr. Strasburger takes great personal interest in the work of his students, and gives them more attention than would be expected from so busy a man.

DR. C. C. PARRY, in a reprint from the Proc. Davenport Acad. Sci., v. 35, confirms the genus *Lastarriæa* Remy and extends its character. In his memoir on Chorizanthe he had included this genus as C. Lastarriæa, but two new species from Chili have confirmed its generic characters, and so it has been restored and becomes *L. Chilensis* Remy, with two Chilian associates.

M. C. COOKE criticizes Stevenson's recent work on "British fungi," in a late issue of *Nature*, by charging that over forty species were wrongly omitted from the first volume, and for other faults, none of which, however, materially affect the value of the work for American botanists. It must be remembered that Dr. Cooke's views rarely coincide with those of his fellow mycologists.

AT THE LAST annual meeting of the Union of Naturalists' Societies of the East of Scotland, Prof. J. W. H. Trail gave an address on the work to be done by such an organization, which in the main is equally pertinent to American societies. He placed bibliographical indexes first, and local lists of different classes of natural history second, both to be prepared by the coöperative system.

"THE WIND as a seed-carrier," was the title of a paper presented by Alfred Russell Wallace at the November meeting of the National Academy of Sciences, in which the author suggested that the power of the wind to occasionally carry seed to extraordinary distances might account even for the transfer of species from cold regions of the northern hemisphere to those of the southern.

BULLETIN No. 1 of the botanical division of the U. S. Department of Agriculture, by Dr. George Vasey, is devoted to economic questions regarding the grasses of the arid districts of Kansas, Nebraska and Colorado, including an item on the advantages of establishing a grass experiment station. We are otherwise informed that a bill for this purpose will be presented at the next session of Congress.

HERR F. FREYN, engineer, (whose address is III, Karmelitergasse, 21, Prague), who has paid much attention to the genus *Ranunculus*, and is preparing a general work on the species, wishes to obtain specimens of those of North America generally, especially of the newly found and the rare or critical species. Indeed, good specimens of any of our species will be welcome. European species are offered in return.

A BIOGRAPHICAL SKETCH of the botanist Mühlenberg, with portrait, has been distributed as a reprint from Hoffman's "Pharmaceutische Rundschau," June, 1886. It is written by Dr. J. M. Maisch, of the Philadelphia College of Pharmacy, and is exceedingly interesting. As closely identified with early American botany as Mühlenberg was, it is specially fitting for American botanists to be acquainted with his life.

THE OCTOBER NUMBER of the *Italian Journal of Botany* contains bryological notes by G. Venturi, the extra-floral nectary of Amygdalaceæ by L. Macchiati, description of some new Malesian Scitamineæ by B. Scortechini, notes on the fruit and seeds of Cacao by T. Caruel, a case of prolification in Spilanthes by F. Tassi, a new station for Aceras anthropophora by P. Severino, and teratological notes by C. Massalonge.

THE FOLLOWING NOTE by Dr. Asa Gray is taken from the *Gardeners' Chronicle* of November 6: "It is a mistake to say that Lespedeza striata is indigenous to most parts of North America. It is a Chinese and Japanese plant, which came to the United States nobody knows how, but not many years ago, but has now spread wonderfully in the southern United States." Notes on its history are given in this journal, vol. III, pp. 4, 42.

IN THE *Bulletin of the Torr. Bot. Club*, for November, there are three papers of systematic interest. Dr. Britton publishes a preliminary list of the N. Am. species of Cyperus, a genus which he has long been studying. Seventy-three species are enumerated, and several new varieties and species are described. Rev. E. L. Greene describes six new Californian Polypetalæ, and Dr. Vasey publishes (with plate) a new genus of grasses, dedicated to Mr. C. R. Orcutt. Orcuttia Californica belongs to the Festuceæ and was found in Lower California.

THE EDITOR of the *Botanisches Centralblatt* desires to have it announced that the report of any American botanical society will be gladly published in that journal, without translation, and fifty excerpts furnished the society free. Two hundred and fifty more copies will be supplied, if desired, at the rate of about thirty cents per page. This generous offer, which gives the society a separate printed report at little or no cost, and brings its proceedings to the notice of botanists throughout the world, ought not to remain unheeded. Address Dr. Uhlworm, Cassel, Germany.

ACTA HORTI PETROPOLITANI, vol. ix, No. 2, appears with ten folded plates and several articles of importance to systematists. C. Winkler describes twenty new Compositæ from Turkestan, E. R. Trautwetter publishes a list of a Turcoman collection, with descriptions of new species, among which the Astragali predominate. Dr. E. Regel also continues his descriptions of new or little known plants. The most important parts of Dr. Regel's contribution are the monographs of the Asiatic genus Eremostachys, and a conspectus of the species of Phlomis.

A PAPER on rhizocarps in the Erian (Devonian) period in America, by Sir Wm. Dawson, forms No. IX of the *Bulletin* of the Chicago Academy of Sciences. It treats of microscopic objects first found by Mr. B. W. Thomas and others in 1865-7, in the clays that underlie Chicago. Similar bodies have since been found in considerable quantities in Ohio, New York, Canada, Scotland, Tasmania, Australia and Brazil, and quite a literature has come into existence. They were figured and described in a bulletin of the same series in 1884, under Dr. Dawson's name of sporangites. The author now believes them to be the spores of Salvinia-like plants, and divides them into five species, under the genus Protosalvinia. The subject is of general interest in suggesting the remarkable abundance of floating rhizocarps in the period preceding the carboniferous.

DR. WILLIAM TRELEASE has published a revision of the North American species of phalictrum, distributed as a reprint of the Boston Soc. Nat. Hist., xxiii, 293-304, accompanied by a plate. The species have always been difficult of discrimination and botanists will value this accordingly. The most valuable characters are taken from the condition of the flowers (whether perfect, etc.), the length and form of filaments, the anthers, and the character of achenia. The foliage is of little diagnostic value. A dozen species are defined, one, T. venulosum, being a new species from the Rocky Mountain region, while Mühlenberg's *T. polygamum* replaces *T. Cornuti* of Gray's Manual, as already noted by the author in this journal, xi. 92. The good plate of achenia helps to make the work of determining species easy.

Rev. E. L. Greene has issued his fifth paper entitled "Studies in the botany of California and parts adjacent," being a reprint from Bulletin 6 of the Calif. Acad. Sci. Most of the contribution is taken up with a study of the genus Brodiæa Mr. Greene has observed the species in the field, and has thus discovered characters unobservable by closet botanists. The genera "confused under Brodiæa" are characterized as *Brodiæa* Smith, in part, *Hookera* Salisb., in part, and *Triteleia* Dougl., etc. A new genus, *Behria*, is added to the group, of which only the umbels are known. Comparing with Mr. Watson's revision of Liliaceæ, Brodiæa is reduced to the second half of the Eubrodiæa, Hookera contains the other half, while Triteleia includes the other two sections. Several new species are added to each genus. Mr. Greene also restores *Syrmatium* Vogel, to include 15 or 18 species of Hosackia. It was the Nuttallian genus Drepanolobus. Some 18 or 20 miscellaneous species are described as new.

Mr. Thomas Meehan has distributed a reprint from *Proc. Philadelphia Acad.*, containing a paper on the fertilization of Cassia Marilandica. Mr. Meehan has always been "upon the other side" in cross-fertilization discussions, disputing in general both the fact and the reason. In this paper he is more convinced than ever of his views that cross-fertilization, if accomplished, is of no benefit, and that there is little to prove that close-breeding is an injury. "In my mind, the facts rather show that instead of any material aid to the propagation of the race being gained, the dependence of a plant on insect aid for fertilization is rather an indication that its race is nearly run, and that it is on the downward track in the order of nature." He cites the Cassia as a case in point, yet says that in an experiment it did not produce a single seed when the flowers are protected from insects. The papilionaceous flowers are said to give us persistent examples of self-fertilization and hence the constancy of garden varieties.

GENERAL INDEX.

*** *Names of new species are printed in* **bold-face** *type; synonyms are printed in italics.*

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