

THE
GEOLOGICAL
AND
NATURAL HISTORY SURVEY
OF
MINNESOTA.

THE TWELFTH ANNUAL REPORT,

FOR THE YEAR 1883.

N. H. WINCHELL, STATE GEOLOGIST.

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YARFEL
STATE ASSOCIATION
OF THE BLIND

ADDRESS.

THE UNIVERSITY OF MINNESOTA, }
MINNEAPOLIS, MINN., DECEMBER 1, 1883. }

To the President of the University :

DEAR SIR:—I herewith tender the twelfth annual report on the progress of the geological and natural history survey of the state. I include herewith a copy of the first annual report for reprint, that report being in constant demand, and out of print now for several years.

Very respectfully, your obedient servant.

N. H. WINCHELL,

State geologist and curator of the general museum.

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REPORT.

I.

SUMMARY STATEMENT.

The greater portion of the time during the year has been given both by Mr. Upham and myself to the final revision of manuscript for the printers, and the reading of proofs, the preparation of maps, plates and other illustrations, and the proofs of the same, intended for the final report. At the present time the following county maps have been drawn, lithographed and printed, showing the geology and surface features, and the lines of equal elevation above the sea, viz: Houston, Winona, Fillmore, Olmsted, Mower, Dodge, Freeborn, Waseca, Steele, Blue Earth, Faribault, Watonwan, Martin, Cottonwood, Jackson, Murray, Nobles, Pipestone, Rock, Lincoln, Lyon, Yellow Medicine, Redwood, Brown, Nicollet, Le Sueur, Wabasha, Scott, Carver, Wright, Lac qui Parle and Big Stone. The counties of Goodhue, Rice and Dakota, and several others, are in course of preparation, and sufficient examination has been made in nearly all the state as far north as Brainerd, for mapping and reporting in the same manner. In the northern half of the state, also, much information has been obtained. Considerable more work, however, must be done in that portion north of the parallel of Brainerd, where the difficulties of travel increase, and at the same time the geology becomes more difficult and more interesting. Should the survey continue according to the present design,

the system of mapping, and of description now being carried on, could be extended over the rest of the state with the present force in about two years. But as the printing of work already prepared, and the preparation of maps and manuscript for future publication, require much time, the completion of the survey cannot be looked for before the close of the fourth year from this date. In addition to this, other matters demanded by the law of the survey are very important, but have been kept in abeyance pending the completion of the strictly geological portion. This will require further time and other workmen. It is to be hoped that the regents will always be able to make an annual increment to the scientific knowledge of the state, in some of the departments of investigation covered by the law of the survey, and that the annual reports will successively become more and more valuable as they become more numerous.

Dr. P. L. Hatch, who has charge of the investigations in the ornithology of the state, has signified his intention to render his final report on the same by or before the spring of 1885.

Mr. C. L. Herrick has been given the mammalogy of the state, with a view to the collection of skins and skeletons for the museum, and the preparation of a final report on the same for publication in about two years.

The only field-work done in 1883, was that performed by myself in Dakota and Rice counties, including, however, further supplementary observations in Mower and Olmsted counties, and a visit to some of the localities of red quartzite in the southwestern part of the state.

Additional cases will soon be placed in the south room of the museum, intended for the reception of the collections of Dr. H. C. Hovey, representing the stalactitic deposits of caves. This valuable collection has kindly been loaned to the University, on deposit, with the only condition that it shall be well kept.

Further additions have been made to the specimens belonging to the general museum, through the agency of the survey, and by donation by the following individuals: W. H. Scofield, of Cannon Falls, and James B. Alexander, of Minneapolis, and by several others.

These are all enumerated in the accompanying list of accessions. Exchanges have been made with A. S. Tiffany, of Davenport, Iowa, and John Eyerman, of Carbondale, Pennsylvania.

The final paper of Mr. Herrick on a portion of the *Crustacea* of Minnesota is presented in this report, illustrated by a number of octavo plates.

The intent of the circular issued in 1876* respecting the botany of the state has been kept in mind. Several correspondents have contributed both information for a catalogue of the species of the state, and specimens for the University herbarium. During the past two years Mr. Upham has been engaged, casually, in the preparation of such a catalogue. There has been considerable request for a more complete listing, and a more full account of the distribution of the plants of the state, than that of Dr. I. A. Lapham, published by the Minnesota Horticultural Society in 1875. The very complete catalogue, prepared by Mr. Upham, is herewith transmitted as a part of this report. It includes and classifies all reliable information on the botany of the state that is now in the possession of the survey, and will serve as a more useful guide to students and others in the future study of species and their distribution in Minnesota, than anything hitherto published.

*See the fifth annual report, p. 64.

II.

PALÆONTOLOGY.

(a)

A NEW TRILOBITE.

In the registration of specimens lying in the university building in 1873, a lot of miscellaneous rocks, minerals and fossils was found that had been presented by the late Dr. Stoneman, of Minneapolis. The fossils and rocks were evidently from the Trenton at Minneapolis; but as there were no certain records respecting them, they were all entered in the register, and finally published, with the note "records doubtful." (*Fifth annual report*, p. 207.) A slab of fossiliferous limestone (Mus. reg. number 90) was thus referred to the Trenton. In the sixth annual report a fossil trilobite, contained on this limestone, was reported after a casual examination as *Asaphus extans*, of Hall (*loc. cit.* p. 161), with the remark that it "has a tuberculated surface instead of lamellose."

In March, 1879, at the request of Lieut. A. W. Vogdes this specimen was sent to him, and he kindly returned the specimen with the following description, as a new species, naming it in honor of Dr. Stoneman.

***Bathyurus Stonemanii*, Vogdes.**

Description.—The pygidium is semi-elliptical, strongly convex, and the width a little greater than the length. The anterior margins are rounded, and the outer margins bordered by a well-defined convex limb. The axis is greatly elevated above the sides, and tapers toward the posterior margin, terminating on the limb. The axis is marked with six rings, the first three being well-defined, and the others not so prominently marked. The dorsal furrows are deep and well-defined. The lateral lobes are convex and have five pleuræ, each being separated by deep furrows. The pleuræ are bent downward and backward, and arise from the second, third,

fourth and fifth axial rings. They all terminate upon the inside furrow which outlines the limb. The points of termination of the anterior pleuræ are on a line with the fifth axial ring. The entire pygidium is bordered by a convex limb which runs from the fulcral points around it. This limb has an inside furrow which runs between the termination of the axis and the limb, and also an exterior furrow.

The surface of the upper dorsal shell is tuberculated.

Locality and geological position. The Trenton group, probably at Minneapolis, Minn. Presented to the general museum by Dr. Stoneman.

This species approaches *B. senectus*, Billings, which has six axial rings and four pleuræ. Our species is, however, much larger, and has a greater member of pleuræ. The inside marginal furrow in the former species does not extend all around the pygidium, but ends abruptly at the end of the axis. Billings' species comes from the Potsdam group, and ours from a different geological position. Our species has certain affinities with *B. extans*, Hall. The most prominent points of difference between the former and that described by Prof. Hall is that the axis is more elevated, and does not terminate so abruptly behind in *B. Stonemanii*. The second dorsal surface of *B. extans* is marked with fine imbricating lamellose striæ, whereas our species is tuberculated.

There are three species of this genus described, which appear in the Trenton group; viz. *B. extans*, H.; *B. longispinus*, Walcott; and *B. spiniger*, H. Of all the species, with the exception of the last named, the pygidium is known, and differs from our species. The only part of *B. spiniger*, H. known to us is the glabella, which is tuberculated; and there is reason to suppose that our species may be the missing part of *B. spiniger*; but it is doubtful.

The geological range of the genus is from the Potsdam to the Trenton group.

(b)

THE AGE OF THE SANDROCK AT AUSTIN, MOWER COUNTY.

On page 360, of the first volume of the final report of the survey, the age of the sandrock at Austin is considered, and Prof. H. S. Williams is referred to as authority for identification of some fossils from that rock. In justice to Prof. Williams the full text of his communication relating to these fragmentary fossils is herewith given. If the horizon of the Austin rock be in the Marcellus shale, the overlying limestones appearing in the Cedar valley near the state boundary, and further south, probably all fall into the Hamilton epoch.

Letter of professor H. S. Williams.

ITHACA, N. Y. Sept. 14, 1883.

My dear professor:

I have examined the fossils which you sent me and enquire particularly about in your letter received a few days ago. The fossils are in very imperfect condition; and the identification cannot be regarded as anything more than strongly probable.

I find in the lot, No. 2699, from Gregson's mill, these species.

1. *Productella truncata*, Hall.
2. A minute lamellibranch, like a small *Aviculopecten*.
3. A minute brachiopod; oval, the smooth surface resembling a dorsal valve of *Ambocælia*, or (?) a *Nucleospira*.

The second lot, No. 2698, Cedar valley, Mower county, resembles lithologically the first, but the fossils are distinct. They are:

1. Numerous cavities of *Aulopora*, or some allied form.
2. A small shell like *Atrypa reticularis*.
3. A small shell like *Atrypa aspera*.
4. *Cyrtina*, like *C. Dalmani*, but may be *C. Hamiltonensis*.
5. Several lenticular-shaped shells which are probably *Nucleospira*.
6. A minute terebratuloid shell of *Rensselæria* type.
7. Trace of a crinoid stem.
8. Trace of a minute *Orthoceras*, or (?) *Coleolus*.

You ask my opinion of the horizon. The material is very unsatisfactory for basing a judgment on; but if the two lots are from the same horizon, it is safe to say that it is lower Devonian.

Taking the fauna of No. 2698 alone, I see nothing to prevent its being Upper Silurian.

If the two lots are from the same rock, I should think from study of the fossils that the horizon is not higher than the base of the Hamilton period, nor lower than the Lower Helderberg; and my opinion is that the fauna belongs to an horizon near the base of the Hamilton, either below it or in an equivalent position to the New York *Marcellus*. The only really satisfactory fossil is the *Productella truncata*; and if the brachiopods of No. 2698 came from a stratum under that containing No. 2699, the No. 2698 lot might occur anywhere from the Hamilton down to the Lower Helderberg.

Nucleospira, *Rensselæria* type of terebratuloids, *Cyrtinas* and *Atrypas* are genera passing from Upper Silurian through lower

and middle Devonian, and generally do not mark any narrow geological horizon.

From their association, and the fact that they are all minute specimens, I should conclude that it was a sparse fauna in unfavorable conditions of life, which might have lived anywhere along the Upper Silurian or lower Devonian. But the *Productellas* are peculiar to Devonian and above.

Have you not found any more fossils? I should think a careful search might bring out specimens that could be determined accurately; and it would be interesting to have the means of determining the species.

I wish I could speak more definitely; but this is the best I can do with the specimens. Possibly this with the stratigraphical study may enable you to fix the horizon.

With sincere regard,

HENRY S. WILLIAMS.

(c)

CRETACEOUS LEAVES. PRELIMINARY STATEMENT OF DR. LEO
LESQUEREUX.

The Cretaceous leaves that have been obtained in the state from the Cretaceous strata at various times and places, have been submitted to Mr. Lesquereux for determination and description. His final report will appear subsequently, but the following is the result of a preliminary examination of a lot of specimens sent.

Dr. Lesquereux' preliminary report.

The content of the lot, received Jan. 14th, 1884, is as follows:

- No. 2143. From the north side of the Minnesota river, eight miles below New Ulm, represents 4 small undeterminable fragments of leaves, without trace of nervation.
No. 2143 (A) is apparently a *Proteoides*.
- No. 3808 and 5163. *Ficus*, sp. nov. No. 5163 is not marked in the list; it is labelled *Austin*.
- No. 3911. *Laurus Nebrascensis*, Lesq., 1 leaf on three pieces.

- No. 3912. *Salix protecefolia*, Lesq.
The above three Nos. are from the north side of the Cottonwood river in Brown county.
- No. 5155 (A). *Populus litigiosa*, Heer, and *Cinnamomum Scheuchzeri*, Heer, on the reverse.
- No. 5155 (B), 5155 (H), 5157 (B). *Magnolia alternans*, Heer.
- No. 5155 (C). *Populus elegans*, Lesq.
- No. 5155 (D). " *Lancastriensis*, Lesq., (probably equivalent to *P. cordifolia*, Newby).
- No. 5155 (F). *Protophyllum crednerioides*, Lesq.?, a fragment; base of leaf destroyed.
- No. 5155 (G, K). *Populites cyclophyllus*, Lesq.
- No. 5155 (I). 2 fragments of superposed leaves, the lower only distinct, *Cinnamomum Scheuchzeri*, Heer.
- No. 5155 (L, M, O). *Populus litigiosa*, Heer, 3 specimens.
- No. 5155 (P). *Populus cyclophylla*, Lesq, a deformed plicate leaf.
- No. 5155 (Q & S). 2 fragments of the same leaf, *Platanus primæva*, Lesq., with a leaf of *Persea*?, not yet satisfactorily determined, upon 5155 (S).
- No. 5155 (E, N, R). 3 undeterminable fragments.
- No. 5156. *Cissus*, sp. nova; name not yet fixed.
- No. 5157 (C). *Salix protecefolia*, Lesq., with a branch of *Platanus* on the reverse.
- No. 5157 (A). *Andromeda Parlatorii*, Heer.
- No. 5158. *Laurus*, sp. nov., not yet named.
- No. 5159. Fragment of undeterminable leaf, areolated by maceration, *Ficus*??.
- No. 5160. Leaf of *Pinus*, sp. nov., not yet named.
- No. 5161. No vegetable remains, but shell or some animal organism. The osseous plate marked by striæ is 2 mm. thick. I have seen along the banks of the Cottonwood river, above the Cretaceous sandstone bearing leaves, large fragments of shells as thick as the plate upon 5161.
- No. 115. *Sequoia*, sp. nov., a specimen which I have already seen here. It bears the label Austin, Minn.

As far as I can see now, the specimens remarked above, 36 in number, represent 16 species, of which 4 are new ones. Of the species, 10 have been recognized in the Dakota group of Kansas and Nebraska, and two in the same Cretaceous formation of Colorado.

The specimens No. 5155 A, down to the end of the list except No. 115, are all from the Cottonwood river, about 3 miles south of New Ulm. They have one species in common with those of the north side of the same river in Brown county, where-from 3 specimens only are sent.

The whole lot is valuable and interesting. One quarto plate would suffice for the figures of the more interesting species and best specimens.

L. LESQUEREUX.

Columbus, O., Jan. 17th, 1884.

III.

THE COMPARATIVE STRENGTH OF MINNESOTA AND NEW ENGLAND GRANITES.¹

BY N. H. WINCHELL.

Having had occasion recently to investigate the qualities of some of the building-stones of the state of Minnesota, I found it necessary to subject them to the usual test of *crushing*, in the form of two-inch cubes, to learn their strength under pressure.

Samples were obtained and dressed to the required size by Mr. William Keating, at the marble shops of Messrs. Sullivan and Farnham, in this city. About one hundred of such cubes were formed, embracing sandstones, limestones, granites and trap rocks. It is intended in this paper to show the remarkable, and unexpected strength exhibited by the crystalline rocks of the state, and especially their superiority in that respect over the granites of New England.

The samples as prepared were carefully chosen to avoid flaws and imperfections due to weathering. They were dressed by hand with hammer and chisel on all six sides, so as to measure two inches on all their edges, the sides all being exact squares. They were sent to Gen. Gillmore, at Fort Wadsworth, Staten Island, where they were subjected to the test for crushing-strength in the same manner as many other granites that have been tested and reported by him in his reports to the chief of engineers, from other portions of the United States and particularly from New England. The tests were applied by Mr. James Cocroft, under the direction of Gen. Q. A.

¹ Read at the Minneapolis meeting of the American Association for the Advancement of Science. August, 1885.

Gillmore. The samples were crushed between steel plates, one of each stone in the direction of the schistose structure, and another in the direction across it, the former being designated as *on edge* and the latter as *on bed*, with the following results:—

Kind of stone.	Location of quarry.	Position.	Strength in pounds	
			of sample.	per square inch.
Dark trap rock, massive melaphyr.	Taylor's Falls, Chisago Co.	On bed	105,000	26,250
		On edge	105,000	26,250
Dark trap rock, from a dyke.	Tischer's creek, Near Duluth, St. Louis Co.	On bed	105,000	26,250
		On edge	105,000	26,250
Gray gabbro, massive, fine.	Bice's Point, Duluth, St. Louis Co.	On bed	109,000	27,250
		On edge	105,000	26,250
Red, fine syenite.	Beaver Bay, Lake Co.	On bed	106,000	26,500
		On edge	103,000	25,750
Red, quartzose syenite.	Watab, Benton Co.	On bed	103,000	25,750
		est.	103,000	25,750
Red, quartzose syenite.	East St. Cloud, Sherburne Co.	On bed	112,000	28,000
		On edge	105,000	26,250
Red quartzyte.	Pipestone City, Pipestone Co.	On bed	111,000	27,750
		On edge	108,000	27,000
Massive, gray syenite, quartzose.	East St. Cloud, Sherburne Co.	On bed	105,000	26,250
		On edge	103,000	25,750
Fine-grained gray syenite.	East St. Cloud, Sherburne Co.	On bed	112,000	28,000
		On edge	105,000	26,250
Fine-grained gray syenite.	(Probably imperfect sample). Sauk Rapids.	On bed	86,000	21,500
		On edge	100,000	25,200
Average of 20 samples.....			104,800	26,200

In order to make a fair comparison, the resultant average strength of the Minnesota samples, crushed between steel plates, should be referred to wooden cushions. Gen. Gillmore's experiments indicate that granite has a greater crushing strength between steel plates than between cushions of wood, amounting to eleven per cent. of its strength between steel. Making such allowance, the average of the Minnesota granites becomes:—

Average strength of 20 samples of Minnesota granites, unpolished, crushed between wooden cushions. 2-inch cubes. Pounds, per 2-inch cube, 93,272; per square inch, 23,318.

This result is obtained by including the strength of the samples both *on edge* and *on bed*, in one calculation.

The following table shows the same data for 20 New England granites, reported by Gen. Gillmore, the most of them being *on bed*, or undesignated as to whether on bed or on edge. In selecting these, I have chosen the stronger of the New England granites from general Gillmore's table, and in all cases except one (in which

the strength *on edge* is reported greater than *on bed*) I have chosen the strength *on bed*, when known. I have avoided every possible error that might be made in favor of the Minnesota granites, and allowed several points that count in favor of the New England granites.

TABLE

showing the compressive strength of New England granites in 2-inch cubes, as reported by Gen. Gillmore (Report of the Chief of Engineers, 1875, Part II). In unpolished cubes, on wooden cushion-blocks.

		Position.	Strength in pounds	
			of sample.	per square inch.
Blue.	Staten I., New York.	On bed	89,250	22,315
.....	Fox Island, Me.	.....	59,500	14,875
.....	Dix Island, Me.	.....	60,000	15,000
Dark.	Quincy, Mass.	.....	71,600	17,750
Light.	Quincy, Mass.	.....	59,000	14,750
Flagging.	North river, N. Y.	.....	53,700	13,425
.....	Cape Ann, Mass.	On bed	59,750	14,937
Porter's rock.	Mystic river, Conn.	On bed	72,500	18,125
Gray.	Stony creek, Conn.	On bed	60,000	15,000
Gray.	Fall River, Mass.	On bed	63,750	15,937
Bluish gray.	Keene, N. H.	On bed	41,000	10,250
Bluish gray.	Keene, N. H.	On bed	51,500	12,875
.....	Millstone Pt., Conn.	.....	64,750	16,187
.....	Greenwich, Conn.	.....	45,200	11,300
Niantic river.	New London, Conn.	.....	50,000	12,500
Niantic river.	New London, Conn.	On edge	56,700	14,175
.....	Vinal Haven, Me.	.....	52,600	13,150
.....	Vinal Haven, Me.	.....	67,000	16,750
.....	Westerly, R. I.	On bed	58,750	14,687
.....	Westerly, R. I.	On edge	59,750	14,937
Average of 20 granites.....			59,785	14,946

We find here that the

Average strength of 20 New England granites, unpolished, crushed between wooden cushions in 2-inch cubes, is, in pounds, per 2-inch cube, 59,785; per square inch, 14,946.

This shows that the average strength of the Minnesota granites is fifty-six per cent of the strength of the New England granites greater than that of the New England granites.

This anomalous result was so striking that I called general Gillmore's attention to it. The strength of the Minnesota 2-inch cubes was so great that it exceeded the highest registration of the gauge in use, and the samples were not reported at first, but were retained for crushing on a more powerful machine at Boston. It occurred to me that possibly there had been a gradual deterioration in the machine, or in the gauge, so that the registration was uni-

formly too high, and this impression was strengthened by comparing the results with the results reported in 1875, for some other stones. One of the limestones reported in 1875 was from the same place (Lemont, Ill.) as one of those I had included in my series, the same being used largely in this city. While at that time the strength of this stone did not reach beyond 14,000 pounds per square inch, the samples I had sent was not crushed because it exceeded 100,000 pounds, the limit of the gauge. Again, one of the granites sent in my series, had been reported in 1875. I refer to that from St. Cloud. The gabbro from Duluth had also been reported. Neither of these then reached beyond 19,000 pounds per square inch, but now one is reported at about 26,000 pounds, and the other about 27,000.

I called Gen. Gillmore's attention to these discrepancies in order that if any error had been committed it might be detected by a re-testing of his gauge, and the proper correction applied before the results were published. Subsequently Mr. Cocroft wrote me that he had the hydrostatic press taken apart and refitted, and the old gauge tested by its maker, who formed a variation of only 200 pounds in 100,000 pounds. On reporting this to general Gillmore, Mr. Cocroft was authorized to have a new gauge made, which should register 175,000 pounds. This new register was used in testing the refractory 2-inch cubes from Minnesota; hence their actual strength is as certainly ascertained as is possible with the apparatus employed.

Now, in discussing this curious anomaly, in order to reach an explanation of it, we are driven to one of three conclusions.

1. Either the cubes used were too large, or,
2. The methods are defective, or,
3. Minnesota granites are actually stronger than those of New England.

(1) Were the cubes too large? I show here several surplus cubes of the same size and style, made at the same time and by the same man, with the same instruments. These are exactly two inches on a side, measured with any ordinary standard. It is evident the great excess of strength shown by the Minnesota cubes cannot be due to their greater size, since the cubes would require to have been very noticeably and remarkable greater than two inches, and they would have been condemned.

(2). Are the methods defective? It would be sufficient, perhaps, to answer that the tests were made with the exactness and well-known integrity of the United States Engineers, under the direc-

tion of general Q. A. Gillmore whose previous experiments and publications have made him one of the best authorities in the United States, if not in the world; and that in consequence of this phenomenon he had special trials made, and new instruments prepared, yet with the final results stated above. It must be admitted that previous tests, made at the same place (Fort Wadsworth, Staten I.), on the stones at Duluth, Saint Cloud and Lemont, giving less compressive strength to those stones than now reported, throws a shadow of doubt on the correctness of the methods employed. It may be possible to explain those three cases in some way satisfactorily, by referring them to imperfections in the cubes. It is certainly not possible to allow them to establish a rule, in the face of twenty other samples which contradict them.

(3). Are the granites of Minnesota stronger than those of New England? We must either allow this, or, on account of the carefulness of the late tests of Minnesota granites, we must impugn all the results and reasoning published heretofore by general Gillmore on the granites of New England. Allowing this, we may speculate as to its possible cause.

It had occurred to me prior to this investigation, from other considerations, that perhaps the last glacial movements in Minnesota were of a later date than those described in New England. The evident freshness of the drift in Minnesota, in its *pose*, and especially of the till, compared with that of southern New England, and southeastern New York, seems to indicate the same differences as to time, of deposit. as can be inferred between the northern and the southern portions of the state of Ohio¹, or the same portions of the state of Minnesota. Of course, the continuous tracing of the same lines of morainic accumulations from east to west will finally determine the eastern analogues of our Leaf Hills and Kettle moraines, and will give a definitive answer to this hypothesis. In the mean time, and before that is accomplished, we may perhaps account for the greater strength of Minnesota crystalline rocks by supposing them less changed superficially by the process of decay, the lateness of the glaciation to which they have been subjected having left them comparatively fresh through the recent removal of a considerable thickness.

¹ Geological survey of Ohio. Report on Delaware county.

IV.

REPORT ON THE MUSEUM FOR 1883.

SPECIMENS REGISTERED IN THE GENERAL MUSEUM IN 1883.

Serial Number.	OBTAINED.		NAME.	No. of Specimens.	Locality.	Formation.	Collector and Remarks.
	When.	Whence.					
5151	Oct. '83.	Presented	Vesicular limestone ("fossil honey-comb")	2	Lauderdale Co., Ala. .	Sub Carb?	Presented by C. L. Herrick.
5152	"	"	Chert from limestone, showing fossil coral, &c.....	1	Waterloo, Ala.	"	
5153	March '83.	"	Altered garnets, (Sudamon crystals?) ...	2	Michigamme, Mich....	Huronian.	Presented by H. R. Harvey. (From the chlorotic schists between the quartzitic hanging wall and the magnetic iron.)
5154	Aug. '83.	"	Silver ore, from Black Hawk mine.....	4	{ Ballard Mt., Silver } { City, N. Mex. .... }	.....		Presented by H. R. Harvey. (Lower level, 230 feet from the surface).
5155	Nov. '83.	Geol. & Nat. Hist. Survey	Cretaceous leaves, various species, oak-like	18	{ Cottonwood river, S } { New Ulm	Dak.	{ N. H. Winchell. (Found in a soft, rusty sandstone.)
5156	"	" "	Cretaceous leaves, various species, beech-like	2	" "	"	
5157	"	" "	Salix proteaefolia, Lesq., Andromeda Parlatorii, Heer, Platanus	3	" "	"	" " "
5158	"	" "	Laurus, Sp. n.	1	" "	"	" " "
5159	"	" "	Fragment of undeterminable leaf, areolated by maceration. (Ficus?)	1	" "	"	" " "
5160	"	" "	Pinus, Sp. n.	1	" "	"	" " "
5161	"	" "	Osseous plate, marked by striae, 2 mm. thick	1	" "	"	" " "
5162	"	" "	Coral, in magesian limestone in the drift.....	2	" "	Gal ?	" " "
5163	"	" "	Ficus, Sp. n. (compare No. 3808).....	1	Austin, Mower Co.	Dak.	{ Deposited by Charles Bromwick. From A. S. Tiffany. Davenport, Iowa.
5164	Oct. '83.	By exchange.....	Favorites favosus, Gold.....	1	Le Claire, Iowa	Niag.....	

5165	"	"	"	.....	Favorites favosus, Gold	1	Niagara Co., N. Y.	Niag.	"	"	"
5166	"	"	"	.....	Halysites catenulata, L.	1	?	Drift Niag?	"	"	"
5167	"	"	"	.....	Heliolites spinopora, Hall	1	Niagara Co., N. Y.	Niagara	"	"	"
5188	"	"	"	.....	A crinoid	1		"	"	"	"
5189	"	"	"	.....	Pentamerus occidentalis, Hall	1	Port Byron, Ill.	"	"	"	"
5170	"	"	"	.....	Strophodonta striata, Hall	1	Le Claire, Iowa	"	"	"	"
5171	"	"	"	.....	Dinobolus conradi, Hall	1	"	"	"	"	"
5172	"	"	"	.....	Trimerella ohioensis, Meek	1	"	"	"	"	"
5173	"	"	"	.....	Ambonychia acutirostris, Hall	2	Port Byron, Ill.	"	"	"	"
5174	"	"	"	.....	Pleurotomaria halei, Hall	1	Le Claire, Iowa	"	"	"	"
5175	"	"	"	.....	Pleurotomaria solaroides, Hall	1	"	"	"	"	"
5176	"	"	"	.....	Cyrtoceras (sp?)	1	"	"	"	"	"
5177	"	"	"	.....	Phragmoceras parvum, H. & W.	1	Port Byron, Ill.	"	"	"	"
5178	"	"	"	.....	Orthis erratica, Hall	1	Madison Co., N. Y.	Hud. River (in drift)	"	"	"
5179	"	"	"	.....	Spirifera cycloptera, Hall	2	Albany Co., N. Y.	Lr. Held.	"	"	"
5180	"	"	"	.....	Meristella arcuata, Hall	2	"	"	"	"	"
5181	"	"	"	.....	Rhynchospira formosa, Hall	1	"	"	"	"	"
5182	"	"	"	.....	Pentamerus galeatus, Dalman	1	Catskill, N. Y.	"	"	"	"
5183	"	"	"	.....	Orthis planoconvexa, Hall	1	Albany Co., N. Y.	"	"	"	"
5184	"	"	"	.....	Platyceras gebhardi, Conrad	1	Catskill, N. Y.	"	"	"	"
5185	"	"	"	.....	Slab, showing Meristella sulcata, Vanx., Avicula rugosa, Con., and Leperditia alta, Con.	1	Anamosa, Iowa	Waterline.	"	"	"
5186	"	"	"	.....	Cyathophyllum (sp.?)	1	Rock Island, Ill.	Cornif.	"	"	"
5187	"	"	"	.....	Cladopora turgida, Rominger	1		"	"	"	"
5188	"	"	"	.....	Spirifera capax, Hall	2	Muscatine, Iowa	"	"	"	"
5189	"	"	"	.....	Spirifera fimbriata, Conrad	1	Davenport, Iowa	"	"	"	"
5190	"	"	"	.....	Atrypa aspera, Schl.	2	Rock Island, Ill.	"	"	"	"
5191	"	"	"	.....	Atrypa reticularis, L.	3	"	"	"	"	"
5192	"	"	"	.....	Pentamerus comis, Owen	8	"	"	"	"	"
5193	"	"	"	.....	Pentamerus arata, Conrad	1	"	"	"	"	"
5194	"	"	"	.....	Strophomena hemispherica, Hall	1	Davenport, Iowa	"	"	"	"
5195	"	"	"	.....	Pleurotomaria arata, Hall	1	Rock Island, Ill.	"	"	"	"
5196	"	"	"	.....	Ptycodus calceolus, M. & W.	3	Davenport, Iowa	"	"	"	"
5197	"	"	"	.....	Cyathophyllum davidsonia, Hall	1	Buffalo, Iowa	Ham.	"	"	"
5198	"	"	"	.....	Cyathophyllum rugosum, E. & H.	1	"	"	"	"	"
5199	"	"	"	.....	Streptelasma rectum, Hall	2	Rock Island, Ill.	"	"	"	"
5200	"	"	"	.....	Favosites hamiltonensis, Rominger	1	Buffalo, Iowa	"	"	"	"
5201	"	"	"	.....	Monticulipora monticola, White	2	"	"	"	"	"
5202	"	"	"	.....	Batocrinus longirostris, Hall	1	Burlington, Iowa	Burlington	"	"	"
5203	"	"	"	.....	Terebratula linklaeni, Hall	2	Buffalo, Iowa	Ham.	"	"	"
5204	"	"	"	.....	Spirifera aspera, Hall	1	Rock Island, Ill.	"	"	"	"
5205	"	"	"	.....	Spirifera engelmanni, M. & W.	1	Rock Island Co., Ill.	"	"	"	"
5206	"	"	"	.....	Spirifera imbrex, Hall	1	Burlington, Iowa	Burlington	"	"	"
5207	"	"	"	.....	Spirifera incerta, Hall	1	"	"	"	"	"
5208	"	"	"	.....	Spirifera pennata, Owen	1	Davenport Iowa	Ham.	"	"	"
5209	"	"	"	.....	Spirifera perextensa, M. & W.	3	Rock Island Co., Ill.	"	"	"	"

Specimens registered in the General Museum in 1883.—Continued.

Serial Number.	OBTAINED.		NAME.	No. of Specimens.	Locality.	Formation	Collector and Remarks.
	When.	Whence.					
5210	Oct. 1883.	By exchange.....	<i>Spirifera plena</i> , Hall.....	3	Burlington, Iowa.....	Burlington	} From A. S. Tiffany. Davenport, Iowa.
5211	"	"	<i>Meristella doris</i> , Hall.....	1	Buffalo, Iowa.....	Ham.....	
5212	"	"	<i>Meristella haskinsi</i> , Hall.....	1	?	"	" " " "
5213	"	"	<i>Meristella meta</i> , Hall.....	3	Buffalo, Iowa.....	Ham.....	" " " "
5214	"	"	<i>Athyris angelica</i> (?), Hall.....	1	"	"	" " " "
5215	"	"	<i>Athyris vittata</i> , Hall.....	5	"	"	" " " "
5216	"	"	<i>Cyrtina acutirostris</i> , Shumard.....	1	Davenport, Iowa.....	"	" " " "
5217	"	"	<i>Atrypa bystrix</i> , Hall.....	5	"	"	" " " "
5218	"	"	<i>Atrypa reticularis</i> , L.....	10	"	"	" " " "
5219	"	"	<i>Strophodonta demissa</i> , Conrad.....	2	"	"	" " " "
5220	"	"	<i>Strophodonta nacrea</i> , Hall.....	1	"	"	" " " "
5221	"	"	<i>Strophodonta perplana</i> , Conrad.....	4	Rock Island Co., Ill.....	"	" " " "
5222	"	"	<i>Pteronites decussatus</i> , Hall.....	1	Buffalo, Iowa.....	"	" " " "
5223	"	"	<i>Productus engelmanni</i> , var. <i>burlingtonensis</i> , Hall.....	1	Burlington, Iowa.....	Burlington	" " " "
5224	"	"	<i>Productus pratienianus</i> , Norwood.....	1	"	"	" " " "
5225	"	"	<i>Productella exanthematus</i> , Hall.....	1	Davenport, Iowa.....	Cornif.....	" " " "
5226	"	"	<i>Chonetes pusilla</i> , Hall.....	1	Rock Island, Ill.....	Ham.....	" " " "
5227	"	"	<i>Chonetes setigera</i> , Hall.....	1	Buffalo, Iowa.....	"	" " " "
5228	"	"	Fossiliferous slab.....	1	Burlington, Iowa.....	"	" " " "
5229	"	"	<i>Metoptoma umbella</i> , M. & W.....	1	"	Burlington	" " " "
5230	"	"	<i>Gomphoceras pingue</i> , Hall.....	1	Buffalo, Iowa.....	Ham.....	" " " "
5231	"	"	<i>Phacops rana</i> , Green.....	1	Rock Island Co., Ill.....	"	" " " "
5132	"	"	Favosites placenta, Rominger.....	1	Livingston Co., N. Y.....	"	" " " "
5233	"	"	<i>Terebratula ontario</i> , Hall.....	1	Erie Co., N. Y.....	"	" " " "
5234	"	"	<i>Spirifera medialis</i> , Hall.....	1	Livingston Co., N. Y.....	"	" " " "
5235	"	"	<i>Spirifera mucronata</i> , Con.....	2	Erie Co., N. Y.....	"	" " " "
5236	"	"	<i>Spirifera sculptilis</i> , Hall.....	2	Livingston Co., N. Y.....	"	" " " "
5237	"	"	<i>Trematospira gibbosa</i> , Hall.....	1	"	"	" " " "
5238	"	"	<i>Trematospira hirsuta</i> , Hall.....	2	Genesee Co., N. Y.....	"	" " " "
5239	"	"	<i>Nucleospira concinna</i> , Hall.....	2	Livingston Co., N. Y.....	"	" " " "

5240	"	"	..... <i>Orthis cyclas</i> , Hall	2	"	"	"	"	"
5241	"	"	..... <i>Atrypa hystrix</i> , Hall	1	"	"	"	"	"
5242	"	"	..... <i>Atrypa reticularis</i> , L.	4	"	"	"	"	"
5243	"	"	..... <i>Platystoma lineatum</i> , Con.	3	Genesee Co., N. Y.	"	"	"	"
5244	"	"	..... <i>Platystoma strophium</i> , Hall	2	York, N. Y.	"	"	"	"
5245	"	"	..... Slab, showing <i>Streptorhynchus chemungensis</i> (a var.), <i>Spirifera alta</i> and <i>S. mucronata</i>	1	Burlington, Iowa	Chemung	"	"	"
5246	"	"	..... Slab, showing <i>Avicula circulus</i> , H., <i>Spirifera strigosa</i> , Meek, <i>S. lineata</i> , Martin, and <i>Nucula</i> (sp.?)	1	"	"	"	"	"
5247	"	"	..... <i>Spirifera subrotundata</i> , Hall	1	"	"	"	"	"
5248	"	"	..... <i>Spirifera</i> (<i>carteri</i> , Hall) <i>eurpidota</i> , Sow. (1812)	1	Le Grand, Iowa	"	"	"	"
5249	"	"	..... <i>Spirifera mucronata</i> , Con.	1	"	"	"	"	"
5250	"	"	..... <i>Spirifera ziczac</i> , Hall	1	"	"	"	"	"
5151	"	"	..... <i>Stenoschisma contractum</i> , Con.	1	"	"	"	"	"
5252	"	"	..... <i>Palaecaris obtusa</i> , M. & W.	1	Nauvoo, Ill.	Keokuk	"	"	"
5253	"	"	..... <i>Archimedes</i> (sp.?)	1	Keokuk, Iowa	"	"	"	"
5254	"	"	..... <i>Spirifera increbescens</i> , Hall	2	Iowa Falls, Iowa	"	"	"	"
5255	"	"	..... <i>Spirifera keokuk</i> , Hall	1	Keokuk, Iowa	"	"	"	"
5256	"	"	..... <i>Spirifera pseudolineata</i> , Hall	1	Nauvoo, Ill.	"	"	"	"
5257	"	"	..... <i>Orthis keokuk</i>	1	"	"	"	"	"
5258	"	"	..... <i>Strophodonta</i> (sp. n.?)	1	"	"	"	"	"
5259	"	"	..... <i>Productus flemingi</i> , var. <i>burlingtonensis</i> , Hall	1	Keokuk, Iowa	"	"	"	"
5260	"	"	..... <i>Productus tenuicostus</i> (?), Hall	1	"	"	"	"	"
5261	"	"	..... <i>Productus wortheni</i> , Hall	1	"	"	"	"	"
5262	"	"	..... <i>Myalina keokuk</i> , Worthen	1	Nauvoo, Ill.	"	"	"	"
5263	"	"	..... <i>Phillipsia portlocki</i> , M. & W.	1	"	"	"	"	"
5264	"	"	..... <i>Zaphrentis dentata</i> , Roninger	1	Spurgeon Hill, Ind.	St. Louis	"	"	"
5265	"	"	..... <i>Productus tenuicostus</i> , Hall	1	St. Louis, Mo.	"	"	"	"
5266	"	"	..... <i>Zaphrentis spinulosa</i> , E. & H.	1	Chester, Ill.	Chester	"	"	"
5267	"	"	..... <i>Lophophyllum prolificum</i> , McChesney	2	Bloomington, Ill.	Coal Mas.	"	"	"
5268	"	"	..... <i>Fenestella shumardia</i> , Froot.	1	Topeka, Kansas	"	"	"	"
5269	"	"	..... <i>Polypora</i> (sp.?)	1	"	"	"	"	"
5270	"	"	..... <i>Synocladia biserialis</i> , Swallow	1	"	"	"	"	"
5271	"	"	..... <i>Terebratulula bevidens</i> , Morton	2	La Salle, Ill.	"	"	"	"
5272	"	"	..... <i>Spirifera camerata</i> , Morton	2	"	"	"	"	"
5273	"	"	.....	1	7 miles N. of Genesee, Ill.	"	"	"	"
5274	"	"	..... <i>Spirifera lineata</i> , Martin	3	Cameron, Mo.	"	"	"	"
5275	"	"	..... <i>Athyris subbilita</i> , Hall	3	Rapids City, Ill.	"	"	"	"
5276	"	"	..... <i>Rhynchonella uta</i> , Marcon	2	La Salle, Ill.	"	"	"	"
5277	"	"	..... <i>Orthis carbonaria</i> , Swallow	2	"	"	"	"	"
5278	"	"	..... <i>Streptorhynchus occidentalis</i> , New.	1	Cameron, Mo.	"	"	"	"
5279	"	"	..... <i>Productus longispinus</i> , Sowerby	2	Rapids City, Ill.	"	"	"	"
5280	"	"	..... <i>Productus nebrascensis</i> , Owen	1	Cameron, Mo.	"	"	"	"

Specimens registered in the General Museum in 1883.—Continued.

Serial Number.	OBTAINED.		NAME.	No. of specimens.	Locality.	Formation	Collector and Remarks.
	When.	Whence.					
5281	Oct. 1883.	By exchange.....	Productus semireticulatus, var. ivesi, New.	1	Atkinson, Ill.	Coal Meas.	{ From A. S. Tiffany, Daven- port, Iowa. " " " " " "
5282	"	"	Chonetes granulifera, Owen	2	La Salle, Ill.	"	" " " " " "
5283	"	"	Chonetes mesloiba, N. & Praten	3	Bloomington, Ill.	"	" " " " " "
5284	"	"	Nucula ventricosa, Hall	3	Springfield, Ill.	"	" " " " " "
5285	"	"	Nucleospira ventricosa, Hall	2	Sheffield, Ill.	"	" " " " " "
5286	"	"	Schizodus alpina, Hall	2	"	"	" " " " " "
5287	"	"	Platystoma peoriaense, McChesney	1	La Salle, Ill.	"	" " " " " "
5288	"	"	"	1	Menard Co., Ill.	"	" " " " " "
5289	"	"	Pleurotomaria grayvillensis, N. & P.	3	Bloomington, Ill.	"	" " " " " "
5290	"	"	Pleurotomaria sphaerulata, Conrad	2	Atkinson, Ill.	"	" " " " " "
5291	"	"	Pleurotomaria subsinuata, M. & W.	4	Springfield, Ill.	"	" " " " " "
5292	"	"	Bellerophon carbonarius, Cox.	2	Atkinson, Ill.	"	" " " " " "
5293	"	"	" marcouianus, Geist.	1	Bloomington, Ill.	"	" " " " " "
5294	"	"	" percarinatus, Conrad	1	Atkinson, Ill.	"	" " " " " "
5295	"	"	" tricarinatus, Shumard	1	"	"	" " " " " "
5296	"	"	Polyphemopsis peracuta, M. & W.	6	Springfield, Ill.	"	" " " " " "
5297	"	"	Rutile (?)	1	{ Wellstown, in Adi- rondack Mts. }	"	" " " " " "
5298	"	"	Hematite	1	Pilot Knob, Mo.	"	" " " " " "
5299	"	"	Apatite	1	Iron mountain, Mo.	"	" " " " " "
5300	"	"	Gypsum	1	Fort Dodge, Iowa	"	" " " " " "
5311	1878.	Presented	Lower jaw with four teeth	1	Rochester, Minn.	Recent	{ Presented by W. D. Hurlbut (found in a marsh). " " " " " "
5312	"	"	Equus caballus, second molar of upper jaw, right side	1	" " " " " "	"	" " " " " "
5313	"	"	Equus caballus, second molar of upper jaw, left side	1	" " " " " "	"	" " " " " "
5314	Dec. 1883.	"	Lignite from a well, one piece 8 in. long	Much	Litchfield, Minn.	Cret. in dr.	G. Dickson.
5315	July 1883.	"	Pottery clay	1	{ Near R-d Jacket R. R. bridge, Mankato }	Cret.	J. G. Koller.
5316	1883.	"	Kaolin (decomposed gneiss)	1	Redwood Falls	Eozoic	S. J. Race.

5317	Nov. 1883.	Geol. & Nat. Hist. Survey	Red quartzite	2	Sec. 8, Delton, Cot. Co.	Potsdam	N. H. Winchell.
5318	"	"	"	1	Sec. 9, " " "	"	"
5319	"	"	"	1	" " " "	"	"
5320	"	"	Upper surface of the Jordan sandstone under the Cret. clay	2	L'Huilier Mound, South Bend	Cambrian	"
5321	"	"	Surface of the Shakopee limestone, coated with a ferruginous crust.	1	Mankato	Shak. & Cret.	"
5322	"	"	"Blue stone"	6	"	Shak.	(J. R. Beatty's quarry).
5323	"	"	Hydraulic shale	5	"	"	"
5324	"	"	Hydraulic limestone	8	"	"	(Standard Cem. Company).
5326	"	"	Hydraulic cement	Two quarts	"	"	"
5327	"	"	White clay between the Shakopee and Jordan	Much	"	Cret.	"
5328	"	"	" " " "	"	South Bend	"	(L'Huil. Mound)
5329	"	"	" " " "	"	Mankato	"	(Cement Company's quarry).
5330	"	"	Red clay	"	"	"	(Near Indian lake).
5331	"	"	Red shale	"	New Ulm	Dakota	(Winkelman's).
5332	"	"	Limestone	2	"	Niobrara	"
5333	"	"	Shaly limestone	1	"	"	"
5334	"	"	Calcite (nail-head spar)	2	"	"	"
5335	"	"	Conglomerate (ferruginous)	2	Mankato	Dakota	(Near Red Jacket R. R. bridge).
5336	"	"	Oolitic chert in conglomerate	2	"	"	"
5337	Oct. 1883.	"	Magnesian limestone	1	Sec. 20, Frankford, Mower Co.	Devonian	(Aaron Bush's quarry).
5339	"	"	" " underlying the "Le Roy rock"	1	½ mile N. of Le Roy village	"	(In the bed of the creek).
5343	"	"	Conglomerate (ferruginous)	3	Sec. 13, Frankford, Mower Co.	Cret.	"
5344	"	"	Shale (whitish)	1	1½ ms. north of Grand Meadow	"	(Beside the road).
5346	"	"	Silicified wood, 75 feet below the surface	1	Sec. 8, Lakeville	Drift	(From a well).
5347	"	"	Copper (2 inches square, ¼ in. thick)	1	Rosemount	"	"

STATE GEOLOGIST.

Specimens registered in the General Museum in 1883.—Concluded.

Serial Number.	OBTAINED.		NAME.	No. of specimens.	Locality.	Formation	Collector and Remarks.
	When.	Whence.					
5348	Oct. 1883.	Geol. & Nat. Hist. Survey	Sand (from the drift)	Much	Minneapolis	Drift	N. H. Winchell. (Bank of Tuttle's creek).
5349	"	Presented	Hydraulic cement	1	Rosendale, N. Y.		
5350	Dec. 1883.	"	Manufactured peat	Much	Near Coon creek, Anoka Co.	Recent	Presented by Dwight Mitchell.
5351	July 24, '83.	"	Gray limestone, with dendritic markings	60	20 miles N. of Gallatin, Montana		J. B. Alexander. (Canon of the Missouri R.)
5352	"	"	Mass (2 feet long) of calcite crystals	1	" " " " " "		" " " "
5353	1883.	"	Silver ore; big San Juan mining district	3	Near Ophir, San Miguel Co., Col.		Prof. S. H. Folsom.
5354	"	"	Magnesian limestone, hammer-dressed	1	Near Winona	St. Law	Winona Freestone Company.
5355	"	"	Pipestone, in part purplish-gray	1	Pipestone City	Potsdam	C. H. Bennett.
5356	"	"	"	2	"	"	D. Sweet.
5357	"	"	" purplish gray.	1	Baraboo, Wis.	"	Prof. R. D. Irving.
5359	1881.	Geol. & Nat. Hist. Survey	Magnesian limestone, pink	12	Kasota	Shakopee	N. H. Winchell. (Hand samples).

V.

CRUSTACEA.

C. L. HERRICK.

THE GEOLOGICAL AND NATURAL HISTORY SURVEY OF MINNESOTA.

N. H. WINCHELL, STATE GEOLOGIST.

A FINAL REPORT

ON THE

CRUSTACEA OF MINNESOTA

INCLUDED IN THE ORDERS

CLADOCERA AND COPEPODA,

Together with a synopsis of the described species in North America, and keys
to the known species of the more important genera.

By C. L. HERRICK, Assistant in Zoology.

MINNEAPOLIS :
JOHNSON, SMITH & HARRISON.
1884.

—❖ PREFACE ❖—

IN presenting what may be denominated a final report of the work done in this state upon the group of crustacea best represented, and, all things considered, most important, the author must admit that the term "final" refers only to his own opportunities and the limitation of time imposed by circumstances.

While a comparatively large proportion of all the species existing within our limits have been examined during the progress of these investigations, there undoubtedly remain many additional and curious forms to reward the search of the student. A great variation in the degree of completeness with which the different genera and species have been treated will be observed, due in part to the circumstances under which they were studied, and frequently to the poverty of material. The entomostracean fauna is quite different at different seasons, and a complete knowledge of even our local fauna requires a long period of observation. Even the dead of winter is a favorable time to study some groups. The late autumn is, perhaps, the most favorable opportunity; for then, in one group, the sexual activities are just at their height, and both sexes may be studied. A number of cladocera are restricted to this season. There are a number (how large it is not yet possible to tell) of species in both groups which are to be sought by night though no phosphorescent species are yet known. Our larger, and, especially, deeper lakes have a quite different fauna from the shallow pools and rivers. In general, the flowing waters are poor in entomostraca. The cladocera or shelled entomostraca, have here received a large share of attention, and more particularly the Lynceidæ, which are the most minute of arthropods. This study has been rewarded with an unexpectedly large number of forms, and a particularly large number of species identical with those of Europe and elsewhere. Prof. Birge is the only American writer who has attempted this group, and his valuable work has made us familiar with the more striking new species. A few new species are included in our list and several varieties hardly yet known in Europe. The remarkable *Monospilius* is among these. This animal has but a single larval eye in the middle of its forehead, and

wears its old covering over the newly-formed shell till the latter is a curious patchwork mass. The attempt has been made to incorporate a brief description of all American species with those found in Minnesota, and also to frame keys for the larger genera, so that the place of a species among its congeners may, at least approximately be found. The difficulty of framing such keys is very great; for few authors have employed the same distinctions in their descriptions, and it is necessary to select points sharply distinctive and conspicuous from the often meagre remainder after striking off scattering particulars. In some cases this difficulty has been greatly enhanced by the possibility that some of the species should be considered synonyms or varietal forms. The tendency to combine questionable forms thus produced it was necessary to offset by what may seem a too great conservatism. Faulty, however, as these keys may be, it is hoped that they will serve a good purpose in the extent which they cover. While the limits of this work preclude much more than a systematic outline, opportunity is taken here and there to admit a word on the anatomy or development. Such allusions must be considered simply accidental, for a complete treatment of these subjects would require large volumes, and the material will be long in gathering. A larger proportion of the rare males of the cladocera are here referred to than in any previous work of equal extent. The genus *Cyclops*, one of the bugbears to fresh-water carcinologists, is perhaps somewhat summarily treated. The excuse must be the condition of the synonymy. However, most of the combinations made were the result of careful study of large series from different localities. The sketches illustrating this paper are photo-printed from the writer's own drawings, and, without the elegance of lithographs, serve the purpose of explaining points of structure which cannot be communicated verbally. I am indebted to Prof. A. S. Forbes for very timely aid in bibliography, without which the paper could not have been completed. To Dr. Lindthal, through my friend Mr. Oestlund, I am indebted for a like service. But my obligation is deepest to Prof. Rudolph Leuckart of Leipzig, who kindly afforded access to almost a complete set of works on European entomostraca. Prof. C. W. Hall has collected at much expenditure of time and labor a set of specimens from different parts of the state which he kindly placed in my hands, thus enabling me to observe the great similarity of widely-separated faunæ. Mr. Lieberg also sent specimens of *Diaptomus stagnalis* from saline pools in Dakota.

INTRODUCTORY.

" Evading e'en the microscopic eye,
 Full nature swarms with life ; one wondrous mass
 Waiting the vital breath, when Parent Heaven
 Shall bid the spirit blow. The hoary fen,
 In putrid streams, emits the living cloud
 Of pestilence. Through subterranean cells,
 Where searching sunbeams scarce can find a way,
 Earth animated heaves. The flowery leaf
 Wants not its soft inhabitants. Secure
 Within its winding citadel, the stone
 Holds multitudes. * * where the pool
 Stands mantled o'er with green, invisible
 Amid the floating verdure, millions stray.
 * * Nor is the stream
 Of purest crystal, nor the lucid air,
 Though one transparent vacancy it seems,
 Void of their unseen people."—*Cowper*.

To the poet only, and the man of science, is it given to meet these "unseen people" on those familiar terms which warrants the use of the word intimacy; yet may not we who, like Sam Weller, find our "vision limited," because we have only eyes, avail ourselves of the kind introduction these people give us, and shake hands, as it were, though perhaps a little stiffly, with our neighbors, the unseen people.

Whether we like it or not—Cowper intimates we shall not—these people, in one way or another, touch us constantly, and like diminutive sprites are ever active in hatching mischief or doing their little favors to humanity. Happily most of these are amiable goblins, and are tireless in endeavors to secure us against our insidious enemies of their own ilk. With your permission we will draw the curtain which separates us from the naiades of our pools and streams.

The numbers of living forms to be found in any pool is a constant surprise even to the student of this subject, and the variety and unique character of the animals, particularly, cause a constant flow of wonder and admiration. Confining ourselves to the crus-

tacean forms which are, perhaps, most typical, abundant and interesting of the smaller animals of fresh waters, it is to be remarked that they are of a practical value to an extent which can hardly be correlated with their seeming insignificance.

To understand this fact it is first necessary to recollect that water in some form is an indispensable vehicle for the nidus of disease germs as well as of all life; desiccation means death. The abundantly-watered portion of our country must become permeated with the pestilential hordes engendered in its fens did not this army of devouring animalculæ destroy the decaying matters accumulating in the waters.

Their importance depends largely on their minute size and unparalleled numbers. The majority of non-carnivorous crustaceans are so constituted that their diet is nearly confined to such floating particles of matter as are present in the water, in a state of more or less fine comminution; for, nearly without prehensile organs, these animals, by means of a valvular or, at most, ladle-like labrum, dip from the current of water kept flowing by the constant motion of the branchial feet, such fragments as the snail and scavenger-fish have disdained. All is fish which enters the net. Think of it, poor dyspeptic, a constant supply of food of every variety and no question asked for stomach's sake! Bits of decaying algæ or the broken fragments of a disintegrated mosquito, all alike acceptable and unhesitatingly assimilated.

Nor is the sanitary aspect the only one in which the *entomostraca*, as our minute crustacea are collectively called, command attention; they are valuable also as a food supply.

Now, does some one jump at the conclusion that the water we drink is filled with aliment in such pleasant form as that represented above—that Dr. Tanner after all lived on a watery solution of entomostraca? Too fast, my friend—food for fishes, but not therefore an insignificant element in our cuisine economy; for it has recently been shown by Prof. Forbes of Illinois, that some of our best fresh-water food fishes are almost dependent on some one or more species of entomostraca. Darwin shows that cats regulate the clover crop of England via field-mice and humble-bees, but it is not half as far from our “bugs” to the price of trout and white-fish.

Still we are not prepared to be surprised at this, for have we not long understood that whales go fishing, with their whalebone nets, for little mollusks not big enough to excite the cupidity of the catorial small boy?

The fact is, that the principle laid down by the Deacon (of venerable memory) that "the weakest pint must stand the strain," maintains in nature aside from the nature of "shays." The minutest forms are in some sense the most important, for they are the links which stand nearest the rock, and if they be loosened the dependent series falls.

The animals of the above group are, it is likely, the best criteria by which to judge of the purity of natural waters if their distribution were correctly understood. The presence of some species in great numbers is sufficient evidence of organic impurity. A critical study of the contents of samples of such waters will enable us to determine their character almost as well as by analysis. The following list of the animal life visible in a quart of filthy pond-water, taken by simple dipping, will perhaps be suggestive on this point:

<i>Daphnia pulex</i>	6
<i>Ceriodaphnia</i>	1400
<i>Simocephalus</i>	56
<i>Cypris</i>	50
<i>Cyclops</i>	30
<i>Sand-fleas</i>	120
	<hr/>
Total Crustacea	1662
Infusoria	35
Arachnida (<i>Hydrachna</i>)	1
Vermes	5
Insecta—	
<i>Coleoptera</i> (larvæ)	8
<i>Diptera</i> (larvæ)	11
<i>Hemiptera</i>	10
Mollusca	35
	<hr/>
Total	1767

The above are simply the animal forms visible to the (trained) unassisted eye; the truly microscopic forms number vastly more.

But each gathering includes specimens of carnivorous entomost-raca as well, and these are not less interesting and bizarre than the cladocera.

The common cyclops, busy picking the bones of a luckless polliwog (must we say purwiggy?), is not less benevolent than the animate filters mentioned above. The amount of such material that they will dispose of in a short period of time is truly astonishing. It is the province of the following chapters to describe briefly such of these animals as fall in the two groups Cladocera and Copepoda and have been noticed in America.

CHAPTER I.

THE ENEMIES OF ENTOMOSTRACA.

First among these rank the young of various fishes which prey upon, and find their entire support in, these minute animals. This subject has been fully treated by Forbes, Ryder and others.

The enemy next most dreaded by entomotraca is, perhaps, the "spectre animalcule" or the larva of the little frost-gnat, corethra. It is no unusual thing to see a corethra carefully gorging itself with a fat cyclops, suddenly seized by the protractile jaws of the dragon-fly larva, shaken for a minute and then engulfed in the tomb-like cavernous mouth below. Nor is the road to the stomach of the dragon-fly always so circuitous. Water-tigers also, with other larvæ, prey upon these unfortunates. The hydra considers them a dainty morsel, and at once paralyzes them by the touch of his nematocystiferous arms; in other words, by the poisonous barbs coiled in concealment in the cells of the tentacles.

If the animal flies from these ubiquitous enemies he almost certainly is betrayed by carnivorous plants which abound in all our waters. Forbes says: "In ten bladders of *Utricularis vulgaris*, taken at random, I found 93 animals, either entire or in recognizable fragments, and representing at least 28 species. Seventy-six of the animals found were entomotraca, and belonged to 20 species." "Just one-third of all the animals found in these bladders belonged to the single species *Acroperus leucocephalus*, Koch."

But among the ranks of enemies must be included certain parasites, both external and internal, of which a variety are known. A few of the most remarkable of these will be mentioned. I may be permitted to quote from an article in the *American Naturalist*, April, 1883:

"We have discussed the relation of the minute fresh-water crustacea to sanitary science in a paragraph in a recent article in the *Naturalist*, but it remains to touch upon another phase of the subject. It may be thought unnecessary to trouble ourselves

about the pathological conditions prevailing among such lowly animals, but it can be shown that these same causes of disease may not be unimportant in connection with human diseases.

It is a fact constantly receiving new exemplification, that the parasites infesting small animals, particularly water animals, are frequently but the immature forms of parasites of animals higher in the scale. These alternating generations are exceedingly difficult to study, so that while all stages may be separately known, only a fortunate combination of circumstances or patient accumulation of facts can connect the individual factors into the complete cyclus.

Thus, for example, Prof. Leuckart has but recently worked out the full life-history of *Distomum hepaticum*, although the adult has been a stock example in helminthological study in the laboratory for years.

The importance of such parasites, even in a commercial view, needs but a reference to trichinosis to illustrate. I am not aware that endo-parasites are known in entomostraca except in the case of cyclops. Embryos of *Cucullanus elegans*, a nematoid worm, enter the body cavity of cyclops and undergo two moults and then are transferred to the intestinal canal of food fishes.¹

A similar parasite of cyclops is *Filaria medinensis*.²

The cladocera are generally quite free from parasites, but I have found in several instances young nematoids in the blood sinus in front of the heart in *Daphnia schæfferi*. These worms subsist upon the nutriment in the blood which constantly bathes the animal. True cysts could not be formed in the cobweb-like tissues of the hosts. This is, so far as I can learn, the first publication of entozoa from cladocera, and the parasites are figured in Plate T, Fig. 15. The animals were from 'Schimels Teich,' Leipzig.

While collecting copepods near Tuscaloosa, Ala., I gathered a number of specimens of *Cyclops tenuicornis*, and nearly all were unusually pale and feeble. On examination they proved to be infested with a worm of the sub-order Distomeæ. This sub-order includes many distressing parasites and forms which are adapted to be widely distributed by a long period of adolescence, and the number of stages passed through before maturity is attained."

"The larvæ live frequently in mollusca, and in maturity inhabit the intestine of vertebrates.

Upon examination, the cyclops individuals collected were nearly

¹Claus. Kleines Lehrbuch d. Zoologie, p. 368.

²Fedschenko. Ueber d. Bau. u. d. Entwicklung d. *Filaria medinensis*, Moscow.

all found affected, some having as many as five parasites of various sizes about the alimentary canal, in the common vascular cavity which corresponds to the entire arterial and venous system of the more highly organized Calanidæ. The Cerцерian or tailed stage was not found. Were the life-history known it would probably appear that the larval stage is passed within some young mollusks, and that the adult infests some vertebrate, probably fish, and would thus be perhaps transferred either in food or drink to the human system.

It is worthy of notice that the host was soon destroyed by the parasite, the post-imago or coronatus form being absent; most of the individuals thus infested possessed abnormally persistent larval characters in antennæ, etc." (See also below on *Lagenella mobilis*).

The external parasites are more numerous but, in the main, less dangerous. Among these are a variety of algæ, and colonies of *Vorticellæ* and related animals. There is almost always a colony of *Acineta* near the anus of *Cyclops phaleratus*. Rarely *Stentor* is found upon the body of *Cyclops*.

The most remarkable ectoparasite among the protozoa is the remarkable louse-like ciliate protozoan, to be described beyond, found as a parasite of *Diaptomus pallidus*.

Finally, certain of the rotifera are very constant enemies of the entomostraca, one species making its diet almost exclusively of *Chydorus sphaericus* and stowing them away with remarkable facility with its forceps-like jaws.

A NEW SPECIES OF CORETHRA.

(Plate V. Figs. 1-4)

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The *Corethra plumicornis* as known in the larval form is one of the most abundant of the inhabitants of our inland waters, and its form and habits are sufficiently well known. (See *Types of Animal Life* by the author for description and figures.)

A second, and presumably new, species was found in a night gathering from Lake of the Isles near Minneapolis. In motion it differed so entirely, though indescribably, that the eye recognized it at once as new. The few specimens then obtained were all that have been seen, but I will here give a brief description of the larva and pupa in hope that the imago may finally be encountered.

The form is more slender than in *C. plumicornis*. The tracheal vessels are of a different form and color, and the viscera have obvious differences. Most conspicuous variations, however, are seen in the shape of the head, which is slender and attenuated toward the insertion of the antennæ. The antennæ are shortish and have a spine outwardly. The cuticular appendages have an unusual form as has the labrum. The anterior part of the head is spiny. The armature of the end of the abdomen is peculiar.

The posterior rudimentary appendages are of a different form, and the claws are replaced by club-shaped bodies. A curious appendage below is indicated in the name. The pupa has an extraordinarily elongate abdomen which terminates in two paddle-like appendages loosely ciliated outwardly. This species may be called

***Corethra appendiculata*, sp. n.**

A NEW ECTOPARASITIC PROTOZOAN.

(Plate V. Figs. 12-13.)

The very strange monocellular animal referred to was found scurrying over the body of *Diaptomus pallidus* in a manner like that of a louse scrambling over a bare spot upon its host. The body is disc-shaped and about .04 mm. in diameter. The lower or ciliated side is flat and circular. The upper or aboral portion is convex with an annular depression of greater or less regularity about half way from the center to the margin. The lower side has a chitinous barred ring, corresponding to the depression above, containing about 25 radially arranged bars, each of which, apparently, forms the support for a long cilium which with the others forms a circlet extending beyond the margin. These cilia are used as feet and by them the animal is able to move in any direction, apparently with none of the uncertainty of motion usual to ciliate infusoria. The protoplasm is granular and contains one or more contractile vesicles, one of which appeared very regularly in the center of the chitinous ring before mentioned. These animals can also swim freely, but after a short excursion usually came quickly back, and after shuffling or sliding over the smooth surface of the crustacean assumed a position of repose. The generic affinities of this protozoan

are uncertain (Chilodontidæ?); the specific name may, perhaps, be safely applied as follows:

pedicularis, sp. n.

Cragin notices the occurrence in American species of Cyclops of *Lagenella mobilis*, Rehberg. This gregarine (?) was found by him at Cambridge, inhabiting in large numbers the digestive tract of species of Cyclops, and has since then been observed in Minnesota.

CHAPTER II.

ORDER CLADOCERA.

This very extensive group contains a variety of types, but there are sufficiently evident connecting links uniting the extremes of structure. The *Gymnometra* which, following the usual custom, we include here, stand distinct from the other groups, yet have sufficiently evident cladoceran affinities. It is very unfortunate for ætiological speculation that this the only truly marine group should stand thus isolated from its fellows. According to the notions at present prevailing, the Phyllopod stands nearest the primitive type of crustacea. There are unmistakable hints at an early origin for that group, and not less evident are certain analogies with both Cladocera and Copepoda.

There has, however, recently been made an attempt to derive the Phyllopod from an original cladoceran stem with, as we think, somewhat unsatisfactory results. Do we not rather see in both groups two like phases which may be looked upon as incidental and comparatively trivial. The shelled and the shell-less phase appears in both. The most closely shelled Phyllopod is unmistakably nearer *Branchipus* even than any of the Cladocera. It would seem that the brief and imperfect embryonic nauplius condition of the latter sufficiently indicated their later origin. Again no fanciful analogy can unite the Ostracoda with the Lynceidæ. We know of no recent discoveries casting discredit on the remark of Balfour: "the independent origin of the Ostracoda from the main crustacean stem seems probable."

Prof. Packard says:¹

"We imagine that when a permanent body of fresh water became established, as, for example, in perhaps early Silurian times, the marine forms carried into it in the egg-condition, possibly by birds

¹"A Monograph of the Phyllopod Crustacea," etc., *XIIth Annual Rep. U. S. Geol. and Geog. Surv. Terr.*

[sic?] or by high winds, hatched young, which under favorable conditions, changed into *Sida*, *Moina*, and *Daphnia*-like forms. The Cladocera are, then, probably the more generalized forms, from which the Phyllopods, at this time and probably ever since Devonian times, *par excellence* a fresh-water assemblage of forms, took their origin." Whatever affinity there may be between the shelled Phyllopods and the Cladocera, it would seem that the evidence is conclusive that the latter group is not the direct continuation of the line of development inaugurated by an ostracode ancestor. As shown beyond, the present centre of the group seems near *Moina* with indications of a divergence from this rather generalized type, especially of degradation and heteronomy on the side of the Lynceids.

It seems at the present time that more might be accomplished for ætiology by a careful study of such groups as the present, in which are a variety of closely allied forms than by the attempt to join widely separated groups. When we shall have siezed upon the latest eddies and mapped their direction, it may become possible to combine the indications in such a way that lines of divergence thus traced accurately through some small part of their course may be produced backward to their intersection. This then is our present duty—the accurate mapping of minute districts and the careful noting of any moving straws, competent to indicate movements in the vast complex of vitalized nature. We conceive the cladocera to have had a comparatively recent origin, and to express the culmination and retrograde development of a plan of structure first differentiated after the appearance of clear bodies of fresh water. All the species save a very few are confined to inland waters. Accepting the above mentioned theory, the *Sididæ* will occupy the first place as departing least from the type from which the whole group sprang, while it is connected by the genus *Daphnella* with the *Daphnidæ*. The *Daphnidæ*, beginning with *Moina*, find their ultimate development in some monstrous forms of the genus *Daphnia*, but pass into the *Lyncodaphnidæ* by way of *Macrothrix*. The links uniting all these minor groups are very obvious.

Our own ideas of the relationships among the Calyptomerous Cladocera are expressed in the accompanying table. This table is to be considered a projection of a portion of a genealogical tree, seen from below, in which the genus *Moina* forms the arbitrarily chosen fixed point. The heavy dotted line is imagined as directed downward vertically. That branch rising toward the top of the

page is growing obliquely upward. The Daphnidæ are represented as expanding upon the same plane as Moina, and the Lyncodaphnidæ extend diagonally downward, producing the Lynceid branch. The Bosminidæ spring from the stem at a lower point. These relations are made obvious by the figure giving a view of the ideal tree as seen from the side.*

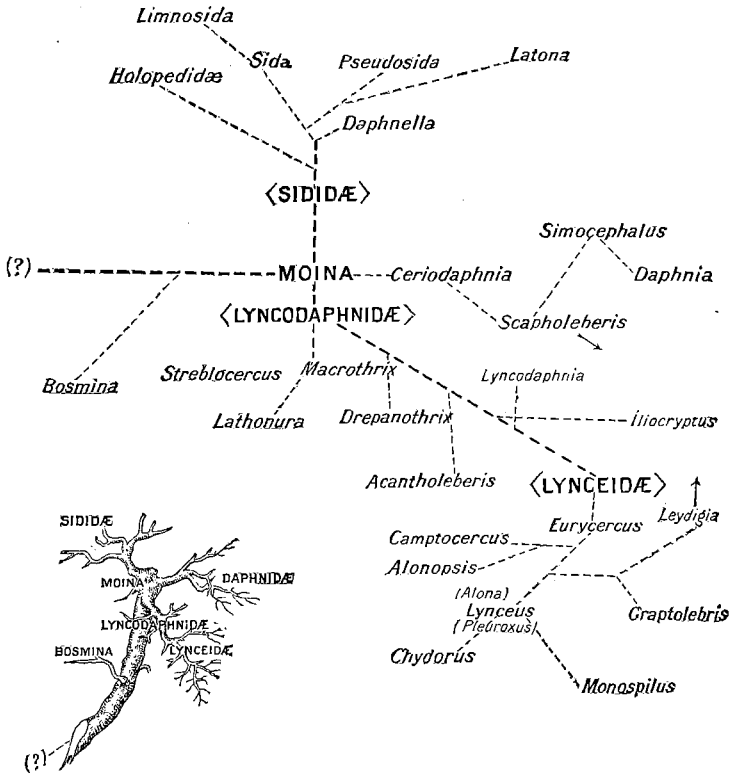


FIG. 1.—TABLE ILLUSTRATING THE RELATIONS OF THE CLADOCERA CALYPTOMERA.

*NOTE.—To adapt the diagram to the theory that the Lynceidæ are the progenitors of Cladocera, it is only necessary to revolve the imaginary line to the right, till it coincides with the axis of that family. The question mark may be understood to indicate that the source of the pivotal group, Moina, is uncertain. The author must confess that his inclination is toward a belief that the line culminating in the Daphnidæ diverged from a group of organisms resembling Phyllopora, more definitely, resembling Limnetes. There is a very remarkable resemblance between the larva of Limnetes and Bosmina. The lateral spines of the former are, as will be shown true homologues of the antennules of Bosmina. The later origin of the Phyllopora in their present form may be well admitted.

1 Entomostraca, seu Insecta testacea, quæ in aquis Daniæ et Norwegiæ reperit descripsit, etc. *Otho Friedric Mueller*, 1785.

2 Monoc. qui se trouvent aux Envir. de Geneve.

The Cladocera or Daphnoidea are characterized by the more or less leaf-like feet, and the lamina of thin chitine which encloses the greater part of the body, or at least forms a sac for the protection of the eggs. This so-called shell springs as a fold from the maxillary segment and is the most conspicuous and variously formed, while really least important, of the structural peculiarities.

All Cladocera begin life with a single median eye, but some lose it during later life. In one case it remains the only visual organ.

The outer covering is in most cases changed by frequent moults. The period of the moult is one of the most precarious in the life history of the animal.

Although figures and brief descriptions of animals belonging to this group are to be found in the works of Swammerdam, Leewenhoek, Trembley and other of the older authors, Mueller¹ was the first to produce a systematic work upon these in common with other minute fresh-water crustacea. He may be called the father of the study of micro-crustacea. Jurine,² an eminent Swiss naturalist, was the next to contribute important discoveries relating to these interesting animals, though Ramdohr had given anatomical details of several species. Gruisthuisen, a little later gives farther details of *Daphnia sima* (*Simocephalus*). The work of Milne Edwards gives a resume of what was known regarding these animals in that period. Soon afterwards the work of Baird became the beginning of a new era, and the study of the minute crustacea sprang into importance at once. The Scandinavian peninsula being the birth-place of the science, it is proper that the most exhaustive work on the group should be performed there.

The most important of the later writers are Leydig, Schoedler, Fischer, Lilljeborg, P. E. Mueller, Sars, Weismann, Claus and Kurz.

The complete bibliography of the subject up to Mueller's time is found in Baird's *British Entomostraca*; the greater part of the later bibliography is to be found in P. E. Mueller's *Danmark's Cladocera*. A few only of the more important works are here mentioned.

Koch, C. L., Deutschlands Crustaceen, etc.

Schoedler, J. E., Ueber *Acanthocercus rigidus*, etc.

Dana, J. D., Crustacea of the Wilkes' Exploring Expedition.

Lievén, Die Branchiopoden der Danziger-Gegend.

Fischer, Leb., Ueber die in der Umgegend von St. Petersburg vorkommenden Crustaceen, etc., 1851.

Lilljeborg, W., De Crustaceis ex ordinibus tribus, (or) Om de inom Skane forekommande Crustaceer af ordningarne Cladocera, Ostracoda och Copepoda.

This valuable work is particularly good on the Cladocera, but is unfortunately without Latin descriptions; so that the Swedish text is a hindrance to its usefulness. It is chiefly of historic value now. Large 8vo; Lund, 1855.

Schoedler, J. E., Die Branchipoden der Umgegend von Berlin, 1858.

Smitt, F. A., Sur les Ephippes des Daphnes.

Lubbock, J., An account of the two methods of reproduction in Daphnia, etc.

Leydig, Fr., Naturgeschichte der Daphniden.

The most magnificent work published.

Lilljeborg, W., Leptodora hyalina, 1861.

Sars, G. O., Om Crustacea Cladocera, iagttagne i Omegnen af Christiania, 1862.

This valuable work is difficult of access, printed on thin paper and without illustrations. A second paper by the same author in 1863 is mentioned, but I have never seen it.

Schoedler, J. E., Neue Beitrage zur Naturgeschichte der Cladoceren, 1863.

One of the most important works on the Lynceidæ. The author is rather too credulous and inclined to form new species.

Klunzinger, Einiges zur Anatomie der Daphniden nebst kurzen Bemerkungen ueber die Susswasserfauna der Umgegend Cairo's.

Sars, G. O., Norges Ferskvandskrebssdyr Cladocera ctenopoda, 1865.

The best work on the Sididæ, etc.

Mueller, P. E., Danmark's Cladocera.

One of the most useful books on the subject. Especially good on Lynceidæ and Bosminidæ.

Plateau, Felix, Recherches sur les Crustacés d'eau douce, etc., 1867-69.

Mueller, P. E., Note sur les Cladoceres des Grands Lacs de la Suisse.

Weismann, A., Bau und Lebenserscheinungen Leptodora hyalina.

Sars, G. O., Om en dimorph Udvikling Samt Generationsvexel hos Leptodora, 1873.

Claus, C., Zur Kennt. d. Organ. u. d. feineren Baues der Daphniden.

Claus, C., Zur Kennt. des Baues, etc., der Polyphemiden.

Gruber and Weismann, Ueber einige neue oder unvollkommen gekannte Daphniden.

Weismann, Thierleben im Bodensee, 1877.

Lutz, A., Untersuchungen ueber Cladoceren der umgebung von Bern.

Claus, C., Die Schalendruse der Daphniden, 1874.

Spangenberg, Fr., Ueber Bau und Entwicklung der Daphniden.

Lilljeborg, W., Crust. Sueecorum Ordin. Branchiop. et Subord. Phyllop., 1877.

Pavesi, P., Nuova Serie di recherche della fauna pelagica nei laghi Italiani, 1877-1879.

Grobben, C., Zur Entwicklungsgeschichte d. Moina rectirostris, 1789.

Weismann, Beitrage zur Naturgesch. der Daphnoiden, Leipzig, 1876-79. (Valuable on the physiology).

The American literature may be catalogued in a few lines. The first descriptions and figures with which I am familiar are those in the Rep. of the U. S. Fish Commission, 1874, where S. I. Smith notes *Daphnia galeata*, *D. pellucida* and *D. pulex*; also a species of *Bosmina*, *Eurycercus lamellatus* and *Leptodora hyalina*.

A. E. Birge was the first to systematically study Cladocera in America, and his "Notes on Cladocera" furnished a basis upon

which to build. A few notes were published by the writer a little later.

A few additional notes and descriptions of new species were published in the *eleventh annual report of the Minnesota geol. and nat. hist. survey*.

Prof. Birge published other notes in the *Medical Journal and Examiner* of Chicago, which I have not seen.

Prof. Forbes of Normal, Ill., in an article in the *American Naturalist*, July, 1882, adds a number of facts and one new species.

In addition to the above, a figure of *Sida* was printed in one of Hayden's Survey Reports, and some account of the Cladocera of lake Michigan was given by B. W. Thomas, I believe, in one of the official reports of the Chicago Water Commission.

CLASSIFICATION OF THE CLADOCERA.

SUB-ORDER I.—CALYPTOMERA (membrane-clothed).

Body enclosed in a bivalve shell. Mandibles truncate below. Maxillæ distinct, spiny. Thoracic ganglia discrete.

TRIBE I.—CTENOPODA.

Feet six, similar, foliaceous, all distinctly branchiate.

FAM. 1.—SIDIDE.

Swimming antennæ with two unequal rami, intestine simple.

FAM. 2.—HOLOPEDIDÆ.

Swimming antennæ simple, elongate cylindrical (in the male prehensile), intestine with two lateral dilations.

TRIBE II.—ANOMOPODA.

Feet five (or six) pairs, the anterior pair more or less prehensile and destitute of branchiæ.

FAM. 1.—DAPHNIDÆ.

Rami of antennæ three and four-jointed, five pairs of feet, the last with a curved appendage guarding branchial sac; antennules of female short, one-jointed.

FAM. 2.—BOSMINIDÆ.

Six pairs of feet, antennules elongated, many-jointed.

FAM. 3.—LYNCODAPHNIDÆ.

Antennules of female elongated, but one-jointed; intestine simple or convolute.

FAM. 4.—LYNCEIDÆ.

Antennæ with both rami three-jointed, intestine convolute, with abdominal but no anterior cæca.

SUB-ORDER II.—GYMNOMERA (destitute of covering).

Body without or nearly destitute of bivalve shell; feet not branchiate, spiny. Anterior thoracic ganglia in one mass.

FAM. 1.—POLYPHEMIDÆ.

Abdomen curved, terminating in two long stylets.

FAM. 2.—LEPTODORIDÆ.

Abdomen straight, ending in short claws.

FAMILY SIDIDÆ.

Head separated from the body by a depression, without prominent fornices (or spreading shields) over the base of the antennæ. First pair of antennæ, or antennules, as we shall uniformly call them, one-jointed, usually rather small in the female, but extending into a very strong flagellum in the male. Antennæ long, biramose, with unequal branches. Mandibles truncate at the end. Maxillæ armed with large spines. The form is usually elongate, and the abdomen often extends beyond the edge of the shell behind. The male openings are usually in the end of long appendages which depend from the base of the post-abdomen. This interesting family is represented in America so far by four species, one of which constitutes a new genus. Others will undoubtedly be found upon a careful study of the fauna of the great lakes. Most of the species prefer the clearer and colder water of large lakes. The processes of development, as traced by the writer, vary very little from the method exhibited by *Moina*. The ephippial condition, however, is not found in these animals which are less subject to destructive influences of the climate. They do, however, produce so-called winter eggs which are laid in October and are distinguished from the summer eggs, which hatch in the brood cavity, by a brown color and the presence of fatty spheres. These eggs are produced in large numbers in distinction from most other Cladocera in which the winter eggs are very few. These eggs are permitted to settle to the bottom and there develop at the proper time. *Sida crystallina* is often found in immense numbers in large lakes which contain abundant plant growth. The size, and especially the reproduction activity, is very dependent on the environment, and hence little success is obtained in preservation in aquaria. Some of the genera are nocturnal and should be sought at the surface on quiet evenings.

I.—GENUS *SIDA*. Straus.

(Plate N. Figs. 12-14.)

Body elongate, hyaline. Head small, quadrate. Fornices absent. Antennules of female small, truncate; of male, with a long

flagellum. Second antennæ with the rami two and three-jointed. Male with the sexual openings just behind the last pair of feet. It is the upper or longer branch of the antennæ which in *Sida* is three-jointed, while the reverse is the case in the next genus. The only species, according to P. E. Mueller, is the ubiquitous *S. crystallina*. The *S. elongata* of Sars is distinguished by the smaller head and its concave lower margin and more elongate shell. The terminal joint of the longer ramus has one less seta than *S. crystallina*, while the post-abdomen has more numerous spines. We incline to believe it a valid variety at least. The bibliography below is extracted from a previous report:

- Daphne crystallina*, MUELLER.
Daphnia crystallina, LATREILLE, BOSC.
Sida crystallina, STRAUS, Mem. Mus. Hist. Nat.
Sida crystallina, M. EDWARDS, Hist. Nat. Crust.
Monoculus crystallinus, GMELIN, MANUEL, FABRICIUS.
Monoculus elongatus, DE GEER, Mem. servir. Hist. Ins.
Sida crystallina, LIEVIN, Branch. d. Danziger Geg.
 BAIRD, Brit. Entom.
 LILLJEBORG, De crust. ex ord. trib.
 FISCHER.
 SCHOEDLER, Die Branch. d. Umg. v. Berlin.
 Neue. Beitr.
 LEYDIG, Naturg. d. Daph.
 SARS, Norges Ferskv-Krebsdyr.
Sida elongata, SARS, " " "
Sida crystallina, P. E. MUELLER, Danmark's Cladocera.
 KURZ, Dodekas Neuer Cladoceren.
 BIRGE, Notes on Cladocera.
 HERRICK, Microsc. Entom.
 LUTZ, Untersuch. u. d. Cladoceren d. Umg. v. Bern., 1878.
 WEISMANN.
 GROBBEN, Entwicklung. Moira.
 HERRICK, Crustacea of Minnesota.

II.—GENUS PSEUDO-SIDA. Herrick. (Genus n.)

Similar to *Sida*. Antennules of the female, with a long flagellum, like that of the male of *Sida*, sensory setæ lateral. Body elongate, head short, extending into a sharp beak. The post-abdomen is armed with groups of sharp spines or bristles. Most characteristic, however, is the fact that the antennary joint, which in *Sida* is two-jointed, in this species is tri-articulate, and the two-jointed ramus has a great number of setæ (16-17).

Sp. 1. *Pseudo-sida bidentata*, Herrick. (Sp. n.)

(Plate K. Fig. 9.)

Post-abdomen armed with 12-14 clusters of spinules in a transverse row; the terminal claw armed with two long basal spines, and with numbers of fine teeth on the inside. The two-jointed

ramus of the antennæ has six setæ on the basal, and ten or eleven on the terminal joint, while the three-jointed ramus has a short terminal joint bearing three spines. The valves are marked with sparse spines on the lower margin. In most respects this species is like *Sida*, which it resembles in size. In the form of the female antennæ it is like *Latona* which it also somewhat resembles in the number of joints of the antennæ and the numerous setæ they bear. It is certainly an interesting transition form. Found only in swamps bordering Mobile bay, Ala., but whether in brackish or fresh water my notes do not inform me. *Sida crystallina* lives far out in the bay, and *Daphnella* is found in pools along shore.

III.—GENUS LIMNOSIDA. Sars.

(Plate N. Fig. 9.)

Head crested; eye in a conical prominence. Shell elongated, produced above in an acute angle. Antennules small, truncate in the female; in the male of enormous size; antennæ very long. Post-abdomen smooth; terminal claw spiny.

The one species, *L. frontosa*, Sars, is not yet known in America.

IV.—GENUS DAPHNELLA. Baird.

Neither beak nor fornices present. Antennules of female small, truncate; those of male long, flagellate. Antennæ with two-and three-jointed rami. Male with a hook on the first foot, and large copulatory organs attached to the base of the post-abdomen.

Sp. 1. *Daphnella brachyura*, Lievin.

Sida brachyura, LIEVIN, Branch. d. Danziger Geg.

Daphnella wingii, BAIRD, Brit. Entom.

Sida brachyura, LILLJEBORG, De crust. ex ord. trib.

Diaphanosoma brandtianum, FISCHER, Ergänz. Berichtlg.

Daphnella brandtiana, SARS, Norges Ferskv.—Krebsdyr.

Daphnella brachyura, P. E. MUELLER, Danmark's Cladocera.

Daphnella brachyura, LUTZ, Untersuchung u. die Cladoceren d. Umg. v. Bern.

Sida brachyura, PAVESTI, Nuova serie di ricerche della fauna pelagica nei laghi Italiani (L. Trasimene).

Daphnella brachyura, HERRICK, Notes on Crustacea of Minnesota.

(Compare also *D. expinosa*, BIRGE, Notes on Cladocera p. 3.)

The species of *Daphnella* found about Minneapolis, occasionally abundant, seems not to differ in any important character from European types of *D. brachyura*, although I formerly regarded it as distinct (*D. winchelli*, Microscopic Entom., Addenda).

Head less than $\frac{1}{2}$ the body (about .27 mm., while the body is .6 mm. long); eye about $\frac{1}{4}$ head; antennæ when reflexed extend a little beyond $\frac{2}{3}$ the length of body. Male, .7 mm. long; antennæ

reflexed, reaching base of shell; anterior antennæ extremely long; copulating organs reaching nearly to end of claws. Having carefully compared our specimens with the descriptions and figures given by Birge for his *D. expinosa*, the evidence seems to indicate not only that they are identical, but both are really *D. brachyura*. The distinctive characters of *D. expinosa* are a greater indentation between head and body, absence of caudal teeth, greater length of male appendages, and the opening of the vasa deferentia below the "instep" of these appendages.

The absence of teeth upon the post-abdomen is of even generic importance according to Sars, who gives it in his synopsis of genera as typical for *Daphnella*. In our specimens the claws are at least pectinate if not serrate, while the appendages of the male reach generally nearly to the middle of the claws. The relative length of these appendages and the antennæ of the male is variable.

Sp. 2. *Daphnella brandtiana*, Fischer.

Head as long as half the body, antennæ when reflexed reaching beyond the posterior margin of the valves. Length 0.8 mm. Of the validity of this species we can form no conclusion. It is usually considered a variety or phase of the above.

V.—GENUS *LATONA*, Straus.

(Plate N. Fig. 8.)

Body elongate, broad; head large and square, appendaged below with triangular laminæ; fornices present. Antennules rather large. The larger ramus of the antennæ is two-jointed and has an expanded process at the base. The lower posterior angle of the shell has a peculiar diverging set of setæ. The shell is often ornamented with numerous flecks of bright color. There is a copulatory apparatus in the male.

***Latona setifera*, Mueller,**

Is the only species, and is not yet recognized in Minnesota, but was found by Prof. Birge in lake Michigan.

FAMILY HOLOPEDIDÆ.

GENUS HOLOPEDIUM, Zaddach.

(Plate N. Fig. 11.)

The peculiar animal bearing the name *Holopedium gibberum* has the brood cavity greatly elevated, and the whole upper part of

the animal is covered by a jelly-like mass secreted as a protection or float. The antennæ are simple in the female and extend through a slit in this covering. In the male they are prehensile and have rudimentary inner rami. It would be difficult to recognize the affinity of the female with its monstrous form were it not for the male and particularly the development history. Found in this state probably only in lake Superior. Forbes mentions it from lake Michigan.

FAMILY DAPHNIDÆ.

The family Daphnidæ contains the genera *Moina*, *Ceriodaphnia*, *Scapholeberis*, *Simocephalus* and *Daphnia*, which include the commonest, as well as some of the largest, Cladocera. The genera may be distinguished by the following table:

- | | | |
|------|---|------------------------|
| I. | Head rounded, not beaked; antennules long in both sexes, shell not covering the end of the abdomen..... | <i>Moina</i> . |
| II. | Head rounded; antennules rather short; shell enclosing whole body..... | <i>Ceriodaphnia</i> . |
| III. | Head somewhat beaked below, shell angled below or extending in long spines from the lower angle, pigment fleck roundish.... | <i>Scapholeberis</i> . |
| IV. | Head beaked below; shell rounded below, with a blunt spine above; pigment fleck elongate..... | <i>Simocephalus</i> . |
| V. | Head beaked below; shell extending in a sharp spine at the upper posterior angle; pigment fleck small..... | <i>Daphnia</i> . |

THE CIRCULATORY SYSTEM OF THE DAPHNIDÆ.

In the *Daphnidæ*, and, indeed, the Cladocera in general, we meet an instance of great development of surfaces at the expense of solidity of form and compactness of organs. The whole body is composed of an aggregate of laminæ, and the appendages all approximate more or less toward this fundamental modification. Thus, for example, the head is a leaf-like body with a laminate shield above and a pair of flat organs beneath. The abdomen terminates in a knife-like post-abdomen, while the thorax, with its narrow form, foliaceous feet and, far more, the enormous development of the outer wall to enclose, more or less fully, the entire body, is the typical illustration of this fact. Necessarily this structural modification exerts a formative influence on the internal organs which are all more or less influenced by it; and this is peculiarly the case with the more external and, in general, the paired organs. Thus the "shell glands," so called, which in Copepoda are generally coiled tubes, become here greatly flattened organs closely united with the shell. The physiological result of this modification is the

sensitiveness to changes in the environment, which is universal among the *Daphnidae*. The compact Copepoda survive the vicissitudes of confinement with comparative immunity, but the first taint in the water destroys the delicate organism of *Daphnia*. The cause for this may be found in the exposure of the most vital and delicate parts of the organism to the influences of the surrounding aqueous medium. In particular the circulatory and respiratory systems, which here are not easily to be distinguished one from the other, constitute a relatively very large area of close contact with the water. It thus happens that the central organs are influenced in a very short time by whatever deleterious substances may be disseminated in the water.

Notwithstanding this lack of centralization, the structure of these animals is of a very considerable degree of complexity and, presenting so many instructive modifications under circumstances so favorable for study, has been very thoroughly investigated. The very transparency which has made it possible to clear up many questionable points in crustaceology from the lessons learned in *Daphnia*, has rendered the investigation of certain sets of organs extremely difficult, and among these may be mentioned the circulatory system. The circulation of the nutritive fluid and the general facts connected with the heart were indeed early understood; but there remains many a detail and some important relations which are as yet either imperfectly known or entirely misunderstood. The following notes are offered as a contribution to the, as yet incomplete, knowledge of the circulatory apparatus.

The observations were confined for the most part to *Daphnia schæfferi* and *Simocephalus vetulus*, with occasional comparisons with *Eurycercus*, *Pleuroxius*, *Pasithea* and others. It is greatly to be desired that the study might be carried to the *Sididæ*, in which the larger size and superior transparency would doubtless reward the search with several, as yet doubtful details. The circulation of the nutritive fluid in the *Daphnidæ*, then, is somewhat complicated, but may be divided into a superficial and a deep system. It must be remarked that this distinction is arbitrary and only used for its convenience. The one extends over the entire inner surface of the carapace, while the latter is in close relation with the vegetative organs, and extends into the branchial vessels of the feet. The nutritive fluid which is normally colorless and supplied with corpuscles of organized nutriment, (it seems doubtful if they should be called blood corpuscles) is confined for the most, if not its entire, course within membranous walls of connec-

tive tissue which, however, instead of assuming a definite form as "blood vessels," for the most part conform to the contour furnished by the firmer organs.

This membrane which is frequently folded upon itself and invests the body walls and the inner organs, is in some places free, and may be seen as a pulsating, swinging film, or, more frequently, it can only be detected as a swaying line (seen in optical sections), thus giving rise to the misapprehension that one is dealing with a thread, or as moving grains, in which case the film is itself invisible but its presence is indicated by the attached grains of protoplasm. About the heart the free swaying portions of this membranous layer are so numerous as to render it almost impossible to distinguish the essential from the accidental appearances.

This membrane must serve the most various purposes; aside from the mere retention and direction of the blood currents, it is often transformed into a branchial surface. At definite points it becomes the bearer of the cells which were above mentioned as grains of protoplasm. These are most numerous in young and well-fed animals, and in particular in gravid females, while, on the contrary, mature males and females after the escape of the young, are nearly devoid of such bodies. These are most numerous in angles of the membrane, particularly about the heart, shell glands, ovaries, intestine and the branchial spaces in the feet.

These cells vary in size from that of the blood corpuscles to larger cells with nuclei of comparatively very large size. It would be too much to say that such cells are developing blood corpuscles; but that they are reservoirs of nutriment which serve to supply the increased demand upon the blood in exigencies of the existence of the animal, cannot be doubted. It is a well known fact that the number of blood corpuscles, so called, likewise varies, and apparently under the same conditions. It seems altogether probable that the two facts may be considered as supplementary, *i. e.* that the same process of depauperating of the blood, which deprives it of its corpuscles in an earlier stage, lays waste those supplies laid up in the cells referred to (whether by their actual separation as blood corpuscles or simply desolving of the contained material is of little importance). These cells also are thus parallelized with the "oil globules" of *Copepoda*. In such copepods as *Cyclops* and *Canthocamptus*, which appear to have no differentiated heart, there are always present drops of colored fluid, which are most numerous in well-fed and pregnant specimens. These

drops occupy the same relative position as the blood globules of other Crustacea, *i. e.*, they lie within a very thin membrane corresponding to the vascular walls of other animals. This membrane, in general, invests the alimentary canal, as can be very readily seen in the abdomen, where it encloses a considerable space about the intestine, which is filled with fluid, investing more or less completely the muscles and other organs. As there is no rapid circulation of blood, these "oil drops" are comparatively stationary, and yet are moved slowly by the constant contraction of the walls of the alimentary canal which, in the anterior part, or stomach, are thick and glandular, while in the abdomen they seem to be more fitted for respiratory function.

The above arrangement in *Cyclops* is correlated with its compact habit and thick carapace, and forms a simple starting-point for the study of the circulatory system in arthropods. It seems that the walls of the membranous blood cavity are themselves also, in places, furnished with muscles, so that the fluid is not dependent entirely on the vermiform or the peristaltic motions of the intestine for its escape from stagnation. If this be correct, we here have an indication of the origin of the central organ of the circulatory system.

But to return to *Daphnia*, the heart lies in the dorsal region over the intestine upon which it may be said to ride, as it were astride, though as we shall see, it is separated from the intestine by other organs. In *Eurycercus* this is most evident, as here the heart is more obviously bifurcate.

The heart and circulation in *Daphnia* has been described more or less at length by many authors, in particular *Claus* (Zur Kenntniss der Daphniden und verwanter Cladoceren. Zeitsch. f. Wiss. Zool. Bd. xxvii.) and *Gruithuisen* (the work of this author I have not seen), while *Weismann* (Ueber Bau und Lebenserscheinungen von *Leptodora hyalina*, 1874) describes the heart of *Leptodora*, and *Claus* (Zur Kenntniss des Baues und der Organ. der Polyphemiden), that of the Polyphemidæ. Other authors, except *G. O. Sars*, who elucidates some points in the circulation of blood in *Sida*, seem to have added little or nothing to our knowledge of this interesting subject.

As already often described, the heart occupies a place in a definite space—the *pericardial chamber*—the summit of which is the dorsal shield which, we believe, should be distinguished from the remainder of the so-called cephalic shield. (It is usual to describe the shell of *Daphnia* as consisting of a bivalve posterior

portion or *ormostegite*, and a simple anterior *cephalostegite*; but it seems much more proper to consider that portion of the shell which covers the pericardial space, and is the point of attachment of the powerful muscles of the abdomen and of the membranous walls of the pericardium, as a distinct portion of the carapace, as it often evidently appears through the presence of a distinct suture, or, in its absence, through the peculiar sculpture of the shell. In such case it might also be proper to distinguish two regions on the lateral appendages of this dorsal shield, an upper and a lower, separated by the more or less obvious line, extending from the union of the lateral lines of the dorsal and cephalic shield in nearly a straight line toward the posterior portion of the shell, and indicating the insertion of the muscles which move the feet and post-abdomen. The lateral walls of the pericardial space are the shell-walls themselves, and the floor is formed by a membrane supported on, and investing in part, the strong muscles which connect the abdomen with the upper anterior part of the dorsal plate. Thus a space is left between the pericardium and the intestine which is occupied by a special blood sinus leading toward the posterior and lower part of the abdomen. The posterior wall of the space is formed by a chitinous partition which bounds the brood space, or its homologue, and is connected by chitinous processes (*stutzbalken*) with the outer skeleton. The anterior, on the other hand, is only bounded by the supporting ligaments of the abdomen above described and membranous partitions. As usually described, the heart lies suspended in the cavity thus defined, by slender muscular threads, more or less like those of the heart of *Corethra* larvæ and the like; and such seems to be the case at first, but a more careful study shows that this is far from correct. On the contrary, the chief supports of the heart are membranes which, seen in cross-section with the attached grains or blood globules, assume the appearance of exceedingly slender structureless threads. The action of re-agents indicates that these supposed threads are not muscles, but composed of connective tissue; while by changing the focus the sharpness of the line is frequently not altered, but *its relative position is changed*,—a simple test which often serves to dispel an illusion of this sort. That there are some threads of the character above mentioned is not to be doubted, as in connection with the valves of the heart; but the proper support of the heart is found in the membranes which invest it in part, and are reflected upon the walls of the shell and, anteriorly, of the intestine. It is not yet possible to fully describe

the insertion of these tissues, as there is so large a number, especially about the anterior opening, where they lie in all directions and at all angles, and are so transparent, that only their vertical sections appear as dark lines. Thus the same membrane appears and disappears, only to re-appear in a different position where it might be readily taken for a distinct membrane. In general, however, I hope to make no serious error in the following summary. Before going into detail, however, it will be necessary to consider the intimate structure of the heart, as well as its general shape and position.

The general shape is that of an irregular oval with the greatest convexity posterior (*Daphnia*, etc.), or it may be strongly bifid and thus somewhat Y-shaped (*Eurycercus*, etc.). It is held in position in the pericardial cavity by the membranes above alluded to, to which it is attached at definite points, the principal of which are two slight enlargements on the lower posterior portion, which are in part opposed to each other and also to a superior posterior point of insertion. All three of these points are thus held in relation with the shell with which the attached membrane is connected on either side below and above. The membrane then extends part way along the heart wall towards the anterior and is then reflected to the shell wall. The result of this is that the pericardial space is an angular cavity opening in front. It would seem as though the membrane attaching the heart were identical with that lining the cavity itself. The heart proper is obviously composed of series of muscular elements, which are considered as simple cells by Claus, and which in young individuals show very distinct nuclei of comparatively large size. These are arranged like the meridian lines of a globe uniting above and below, thus forming the most effective apparatus possible for contracting the heart. In the smaller Daphnidæ, as stated by Claus, there seems to be but a single layer of muscular rays, but in *D. schæfferi* and *Simocephalus* I have repeatedly satisfied myself that some of the longitudinal rays sink below the others and form a series of *longitudinal muscles*, as stated by earlier writers. These are furnished with a nucleus which is frequently more or less external, appearing like a spherical appendage. In *Leptodora* Weismann has shown the heart to consist primarily of a membrane of connective tissue, upon which the muscular fibres or cells sit in somewhat the same position as in *Daphnia*, except that there is not the same regularity in the arrangement. There are many considerations which would lead us to expect the same structure in *Daphnia*, though it is not yet

demonstrated; and the structure of the anterior opening seems to point in the same direction. At any rate there is a close connection between the muscular and connective parts of the heart. We have, then, in the heart of *Daphnia* a highly developed apparatus for closing it, but apparently none for its opening. This certainly is not accomplished by the few fibers which connect the heart with the shell, the very contractility of which is doubtful. Nay, more, these are insufficient even to hold it in its place in the cavity. Still less can we assume that the heart, from any inherent power, can open itself. This must be explained by the operation of two factors which are interdependent, *i. e.*, the elasticity of the supporting membranes and the unequal pressure of the blood in different parts of the body. 1. The membranes which support the heart are attached not at right angles, but, on the contrary, in a direction more nearly parallel to the walls of the heart, and thus whatever elasticity they possess is greatly increased; and the diminishing of the size of the heart draws these membranes out of their position at the expense of their elasticity, which tends to restore them to their original position when the pressure is removed, in the same way a drum-head returns after a blow to its normal position. This factor is, however, only operative so long as the whole system of membranes to which these belong is distended with fluid. If this blood cavity be punctured, the fluid flows out and the heart shrivels. It may continue to beat for some time, but it will be seen that the effort consists simply in a vigorous contraction which is followed by no perceptible enlargement. 2. After the systole the blood of the heart is forced toward the head, whence it is prevented from re-entering the pericardial space directly by the valves and the membrane enclosing the arterial blood. The pressure is therefore increased in all parts of the system, except the pericardial chamber where it is greatly diminished. The membranes supporting the heart are thus unusually tense, and the muscular effort having ceased, the walls of the heart are distended, and blood flows in in the direction of the least resistance through the two lateral openings or ventral valves of the heart. The contraction of the heart during the systole is not simultaneous in different parts, but begins by the contraction of the posterior part where, being nearly free, the motion is more marked. At the close of the systole the heart is irregularly contracted, the points of attachment above described being more distended than the remaining portions. The anterior of the heart is rendered very difficult to study by the fact that its opening is

covered by the muscles of the mandibles and obscured by the many supporting and vibrating membranes alluded to.

It is, however, suspended by two folds of membrane which I have been inclined at times to believe blood-vessels through appearances resulting from the confused currents flowing about them. The upper margin is also attached by a pair of cords directly to the superior part of the shell. The anterior opening or arterial valve is most perplexing, and the following description which applies only to *Daphnia schæfferi* must be subject to some doubt. It appears however that it has been in a measure misunderstood by previous writers, and namely by Claus, who compares it with that of *Leptodora*, which if correctly described by Weismann, is not at all identical in form, but quite comparable with one of the sides or lips of the venous opening. It does not seem to be connected by a thread, as stated for *Leptodora*, with the aortal bulb, for in reality there is no aortal bulb; the heart simply is connected with the system of membranes which more or less inclose the system. The floor of the so-called aortal space is a membrane which separates the outflowing stream from a current which flows toward the abdomen and passes directly under the arterial opening, so that it appears as though there was a stream entering the heart from before as well as at the sides; the arterial opening being nearer the dorsal part of the heart than is naturally expected, and the slight enlargements at the attachment of the supporting membrane favoring the impression that there is here a veritable opening. The out-flowing blood stream is bounded at first by the membrane above mentioned, which is farther on reflexed onto the shell and intestine so that the streams in the head flowing just under the shell are separated from the deep dorsal stream flowing from the heart.* This main current passes to the region of the eye between the horns of the cæca of the alimentary canal, and thence beneath the stomach, and here divides, part becoming external and a deeper part passing under the intestine, thence in front of the heart, flows into the deep sinus which, as before said, passes beneath this organ. Other portions of the returning stream flow around the angle of the union of the head and body and constitute a stream just above the feet in which the current flows vigorously.

Yet other portions flow into the region of the shell-gland and are united with blood which here passes through the numerous sinuses described by Claus as surrounding this organ (Die Schalen-

*In *Pastthea rectirostris* this septum is easily seen as a swaying membrane, which near the eye is reflexed to the top of the shell.

druse der Daphnien) and thence flows into the abdomen, uniting with the other two streams. A part also of the current in the head flows into the antennæ where it follows a deep course through the basal joint in which the corpuscles may be seen to emerge to the surface from two points where are spaces between the powerful muscles, the first being near the base and the second near the extremity of this joint, and then to return and join the superficial current.

The corpuscles appear to enter the rami very rarely if at all. That part of the superficial stream which reaches the interior of the pericardial chamber passes between the muscles of antennæ and jaws and seems to find its way into the great current beneath the heart, though I have also thought to have seen it flow directly into the pericardial space as the lateral superficial streams do. That part of the superficial stream which reaches the posterior margin of the shell returns through a canal formed by the walls of the shell and the brood-space, between the "stutzbalken" of which the blood corpuscles can be seen to glide more rapidly than in the free lateral spaces.

Lastly, it only remains to follow the fortune of the strong stream flowing along the neutral surface of the abdomen. The strong current flowing beneath the heart enters a broad sinus which lies over the intestine and extends for over a third of its length, where its walls unite with the surface of the intestine above and thus open downward on either side.

The stream thus directed flows toward the openings of the base of the feet. The structure of the branchiæ has not yet been clearly described. Instead of nearly spherical or oval chambers they are really tubes which connect, on one hand with the opening above, and below with the general cavity of the limb, whence the blood returns to the abdomen. The current is very rapid through these tubes. The blood having been returned to the abdomen, courses in the well known manner through the post-abdomen and flows over the intestine, thence over the back-flowing stream to the posterior lower opening of the pericardial chamber.

The study of the actions of the heart is rendered more difficult by the fact that in order to secure the greatest possible transparency, the living animal must be covered and a little pressure applied, which is frequently attended with abnormal variations of the circulation. In particular if the usual exit of the blood be stopped by the cæca of the intestine, as is frequently the case, the operation of the heart may be reversed, when a vigorous stream may be

seen to enter the arterial opening and emerge from the ventricles. This process would be impossible if the anterior valve were as described by Claus and Weismann; while being really more like the venous valves, it is easily and frequently permitted. The current of the blood in this case stagnates except near the heart.

The rapidity of the pulsations of the heart varies with age and condition of rest or motion.

In *D. schæfferi* this variation may range from about 150 per minute to perhaps 250, 200 being probably a fair average. In a young *Simocephalus* I have observed a heart beat 300 times in a minute. Again, in a specimen of *D. Schæfferi* at rest the heart was beating 170, but during the spasmodic motion of feet and antennæ the pulse rose to over 200.

I.—GENUS MOINA. Baird.

The systematic position of this genus has been the theme of some discussion, it being claimed, with good reason, that there are many resemblances to the Lyncodaphnidæ (P. E. Mueller considers it a transition to the Bosminidæ and lyncodaphnids); on the other hand, Leydig and Kurz regard it more closely allied to the Sididæ, with equally good reason. The long antennæ, long narrow antennules and many peculiarities in form, etc., suggest the macrothroid crustaceans; the extended abdomen and especially the location of the male seminal opening are like *Daphnella*, which *Moina* resembles in motion and habit very strikingly. The absence of the pigment fleck is no more a characteristic of the Sididæ than of other groups. After all has been said, the immediate affinities of the genus are acknowledged to be with the Daphnidæ.

The true place of the genus, as it appears to the writer, was hinted at by Birge (Notes on Cladocera). *Moina* seems to be the pivotal point of the Cladocera, at least of the families above mentioned. Without going into phylogenetic speculation, it is suggestive that this genus can and does by preference live in very impure water and may therefore have had an early origin. From *Moina* diverges the stem of the Daphnidæ by way of *Ceriodaphnia*, *Simocephalus* and *Daphnia*. These two latter genera are intimately connected by *Simocephalus daphnoides*, Herrick. *Scapholeberis* is connected with *Ceriodaphnia* through *S. angulata*, Herrick. The Sididæ seem to diverge by the way of *Daphnella*, through which by means of *Pseudo-sida* the genus *Sida* is reached, and finally *Limnosida*, *Latona* and *Holopedium*. The relationships of the curious *Polyphemidæ* are less evident.

The Lyncodaphnidæ make an easy transition to the Lynceids proper, while the Bosminidæ are still quite isolated, but are suggested by *Macrothrix pauper*. The fact that *Moina* stands thus related to radiating groups is simply suggestive, but it is suggestive of its possible antiquity and synthetic character.

The three species of this genus stand very poorly distinguished from one another and their specific validity may be doubted.

The most exhaustive study of the embryology of the Cladocera was based on *Moina*. (*Grobben, Entwickl. d. Moina, etc.*)

The genus is characterized by Weismann and Gruber¹ about as follows:

Head prone; separated by a depression from the thorax; fornices obscure; rostrum none; pigment fleck absent; antennules of the female large, moveable, furnished with a sensitive seta near the middle, flagelliform; antennules of the male very large, hooked at the end. The setæ of the antennæ are all ciliate; the tri-articulate ramus with five setæ; posterior margin of the valves thicker in the median line; caudal setæ very large, about twice in the length of the animal; anus above the claws; feet of the first pair of the male with a strong hook.

Weismann has shown that both summer and winter eggs originate from groups of four cells, one of which only is transformed into the egg, the remaining three serving simply as a supply of nourishment for the egg, which absorbs it directly. Both eggs and nutrient cells develop from the epithelium of the termination of the ovary. The summer eggs have less yolk than the winter brood, and the yolk is bluish in the summer eggs and deep red in the winter eggs of *Moina rectirostris*; while in *M. paradoxa* the summer eggs have yellow and the winter set snow-white yolk. There are never more than two winter-eggs in any of the Daphnidæ, but there are as many as twenty summer eggs in some cases in *Moina*. In *M. rectirostris* only one winter egg is produced, which is one of the best distinctions of the species, as this is, perhaps, the only case. (*Naturgeschichte der Daphnoiden, Weismann.*) The first generation, springing from the winter eggs (impregnated eggs), is composed solely of females which reproduce parthenogenetically; the second brood contains sexual males and females, thus completing the cyclus.

¹ *Ueber eine neue oder unvollkommen gekamte Daphniden, Freiburg, 1877.*

Sp. 1. *Moina rectirostris*, Mueller.

(Plate A. Figs. 2, 5, 8, 10, 11.)

A. Var. vera.

Daphnia rectirostris, O. F. MUELLER, LATREILLE, BOSC, DESMAREST, SCHRANK, LEYDIG.
Monoculus rectirostris, GMELIN, FABRICIUS, MANUEL, JURINE.
Pasilthea rectirostris, KOCH.
Moina rectirostris, BAIRD, WEISMANN, KURZ, BIRGE.

B. Var. brachiatus.

Monoculus brachiatus, JURINE.
Daphnia brachiata, DESMAREST, EDWARDS, LEYDIG.
Moina brachiata, BAIRD, WEISMANN.

C. Both varieties.

Moina brachiata, P. E. MUELLER, LILLJEBORG.

The only tangible difference between the two forms thus united is the fact that *M. rectirostris* produces but a single winter ovum and hence has a one-chambered ephippium, while *M. brachiata* has a two-chambered ephippium.

The head is separated from the thorax by a marked depression; there is a deep depression above the eye; the margins of the shell have few bristles. The post-abdomen, which extends far beyond the edge of the valves, bears about eleven hairy spines on either side, the lower spine being two-cleft at the end; the base of the claws bears a comb of small teeth, and the posterior margins are bristled. The ephippium is oval; and the single cavity in *M. rectirostris* has its longer axis horizontal, while the two cavities of *M. brachiata* are vertical. The depression above the eye is deeper in the males, in which sex also the antennæ are longer and bent at the middle. The seminal bodies are stellate. Length 1, 2 mm. The form is subject to the greatest variation due to the varying number of summer eggs. Birge finds this species abundant. I have found both this and the following species in various parts of the Mississippi valley from Mobile to the upper river region.

Sp. 2.—*Moina paradoxa*, Weismann.

(Plate A. Figs. 1, 3, 6, 7, 9.)

The species differs in a few very insignificant points from the previous one. The head is short and nearly evenly convex above, with no deep depression above the eye; teeth of terminal claws reduced to bristles which are only a little longer than the series extending down the claw as in the above species; the first

¹Gruber and Weismann, ueber einige neue oder unvollkmmen gekannte Daphniden Freiburg, 1877

foot of the male is furnished with a long bristle; the lower shell margins are more bristly than in the previous forms; the ephippium has two cavities, while the seminal bodies are crescent-shaped.

Sp. 3.—*Moina micrura*, Kurz.

This form may be of specific value, but it is not sufficiently distinguished to make this certain. As described by Kurz, it seems to be smaller (1 mm.) and most to resemble *M. paradoxa*, which was not at that time described. The post-abdomen is short and has few (6) spines, while the terminal claws are short and smooth; the head has a sinus above the eyes; the eyes are smaller, with numerous lenses; the antennules are shorter (?) than in *M. rectirostris*; the mandibles are partly exposed, while the shell margin overlying is notched. Males and ephippial females were not observed. Not distinguished in America.

II.—GENUS CERIODAPHNIA, Dana.

The genus *Ceriodaphnia* is the successor to *Moina*, which some species greatly resemble; the post-abdomen, however, is shorter and has a habitus resembling *Daphnia*; the antennæ are smaller, and the shell is thick and coarsely reticulated.

Ceriodaphnia has the same general mode of life as *Moina*, living in muddy pools in late summer and bearing numerous broods which often greatly extend the brood cavity. The antennules are shorter but have a similar form; the male antennæ show a transition in the various species from forms adapted for prehension to such as are found in *Daphnia*. The brood cavity is closed by two ridges on the abdomen instead of one, as in *Moina*, or three, as in *Daphnia*.

The ephippium contains but a single ovum. In general, the form is oval or quadrate, angled but not spined posteriorly; head separated from the body by a deep depression; pigment fleck present; beak absent; antennules moveable, rather short; antennæ with the three-jointed ramus with five setæ; first foot of the male with a hook or flagellum.

The members of this genus are danger signals from a hygienic point of view, for they frequent water containing decaying matter; as many as 1,400 were counted in a single quart of such water. The genus is particularly perplexing, as the varieties named seem to be hardly entitled to specific rank and are so similar as to require great care to properly distinguish.

The following artificial key, it is believed, will assist in placing the specimens which may be obtained in America. There seems no reason to doubt that our fauna is very similar to that of north Europe. Of the twelve species here enumerated at least one-third may be synonyms and others of the remainder are with difficulty distinguished.

ARTIFICIAL KEY TO THE GENUS CERIODAPHNIA.

A. Shell irregularly striate.

1. *C. megops*, Sars.
2. *C. cristata*, Birge.

B. Shell with hexagonal meshes.

a. Shell with doubly contoured markings.

- (aa) Head broad, short.
3. *C. pulchella*, Sars.
- (bb) Head narrowed, depressed.
4. *C. rotunda*, Straus, (antennules normal.)
5. *C. alabamensis*, Herrick, (antennules elongate.)

b. Shell simply marked.

- (cc) Claws with teeth.
6. *C. reticulata*, Jurine.
- [7]. *C. dentata*, Birge.
- (dd) Claws without teeth.
- I. Antennæ very long.
8. *C. punctata*, P. E. Mueller.
- II. Antennæ normal or short.

* Post-abdomen broad.

9. *C. laticaudatus*, P. E. Mueller. 1 mm. long.
- [10]. *C. consors*, Birge. 0.5 mm. long.

** Post-abdomen narrow.

- † Head not angled behind the eye.
11. *C. quadrangula*, Mueller.
- ‡ Head abruptly angled behind the eye.
12. *C. scitula*, Herrick.

C. Shell reticulate with rectangular meshes.

13. *C. nitida*, Schoedler.
- [14]. *C. textilis*, Dana.

Sp. 1. *Ceriodaphnia megops*, Sars.

(Plate A. Figs. 16, 20.)

Ceriodaphnia megops, Sars, P. E. MUELLER, KURZ. (The earlier synonymy is doubtful. See note, page 26, Schoedler's Neue Beitrage zur Naturgeschichte der Cladoceren.)

This species is one of the largest and most readily distinguished as well as rarest of the genus. Very characteristic is the fine anastomosing striation which breaks up into reticulation only near the shell margins. This species seems to form the transition toward *Simocephalus* with *Scapholeberis*, which, however, diverges along its own peculiar track. The length is sometimes 1 mm. The head is obscurely angulated in front of the antennules, which are large. The antennules of the male are long and have a hooked setæ at the end.

Typical *C. megops* has not yet been found in America, but the following form takes its place.

Sp. 2 *Ceriodaphnia cristata*, Birge.

The description given by Birge would apply in almost every particular to *C. megops*, though he seemed to overlook the close conformity. The size is much less (0.7 mm.), and the post-abdomen seems more abruptly truncate; moreover the number of anal spines is less. The crest upon the dorsal margin may be the effect of prominences such as are described by P. E. Mueller; at any rate, in view of the fact that but few specimens were discovered, the suggestion lies near that *C. cristata* is the young or, at least, a reduced form of *C. megops*.

Found at Southampton, Mass.

Sp 3.--*Ceriodaphnia pulchella*, Sars.

(Plate A. Figs. 14, 19.)

Ceriodaphnia pulchella, Sars, P. E. Mueller, Kurz.

Very much like *C. reticulata*, but smaller. Head large, turgid, and angled in front of the antennules, forming almost a right angle; fornices moderate; antennules rather large; shell oval, reticulated with double contour lines; post-abdomen of medium size, narrowed toward the end, slightly truncate, with about nine spines; terminal claws short, smooth. The flagellum of the male antennæ is but slightly hooked, 0.5—0.6 mm. long. This species is not certainly identified from America, though a form with smooth claws and small fornices occurs with *C. dentata* in some places.

Sp. 4. *Ceriodaphnia rotunda*, Straus.

(Plate B. Fig. 1. Plate A. Figs. 13 and 23.)

Daphnia rotunda, Straus, Baird.

Ceriodaphnia rotunda, Schoedler, Sars, P. E. Mueller, Kurz.

As said by Kurz, this species is not easily mistaken; the small head (only paralleled by the following), the very evident reticulations and the broad abdomen give it a peculiar habitus which is unmistakable.

Head depressed, small, spiny below, not angulated; fornices prominent, thorned; body rotund, almost spined above; shell doubly reticulate; post-abdomen broad, with seven or eight anal spines; claws large, smooth. The male antennules are little larger than those of the female. I have not yet seen this species in America.

Sp. 5. *Ceriodaphnia alabamensis*, Herrick.

(Plate B. Fig. 2.)

(American Naturalist, May 1883. Plate v, Figs. 11, 12.)

This species was seen but once and is insufficiently known. The body is elongate, quadrate, the shell reticulated with double contour lines, the head very small and produced downward below the eye, which is very small, the antennules are longer than in any other species, obviously two-jointed, with a lateral seta; the antennæ are very long; post-abdomen long and rather narrow, with the margins nearly parallel, truncate at the end, with over nine anal spines; claws smooth, abruptly truncate. My drawing represents a daphnia-like set of processes for closing the brood cavity. Length 1 mm. (?)

Tuscaloosa, Ala.

Sp. 6 *Ceriodaphnia reticulata*, Jurine.

Monoculus reticulatus, JURINE.

Daphnia reticulata, BAIRD, LEYDIG.

Ceriodaphnia quadrangula, SCHOEDLER.

Ceriodaphnia reticulata, SARS, P. E. MUELLER, KURZ, HERRICK.

Head long, obscurely angled in front of the antennules; fornices very prominent; antennules small; post-abdomen of moderate size, rounded at the end, slightly tapering; about eight long anal teeth; terminal claws with a series of sharp spines at the base. The reticulations are sharp but simple. The flagellum of the male antennule is either straight or moderately curved. Kurz says that some varieties have the fornices blunt whereas others are sharp. I have seen only the blunt form which is then much like the next.

Sp. 7. *Ceriodaphnia dentata*, Birge.

This form differs from the above only in having the inside of the claws fringed with minute bristles (sometimes absent), the angle

of the head being more marked and the fornices less prominent. It is difficult to say whether our Minnesota specimens most resemble this or the typical *C. reticulata* of Europe. They seem intermediate, some having fornices with an abrupt angle. It may be instructive to quote Kurz on the European *C. reticulata*—"Examples occur 0.8-0.9 mm. long, others on the contrary only 0.5-0.6 mm. long and combining with the smaller size some differential characters. In the larger variety I found the foruix obtuse, while in the smaller it extends in a sharp thorn directed upward and outward. In this small sub-species the secondary teeth of the claws of the post-abdomen seemed to be absent, though in *C. reticulata* 3-5 are constantly present."

Sp. 8. *Ceriodaphnia punctata*, P. E. Mueller.

(Plate A. Figs. 1-3.)

Head depressed, rounded at the end, not angulated, ornamented with minute spines within the hexagonal areas. Fornices slightly prominent, either smooth or spiny; antennules very long; shell rotund, reticulated; post-abdomen of medium size, width nearly uniform, truncate below at an obtuse angle; anal spines large, increasing toward the end; claws smooth. Length 0.7-0.9 mm.

Found as yet only in Scandinavia.

Sp. 9. *Ceriodaphnia laticaudata*, P. E. Mueller.

(Plate A. Fig. 22.)

Ceriodaphnia quadrangula, SARS, (sede MUELLER.)

Head small, depressed, rounded at the end, not angulated; fornices prominent; shell roundish, or sub-quadrangular, moderately reticulated; antennules rather large; post-abdomen broad, narrowed from the middle to the end; the nine or ten small anal spines nearly equal; claws large and smooth. In P. E. Mueller's time males unknown. Length 1 mm. Specimens 0.6 mm. long from Minnesota agree in most respects, but the reticulation is very marked and irregular and the terminal claws are pectinate. This form constitutes a transition to the next.

A species related to *C. laticaudata*, but only half the size, was found in Clarke's lake, a small but very deep pool, containing a fauna like that of the great lakes. The appearance is like the small form alluded to under that species, but the claws are smooth, the head is slender and strongly angled behind the eyes, and the antennules are of rather large size. The fornices are not very

prominent. The shell is large-reticulate and the abdomen is large and obliquely truncate, the anal teeth being very large and strongly curved. The only individuals seen were ephippial females measuring .55 mm. This may be.

Sp. 10. *Ceriodaphnia consors*, Birge.

This species differs from *C. laticaudata* in one or two points, being about one-half the size and having fewer caudal teeth. Birge says the abdomen is broad and obliquely truncate. The difference between being obliquely truncate and narrowed at the end in some circumstances disappears, so that really this species seems quite close to *laticaudata*.

Found in Madison, Wis.

Sp. 11. *Ceriodaphnia quadrangula*, Mueller.

(Plate A. Figs. 17-18.)

Daphnia quadrangula, O. F. MUELLER.

Daphnia reticulata, BAIRD.

Ceriodaphnia quadrangula, P. E. MUELLER.

Head depressed, rounded at the end, only slightly angled; fornices prominent, antennules large; post-abdomen narrow, of equal width for the lower half, rounded at the end, with about eight small spines; claws smooth, length about 0.6 mm. This species resembles a smooth-clawed *D. reticulata*.

Sp. 12. *Ceriodaphnia scitula*, (Sp. n.)

(Plate B. Figs. 5-7.)

One of the most abundant species of *Ceriodaphnia* in Minnesota is a large form much resembling *C. quadrangula*. The post-abdomen is exactly as in *C. reticulata* or *C. dentata*, which latter it resembles in having a sharp angulation in front of the antennules. The shell is oblong and heavily marked with minute, regular hexagonal lining; the upper angle is rather sharp. The head is closely appressed, the fornices are prominent and abruptly truncate at the tip, the eye is small, the pigment fleck also small; antennules short. The post-abdomen is of moderate size, narrowed toward the end and armed with about ten powerful curved spines; the terminal claw itself is large and curved, armed only with fine spines extending down the entire inner side. The size is 0.8—1.0 mm.; color pinkish, opaque; antennæ, especially, often bright pink. Male 0.6

mm., flagellum of the male antennæ long; sensory filaments lateral, also one anterior, lateral flagellum.

Distinguished from *C. quadrangula* by the prominent fornices, large anal spines, small reticulations, form of head and larger size.

A small variety resembling the above very closely is the commonest form in our larger lakes; the reticulation is commonly larger but less distinct, the head is depressed and narrowed, with a sinuous upper outline. The fornices are prominent and the form of the post-abdomen is exactly as in the last. The spines of the post-abdomen are very long and seated on small eminences. The length hardly exceeds .55 mm. The claw is densely ciliated, but not spined; these smaller forms have but few eggs (two). The young have a thorn on the angle of the fornices. Plate J. Fig. 1 represents the ephippial female of this species. There seems no reason to doubt that this is only a variety of *C. scitula*. The small form of *C. reticulata* mentioned by Kurz might be referred here, while the larger form with less prominent fornices is not so different from the American *C. dentata*.

Sp. 13. *Ceriodaphnia nitida*, Schœdler.

Ceriodaphnia quadrangula, LEYDIG.

This species seems to be characterized by the quadrangular form of the meshes of the shell-markings and the presence of teeth upon the claws.

Sp. 14. *Ceriodaphnia textilis*, Dana.

This species is not sufficiently fully figured to allow of a suggestion as to its affinities.

Daphnia rotundata, Say, is very probably a member of this genus, though the description is hardly intelligible. "Body rounded behind; upper antennæ three-branched, a small spine above at the joints; lower five-branched; color white. Length 0.5." It is probable that we should read "upper branch of antennæ with three setæ", etc., in which case we may identify the above with *Chydorus* or the like.

III.—GENUS SCAPHOLEBERIS.

The genus *Scapholeberis* stands rather closely related to *Ceriodaphnia*, from which it is at once distinguished by the angled or spined lower posterior angle of the shell. The head is rather

clumsy, and the continuation of the fornices runs toward the apex of the incurved beak, which commonly lies within the valves of the shell. The lower anterior angle has a prominence and there is a basin-shaped area inclosing the base of the antennæ, part of which lies on the shell and part on the head. This area is more strongly lined or reticulated than the rest of the shell. The lower margin is straight and terminates, in most forms, in a long scythe-shaped spine which is directed backward. The shell itself is usually indistinctly reticulate or unmarked, and commonly is deep colored. The post-abdomen is very like *Ceriodaphnia* or more as in *Simocephalus*; the anal spines are few and the older specimens have more than the young; the place at which additional spines are to appear is marked by prominences. The eye is of moderate size, the pigment fleck rather small and the antennules short and hidden by the beak. The antennæ are of small size and generally dark colored. The ephippium contains but one egg; the males do not have altered antennæ or feet. The sexual periods fall in early summer and in autumn, according to Weismann; the males appear but sparingly. The species *S. mucronata* is very abundant everywhere, while the others are less frequently seen.

Sp. 1. *Scapholeberis mucronata*, Mueller.

(Plate J. Fig. 5.)

Daphnia mucronata, MUELLER, LEIVIN, LILLJEBORG, FISCHER, LEYDIG, BAIRD, HERRICK.

Scapholeberis mucronata, SCHOEDLER, P. E. MUELLER, KURZ, WEISMANN, BIRGE, HERRICK.

This well-known species with rather short spines below is found abundantly everywhere. In this country at least it is characterized by a dark color. The head is large, rounded in front of the large eye, serrate below and extending posteriorly into a roundish beak, back of which are the short antennules. The fornices are very short and rounded; a line connects the fornices with the beak by a sudden deflection downward; it sets off the area which forms a part of the basin of the antennæ. A second line springing from just above the termination of the fornices passes over the eye by a broad curve. The post-abdomen is truncate and bears beside the terminal claws four or more spines which rapidly decrease in size. The claws are minutely spined; the spines on the shell are of variable length, but do not exceed one-fourth the length of the remainder of the lower margin. This species ranges over all Europe and eastern United States.

Length 0.6 mm.—0.8 mm.

Sp. 2. Scapholeberis cornuta, Schcedler.

(Plate T. Fig. 6.)

Monoculus bispinosus, DEGENER.*Daphnia mucronata*, var. *acule rostrata*. BAIRD.*Scapholeberis mucronata*, var. *fronte cornuta*, P. E. MUELLER.

This species differs from the above only in having a sharp curved horn on the head in front of the eye. The use of this appendage can only be conjectured; but it may be that, like the curved beak of *Ripophilus*, it serves to clear away rubbish in the filth in which these animals frequently live. This form, be it variety or species, is not known in America.

Sp. 3. Scapholeberis armata, (Herrick.)

(Plate B. Figs. 10-11.)

Scapholeberis mucronata, var. *armata*, HERRICK.

A very beautiful and unique species, which possesses the extreme development of the peculiarities of the genus. The head is shaped very much as in the previous species, the fornix is squarish, the basin for the antennæ is small. The upper lines from the fornix meet behind the eye; the form of the shell is as in the above, but the spines upon the lower margin are longer. The scythe-like spine on the lower angles of the valves is extremely long, falling little short, in extreme cases, of being as long as the entire lower margin, in others about one-half as long. There are the usual lines parallel to the lower edge of the shell. The specimens having the longest spines were found in fresh water about Mobile, Ala., but the species occurs in Minnesota and intermediate points, though sparingly.

Sp. 4: Scapholeberis nasuta, Birge.

Form much as in the last, head shorter, "prolonged into a rather sharp beak, at whose apex the continuations of the fornices unite. The beak does not project downward as in *S. mucronata*, but backward, and in its natural position lies between the valves." The usual reticulated and lined areas are present and the balance of the shell is covered with "small pointed projections." "The antennules are much larger than in *S. mucronata*, though they do not project beyond the rostrum." The pigment fleck is long and large; the post-abdomen is much as in the preceding species; the terminal claws have several fine teeth. The males have the open-

ing of the vas deferens close behind the terminal claws; mucro short and blunt, length 1 mm. This species is very near the next, but differs in several particulars. It forms the transition to the next, which is the extreme of the genus in a direction converse to that pursued by the *S. armata*.

Sp. 5. *Scapholeberis angulata*, Herrick.

(Plate B. Fig. 9. Plate T. Fig. 7.)

American Naturalist, 1883.

Form as in the above, but comparatively larger; valves quadrangular, anterior margin strongly arched; head short, only slightly concave below the eyes; the beak is as in *S. nasuta*, but seems to be directed more nearly directly downward than in that species. The anteaunules are long and resemble those of *Simocephalus*. The pigment fleck is square and rather large; the antennæ are of the usual size. The reticulated areas are as in the other species. The post-abdomen is more as in *Daphnia*, not so squarely truncate and with five to seven large teeth; the first foot has one elongated jointed seta; the posterior angle of the shell has no spine, at most there is a somewhat prominent acute angle, the inner shell layer is armed at this point with some elongated teeth as in the corresponding situation in *Simocephalus*. On the whole, there is a similiarity to that genus in this as well as in the previous species. *S. nasuta* has a short spine and elongated pigment fleck; the present species has a squarish but rather large fleck and no spine; the post-abdomen has a greater number of spines than any other species. South of Tennessee river, in Alabama and Mississippi.

The species of this genus are predominately American, four out of the five being found in the United States; the fifth, moreover, is more often regarded a variety of one of the others; in fact, the absence of *S. cornuta* from America is one of the most important supports of the specific independence of the two forms. All the species delight in disporting themselves near the surface in sunny weather.

IV.—GENUS SIMOCEPHALUS.

Although a very well circumscribed group, this genus passes into the next rather directly by means of *S. macrothroides*. The connection on the other hand seems to be by the way of *Scapholeberis*, though there is a rather broad separation between even *Scapholeberis angulata* and any known *Simocephalus*. The en-

larged spines near the angle of the shell and the form of the antennules as well as some other points, show a transition through that species toward the present genus. The general form is quadrate with the lower posterior margin sinuate; in young specimens the shell is nearly a perfect rectangle. The upper margin is produced more or less at the point of union with the free posterior margin and the shell is either arched or very abruptly angled above the prominence in old females. The head is produced into a projection at the eye while the beak proper is between the anterior margins of the valves; the pigment fleck is rather large and variously shaped. The fornices are larger than in *Scapholeberis* and extend to the front of the head over the eyes; the antennules have a lateral flagellum which is large and lance-shaped. The post-abdomen varies very little in shape; it is truncate and excavated below and very broad. The anal teeth are few, large, curved, pectinate; the claws are straightish and pectinate or spined; the labrum is shaped as in *Daphnia*; the anterior part of the stomach has the usual cæca.

The members of this genus are among the most abundant and conspicuous of the family and are more persistent during the changing seasons than any other form. *S. vetulus*, the commonest species, stands in the centre of the genus, while two extremes are expressed by the other members of the group.

The winter or sexually produced eggs are lodged in an ephippium or saddle-like modification of the shell, which is finely reticulate; while the shell is usually marked by fine anastomosing lines which, in some species, show clearly their derivation from a rather fine hexagonal marking.

The sexual periods, when males are produced, occur in autumn and spring. The males have few distinguishing characteristics, the form being that of the young female.

The opening of the vasa differentia is back of the anus, hence these ducts cross the course of the intestine. They have ejaculatory muscles about the lower part. The smaller species are frequently deeply colored with pink, purple and brown fatty deposits and the markings are more conspicuous than in the American *Eurycercus*, which is itself often brightly spotted with blue or purple. The aspect in the water is between that of *Eurycercus* and *Daphnia*.

The first mention made of any member of this genus in America is Say's description, repeated in Dekay's *Crustacea of New York*, of *Daphnia angulata*. This description which follows is quite suffi-

cient to identify the genus, and indeed to indicate that either *S. americanus* or a related form is intended, but it is hardly competent to alter names the significance of which is quite clear.

"Sides striate with numerous parallel minute oblique lines; hind edge of the body with a prominent angle in the middle. Antennæ with four filaments on the upper and five or the lower branch. Color white or red. Length 0.1; stagnant water in the forests of the Southern States."

Sp. 1. *Simocephalus vetulus*, Mueller.

Daphnia vetula, BAIRD, HERRICK.

Daphnia sima, MUELLER, LATREILLE, BOSCH, RAMDOHR, GRUITHUISEN, DESMAREST LAMARCK, M. EDWARDS, KOCH, GMELIN, MANUEL, JURINE, LILLJEBORG, LEYDIG.

Simocephalus vetulus, SCHOEDLER, P. E. MUELLER, KURZ, WEISMANN, CLAUS, LUTZ, BIRGE.

This commonest and one of the largest species is apparently distributed over the northern hemisphere and abounds in all the more shallow lakes. The head is rounded in front and is not angled between the prominence of the eye and the beak. The body is very large and not abruptly angled above, the spine of the shell being inconspicuous and high, so that the free posterior edges of the shell lack little of equalling the greatest height of the shell. The shell is covered with minute dense striations which spring from the free edges. The pigment fleck is elongated in old specimens and the upper angle follows up beside the suture separating the antennary basin from the rest of the shell of the head. The antennules are ornamented with minute spines. At the lower angle of the shell are three curved spines which differ from the preceding filaments. The number of eggs which are produced at once is truly immense. Under favorable circumstances this species reaches a large size, falling little if any short of 3 mm. *S. vetulus* lives, by preference, among the leaves of aquatic vegetation. With us this species seems to live in the smaller pools as well as in lakes of some size. I am not able to see any difference in this respect between the various species.

Sp. 2. *Simocephalus serrulatus*, Ksch.

Daphnia serrulata, KOCH, LIEVIN, FISCHER, LILLJEBORG.

Simocephalus serrulatus, LEYDIG, SCHOEDLER, P. E. MUELLER, KURZ.

Head narrow, extending anteriorly into a sharp spiny angle in front of the eye. Dorsal line of the shell abruptly angled or curved posteriorly, projecting to form a broad obtuse spine behind;

this spine is serrate with sharp teeth and lies somewhat above the middle of the height of the animal, so that the free posterior margins of the shell fall much short of reaching the greatest height of the shell. Post-abdomen of the usual form, with the claws armed with two series of spines or bristles, the outer being much the larger; anal teeth curved or angled, dentate; pigment fleck triangular or rhomboidal. Length 2.0 mm., 2.5 mm.

I am not sure that the three following species are more than varieties; the first in particular is very close to the European type.

Sp. 3.—*Simocephalus congener*, Birge.

My own observations of this form made throughout the Mississippi valley are not in complete accord with the description of Birge, but it seems improbable that there is any mistake in the identification. The very generally distributed form on which this species rests is subject to marked variations within certain limits. This species differs from *S. serrulatus* in the following points. The head, although prominent and spiny near the eye, is not angled between this prominence and the beak; in fact, it is either straight or simply curved. The pigment fleck is usually rhomboidal and only occasionally oval, triangular or irregular. In other respects the agreement is rather close; the terminal claws have two series of spines, one of which is larger (not, as said by Birge, equal); the outer series is not so much larger as in *S. rostratus*, but not nearly as inconspicuous as in *S. vetulus*. The terminal claws are rather evenly curved. This species is frequently colored with pink or brown markings. In old females the back is squarely angled above, forming a pocket for the eggs. The size falls short of that of the last species. I have found this species from the gulf of Mexico to Minnesota.

Sp. 4.—*Simocephalus rostratus*. (Sp. n.)

This form is of the size and color of *S. americanus*, and approaches nearest to Schodler's *S. expinosus* in general characters. The back is arched above but not abruptly angled; the spine is as in *S. americanus* but not so low. The free posterior shell margins are somewhat shorter than the greatest height of the shell. The head is produced below the eyes in an angle like a right angle, which is not spiny. The lower margin of the head is excavated to form a right angle, and in front of the smooth antennules forms a very prominent beak, beyond which the antennules reach but a short

distance. The terminal claws of the post-abdomen are straightish and are more heavily spined than in the preceding; the anal spines are doubly curved or geniculate. The pigment fleck is rhomboid or pentagonal; the antennules are smooth. The abdominal processes differ somewhat from the previous species, in which the second one is rounded above, for in this it is squarely truncate. This species was found only in shallow pools at Ocean Springs, Mississippi, and was very carefully compared with *S. americanus* which is also found there.

Sp. 5. *Simocephalus exspinosus*, Koch.

Head extending into an obtuse angle at the eye, pigment fleck rhomboidal. Shell without a spine; maximum height of the shell greater than that of the free posterior margin. Caudal claws with an unequal series of spines; anal spines evenly curved. There is little to distinguish the above from this species save the geniculate anal spines and the presence of a blunt spine on the shell.

Var. congener, Schoedler,

has the lower outline of the head sinuate instead of angled.

Sp. 6. *Simocephalus daphnoides*, Herrick.

American Naturalist, 1883.

A curious transition form, found only south of the Tennessee river, was described in the American Naturalist in May, 1883, under this name. By an oversight a comparison made with *S. americanus* appeared as though made with *S. vetulus*. The general shape is oval; the greatest height of the valves lies near the middle and not posterior to it as in all the other species. The head is short, depressed, rounded in front; the beak is wanting; the lower margin of the head is straight. The pigment fleck is small, oval or irregular; the fornices are small and short. The antennules are smooth.

The post-abdomen is narrow, shaped more as in *Daphnia*; the terminal claws are straightish and fringed part way with spines; the anal spines are slightly curved. The processes of the abdomen are long, as in *Daphnia*. The shell is covered by the characteristic striations and extends into a blunt spine. In every detail, almost, there is an approach toward the genus *Daphnia*, while the general result is sufficiently like *Simocephalus*. The lower angle of the shell is not armed with the peculiar curved spines as in all the other

species. This species becomes over 1-10 inch long. In such old individuals the spine is nearly midway of the height.

One could wish a trifle closer link to *Scapholeberis* than that furnished by *S. angulata*; but, on the whole, the position of this genus can not well be called in question. America has four species out of the six known and but one of these certainly identical with the European, though others are probably too closely related.

NOTE.—On p. 47 read *S. Americanus*, Birge, not *S. Congener*.

V. GENUS DAPHNIA.

Long considered the type of the family, this genus is most frequently seen, or, at least, is more conspicuous than any other group. It has already been pointed out that the forms here united are the extreme development of a diverging line. *Simocephalus* is the link connecting it with the typical forms of the family. As might be expected, this genus presents more puzzling problems than any of the others. It contains more peculiarities of structure and diversities of habit and development than any other of the genera. Here the sexual differences are most interesting. The young are hatched with a pendant appendage attached to the upper posterior angle of the shell, which soon becomes the rigid spine characteristic of the younger stages and males of the genus. The females almost immediately after birth commence the production of eggs by an asexual process. Groups of epithelial cells containing four each are formed and one of the cells of each group develops at the expense of the others, forming the egg. Many such eggs are laid simultaneously and deposited in the cavity between the shell and the dorsal part of the animal. The eggs are prevented from escaping by means of three long processes, of which the first is much the larger and curves forward. At stated periods in spring and autumn the males appear; the females of the generation in which occur the males have a tendency to produce eggs of a different sort charged with a different mission. At the same time the upper portion of the shell (that surrounding the brood cavity) becomes finely reticulated and pigment is deposited between its layers. This ephippium, as it is called, in allusion to its saddle-like form, is the case in which the winter egg is to pass the period of cold or drought which is to follow. The method of the formation of the ephippium is obscure and, in spite of the investigations of Lubbock and Smitt, considerable remains to be learned with reference to this interesting modification of the shell. Some rather careful study has been devoted to this

subject by the writer, but it was unfortunately interrupted before completion. The most promising method of pursuing the investigation is that of sectioning ephippial females in various stages with the microtome. A preparation of soap was employed with partial success as a medium for embedding, and figures of some of the many sections made are drawn on plate P. Figure 10 is a vertical section through the middle of an ephippium which has been cast off. The outer and inner shell layers are distinct and one of the eggs is divided in the middle. No pigment or protecting material was deposited in this case, which is the simplest possible. Fig. 9 represents a section just back of the head; it passes diagonally, severing the heart longitudinally (h). The intestine (a), the ovaries (g), the mandible (m), the labrum (l), and certain suspensorial muscles (?) are seen *in situ*. Only a portion of the ephippium is cut and the double layers enclose a large mass of protective matter. Fig. 8 is a vertical section through the middle of the animal, and the usual form of the ephippium is seen with its large amount of protective matter obscuring all else. Fig. 7 is a longitudinal section of an ephippium similar to that seen in Fig. 10. It is hoped to present at some more appropriate time a fuller account of the formation and process of moulting this saddle.

DEVELOPMENT OF DAPHNIA.

Although the careful researches of Claus and Grobben have added much to our otherwise rather meager knowledge of the development of the cladocera, there still remain many interesting points, particularly with reference to the individual species, which merit careful study.

The following observations relate to the single species (*D. schæfferi*) which was available during a short stay in Leipzig:

The winter eggs of *D. schæfferi* are two in number and are lodged in the well known manner in an ephippium.

The shape of these eggs is sharply ovoid, there being no distinguishable difference between the two ends. The position in the ephippium is not, as might be expected, with the longer diameter paralld to the axis of the body, but the posterior end is slightly elevated. This is undoubtedly due to frequent elevation of the abdomen between the valves during the extrusion of the eggs.

The color is dark green and the only protection as the egg leaves the ovary is a thick, tough shell which is at first so soft as to be susceptible to pressure. It is thus reticulated, apparently through the simple pressure of the walls of the ephippium.

The length is 0.43 mm.; width .33 mm. in the average, though eggs were occasionally found of an elongated form, measuring .48, .31 mm. The contents of the egg consist of spheres of greenish plasma of various sizes and fat or oil drops. These oil globules are not very numerous as compared with those of the summer eggs, and likewise never attain the dominant size seen in the latter. The various forms assumed by the plasma balls are perplexing but frequently result from the action of external agents. The cleavage stage was not seen, and if actual segmentation takes place, it must be inconspicuous as would be expected from the large quantity of yolk present. The differentiation of the blastoderm occurs very early, perhaps in the ovary itself, and the result is a tolerably uniform layer of prismatic cells. The egg now comes to a period of repose after the blastoderm has produced a second external envelope apparently by simple secretion.

This envelope consists of a fine structureless membrane. The egg, under ordinary circumstances, remains dormant during the winter in this most favorable stage. The reason for which is evidently the fact that the differentiation has proceeded to the extent of producing the greatest number of protective layers without materially increasing the complexity, and thus the sensitiveness, of the organism. Under favorable circumstances the development proceeds farther and near one pole appears a slight indenture of the surface which grows deeper and seems to form a true invagination. This blastopore, if such it really be, remains for some time, generally till the two "scheitel" plates appear. These "scheitelplatte" are formed by a simultaneous thickening and lengthening of the cells of limited areas on opposite sides of the egg, near the opposite pole from that occupied by the blastopore. The "scheitelplatte" are situated at right angles to a plane perpendicular to the blastopore. The nuclei of the cells of the "scheitelplatte" are nearly .0208 mm. in diameter, while those of the other blastoderm cells are about half that size.

The egg remains a long time in this stage, while the following stages are passed through quite rapidly till the embryo assumes its nauplius form. The remainder of the development agrees, so far as seen, quite fully with that of the summer eggs, to which we will now return.

The summer eggs vary greatly in size and number, but are nearly as large as the winter eggs. The number is sometimes reduced to two or three or rises to as many as fifteen or even more. In color the eggs also vary from green to brown. The fresh egg

consists, as the winter egg, of two sorts of yolk spheres. The plasma or formative yolk contains colored globules of rather small size, distributed throughout the whole of the mass quite uniformly. The food yolk or oil globules assort themselves in two sizes; first, a few (generally three) very large oil drops, which persist throughout the earlier stages of the embryo; second, smaller globules of apparently the same character, which are quite numerous and form a very considerable part of the contents of the egg. In an egg of about .35 mm. in diameter, the largest of the smaller size of oil drops measured .029 mm. while the larger three exceeded .060 mm. The oil drops are distinguishable by their light refractive power, pellucidity and the intense dark brown or black color assumed when treated with osmic acid. The latter reagent affects the formative yolk but slightly. It will be seen that though the summer egg is nearly as large as the "dauerei" in some cases, yet the relative amount of formative yolk is more diverse than at first appears.

The great similarity between the two sorts of eggs in *Daphnia schaefferi* is throughout striking as compared with *Moina*, the only one of the Daphnidæ the development of which is fully studied. In the summer eggs I have not been able to see the complete segmentation described for *Moina*. The following stages are much as described by Grobben. An invagination occurs and a median swelling appears on the ventral aspect of the egg.

Labrum and second antennæ bud out and are soon followed by the antennæ, mandibles and two pairs of maxillæ, after which the five pairs of feet soon appear. In an early stage there is present a basal palpus to the second antennæ, a fact not before observed, and this persists as the small two-bristled wart found on the basal joint of the antenna. It is a conspicuous object in the embryo and is thus a true embryonic organ.

The eyes of the embryo appear as two separate pigmented flecks which approximate and are covered with an oval refractive body, which later is penetrated by the pigment and divides to form the small lenses. Soon after this the shell grows over the eye as described for *Moina*.

The first indication of the shell appears as two folds of the maxillary region of the back, being thickest laterally. These grow forward and backward to form the cephalic and body shield. At a little later stage there appears a very interesting modification of the shell which stands in close relation to the growth of the brood sac. A slight protuberance appears on the margin of the shell in

the median dorsal line and extends toward the abdomen. It grows much more rapidly than the other parts of the shell and, in a later stage, forms a comparatively enormous tail, which curves under the animal between the shell valves which now extend beyond the body. This "tail" extends well along the ventral margin of the shell and reminds, by its position, of the tail of a frightened dog. The true tail, or post-abdomen, is, in the meanwhile, well developed and is constantly kicking the useless protuberance of the shell upwards. As the animal leaves the egg this projection becomes straightened as in the young *D. pulex*, finally becoming the still considerable spine, though it is proportionately much shorter than in the embryo. The spine becomes shorter with successive moults and the mature form has only a slight rounded knob in place of a spine more than half the length of the body.

The use of the long spine in the young *Daphnia* is a matter of interest. Its length agrees pretty well with that of the brood cavity and it seems possible that it serves to prevent the shell from bending abruptly down when it is only partially removed during the moult and thus breaking off and so leaving a portion of the clothing of the brood-cavity therein to become a source of irritation. This is more necessary for the young since the brood cavity is narrow and the shell weak, so that while the outer shell is removed like a glove from the finger, it can not be pulled upward or downward, but directly backwards. It is well known that male *Daphniæ* often have the spine, while the females may have none, and here again it is possible that the narrower cavity over the abdomen requires this assistance, while this is not the case with the females.

The shell gland is early formed and the branchial lamellæ of the feet appear almost simultaneously with the feet themselves as distinct lobes. The branchial chamber is not a simple chamber, but is essentially a curved tube as can be very well seen in the last foot of the adult. This tube doubles upon itself and crosses in the manner of a loop and a constant stream flows rapidly through it.

The nervous system is, at first, paired from beginning to end and first unites anteriorly, the ocular ganglia fuse after the union of the two pigment flecks in the compound eye, then the cephalic ganglion is formed by the union of the two pre-œsophagal ganglia, the commissures passing about the œsophagus. I have not been able to determine if the sub-œsophagal ganglia become fused. From the anterior ganglia spring the nerves to the antennæ and

jaws, which latter are the larger in the embryo, being exceedingly large nerves.

This key contains the majority of the genus, but falls short of completeness. The following species are uncertain. W. Schman-kewitsch described as new *D. degenerata* and *D. rudis*, from salt or brackish waters. These he regards as degenerate forms produced by the inferior aeration of dense waters. The author does not appear to recognize the modern distinctions of genera so that, not having seen the work, even the generic position can not be definitely stated. His investigations seem to show that the proximity of salt waters influence the form of the body, or, perhaps, that there is a constant interchange between the sub-marine and fresh-water species. *Daphnia brevicauda*, Chambers, is an incorrectly figured and described Simocephalus.

KEY TO THE GENUS DAPHNIA.

Section I. Pigment fleck present.

A. Head short, equally rounded.

1. *D. psittacea*, Baird.

B. Head not regularly rounded, more or less beaked.

(a) Claws spiny.

- I. Abdomen broad, series of anal spines nearly equal, neither head nor back keeled.

† A marked sinuosity in the posterior outline of post-abdomen.

2. *D. schaefferi*, Baird.

D. ovata, Sars.

D. pennata, Mueller.

†† No well marked depression.

3. *D. pulex*, Mueller.

4. *D. schaedleri*, Sars.

D. hastata, Sars.

D. obtusa, Kurz.

II. Abdomen narrow, shell keeled somewhat dorsally.

5. *D. minnehaha*, sp. n.

6. *D. carinata*, Sars.

(b) Claws nearly or quite smooth.

I. Head not erected.

7. *D. longispina*, Leydig.

8. *D. rosea*, Sars.

9. *D. similis*, Claus

D. lacustris, Sars.

D. cavifrons, Sars.

10. *D. hyalina*, Leydig.

11. *D. dubia*, Herrick.

D. pellucida, P. E. Mueller.

D. galeata, Sars.

12. (?) *D. lævis*, Birge.

Section II. Pigment fleck absent.

A. Head but slightly crested.

1. *D. longiremis*, Sars.

B. Head strongly crested.

2. *D. cristata*, Sars.

3. *D. cucullata*, Sars.

D. apicata, Kurz.

4. *D. kalbergensis*, Schoedler.

D. cederstromli, Schoedler.

D. retrocurva, Forbes.

D. vitrea, Kurz.

5. *D. magniceps*, sp. n.

SECTION I.

A. *Head short, evenly curved.*

Sp. 1. *Daphnia psittacea*, Baird.

Mentioned by SCHOEDLER, FRIC and KURZ.

This species is at once recognized by the head, which is very short and evenly curved, or nearly so, from the heart to the beak. The shell is high, oval, with a rather short spine. The fornices are wide and angled behind; the antennules are longer than in most species; the post-abdomen is very large, but narrows toward the end and has comparatively few anal teeth, which are of unequal size. This is one of the largest of the genus. Not yet found in America.

B. *Head more or less concave below, at least not evenly arched.*

Sp. 2. *Daphnia schæfferi*, Baird.

(Plate M. Figs. 1—4.)

Daphnia pennata, MUELLER.

Daphnia pulex, STRAUS, KOCH, (fide P. E. MUELLER.)

Daphnia magna, LILLJEBORG, LEYDIG, etc.

Daphnia schæfferi, SCHOEDLER, KURZ.

The largest species of the genus, is of an elongated oval and ventricose form. The spine is entirely absent in old females and of only moderate length in the young. The antennules of the male are long and have a very long flagellum. The post-abdomen is narrowed suddenly below the anus so that the spines consist of two sets; the terminal claws are spiny at the base. Although

very similar to *D. pulex*, it may be recognized at once by the concavity of the dorsal margin of the post-abdomen. The plate will make any detailed description superfluous. A common species in Europe, but not yet found in America.

Daphnia ovata, Sars, seems probably this species, but Sars was troubled by Straus' mistaken reference.

Daphnia pennata of Sars may also be this species or, more probably, *D. pulex*. The Latin description given by Sars is appended for convenience of reference.

***Daphnia pennata*, Sars.**

"Antecedenti (*D. pulex*) simillima, caput autem a latere visum latius, rostro brevior, supra visum testa cetera parum angustius fere cordiforme, antice acuminatum. Processus anteriores duo disjuncti. Margo posterior postabdominis in medio sinulo parvo et infra hunc utrinque aculeis 16-18 armatus. Color ut in antecedente. Longit. 2½mm."

***Daphnia ovata*, Sars.**

"Caput a latere visum ante oculum fere angulatum, margine inferiore leviter concavo in rostrum longum apicem versus attenuatum, extremitate tenuissima exeunte, spura visum ut in *D. pennata* cordiforme. Testa cetera a latere visa ovata, margine superiore et inferiore in femina adulta fere æquæ arcuatis, postice in medio spinam formans brevissimam vel omnino obsoletam. Processus anteriores duo abdominis disjuncti. Margo posterior postabdominis in medio sinuatus, utrinque aculeis 20-22 armatus. Color albido-flavescens vel virescens. Longit. circit 3 mm."

Sp. 3. *Daphnia pulex*, Mueller

This commonest of our Daphnids is apparently circumpolar in distribution. I have found it in Alabama near the Gulf and it also occurs near lake Superior.

Oval, either elongate or short, spine springing from the upper angle of shell or in some cases near the middle. The spine is rather long in young individuals but becomes very narrow in older ones or entirely disappears. The abdominal processes are long, not coalescent, or slightly united at the base. The head is concave below and extends into a prominent beak. This species is either very variable or several species are frequently united under the term. Two types have been recognized in America. One, abundant in spring in smaller ponds in Minnesota, is rather short, arched above, and in old females with the spine situated near the middle of the posterior margin. This form is quite typical for the species and occurs from April to mid-summer. Another variety was found in Alabama in late autumn, and similar animals in mid-winter in lake Calhoun, Minnesota. This type has a much more elongate body, the very slender but rather short spine springs from the upper

margin of the shell or is quite wanting. This longer form has the beak slightly arched so as to resemble a "Roman nose." The anal spines are less numerous (10-14 while typical *D. pulex* has nearly 20). The young of this form, which may be called

***Daphnia pulex*, var. *nasutus*, (Var. n.)**

(Plate N. Figs. 1-4.)

vary much among themselves but, in general, resemble the young of the European form.

Daphnia pulex has been mentioned by a number of authors in America, Smith, Birge, Chambers and Herrick having noted its occurrence in various parts of the United States. *D. obtusa*, Kurz, is apparently only the spineless condition of the above or a related species. No *Daphnia* is without the spine through life; such a form would constitute a new genus at once.

Sp. 4. *D. schoedleri*, Sars.

Seems to resemble *D. pulex* very closely but differs in having the lower margin of the head nearly straight, terminating in a short straight beak. The spine springs from the middle of the posterior margin. The anal spines are 14-16 in number. Length 2.33 mm.

This name is applied by Sars to Schoedler's *D. longispina* which is not *D. longispina* of Leydig.

Sars' *D. hastata* is so insufficiently defined that it will probably be necessary to drop it from the list.

Sp. 5. *Daphnia minnehaha*, (Sp. n)

(Plate K, Figs. 1, 2; Plate L, Figs. 1, 2.)

This species, which occurs in small pools in autumn (affluents of Minnehaha creek, etc.,) closely corresponds apparently to Sars' *Daphnia carinata* but differs in numerous points. It, in fact, is more nearly related to *D. pulex* than the group under which that species is placed.

The form is oval, arched above, narrowed posteriorly, terminating in a rather short spine which curves lightly upwards. In males and young females the spine springs from the upper angle, but in old females having many summer eggs the spine is nearly median. The head is depressed, strongly arched and keeled slightly above the eye, which occupies the extreme end of the forehead. The keel of the head extends into a slight angle over the heart and continues

down the back. In young females and in males the slight angle is replaced by a strong knife-like projection which extends into from 1 to 4 sharp teeth, the anterior tooth being directed forward. The males, in particular, have this feature emphasized. *D. longispina* has a somewhat similar projection but the more nearly related forms seem not to show this peculiarity. The beak is slightly curved and the lower margin of the head is slightly sinuate. The shell has the usual square reticulations and is usually very transparent but in peaty waters becomes brownish. The size is small but variable; 1.8 mm. is a common measurement. The post-abdomen is narrow, the claws are armed with four or more teeth and a series of lateral bristles. The anal spines are eleven or more in full grown females and decrease only moderately upward. The processes of the abdomen are distinct. The males are smaller and strongly carinated above and of the same form as young females. The antennules are rather long, with a short lateral and a long terminal flagellum, which latter is more than twice the length of sensory setæ which are partially lateral. The first foot has a strong claw and a long flagellum, while the second feet have a small spiny hook. There is a single abdominal process which is not hairy as in *D. pulex*.

Sp. 6. *Daphnia carinata*, Sars.

Very similar to the last but, according to Sars, the claw has no well marked teeth, a short flagellum on the male antenna, and the abdominal processes are united at the base (which may indeed be sometimes the case in the above.)

D. cavifrons, Sars, has a prominence on the forehead and the lower margin of the head is strongly concave, otherwise hardly distinguishable save by the absence of the keel above.

Sp. 7. *Daphnia longispina*, Mueller.

D. longispina, O. F. MUELLER, BAIRD, LEYDIG, SARS, P. E. MUELLER, KURZ, WEISSMANN, etc.

Oval, elongate; head large, rounded in front, lower margin somewhat concave; rostrum long. Spine very long, springing from the middle of the posterior margin. Post-abdomen attenuated toward the end. Terminal claws smooth or simply ciliate, spines few. The abdominal processes are united at the base a very little. Flagellum of the male antennule hardly longer than the sensory setæ. The young have three teeth above as in *D. minnehaha*. There is

a great deal of diversity of opinion as to the value of this name. Not that there is any doubt of the existence of a widely distributed form which in general is that intended by Leydig and others, but the variation is so great that the possibility remains that more than one species is included under the one title.

P. E. Mueller recognizes two varieties depending chiefly upon the length of the spine.

D. lacustris, Sars, is nearly related, if not a variety of the above.

Sp. 8. *Daphnia rosea*, Sars.

(Plate K. Figs. 10-12.)

In form very like *D. longispina*, this species, which is the only representative of this smooth-clawed, unkeeled group yet found in America, might perhaps be appropriately re-united with that species, but, as there seems little doubt of the identification with Sars' variety, as above, I prefer to use his name.

Body oval, moderately ventricose; head of moderate size, lower margin nearly straight; eye situated in the anterior prominence. The beak is not very prominent. The upper outline of the head is slightly concave above the eye or rather less convex. The head is separated from the body by a marked depression. The spine of the shell springs from the upper angle or is quite wanting. The post-abdomen is of moderate size, somewhat narrowed toward the end. The claws are smooth, the anal spines nearly equal, straight, about 14 in number. The abdominal processes are not coalesced or but slightly so. Length 1.50 mm. to 2.0 mm. The species was collected sparingly in a large gathering of *D. pulex* from a small lake in early spring.

The size and conformation of the abdominal processes is very variable and the long and very slender spine is frequently absent.

Sp. 9. *Daphnia similis*, Claus.

The description of this species, which was bred in confinement from eggs brought in mud from Jerusalem, I am, unfortunately, unable to quote. Judging however, from the figures which alone I now have access to, it belongs in the group of *D. longispina*, though in many particulars it resembles *D. schæfferi*. The form is elongate, the spine short and springing from the upper margin. The antennule of the female is very large and flagellate, while that of the male is like that of *D. schæfferi*. The flagellum and hook of the first foot of male are rather small.

We now come to a group of related species which are most difficult to circumscribe on account of their extreme variability. According to the view of Lutz they would all fall into the old *D. hyalina* of Leydig. More probably, however, some of these forms are of nearly or quite specific value.

Sp. 10. *Daphnia hyalina*, Leydig?

(Plate L, Figs. 3, 5.)

Daphnia longispina, HERRICK.

I have elsewhere given a brief account of the post-embryonic development of a species which agrees best with Leydig's figures of *D. hyalina*.

The lower outline of the head is nearly straight, the eye being always approximated toward it. In young specimens the head is sharp in front and crested. The lower margin of the head appears very long and the beak turns backward. The spine is very long in young forms but is short in old females. The male resembles very much the young female. The post-abdomen is narrowed toward the end, the terminal claws are smooth, the anal teeth few and the abdominal processes united. Our specimens are from Paducah, Ky., south of the Ohio river.

I do not know how to distinguish *D. laevis*, Birge, from *D. hyalina*, save that the abdominal processes are said to be distinct. Both forms were observed in the above mentioned gathering. If, however, Birge's figures are characteristic, he had a different variety before him from ours; it seems somewhat like *D. galeata*.

D. pellucida, P. E. Mueller, differs from *D. hyalina* in the presence of a series of small teeth on the caudal claws, and a more strongly curved beak.

It is just now brought to my attention that P. E. Mueller, in a late work, identifies *D. pellucida* with *D. hyalina*; though he still holds *D. galeata* distinct.

***Daphnia galeata*, Sars.**

(Plate T. Figs. 7, 8.)

According to P. E. Mueller, this species differs from *D. pellucida* in the absence of teeth on the caudal claw, and, in one variety, by the acuminate head, which seems the only form for which the name is distinctive. Kurz found only the var. *frons rotundata*. According to Forbes, both varieties, the first of which he identifies with *D. pellucida*, occur in lake Michigan.

S. I. Smith finds both in lake Superior, and seems to have no doubt of their distinctness. One of the forms which I have seen differs a little from either of the above, and had a different habitat. Kurz has described the male, which has a very short flagellum upon the antennule. A single source for *D. galeata* was found in a small pool known as Clarke's lake. This is the more remarkable, as this species, which is almost confined to larger bodies of water, is found nowhere else in the vicinage of Minneapolis, while this minute lake, though as deep, perhaps, as any of the largest in the county (say 40 feet), contains a number of forms known otherwise only in the Great Lakes. Kurz's remarks on the specimens collected by him apply equally to these. Were the claws dentate, the animal would pass as *D. pellucida*. The young have no horn on the head. The spine of the shell is nearly as long as the whole animal in the young. The male of our form is 1.2 mm. long, excluding the spine which measures 47 mm. The flagellum is a very little longer than the sensory setæ, and there is a very minute lateral flagellum. A peculiarity of this species is the scattered thorny armature of the spine of the shell. There is but little change in the form of head with age. The form of the last feet is peculiar. The ephippium occupies comparatively a small part of the valves and the spine becomes very short and quite smooth. The sexual period occurs in September and October.

The above statements regarding *D. galeata* require a modification, for in another deep lake the writer has since secured the typical crested *D. galeata* with even a higher crest than that figured by P. E. Mueller. The head ends in a sharp angle. The single female seen was in company with the rounded variety and numbers of *D. kalbergensis*, which it resembles in many respects. Our fauna therefore is quite complete in these remarkable forms.

(See Plate U. Fig. 6.)

Sp. 11. *Daphnia dubia*, Herrick.

(Plate L. Figs. 7, 8.)

American Naturalist, 1883.

The life history of this form is insufficiently known, but there seems no reason for doubting that it constitutes a new and easily recognizable species. It is nearly related to *D. hyalina*, but the head is strongly crested all round and the eye is withdrawn, in young as well as old specimens, toward the middle of the head. This peculiarity is shared in this degree by no other *Daphnia*

The form is as in *D. pellucida*, but the spine is more slender and directed upward. The head is shaped much as in *D. vitrea* in the young, but is much less prominent. The older form has a shorter and more slender spine (none were seen in the ultimate or spineless stage). The head is more evenly rounded, but still well crested. The abdomen is very slender and the anal teeth diminish rapidly in size from below upward. The claws are very short and armed down the whole length with fine bristles. The abdominal processes are well united at the base in old specimens, so that the second seems a small process of the first. The shell is very transparent and the spine is longer than in any other Daphnid. In a young specimen the spine was 1. mm., the body 0.7 mm., and the head 0.4 mm. In this specimen the spine was slightly curved, the head elongate with a slight ridge in front. Another individual had the spine 1.1 mm. long, while the remainder of the animal was 1.3 mm. This specimen also had a knife-like hyaline ridge on the crest, which was obliquely truncate in front; it also had numerous summer embryos in the brood sac. The spine was perfectly straight and but slightly inclined upward. Older individuals have a rounded crest as figured and no ridge. The spine is relatively somewhat shorter but much more slender. The characters which most clearly distinguish this species are the well crested head, which in young as well as sometimes older specimens has a median hyaline ridge, the withdrawal of the eye from the margin and the very long spine. It resembles *D. galeata* in earlier stages. It is very much like *D. lævis* or, in other words, is in the group of *D. hyalina*; but the study of a considerable number of specimens from different localities convinces me that it can not be united with that species in any of its varieties. This species has only been found in autumn, Sept.—Nov., lake St. Croix and Richfield in Hennepin county.

SECTION II.

Pigment fleck wanting. Head crested. The small, hyaline species constituting this section, elevated by Schœdler to the rank of a genus (*Hyalodaphnia*) and by Sars to that of a subgenus (*Cephaloxus*), are chiefly residents of the deeper parts of our larger lakes. These forms, from their rarity, have been little studied and it is uncertain how far the assumed specific distinctions are valid.

Two species are known in America and they are not confined to large lakes.

Sp. 1. *Daphnia longiremis*, Sars.

Hyaline, compressed, seen from the side, rounded, lower margin strongly arched; spine long, straight, oblique. Head rounded, lower margin nearly straight, ending in a beak directed downward, acute anteriorly. Eye small. Antennæ very long. Length 1 mm.

The abdomen is said to be similar to that of *D. longispina*. From the brief description given by Sars it would appear that this species is characterized by a rounded and uncrested or slightly crested head. Though imperfectly described, it is here mentioned to direct attention toward any such species as may be found in America.

Sp. 2. *Daphnia cristata*, Sars.

Compressed, long. Head acute in front, strongly crested, lower margin nearly straight. Dorsal line of body little curved, spine long in the young, strongly curved. Head of male smaller, flagellum of antennule twice as long as the setæ; first foot well clawed. Length of female 1.33 mm.

Sp. 3. *Daphnia cucullata*, Sars.

D. herolinensis, SCHOEDLER.

Very like the above, but the margin of head is not straight below, is, however, extremely variable and ends in a sharp angle. The eye lies nearly midway between the heart and the end of the head and near the lower margin. The two anterior processes of the abdomen are united for most of their length. The flagellum of the male antenna is about as long as the terminal setæ.

D. apicata, Kurz, seems to be a large variety lacking the sharp spine of the head. In the main it agrees quite well. Although the post-abdomen is broader than figured by Mueller, the number of teeth corresponds with Sars' description.

Sp. 4. *Daphnia kalbergensis*, Schoedler.

(Plate U. Figs. 1—3).

Form oval, spine long. Head high, compressed, enormously elongated, beak obtuse. Eye small. Abdominal processes not united. Caudal claws ornamented with small setæ. Antennæ of male with a short flagellum. Length of head nearly equal to that of body exclusive of spine.

D. vitrea of Kurz seems not improbably a varietal form of the above though the crest is lower, the size is less and the post-abdo-

men is more slender and has fewer teeth; the differences are, however, hardly specific.

I am not convinced that either *D. cederstromii*, Schoedler, or *D. retrocurva*, Forbes, are really distinct species, although the latter, with its more strongly crested head, is said also to have a series of teeth on the terminal claw. Perhaps it forms with *D. cederstromii* the fifth and extreme phase of this group.

Since writing the above account of *Daphnia kalbergensis* this truly monstrous species has come to light in the vicinity of Minneapolis. The opportunity is thus afforded to verify the suspicion expressed above that a number of species must be united under this name. P. E. Mueller gives the following measurements for *D. kalbergensis*: head 0.9—1.0 mm., body 1.0—1.1 mm., spine 0.7—0.75 mm. Kurz for his *D. vitrea* gives a length of 0.85 mm. plus 0.25 mm., the length of the spine. Judging from his figure, the head would not measure over 0.35 mm.

Forbes says of his *D. retrocurva* that the head is two thirds as long as the body.

Our specimens measured as follows:

No. 1. 1.6 mm, head somewhat more than half the body and almost exactly like *D. vitrea* in form.

No. 2. Head 0.6 mm., body 0.9 mm., spine 0.5 mm.; about 9 anal spines. Head in this case moderately curved upward.

No. 3. Head 0.95 mm., body 0.95 or less, spine 0.5 mm.; or the head as long as or, indeed, considerably longer than the body and directed upward.

The males have the crest much lower, the spine longer, and the form of antennules figured by P. E. Mueller. In the older females the beak is elevated above the antennules, as remarked by Forbes, but in smaller individuals there is very little difference between our specimens and Mueller's figures.

The claws of the post-abdomen have, besides the row of fine teeth mentioned by Mueller, a cluster of sharp teeth just at the base.

Found, together with typical *D. galeata* and the rounded form, in a small deep lake or expansion of a creek not far from Medicine lake, Hennepin county, Minn.

Sp. 5. *Daphnia magniceps*. (Sp. n.)

(Plate U. Fig. 15).

The peculiar form figured in the Tenth annual of this survey seems indubitably new and is distinguished by the peculiar shovel-shaped head, which is scarcely crested but is broadest beyond the

middle. The spine is long, the claws smooth, the abdominal processes united and the shell transparent. The eye is near the end of the rounded head and is large; the pigment fleck was apparently absent. Found with *Daphnia minnehaha* in a shallow swampy pool in autumn.

FAMILY BOSMINIDÆ.

The sole genus of the family, *Bosmina*, contains over a dozen nominal species which are among the most difficult to define of any cladocerans. The number is here reduced to nine and the probable position of the rejected species is indicated. This is not done because the author presumes upon the slender material at hand to revise the genus; but simply from the fact that the descriptions of the earlier writers do not permit a proper discrimination; so that this necessity is entailed upon any one who would give a birds-eye view of the members of the genus. The *B. diaphana* is founded upon a different twist in the antennules and no hesitancy is felt in uniting it with Sars' *B. lilljeborgii*. The other species, *B. brevis* and *B. nitida*, are omitted simply because there seems to be no way of separating them satisfactorily from *B. maritima* and *B. obtusirostris* respectively. Three species have been found in Minnesota, but practically no attention has been given to the genus here.

Bosmina macrorhyncha found in Egypt is not here included, its description being inaccessible to me.

B. lævis, Leydig, seems simply a smooth condition of other species. Whether *B. curvirostris*, Leydig, is or is not valid must, so far as I am concerned, remain at present doubtful.

GENUS BOSMINA.

A. Shell extending into a spine behind.

(a) Antennæ curved outward.

1. *Bosmina cornuta*, Jurine.

(b) Antennæ not curved outward.

I. Shell reticulated, at least in part.

† Flagellum midway between eye and the sensory setæ of antennæ.

2. *Bosmina longirostris*, Mueller.

†† Flagellum nearer eye.

3. *Bosmina maritima*, P. E. Mueller.

4. *Bosmina longispina*, Leydig. (*B. brevis*?)

II. Shell striate.

† Antennules long.

5. *Bosmina striata*, Herrick.

†† Antennules short.

* Rostrum long.

6. *Bosmina lacustris*, Sars.

** Rostrum short.

7. *Bosmina obtusirostris*, Sars. (*B. nitida*, Sars?)

B. Shell not spined behind.

(a) Shell strongly arched above.

8. *Bosmina tilljeborgii*, Sars. (*B. diaphana*?)

(b) Shell moderately curved above.

9. *Bosmina microps*, P. E. Mueller.

Concerning the identification of *Bosmina longispina*, Leydig, with *B. brevisrostris*, P. E. Mueller, it must be said that the bow is drawn at a venture, for Mueller, in his paper on the Cladocera of Swiss Lakes, in a fit of absent-mindedness refers to *B. lacustris*, P. E. Mueller, citing p. 149 of Denmark's Cladocera. On the page in question are descriptions of *B. maritima* and *B. brevisrostris* of which the latter is probably the one meant. Sars' *B. lacustris* seems quite different, being strongly marked by longitudinal lines, while Leydig says of *B. longispina* "shell striped and small reticulate," and P. E. Mueller says in *B. brevisrostris* the shell is "utydeligt reticularet" i. e. indistinctly reticulate.

The three species so far identified in America are *B. longirostris*, of which a figure is given (plate J, fig. 2,) *B. cornuta* and *B. striata*, which may possibly be yet identified with one of the European species, though it seems improbable. I have also seen a species like Leydig's *B. lævis*, but considered it a smooth variety of *B. longirostris*.

FAMILY LYNCODAPHNIDÆ, Sars, 1861; Herrick, 1881.

This is a rather small family with seven genera of minute animals which are abundant only in summer. Many and, indeed, most of the species are among the rarer of fresh-water crustaceans of this group, and a few are among the rarities which only now and then reward the collector. This family undoubtedly is the link connecting the Daphnidæ with the Lynceidæ, relationships to which are expressed by *Macrothrix*, on the one hand, and *Lyncodaphnia*, on the other.

The rank of this group as a family must be, of course, a matter largely of opinion. Sars was the first to adopt this view, sustained by certain curious transition forms leading toward Lynceidæ. Later writers seem never to have found these genera and the group was

again included with the Daphnidæ. The writer, upon the discovery of the Lyncodaphnia, was forced to regard this group as of equivalent grade with the above mentioned families and again proposed the family name Lyncodaphnidæ.¹

The genus *Ilyocryptus* is a little one side the normal course of the family and seems related to the lynceid genus *Leydigia*.

The waters of the northern United States are very rich in members of this family.

The aberrant family *Bosminidæ* finds its only connection with other Cladocera through this group by means of the remarkable *Macrothrix* (?) pauper; and here it is only vaguely hinted at in the elongated antennules and angled lower margin of shell, as well as the presence of certain bodies near the base of the antennules. It has been affirmed that none of the Lyncodaphnidæ have an ephippium, i. e. the saddle-shaped thickening of the shell walls to include and protect the winter eggs; but I have discovered it in the case of *Macrothrix tenuicornis*, Kurz, and presume it may occur exceptionally in others. Kurz says that *Ilyocryptus* has no moult proper, but this probably refers only to the European *I. sordidus*. The American species differs from the generic description given by Kurz, and may be different in this respect also.

In this family the regularity in the disposition of the setæ on the antennæ is broken and the fringing of these hairs serves the purpose of specific distinction. The antennules are always long and frequently differ considerably in the sexes. The pigment fleck is always present (Kurz is in error in denying its existence in *Lathonura*). In many forms there is no free posterior margin of the valves, while the lower is generally thickly beset with movable spines. The Lyncodaphnidæ will be distinguished from *Ceriodaphnia*, which they resemble, by their motion, which is a succession of quick bounds, while the broader *Ceriodaphniæ* hobble along as though heavily weighted by the enormous mass of eggs with which they are generally laden. The abdomen is usually short and the anus is behind the terminal claws, but in *Ilyocryptus* the claws are long and spined at the base. In the American *I. spinifer* the anal opening is elevated to a point nearly underneath the stylets, and there is a rudimentary anal cæcum as in Lynceids.

The males have the opening of the vasa deterentia in front of the claws, which may be absent; the antennules are also modified, being longer and curved. In *Lathonura* the abdomen is elongated

¹ Notes on some Minnesota Cladocera. 1881.

posteriorly till it begins to suggest a transition to *Polyphemus*. The known genera and their distribution is as indicated below.

Half of the known species are found in America; one sixth being peculiar to it.

GENERA.	Total number of species.	European.	Also American.	Only in America	Total American.
1. <i>Macrothrix</i>	4	3	2	1	3
2. <i>Lathonura</i>	1	1	1	..	1
3. <i>Drepanothrix</i>	1	1	.....	.....	.....
4. <i>Streblocercus</i>	1	1	.....	.....	.....
5. <i>Acantholeberis</i>	1	1	.....	.....	.....
6. <i>Ofryoxus</i>	1	1	1	.....	1
7. <i>Lyncedaphnia</i> ?	1	.....	.....	1	1
8. <i>Ilyocryptus</i>	3	2	.....	1	1
Totals	13	10	4	3	7

I. GENUS *MACROTHRIX*, Baird.

Body oval, pointed behind; head broad; antennæ of first pair long, nearly straight, beset with spines, olfactory threads terminal; swimming antennæ large and powerful, propelling the animal by bounds; three-jointed ramus with a greatly elongated seta which is thorned and jointed; labrum with the basal joint enlarged, resembling that of Lynceids; first foot with a hook in both sexes; last foot with a long process (respiratory body); abdomen short; claws short; caudal stylets often with a bush of hairs at tip. The intestine is straight and without cæca in front or behind.

The first one to observe a member of this genus, apparently, was O. F. Mueller whose *Daphnia curvirostris* is usually referred to *Macrothrix laticornis*.

The name *Echinisca* was proposed by Lievin, but *Macrothrix* was applied by Baird in 1843. Four species are known, three of which occur in America and without doubt the fourth will ultimately be found. No males of this genus were known till 1877 when the male of *M. laticornis* was described and figured.¹ Nearly two years later the male of *M. rosea* was described from Wisconsin by E. A. Birge. Descriptions of the male of *Lathonura* are also given in both the above mentioned sources.

Sp. 1. *Macrothrix laticornis*, Jurine.

(Plate C. Figs. 7, 8 and 9.)

Daphnia curvirostris(?), MUELLER.

Monoculus laticornis, JURINE.

Lynceus laticornis, DESMAREST.

¹ Gruber und Weismann, Ueber einige neue oder unvollkommen gekannte Daphniden. Freiburg.

Macrothrix laticornis, BAIRD, Ann. Mag. Nat. Hist.

Acanthocercus curvirostris (?), SCHOEDLER, Erichs. Archiv, 1846.

Daphnia curvirostris, FISCHER.

Macrothrix laticornis, LILLJEBORG, LEYDIG, BAIRD, P. E. MUELLER, FRIC, KURZ, SARS, LUTZ, CLAUS (Die Schalendruse d. Daphnien), NORMAN and BRADY (Monogr. Brit. Entom.), GRUBER and WEISMANN, WEISMANN, (Beitrage zur Naturgeschichte d. Daph.)

This is the commonest European species and is the type of the genus, showing its rather conservative position by the broad tip of the antenna which is a feature exhibited by embryos and young of other species. The shell has a warty surface and is toothed above, while the lower margins are fringed with long unequal spines in groups of threes or fours.

The form is roundish with a blunt posterior angle, the ventral margin being regularly curved. The antennules are short and enlarged at the end. The form is an irregular pentagon; a pair of slender spines sits at the angle near the base.

The swimming antennæ with the seta on the first joint of 3-jointed ramus very long. Post-abdomen truncate at the end, short, posterior margin beset with series of bristles.

Length of male 0.5—0.6 mm., of female 0.4 mm.

This is the smallest of the genus and will undoubtedly be found in America.

Sp. 2. *Macrothrix rosea*, Jurine.

(Plate C. Figs. 5, 6, 11, and 13.)

Monoculus roseus, JURINE.

Lynceus roseus, DESMAREST.

Daphnia rosea, M. EDWARDS, JURELL.

Echinisca rosea, LIEVIN.

Macrothrix rosea, BAIRD, LILLJEBORG, P. E. MUELLER, BIRGE.

The body is sub-oval, terminating behind in an acute angle; the lower margin is less conspicuously spined than the last or the following; the antennæ are but slightly dilated at the end and nearly straight. The longest seta of the antennæ is longer than in the last, reaching beyond the tips of the terminal setæ; abdomen more slender, sinuate in front, beset with short hairs.

Length 0.6 mm, male 0.3 mm. The male has no claws on the end of the post-abdomen, and the antennules are curved and elongated. Figures 5 and 13 are copied from Birge.

Sp. 3. *Macrothrix tenuicornis*, Kurz.

(Plate C. Figs. 1, 1 a, 2, 2, and 12.)

(See Notes on Cladocera of Minnesota, p. 245.)

The body is oval, produced posteriorly in a sharp point; the abdomen is strongly arched, while the upper outline of the head is a regular curve or slightly extended in front of the eye; the antennules are long, nearly straight and a very little narrowed toward the end, just in front of which is a series of short teeth; there is no lateral spine, but a strong terminal one in addition to the sensory filaments; the pigment spot is large, the eye small and the lobus opticus well separated from the ganglion; the antennæ have a very powerful basal joint; the elongated seta is very stout and densely spiny, with a tooth at its flexure; two of the terminal setæ are spiny, for the basal half; the valves are beset with very long spines in sets of three each, all having different positions; the abdomen is nearly as in *M. rosea*, but the posterior margin has a series of long sharp teeth; the mandibles are nearly completely exposed by the arched anterior margin of the valves.

The labrum, in this species, is an odd link between that of the Daphnidæ and Lynceidæ. The basal segment is greatly enlarged and is sub-triangular in outline, with a movable lip attached to the inner free face; the typical daphnoid structure is preserved, but the enlarged salient angle of the basal portion shows how the transition to the great triangular labrum of *Alona*, etc., is made. In young specimens the head is proportionately larger, the antennules are broader at the tip, and the dorsal outline is less convex; the marginal spines of the valves are also proportionally larger, as are the appendages of the first and last pairs of feet. This is one of the largest species of the genus, 0.75 mm. being the length. This is very close to *M. rosea* but seems distinct.

This form is quite common about Minneapolis, Minn., but is not yet noted elsewhere in America.

Sp. 4. *Macrothrix pauper*, Herrick.

(Plate C. Fig. 4.)

This species is described from a single specimen from L. Minnetonka, and I can add nothing to the very meager notice given then.¹

¹ Notes on some Minnesota Cladocera. 1881. C. L. Herrick.

The body is broad and very narrow, the lower outline is angled and nearly unarmed; the pigment fleck and eye are small and approximated; antennules very long and curved backward and outward; abdomen short, ciliate below; claws short, ciliated. This female had a full complement of eggs but the antennæ resemble those of a male. This is unusually interesting and should be rediscovered and studied; for there seems to be some affinity between this species and *Bosmina*, and it is probable that it requires to be distinguished generically from *Macrothrix*.

II. GENUS LATHONURA, Lilljeborg.

The form is oval; the head is curved more than in *Macrothrix* and the shell is more obtuse behind, sinuate below where it is beset with short spines anteriorly; first antennæ long, straight; second antennæ with five setæ on each ramus; only four pairs of feet apparent; abdomen short, prolonged upward to the insertion of the caudal stylets; male similar but smaller.

Sp 1. *Lathonura rectirostris*, O. F. Mueller.

(Plate D.)

Daphnia rectirostris, O. F. MUELLER.

Pasithea rectirostris, KOCH, Deutschland's Krust., etc.

Daphnia brachyura, ZADDACH, Syn. Crust. prussicorum. LIEVIN, Die Branch. d. Danziger Gegend.

Daphnia mystacina, FISCHER, St. Petersb. Branchiop.

Lathonura rectirostris, LILLJEBORG, De Crust. ex ord. trib.

Pasithea rectirostris, LEYDIG, Naturg. d. Daph.

Lathonura rectirostris, NORMAN and BRADY, Monogr. Brit. Ent.; P. E. MUELLER, Danmark's Cladocera.

Lathonura spinosa, SCHOEDLER, Branchiop. d. Umg. v. Berlin.

Pasithea rectirostris, GRUBER and WEISMANN, Ueber einige neue od. unvolk. gekannte Daph.

Lathonura rectirostris, BIRGE, Notes on Cladocera. HERRICK, Notes on Minnesota Cladocera.

The only species of the genus is distributed probably over the entire northern temperate zone. It has been found in America at Cambridge, Mass., and in the vicinity of Minneapolis, at both of which places it is very rare.

The form is a rather quadrangular oval, the head being strongly arched to the beak which is much farther posterior than in *Macrothrix*, in this respect resembling the *Daphnidae*; the eye occupies the center of the lower part of the head margin, and is of moderate size; the pigment fleck is near the base of the antennules and well removed from the eye; the antennæ are straight and long, with a

sensory bristle near the base in front and two bristles a third from the end; the second antennæ are furnished with a powerful basal joint, while each of the main subdivisions of the rami has its bristle, which are nearly equal; two of the terminal setæ are toothed for the basal half and pectinate distally, but the others are feathered throughout; the four-jointed ramus has a spine on the second joint and a longer one at the end, and all the joints of both rami are ornamented with triple series of spines; the maxillæ are three-spined at the end and are in almost constant motion; the first pairs of feet have curious comb-like bunches on some of the setæ; the abdomen is very short and terminates in inconspicuous teeth, the posterior part of the abdomen being ornamented with teeth flattened longitudinally so as to look like spines from the side; the last foot is simple but bears a large appendage; the posterior third of the shell is fringed by extremely minute spines, but anteriorly by lanceolate stiff spines flattened longitudinally like the spines of the abdomen; the caudal setæ are seated on a high prominence of the abdomen, and are fringed along their whole length, not merely at the end. The female is 1 mm. long, the male 0.5—0.6 mm., in which sex the antennules have more numerous lateral bristles, the first foot has a claw and the back is less elevated. The semen bodies are irregularly round with small nuclei.

III. GENUS STREBLOCERCUS, Sars.

In form like *Macrothrix laticornis*, head terminating in a long rostrum bearing the long, twisted antennules. Antennules very large, curved backward and outward. Head not separated by a distinct depression from the body, very high, slightly arched above, abruptly curved below with spines upon the margins. The antennæ are large; four-jointed ramus much the longer, with four setæ. Labrum with a large process. Post-abdomen as in *Macrothrix laticornis*. Eye near the beak; pigment fleck small, below it at the base of the antennules. Length .33 mm. *S. minutus* is the only species.

Our *Macrothrix pauper* seems a near approach to this genus; both have a strong spine or claw on the first foot which projects beyond the shell, but there are many differences. *M. pauper* is 1 mm. long.

IV. GENUS DREPANOTHRIX, Sars.

The head not separated from the valves by a depression; fornices moderate; rostrum rather acute, distant from the anterior edge of the valves. The form is subrotund; reticulate, with the margins of shell fringed below by long movable spines; pigment fleck present; swimming antennæ with three ciliated setæ on the 4-jointed ramus, the 3-jointed ramus with its basal joint armed with an unjointed, strong, spinous seta and four ciliated setæ on the remaining joints. The post-abdomen is broad. The male has longer antennæ and a hook on the first foot.

Sp. 1. Drepanothrix dentata, Euren.

(Plate C. Fig. 14.)

Acantholeberis dentata, EUREN.*Drepanothrix setigera*, SARS.*Drepanothrix hamata*, SARS.

This animal is only 0.5 mm. in length. The antennules are laterally curved in the middle and ornamented with notches on the margins; the pigment fleck is quadrate and rather large; the post-abdomen is truncate at the end, convex behind and ornamented with a series of small spines. Only found in Scandinavia as yet.

V. GENUS ACANTHOLEBERIS, Lilljeborg.

Head separated by a depression from the body, with fornices above the base of the swimming antennæ; rostrum erect, rather acute; shell oblong, truncate behind, ciliate below with long setæ; macula present; antennules rather long, movable, sensory setæ terminal, bifid at the apex.

The tri-articulate ramus has a long spiny seta on the basal joint; feet six pairs; no abdominal process; post-abdomen wide, large; intestine without cæca.

Sp. 1. Acantholeberis curvirostris, Mueller.*Daphnia curvirostris*, O. F. MUELLER.*Acanthocercus rigidus*, SCHOEDLER, LIEVIN.*Acantholeberis curvirostris*, LILLJEBORG, P. E. MUELLER.

This species of a genus approximating the Lynceids has not yet been found in America but is to be expected.

The abdomen is rounded toward the end and spiny posteriorly; the terminal claws are furnished with two strong teeth at the base,

followed by a series of fringing bristles. The length, according to Mueller, is 1.5 mm. This is a rare form in Europe.

VI. GENUS *OFRYOXUS*, Sars.

The single species constituting this genus seems to have been seen by no writer save Sars. At the time my previous paper on Cladocera was published, Sars' description seemed not to apply to the form called *Lyncodaphnia*. Since then several stages in the growth of *Lyncodaphnia* have been encountered, which so far agree with what is said of *Ofryoxus gracilis* that it is doubted if the two forms are not identical.

VII. GENUS *LYNCODAPHNIA*, Herrick.

(Plate B. Figs. 12, 15; Plate B1, Figs. 1, 3.)

Body elongated, somewhat rectangular as seen from the side, greatest width and height of shell a little posterior to the heart; head separated by a depression from the body, truncate below; antennæ and antennules much as in *Macrothrix*; 4-jointed ramus of antennæ with no lateral setæ; eye small, pigment fleck present; intestine twice convoluted, expanded posteriorly, with anterior but no posterior cæca, opening near the "heel" of the post-abdomen: post-abdomen large, triangular; terminal claws long, rather straight, with two accessory spines at the base.

The species upon which this genus was founded¹ occurs in August and September in the larger lakes of Minnesota.

Lyncodaphnia is, as was suggested, a curious transition form linking the *Daphnidæ* with the *Lynceidæ*.

A farther study of the genus shows that, in some respects, it is more closely allied to both groups than before suspected. The habit and appearance in the water reminds us of *Simocephalus*, a resemblance which an occasional spot of pink or blue color heightens.

L. macrothroides not only has the disc-like last foot colored but the swimming antennæ are banded with purple as in *Simocephalus rostratus*, Her., and *S. americanus*, Birge. The intestine has anterior cæca, which is not the case in *lynceids* nor, indeed, in other *Lyncodaphnidæ*.

The four-jointed ramus of the antennæ approaches *Lynceidæ* in the absence of a lateral seta, but the other ramus is as in *Macrothrix*. The convolution of the intestine, the form of the post-abdomen and the situation of the anus, are all of a strictly *lynceid*

¹ Notes on Minnesota Cladocera, p. 247.

type; moreover the flattened appendage of the last foot is like that of *Eurycerus*.

Even in the form of the shell there is a combination of characters; the anterior part of the shell has the form peculiar to *Lyncodaphnidæ*; but posteriorly it again expands and becomes truncate behind; the form in the adult is not unlike that of some *Lynceidæ*, but the young has a long spine posteriorly exactly like the spine of *Daphnia*. The latter fact is very instructive, for it indicates that the theory proposed (*Am. Naturalist*, 1882, p. 815) to explain the origin of this appendage is probably the correct one. Professor Leuckart suggested that this spine was a balancing rod intended to keep the proper equipoise over the center of gravity; but it is difficult to see why these long-bodied forms, in which the greater part of the weight lies "abaft" of the pivotal point—the base of the antennæ—should be thus provided while the shorter forms are not. We conceive that it is an apparatus for effecting the moult of the inner lining of the brood cavity of long-bodied and tender-shelled animals such as *Daphnia* and the present genus. The great development of the head in the crested *Daphnidæ* may undoubtedly be explained upon Prof. Leuckart's theory.

Sp. 1. *Lyncodaphnia macrothroides*, Herrick.

(Perhaps = *Ofryoxus gracilis*, Sars.)

Notes on Cladocera of Minn., p. 247.

Sub-rectangular, greatly elongated, truncate behind, with a slight spine above; head and eye small, fornix moderate, beak truncate; antennules rather long, slightly curved, tapering a little toward the end, whence spring three lanceolate spines and several sensory filaments, five stout spines behind, above the middle, and several more slender ones; swimming antennæ very long, terminal setæ smooth to the joint; labrum as in *Daphnia*; mandible attached behind a salient angle of the front margin of the shell; no abdominal processes; post-abdomen broad above, triangular; terminal claws pectinate, furnished with one very large toothed accessory spine and a smaller one; the first foot has a hook; the last foot consists of a large oval plate which bears posteriorly the ordinary branchial coil, here shaped like a thumb and forefinger. The young is of a different shape and bears a long spine. The male is unknown.

VIII. GENUS ILYOCRYPTUS.

Form compact, short; head short, triangular, with large fornices forming a roof over the head; the posterior margin of shell nearly as long as the inferior; lower angle a broad curve; antennules two-jointed, basal joint very short, second joint straight, rather long; setæ terminal, but one seta near the base; the four-jointed ramus of the antenna with but three (terminal) setæ; six pairs of feet, last pair rudimentary; tail large, as in *Lyncodaphnia*, anus elevated; intestine straight, without cæca, but an expansion near the rectum sometimes simulates one; the margin of the shell is bordered with long spines, which may be branched or simply pectinate. There is often, perhaps generally, a failure to entirely remove the moulted shell; when this occurs, the newly-formed shell from each moult remains under the older ones till the animal seems to be wearing six or more overcoats, and the spaces so formed become filled with algæ and filth till the animal is no longer able to swim. P. E. Mueller and Kurz, who seem to have seen only *I. sordidus* agree that *Ilyocryptus* can not swim, but poles along in the mud on the bottom by means of antennæ and abdomen; our *I. spinifer*, on the other hand, swims freely till loaded up with old clothes and filth.

This genus is also closely allied with the *Lynceidæ*.

Sp. 1. *Ilyocryptus sordidus*, Lievin.

(Plate C. Figs. 15, 16, 17.)

Acanthocercus sordidus, LIEVIN, LEYDIG.

Ilyocryptus sordidus, SARS, NORMANN, P. E. MUELLER, KURZ.

Body higher than long; head small, terminating anteriorly in almost a right angle; posterior part of the shell margins covered with branching, thorny spines; antennules cylindrical; antennæ short; four-jointed rami with no lateral setæ; post-abdomen large, broad; terminal claws with two spines at the base; anus in the middle of the posterior margin, which is very heavily armed with spines; a hairy abdominal process is present according to Kurz.

There are no anterior cæca (my statement that P. E. Mueller described such cæca was an error; see Notes on Cladocera of Minn., p. 246).

Sp. 2. *Ilyocryptus spinifer*, Herrick.

(Plate C. Figs. 18—19.)

Usually longer than high; head rounded, almost exactly like *I. sordidus*, but the form of the post-abdomen differs a little in the higher situation of the anus and the great elongation of four or five of the lower spines of the posterior margins; the margins of the shell are beset with pectinate setæ which do not branch. The nearest approach to branching setæ yet seen are figured on plate C, fig. 18 a; this consists in the outgrowth of a spine from near the base, and such setæ are found only on part of the posterior margin.

It seems that our form is rather close to *I. sordidus* though clearly distinct.

This species occurs in many of our lakes, and is found most frequent in late summer.

Sp. 3. *Ilyocryptus acutifrons*, Sars.

This species is only mentioned in the appendix to the paper of Sars on the Cladocera from the vicinity of Christiania. The following is a condensation of the description.

Head large, acute in front. Shell truncate behind, with shorter setæ behind than below. Antennules shorter and thicker than in *I. sordidus*. Antennæ long and robust. Abdomen with a short, obtuse process. Post-abdomen shorter than in *I. sordidus*, posterior margin continuous, anus terminal; caudal claws straight, very long, with two minute basal spines. Pigment fleck almost touching the eye. Length less than in *I. sordidus*.

This species seems in some respects more like a true lyncodaphnid than either of the other species. It is doubtful if it belongs here.

FAMILY LYNCEIDÆ.

GENERA.	Number of known species.	European.	Also in America	In America only.	Total American.
1. <i>Eurycerus</i>	1	1	1	.....	1
2. <i>Acroperus</i>	2	2	1	.....	1
3. <i>Camptocercus</i>	6	5	1	1	2
4. <i>Alonopsys</i>	3	2	1	1	2
5. <i>Leydigia</i>	2	2	2	.....	2
6. <i>Graptoleberis</i>	2	2	1	.....	1
7. <i>Crepidocercus</i>	1	.....	.....	1	1
8. <i>Alona</i>	21	14	6	7	13
9. <i>Alonella</i>	5	5	2	.....	2
10. <i>Pleuroxus</i>	14	8	1	6	7
11. <i>Harporhynchus</i>	1	1	.....	.....	.....
2. <i>Chydorus</i>	8(?)	6(?)	3	.....	3
13. <i>Anchistropus</i>	1	1	.....	.....	1(?)
14. <i>Monospius</i>	1	1	1	.....	1
Totals.....	68	50	20	16	37

Out of the fourteen genera, two (or perhaps only one) are not yet known from America, while one is restricted to it. The American species, 45 per cent of which are new, aggregate 72 per cent of the European. 54 per cent of all the known species are American, and most of these have been found within a range of ten miles of Minneapolis. It is probable that the number of species peculiar to America is too high proportionately rather than the reverse, and the comparatively high per cent of new species is due to an actual larger fauna in the New World, while many Old World species remain to be identified. A few of the European species are very likely synonyms, permitting farther reduction.

This family, which is numerically the largest among the Cladocera, is, in the main, well limited, though there are transitions toward the Lyncodaphnidæ, which are quite direct. The genera *Lyncodaphnia*, *Ofryoxus* and *Ilyocryptus* lead toward the Lynceidæ unmistakably. Most of the members of this family are small, comparatively few exceeding one millimeter in length. The head is covered with an arched shield, which frequently passes with no indentation into the shell of the body. This head-covering generally extends forward and downward to form more or less of a sharp angle in front, while in several genera it is simply rounded in front. It, in either case, arches over the more fleshy lower side of the head from which hang the two short antennules and the labrum, while the strong two-branched antennæ spring from well up under its posterior expansion. The rounded sides of this shield, which protect the insertion of the antennæ, are called the fornices. Above the insertion of antennules is a dark fleck lying near or on the lower angle of the brain; this is the larval or nauplius eye, which is the first to appear in all these small crustacea. This *macula nigra* is not infrequently as large as the eye itself,* or even larger, and in one genus it is the only visual organ. The antennules are small and bear on the end several sensory filaments as well as a lateral flagellum. The antennules of the male differ very little from those of the female. The labrum is furnished with a process, which is triangular or semicircular and is usually larger than the terminal portion. The mandibles are as in *Daphnidæ* but usually shorter. Maxillæ are often conspicuous, but the first pair of feet serve, by a slight alteration at the base, the same purpose. There is rarely an indication of the sixth pair of feet, and the antennæ have both rami three-jointed. The terminal part of the body, or

* The name "Lynceus" is derived from that of the son of Aphareus who was famous for the sharpness of his vision.

post-abdomen, is usually enlarged, and the anal opening is near its base; the armature is usually considerable. The form of the post-abdomen is one of the best criteria for distinguishing genera and species—a process often attended with much difficulty.

The shell is of various forms, frequently beautifully sculptured. The number of eggs produced at one time is limited, and the winter eggs are very often laid in the brood-cavity with no preparation of the shell previous to it, in other words, the ephippium may be absent. On the other hand, sometimes the shell is considerably modified, and generally there is a deposit of dark pigment in the upper part of the shell. The males are very rare and until recently few were known. The diligence of Kurz has added a great many, and we now have a fair idea of the sexual variations. These consist usually in a narrower body and shorter beak, in a strong hook of chitin on the first foot and certain modifications of the post-abdomen. The hook mentioned is simply an enlargement of one of the terminal bristles of the foot, and serves to fasten the animal to the shell of the female. In one American species of *Pleuroxus* we find an approach to this structure in the female—an interesting example of inheritance of sexual peculiarities across the sexes. The alterations in the form of the post-abdomen consist in a narrowing or excavation of that organ to permit its introduction into the brood-cavity, and in some forms (*Chydorus*) this change can only be understood by observing the form of the shell of the female about to produce winter eggs. In general, as in other Cladocera, males are found only at the period when the females are sexually perfect. The ordinary method of reproduction is by virgin-bearing or parthenogenesis. In some cases it would seem from Weismann's observations that the sexual method occurs only incidentally. The orifice of the male organs is between, or anterior to, the terminal claws of the post-abdomen (*Eurycerus* alone excepted). The males are usually but not always smaller. Plate E gives views of typical Lynceidæ Fig. 1 is particularly instructive, for in it the details which can be usually made out in the living object are represented. The following points may be especially noticed. The large size of the pigment fleck, the large antennules (A^1), the keel of the labrum (*Lb.*), the peculiar modification of the first pair of feet to assist the maxillæ (not shown) which are exceedingly small, the largely developed anal gland (*A. g.*), the form and muscular mechanism of the abdomen, which, however, is better illustrated by fig. 10 of the same plate. Fig. 1 contains an embryo seen from the side with the partially developed limb. Fig. 3 shows the appearance of a differ-

ent embryo from below and in an earlier stage. Fig. 2 illustrates the relation of the brain to the eye and the very small optic ganglion. Fig. 9 of plate G gives details of the feet in another species, and the modifications seen in the male of the same species are sufficiently shown in fig. 1 of the same plate, which also well illustrates the various sculpture of the shell displayed by this group. Figures 4 and 9 of plate F show curious modifications of the post-abdomen of the male, and fig. 7 exhibits the structural peculiarity of sexually perfect females which is correlated with it or, perhaps we may say, occasions it.

SUB-FAMILY I.—EURYCERCINÆ.

A single species constitutes the sub-family, and it will be necessary to point out only those points which are distinctive.

The Eurycercinæ differ from the true Lynceidæ and approach the Lyncodaphnidæ in having the digestive tract not coiled, with two cæca in front and the anus at the end of the post-abdomen. Many eggs are produced at once. The male opening is at the base of the abdomen, as in Sididæ. The general habitus is, however, lynceid. The males appear in autumn or when, by the gradual drying up of the water or other causes, the continued existence of the animals is threatened.

I. GENUS EURYCERCUS, Baird.

Characters of the sub-family.

Eurycercus lamellatus, O. F. Mueller.

(Plate H, Figs. 5-6.)

Lynceus lamellatus, MUELLER, EDWARDS, KOCH, ZADDACH, LIEVIN, LEYDIG, ZENKER
Eurycercus lamellatus, BAIRD, LILLJEBORG, SCHOEDLER, P. E. MUELLER, KURZ, BIRGE,
HERRICK.

Eurycercus laticaudatus, FISCHER, SCHOEDLER.

A gigantic lynceid, reaching the dimension of 3 mm. The figure of the male given will sufficiently illustrate the general form. The abdomen is broad and armed behind with a dense row of saw-teeth. The eye is larger than the rather small pigment fleck, and the intestine is bent upon itself but not coiled. The last foot is found in few other Lynceidæ. Acroperus has the same, and Pleuroxus unidens also has a rudimentary sixth foot.

SUB-FAMILY II.—LYNCEINÆ.

Intestine coiled; anus near the end of the post-abdomen; opening of vas deferens nearly terminal. There are no anterior cæca but usually a single anal diverticle of the intestine. Rarely or never more than two embryos produced at once.

SERIES A.

Head or dorsal line keeled or ridged; abdomen long; shell marked with diagonal striae. This section is proposed for the old genera *Camptocercus*, *Acroperus* and *Alopnosis*, which seem to form a natural group though passing directly into *Alona*.

II.—GENUS CAMPTOCERCUS (> *Camptocercus*, Baird).

This easily recognizable genus contains two groups, each with several nominal species, which are distinguished mainly by the width of the post-abdomen. In both the shell is elongated, more or less quadrangular, longitudinally striate, armed behind with one to four minute teeth. The head and back are keeled and the former strongly arched. The antennules rarely extend beyond the beak and are commonly curved laterally. The eye is proportionately small. The post-abdomen is long and furnished with a lateral row of scales. The terminal claws have a single basal spine and are serrate. There is an ephippium, and the male opening is in front of the terminal claws.

SUB-GENUS 1.—ACROPERUS, Baird.

Post-abdomen broad, margins parallel; anal teeth very minute lateral scales large and usurping their place. Antennæ with eight setæ ($\frac{300}{311}$). Three species are described, one of which is very abundant in Minnesota.

Sp. 1. *Acroperus leucocephalus*, Koch.

(Plate E, Fig. 5. Plate I, Fig. 9.)

Lynceus leucocephalus, KOCH, FISCHER.

Acroperus harpæ, BAIRD.

Acroperus leucocephalus, SCHOEDLER, P. E. MUELLER, KURZ.

Acroperus sp., HERRICK.

Acroperus striatus, JURINE, M. EDWARDS, LIEVIN, LILLJEBORG, LEYDIG, etc., seems to belong here, but I am able to add nothing to the elucidation of the puzzle.

Body rounded above, angled behind; head moderately arched and carinated. Lower margin of the shell pectinate, terminating in

two teeth. The antennæ are long and when reflexed the setæ reach nearly to the posterior margin of the shell. The posterior angle is not always as prominent as shown in fig. 5.

Sp. 2. *Acroperus angustatus*, Sars.

(Plate I. Fig. 10.)

Acroperus angustatus, P. E. MUELLER, KURZ.

This species is distinguished from the former by the head, which is higher and very strongly arched. The dorsal contour is nearly straight. The antennæ are shorter. The form of the post-abdomen of the male is less different from that of the female than in the above. The length of both species is about 0.7 mm.

The American form figured in fig. 5 of plate E differs from both the above slightly. The head is carinated and incurved almost as in *C. angustatus*; the antennæ fall a little short of reaching the posterior margin of the too low and oblong shell; there is an obvious depression between the head and body. However, in the main there is close agreement with *C. leucocephalus*, to which it has been previously referred. There is always a rudiment of an additional pair of feet.

A. cavirostris, P. E. Mueller, is not known in the female sex. The male has a twisted caudal claw.

SUB-GENUS 2.—CAMPTOCERCUS, Baird.

Although the general form is similar to the last section, the body is usually longer; the post-abdomen narrows toward the end; the anal teeth exceed the lateral row; the antennæ have usually but seven setae ($\frac{300}{310}$).

The species enumerated are so closely related as almost to baffle definition.

KEY TO THE SUB-GENUS CAMPTOCERCUS (verus).

Beak pointed.

(a) Head depressed.

I. Pigment fleck larger than the eye.

1. *C. biserratus*, SCHOEDLER.

II. Pigment fleck smaller than the eye.

2. *C. macurus*, O. F. MUELLER.

(b) Head directed forward.

3. *C. rectirostris*, SCHOEDLER.

Beak truncate below.

4. *C. latirostris*, KURZ.

Beak cleft below or with a forward projection.

(a) Antennules shorter than the beak.

5. *C. liljeborgii*, SCHOEDLER.

(b) Antennules longer than the beak.

6. *C. rotundus*, HERRICK.

Sp. 1. *Camptocercus biserratus*, Schoedler.

(Plate I. Fig. 4.)

Is very nearly related to the next, from which it is distinguished chiefly by the fact that the pigment fleck is larger than the eye. Schoedler overlooked the fact that in *C. macrurus* there is a lateral line of scales on the abdomen, and relied upon that character to distinguish this form. (Schoedler says that the pigment fleck in *C. macrurus* is smaller than the eye, P. E. Mueller says they are nearly equal, while in our specimens they are much smaller or nearly equal.) If much variability is found, Schoedler's species seems to rest on a slender basis. The basal spine of the claw, however, seems to be peculiar in sitting on a distinct prominence.

Sp. 2. *Camptocercus macrurus*, Mueller.

(Plate E. Fig. 10.)

Lynceus macrurus, LILLJEBORG, SCHOEDLER, P. E. MUELLER, KURZ, BIRGE, HERRICK.

This universally distributed species occurs in our larger bodies of water and is not rare, though hardly abundant.

The body is long and nearly rectangular; the head strongly arched and keeled. The keel of the head is extended down the whole dorsal line. The dorsal line is moderately curved, while the shell is but slightly excavated below. The head extends into a blunt beak looking downward; the direction of the head is somewhat variable (from vertical to an angle of about 30°). The eye is much larger than the pigment fleck; the antennules are shorter than the beak, and have one elongated terminal seta. The post-abdomen is very long and has numerous anal teeth as well as a lateral row of scales. The basal spine of the claws is large and serrate, the claw itself being nearly straight and armed with an increasing series of spines to beyond the middle. The lateral scales of the post-abdomen are inconspicuous. The shell gland is long. The antennules reach to almost the end of the beak, are curved and bear a lateral flagellum. The first foot of the female has a sort of hook (branchial sac?). The labrum is armed with teeth on the posterior face of the triangular process. The intestine is very strongly, almost twice coiled. The lower margins of the valves are

feebly spined for three-fourths their length, and armed with from one to four teeth at the angle. Length 0.8 mm. to 1.0 mm.

Sp. 3. *Camptocercus rectirostris*, Schoedler.

(Plate I. Figs. 1—3.)

Camptocercus rectirostris, SCHOEDLER, P. E. MUELLER, KURZ.

Distinguished from the above, which it closely resembles, by the form of the head, which is less rounded and directed anteriorly. It hardly exceeds half the height of the body. The beak is sharp. I am not sure that Weismann's figures (l. c., plate XI, figures 13 and 14) really belong to this species, for the drawing of the post-abdomen does not agree with that of P. E. Mueller fully. Outline copies of the former are given in plate I, figs. 1 and 2. The male has a hook upon the first foot. Not yet recognized in America.

Sp. 4. *Camptocercus latirostris*, Kurz.

(Plate I. Figs. 5—6.)

C. lilljeborgii, P. E. MUELLER(?).

Closely allied to the next, but distinguished by the position of the head, which is a little less depressed, and, especially, by the truncate beak. The dorsal margin is convex and crested; the lower outline is also convex. The claws are toothed more as in *C. macrurus* than the following. The basal spine springs from the claw itself and not from the post-abdomen as in the next. Length 0.9 mm. to 1.0 mm.

Sp. 5. *Camptocercus lilljeborgii*, Schoedler.

(Plate I. Figs. 7—8.)

Head depressed, rounded in front; beak divided at the end by the extension of the fornices. The terminal claws are pectinate for their entire length, and the basal spine is seated on the end of the post-abdomen. This species, in the main, closely resembles *C. macrurus*.

Sp. 6. *Camptocercus rotundus*, Herrick.

The second of the two species found in America is this short, strongly carinated form, which is known from a single gathering. It differs from all the above species, with which it agrees pretty well in shape, by its more compact form; high dorsal keel (which extends the entire length of the body); the long antennules, which extend far below the beak; and the somewhat pointed beak. The

head is much as in the last, but it is not certain that the beak is cleft, although it has a peculiar form (not indicated in the figure) near the end. The length is 0.7 mm. The terminal setæ of the antennules are very unequal; but in most points, as in the armature of the post-abdomen, the details resemble *C. macrurus*.

III.—GENUS ALONOPSIS, Sars.

This curious genus includes three species of small lynceids, which exhibit a combination of characters. The form of the beak and head is like that of *Pleuroxus*, which the form and sculpture of the shell otherwise resembles. The back is extended more or less in a knife-like ridge above, thus resembling *Acroperus*, a resemblance heightened by the excavated lower margin. The form of the post-abdomen approaches that of *Acroperus*, but in that genus it is of about equal width throughout and in this it rapidly narrows. The internal organs and feet are of the typical lynceid form, while the antennæ are as in *Pleuroxus*.

The type of the genus, *A. elongata*, is apparently much closer to *Acroperus* than the two species which have been identified in America.

Shell sub-rectangular, high, produced into a ridge above; lower margin convex anteriorly, concave behind; beak rather long; antennules slender; antennæ with eight setæ; abdomen long, narrowed toward end, incised at the extremity; claw rather large, with median spines and a basal thorn; third foot with a long bristle. Male smaller, without the carina above; orifice of sexual organs in front of the claw, which is removed from the anterior margin. The young are more elongate and (sometimes) have hexagonal reticulations instead of the usual strong diagonal striæ. Motion slow.

Sp. 1. *Alonopsis elongata*, Sars.

Lynceus macrurus, LLEVIN.

Lynceus macrurus, ZENKER, LEYDIG.

Alona elongata, SARS.

Acroperus intermedius, SCHOEDLER.

Alonopsis elongata, P. E. MUELLER.

The shell is wide, the upper margin forming an even curve, manifestly angled behind; ventral margin nearly straight, ciliated throughout, with a single tooth behind. Fornices large; head narrow, not carinate. Post-abdomen compressed, truncate at the end, armed with a series of marginal spines and of lateral scales; caudal claws large, with a single spine at the base and two median spines followed by a series of minute setæ.

This form I have never seen, and it seems somewhat doubtful that the following really belong with it.

Sp. 2. *Alonopsis latissima*, Kurz.

(Plate E, Fig. 8. Plate G, Figs. 1 and 9.)

Body very high, compressed, with a high dorsal keel or ridge; the upper outline strongly and evenly arched, terminating behind in no angle; lower margin almost angled at the anterior third, rounded behind, fringed with long bristles anteriorly, with short ones posteriorly. Head very narrow; beak extremely long; fornices small; antennules nearly as long as the beak, straight and narrow; pigment fleck smaller than the eye. The abdomen is long, somewhat narrowed toward the end, where it is deeply cleft; the terminal claw is furnished with a large and small basal spine, while there is an increasing series of spines extending to the middle.

The elongated spine of the third foot is pectinate and reaches nearly to the posterior margin of the shell. The shell is marked by few strong striæ which are diagonal except anteriorly where are a few parallel to the front margin. The male is small and lacks the crest on the back, while the lower margin is straight; the antennæ are longer than the beak and differ somewhat from those of the female. The first foot has a claw. The post-abdomen lacks the anal teeth. Kurz gives the size as 0.5 mm.

The American form varies between 0.45 mm. and 0.55 mm., and seems to have a higher dorsal keel and longer beak. Kurz speaks of but a single accessory spine on the terminal claws; there is, however, a second very minute spine or cluster of hairs in this as well as the following.

Found in the same gathering with the following near Minneapolis (marshy off-set from Bassett's creek near Oak Lake Addition).*

*NOTE TO ALONOPSIS LATISSIMA. (See Fig. 1, Plate G.) Since writing the above the males of our American form have been found; they are shaped as the females, with a high dorsal keel; the post-abdomen is rounded, with transverse series of small bristles; the claw has a minute median spine, and the *porus genitalis* is anterior and elevated.

Sp. 3. *Alonopsis media*, Birge.

(Plate E. Fig. 9.)

I give Birge's description verbatim:

"Rostrum prolonged, and shell sharp, somewhat quadrangular in shape, marked by striæ. The dorsal margin is convex, the hinder margin nearly straight. Its lower angle is rounded and without teeth. The lower margin is concave and has long plumose setæ.

The front margin is strongly convex. The post-abdomen is long and slender, resembling that of *Camptocercus*, and is notched at the distal extremity; it has two rows of fine teeth and some fine scales above them. The terminal claws are long, slender, with a basal spine, a spine in the middle, and are serrated. The antennules are long and slender, but do not reach to the end of the rostrum. They have each a flagellum and sense hairs. The antennæ are small and have eight ($\frac{300}{311}$) setæ and two ($\frac{100}{100}$) spines. The labrum resembles that of *A. leucocephalus*, but is slightly prolonged at the apex. The intestine, cæcum and color resemble those of *Acroporus*. There is a trace of a keel present on the back."

The specimens seen in Minnesota resemble this species very nearly, apparently, but there are some differences. The terminal claw of the post-abdomen has an increasing series of spines to the middle; there seems to be no lateral row of scales beside the anal teeth; the abdomen is rather broad at the base and narrows toward the end. The shell is not square behind. The lower margin has a few long hairs anteriorly which are followed by a series of teeth, and in the concave part a somewhat longer set to a point just before the lower curved angle.

The pigment fleck is nearly or quite as large as the eye. The antennule is shorter than the beak (which is almost as in *Pleuroxus hastatus*), and has a flagellum about midway; at its base it is narrowed and inserted on a prominence.

The embryo still in the brood sac had a more elongate form and hexagonal reticulations upon the shell, while the antennules were longer than the very long beak, and the pigment fleck was smaller than the eye. Length of female 0.52 mm. The color is darker, and the striæ more numerous, than in *A. latissima*.

SERIES B.

This section includes forms with (usually) no keel above, or, if keeled, the post-abdomen is not long. The majority are highly arched dorsally, and have comparatively short post-abdomen and pointed beak. The antennæ are usually feeble and the motion slow.

- A. Post-abdomen nearly round in outline, armed with very long stout spines, terminal claw with one minute basal spine or none; greatest height of shell about equal to the posterior margin.
 1. Genus *Leydigia*.
- B. Greatest height of shell moderately exceeding that of posterior margin; post-abdomen more or less triangular, armed with bristles; shell marked with hexagonal meshes.
 - (a) Head nearly horizontal, blunt; post-abdomen prominent in the anal region.
 2. Genus *Graptoleberis*.

- (b) Head depressed, acute; post-abdomen excised near the anus.
3. Genus *Crepidocercus*.
- C. Post-abdomen more or less quadrangular, armed with one or two rows of small teeth on either side behind; terminal claws with one or two basal spines; height of posterior shell margin usually less than the greatest height of shell.
4. Genus *Lynceus*.
- D. Greatest height of shell little less than that of posterior shell margin; post-abdomen terete; terminal claws very minute.
5. Genus *Phrixura*.
- E. Greatest height of shell more than double that of posterior margin.
- (a) Eye and first foot normal.
6. Genus *Chydorus*.
- (b) First foot with a claw which extends beyond the shell.
7. Genus *Anchistropus*.
- (c) Eye absent, only pigment fleck used for vision.
8. Genus *Monospilus*.

IV.—GENUS LEYDIGIA, Kurz.

In this genus, both the known species of which are found in America, the posterior part of the shell and body is emphasized at the expense of the anterior. The curved posterior margin is equal to the greatest height of the shell. The head and anterior part of the body are of the form characteristic of *Alona*; indeed, the whole body is in plan like *Alona*, but in the back part the organs are all enlarged. The general form of the body and abdomen recalls *Ilyocryptus*; the post-abdomen, in particular is very like that genus. The last two pairs of feet are much enlarged. The shell is usually irregularly marked with longitudinal striæ; the lower margin is covered with long spine-like setæ. The post-abdomen is armed with several sets of long spines and aggregations of bristles and small spines; it is almost round and enormously enlarged. The intestine is coiled and expanded at the end, but the anal cæcum is rudimentary. The antennæ are heavily spined and have eight setæ; the labrum is more or less hairy. The male has a strong hook on the first foot, and between the terminal claws of the abdomen is a peculiar intromittent organ.

Sp. 1. *Leydigia quadrangularis*, Leydig.

(Plate H. Fig. 4.)

Lynceus quadrangularis, LEYDIG, FRIC.

Alona leydigii, SCHOEDLER, P. E. MUELLEE.

Leydigia quadrangularis, KURZ.

The shell is comparable to that of *Alona quadrangularis*, but higher behind; the markings are not very distinct; shell transparent. The head is very small; the eye smaller than or of about the size of the pigment fleck. The post-abdomen is very broad, the

posterior margin nearly the segment of a circle, armed with numerous very long unequal spines which extend only about half the height, being replaced by short close hairs; the anal opening is very high; the terminal claws are long, straightish, and have a small thorn near the base.

The males are smaller than the females, and the abdomen is less broad; the antennules are longer than the beak and furnished with a flagellum. The sexual period occurs in September or irregularly. This species has only been encountered once, during September, in Poplar river, Cullman county, Alabama.

Sp. 2. *Leydigia acanthocercoides*, Fischer.

Lynceus acanthocercoides, FISCHER, LEYDIG.

Eurycercus acanthocercoides, SCHOEDLER.

Alona acanthocercoides, P. E. MUELLER.

Leydigia acanthocercoides, KURZ.

Leydigia quadrangularis, HERRICK.

This species, reported in a previous paper, is, as was said, nearest like *L. acanthocercoides*; and I am now able to verify the very inconspicuous differences upon which the two are separated. Our specimens of the *L. quadrangularis* have the pigment fleck fully as large as the eye, Kurz to the contrary notwithstanding, and the claw of the post-abdomen is present, while in the present species the pigment fleck is much larger and furnished with lenses; the spine of the claw is wanting; the labrum is densely hairy; the abdomen is narrower, and the shell higher. The shell is very obviously striped in the posterior portion. The anus is higher than in the previous species. In other respects the two seem alike.

v.—GENUS GRAPTOLEBERIS, Sars.

A genus containing two closely allied species, having some affinities with *Alonella*. The shell is entirely reticulated, and there is a sort of crest along the back; while, on the other hand, the head is flattened and rounded in front. There can hardly be said to be a beak. Seen from above, the animal resembles some species of *Alonella*, but the head is larger proportionally and more horizontal. The lower posterior angle is spined. The antennæ have seven setæ and are very long, in this respect resembling *Camptocercus*. The dorsal contour is not greatly arched. The post-abdomen has short claws and anal bristles, but no teeth.

Sp. 1. *Graptoleberis testudinaria*, Fischer.*Lynceus testudinarius*, LEYDIG, LILLJEBORG.*Lynceus reticulatus*, FRIC.*Alona testudinaria*, SCHOEDLER.*Graptoleberis testudinaria*, KURZ.*Graptoleberis incermis*, BIRGE.

Form trapezoidal; lower margin straight, armed behind with two teeth, thickly beset with long hairs in front; the dorsal margin is not greatly elevated, rounded at the posterior angle, forming a slight "hump" where it unites with the head shield. The head and shell are reticulated with hexagonal or quadrangular markings. The shell gapes below and rises to a sharp ridge above. The antennæ have long rami, the antennules being hardly longer than the fornices. The eye is large; the pigment fleck is small. The post-abdomen is narrowed toward the end, rounded in front; the terminal claws are small and have two basal teeth. The dorsal margin of the post-abdomen is covered with tufts of hairs. The winter eggs have no ephippium. Length 0.55 mm. to 0.7 mm. The male is smaller and has a lower dorsal keel; the post-abdomen is excavated behind.

The only differences between the Minnesota specimens and the typical European form seemed to be the absence of the very minute spines on the front of the terminal claws. The eye and pigment fleck are of about the proportions figured by Kurz. Birge's figure of the post-abdomen does not agree with his description fully. Our Minnesota specimens have an obvious but not high keel.

Sp. 2. *Graptoleberis reticulata*, Baird.*Alona reticulata*, BAIRD, P. E. MUELLER.*Lynceus reticulatus*, LILLJEBORG, LEYDIG.*Alona escirostris*, SCHOEDLER.*Graptoleberis reticulata*, SARS, KURZ.

Shell almost rectangular, reticulate, ventral margin straight, ciliate anteriorly, with two teeth behind. Pigment fleck smaller than the eye. Post-abdomen short, narrowed towards the end, dorsally covered with clusters of spines; caudal claws with a minute tooth at the base. Length 0.4 mm. to 0.5 mm.

The pigment fleck is nearer the end of the beak than the eye, and is smaller than in the previous species, but, on the whole, there is perhaps, too great similarity.

VI.—GENUS CREPIDOCERCUS, Birge.

The characters of this group place it rather near *Alonella* or between that and *Pleuroxus*. Form sub-quadrate with rounded angles; dorsal line uniformly arched, terminating in a sharp angle behind; lower margin convex, armed behind with a single spine as in *Pleuroxus unidens*, and along the entire length with loose setæ. Beak of moderate length, acute. Post-abdomen deeply incised in the anal region; lower posterior margin straight, rounded at the apex; ventral margin straight or concave; claws with a single basal spine and a few teeth. The post-abdomen is shoe-shaped and armed with transverse rows of setæ.

The antennæ are large, having eight setæ and the usual spines. Shell smooth or reticulate.

Sp. 1. *Crepidocercus setiger*, Birge.

(Plate F. Fig. 13.)

Length 0.4 mm. to 0.5 mm. Minnesota specimens measured 0.5 mm. This, the only species of the genus, is but rarely encountered, and is so peculiar as to be easily recognized when seen. *Alona intermedia* has a post-abdomen with clusters of bristles, but in *Crepidocercus* the post-abdomen is more as in species of *Graptoleberis* than any other genus. The markings upon the shell are very indistinct.

VII.—GENUS LYNCEUS, O. F. Mueller.

The perplexing inter-relations between the three genera *Alona*, *Alonella* and *Pleuroxus* give rise to the utmost confusion. No two authors are agreed as to their respective limits, and the points given by Kurz, who has carefully gone over the ground, are obviously insufficient. Although there may be practical benefits to be derived from the continuance of the nomenclature in use for groups which in the general view can be distinguished, the value from a theoretical standpoint is reduced to a minimum.

The genus *Camptocercus* (including here *Acroperus*, which differs solely in the form of the abdomen, as a sub-genus) passes through *Alonopsis* into the group represented by *Alona*. *Leydigia*, although very near such forms as *Alona quadrangulata*, may be conveniently distinguished as a transition to species like *Ilyocyptus*.

Phrixura, Graptoleberis and Crepidocercus, each containing few species which can be readily recognized, fill a place in the system; but it is practically impossible to distinguish Alona from Pleuroxus without instituting the very indefinite genus Alonella to contain a variety of small intermediate forms. Percantha, Rhyppophilus, Harporhynchus and Pleuroxus seem to be pretty generally regarded as constituting a single group which may be recognized by the long rostrum, high shell and greater development of the antenna bristles. Alona, on the other hand, with its broader fornices, shorter beak, fairly developed antennæ, and more rectangular shell, is, perhaps, the pivotal point of the group. According to this view, then, the old name *Lynceus* is revived for the aggregate; and the other names are retained, in part, as titles of largely conventional groups or sub-genera, thus:

GENUS LYNCEUS.

Sub-genus ALONA.

Section A. *Alona vera*.

Section B. *Alonella*.

Sub-genus PLEUROXUS.

Section A. *Pleuroxus verus*.

Section B. *Leptorhynchus*.¹

Characters of Percantha and Rhyppophilus are combined in the species *P. procurvus*, Birge, so that one must be dropped or new diagnoses formulated. I am not sure that the same species is not at first *Pleuroxus verus*² and only later assumes the form known as *Rhyppophilus*. So with Percantha the amount of serrature of the posterior margin is in part a question of age.

SUB-GENUS ALONA.

This group contains two sections which resemble each other in form and, in general, in detail; but it is exceedingly difficult to formulate a diagnosis that shall strictly limit it. The form is generally sub-quadrangular with rounded corners; the terminal claw is armed with but a single spine at the base; the beak is rather short; and the prevailing marking consists of longitudinal lines.

Section A. *Alona (vera)*. Baird.

This genus contains a large number of minute animals which are widely distributed.

¹ Instead of *Harporhynchus*, a name preoccupied in zoology.

² Embryos of *P. procurvus* have the part which is to be curved forward attenuated before leaving the brood-cavity, however.

The authors who have done the most to elucidate this genus are Schoedler, P. E. Mueller, and Kurz. Birge has contributed most largely, thus far, to the knowledge of American species, which are, for the most part, identical or very close to the European. No other genus is so difficult among the Lynceidæ, for the most minute differences are relied upon to distinguish species. The species of this genus are not greatly altered by the production of the winter eggs. The males are frequently but little smaller than the opposite sex, and are recognized by the altered form of the post-abdomen and the presence of a hook on the first foot. The form is more perfectly rectangular than in the next section; the shell is only exceptionally reticulated and very rarely tuberculate, occasionally smooth. The lower angle of the shell is not armed with spines, but is generally rounded. There is only one basal spine upon the claw of the post-abdomen, which usually bears a row of scales beside the anal spines. The antennæ have eight setæ. The claw of the male post-abdomen is removed from the lower angle.

About twenty species are known, all of which that seemed recognizably defined have been included in the following key, which is believed to be more nearly natural in its arrangement than that of Kurz, which would separate the European and American representatives of the *A. parvula* group. Many more forms remain to reward the labor of American students. Those mentioned from Minnesota could probably all be found by a few days search in one locality.

KEY TO SECTION A, ALONA.

A. Shell reticulate.

(a) Reticulations horizontal.

1. *A. guttata*, Sars.

(b) Reticulations oblique.

2. *A. angulata*, Birge.

B. Shell lined, smooth or tuberculate.

(a) Over 0.5 mm. in length.

I. Shell densely striate.

3. *A. sanguinea*, P. E. Mueller.

II. Shell normally, evidently striate.

* Post-abdomen narrowed at the end.

† Armed with elongate teeth below.

4. *A. tenuicaudis*, Sars.

†† Teeth of post-abdomen nearly equal.

5. *A. lineata*, Fischer. (Shell arched.)

6. *A. modesta*, Herrick. (Shell straight above.)
 ** Post-abdomen not narrowed.
 † Antennæ with seven setæ.
- (?) 7. *A. costata*, Sars.
 †† Antennæ with eight setæ.
8. *A. quadrangularis*, Mueller.
 III. Shell faintly, irregularly striped; eye of same size as pigment fleck.
9. *A. oblonga*, P. E. Mueller.
 IV. Shell smooth.
10. *A. affinis*, Leydig.
- (b) Under 0.5 mm. in length.
- I. Post-abdomen armed with a row of hairs terminating in large teeth.
11. *A. dentata*, P. E. Mueller.
 II. (One or) two rows of teeth present.
 * Shell densely and evenly striate.
12. *A. elegans*, Kurz.
 ** Shell not densely lined.
 † Shell smooth or lined longitudinally.
 ‡ Teeth of post-abdomen unequal, the lower ones enlarged.
13. *A. porrecta*, Birge.
 †† Teeth nearly equal.
 § Form elongated; abdomen with a lateral line of spiny scales.
14. *A. spinifera*, Schoedler.
 §§ Form squarish; abdomen with a lateral line of simple spines or bristles, or neither.
15. *A. parvula*, Kurz.
16. *A. glacialis*, Birge.
 ††† Clusters of bristles, not spines, on the posterior edge of the post-abdomen.
17. *A. intermedia*, Sars.
 † Shell smooth or tuberculate.
- 18, 19. *A. tuberculata*, Kurz, Herrick.

Sp. 1. *Alona guttata*, Sars.

A small species of sub-quadrangular form. The beak is very short; the eye small, but larger than the minute pigment fleck. The shell is short, with a rounded posterior angle and marked by hexagonal or rectangular meshes running about parallel with the lower margin. The post-abdomen is of moderate size, rounded at the apex, with a series of stout teeth behind; the terminal claw has a minute basal spine. P. E. Mueller, in Denmark's Cladocera, confused this with *A. intermedia*, which he described under this. The post-abdomen in that species is larger, less rounded behind, and armed with clusters of spines instead of teeth. The length is about 0.3 mm. in both.

Sp. 2. *Alona angulata*, Birge.

Dorsal margin considerably arched, terminating in a more or less obvious angle at the hinder corner; the hinder edge is convex, as is also the front margin; the ventral margin bears plumose setæ. Beak pointed, extending nearly to level of ventral margin of the valves. Fornices broad. Shell obviously striated diagonally and less obviously marked by cross lines. Post-abdomen broad, truncate; about twelve anal teeth, with a series of scales and hairs back of them. The pigment fleck is much smaller than the eye. Male smaller; beak shorter; post-abdomen with a lateral row of hairs; anterior feet hooked; sculpture less distinct. [Birge.] Length of female 0.4 mm; male 0.35 mm.

Sp. 3. *Alona sanguinea*, P. E. Mueller.

(Plate I. Fig. 20.)

Body nearly rectangular; ventral margin nearly straight, with short setæ; posterior angle rounded, unarmed. Beak short; pigment fleck much larger than the eye. Post-abdomen large, the end truncate, broadened; posterior margin rounded, with a series of spines and a lateral row of scales; terminal claw with a small spine. The shell is ornamented with fine, close, longitudinal striations. Length 0.9 mm. *Alona elegans* is very near to this and should have followed. In August, 1878, I took an *Alona* marked as in *A. sanguinea* and agreeing with Mueller's description in all points which can be verified in the drawing. The small size of the eye is remarkable for so large an animal. I have never again seen this species; it seems to be very rare here and in Europe.

Sp. 4. *Alona tenuicaudis*, Sars.

(Plate I. Fig. 11.)

Alona tenuicaudis, Sars, P. E. MUELLER, Kurz.*Alona camptocercoides*, Schoedler.

Form nearly rectangular; ventral margin rounded, with long setæ, posterior angle rounded. Beak short, pigment fleck smaller than the eye. Post-abdomen with sides parallel, long, incised below; lower angle armed with about six strong teeth, remainder of the series small; a lateral line of scales present; claws with a strong basal spine. The shell is striate with longitudinal lines. Length 0.5 mm.

One of the most easily recognized species; not identified in America.

Sp. 5. *Alona lineata*, Fischer.

Lyneus lineatus, FISCHER, LEYDIG.

Alona lineata, SCHOEDLER, P. E. MUELLER, KURZ.

Alona rectangularis, SARS.

The upper margin is rounded, the lower one somewhat sinuate, with setæ of moderate length. The beak is tolerably long, reaching nearly to the level of the lower margin of the shell; the pigment fleck is less than the eye, to which it is much nearer than to the end of the beak. Post-abdomen short, broad and tapering toward the end, truncate, armed with about ten large teeth; caudal claws with a small basal tooth. Shell marked with distinct lines running horizontally. The ehippial females are recognized by a deep color and the greater elevation of the back. Length 0.5 mm., 0.6 mm. The male has a weak hook on the first foot, and the post-abdomen is narrowed toward the end; the terminal claw has no spine.

The Minnesota representative of this widely distributed species differs in some respects. The lower margin is nearly straight, and rather sparsely hairy; the beak is blunt, but, on account of the spreading of the extremely wide fornices, does not appear so except under pressure.

The beak reaches nearly to the lower shell margin. The antennules are narrow, one or more of the setæ being elongated. The dorsal margin is either nearly straight or strongly arched behind; in either case the greatest height of the shell is back of the middle. The pigment fleck is large. The post-abdomen is just as in *A. lineata*, but the lateral row seems to be of spines rather than fringed scales. The shell is marked by rather evident or indistinct lines. The form agrees pretty well with Schoedler's figure, except that the posterior shell margin is much higher. The antennæ have eight setæ, but the last one is very weak. The terminal setæ seem sometimes to be spined, as figured by Schoedler, but in some specimens they are perfectly smooth. There is a circlet of spines on the second joint of the setose ramus. There is a hair on the inner aspect of the protuberance of the labrum. The eye is somewhat nearer the pigment fleck than is the end of the beak. If it is desirable to apply a new name to a form at least so near the European *A. lineata*, it may bear the name first given it in my note-book.

? **Sp. 6. *Alona modesta*.** (Sp. n.)

(Plate H, Fig. 3; and Plate Q, Fig. 4.)

The length varies between 0.41 mm. and 0.55 mm. The smaller forms have the back most rounded, while a specimen 0.55 mm. long will appear very like *A. quadrangularis*. Males are elongate; hook of first foot strong, accompanied by a heavy growth of small spines; terminal claw of abdomen with a minute spine.

? **Sp. 7. *Alona costata*,** Sars.

Founded practically upon the absence of the eighth seta of the antennæ. The description given by Sars will not render it recognizable so that there is no occasion to repeat it here. In all the species of this section the eighth seta is small and may be absent.

Sp. 8. *Alona quadrangularis*, Mueller.

(Plate E. Figs. 1—2.)

Alona sulcata, SCHOEDLER.

Alona quadrangularis, P. E. MUELLER, KURZ, HERRICK. The further synonymy of the species may well be doubtful, for there are species so closely allied as to render a strict determination difficult.

Lynceus quadrangularis, O. F. MUELLER, is the name employed, and is thought to be identical with the *Alona quadrangularis* of Baird.

Shell quadrangular, highest behind; lower margin straight; posterior margin curved; lower angle rounded, striped with rather evident lines which are parallel and straight. The beak is quite long; the pigment fleck is smaller than the eye. The post-abdomen is broadest near the end, where it is strongly rounded; the numerous anal spines are strong and emarginated, supported by a lateral series of scales; the terminal claw and its basal spine (in American forms) are denticulate (Kurz says smooth in European specimens). The feet are of the typical *Alona* form (see plate E, fig. 1). The shell gland is rather conspicuous; no true ephippium. The abdomen of the male lacks the spines, but is otherwise similar. Length 0.6 mm. to 0.7 mm. Less abundant in Minnesota than the next. Both this and the following species were recognized in 1878, but were thought to be the same species. (See *Microscopic Entomostroaca*, p. 109.)

Sp. 9. *Alona oblonga*, P. E. Mueller.

Alona oblonga, KURZ, BIRGE.

Alona quadrangularis, LILLJEBORG.

Differs from *A. quadrangularis* in the following points:—the greatest height of the shell is anterior to the middle; the lines are

less evident, and all confined to the lower part of the shell, while the centre of the valves is marked with very minute striæ; the pigment fleck equals the eye; and the post-abdomen is of about the same width throughout and hardly as round below. This and the preceding species have a well marked keel on the process of the labrum. The size is greater, this being one of the largest and most abundant, as well as one of the most striking species. It, perhaps, should rank as a well marked and permanent variety of the above. Length 0.9—1.0 mm. The abdomen of the male is narrowed at the end and lacks the teeth. Lakes about Minneapolis.

(A small form of *A. quadrangularis* in lake Calhoun had the eye and pigment fleck equal and the terminal claw smooth.)

Sp. 10. *Alona affinis*, Leydig.

(Plate F. Fig. 14.)

Lynceus affinis, LEYDIG.

Alona affinis, SCHOEDLER.

Form sub-quadrangular; height about once and one-half in length; the dorsal outline forming a regular and low curve from end of head to upper posterior margin; lower outline very slightly sinuate, anterior one not at all; posterior angles rounded; head nearly horizontal; eye of moderate size; pigment fleck considerably smaller; antennules rather large, with unequal sensory hairs at the end, one spine just above the end in front and a bunch of minute hairs near the base behind; antennæ comparatively large, basal joint spiny, outer ramus with three setæ, two of which have thorns at their middle, also a terminal spine; inner branch with two of the terminal setæ thorned and the upper lateral seta reduced. The post-abdomen is very broad and short, expanded below and rounded at the end; the terminal claws are straightish, denticulate, and the spine at the base is also dentate; there is a series of heavy spines on the upper margin of the post-abdomen, accompanied by a series of scales on the side. The shell is unornamented and fringed below with short bristles. Length 0.9 mm., or more. This fine species is recognized by its smooth shell, the horizontal position of the head, and the form of the post-abdomen; it belongs among the largest of the genus. Lakes near Minneapolis, not rare.

Birge quotes *A. spinifera* from Wisconsin. In all probability that species is the younger stage of the above.

Sp. 11. *Alona dentata*, P. E. Mueller.

(Plate I. Figs. 12—13.)

Form sub-rectangular, somewhat arched above, obscurely longitudinally striated; lower angle obtuse, margined below with short setæ. Post-abdomen small, slender, armed with a lateral line of scales and two strong teeth at the lower angle; claw with a minute basal spine. The form of the post-abdomen is identical with "*Harporynchus*" *falcatus*, Sars, which this species also resembles in having the pigment fleck larger than the eye, and in general form and the character of the striation. The beak, however, is very short. In size P. E. Mueller says it is among the smallest of the genus.

Sp. 12 *Alona elegans*, Kurz.

(Plate I. Fig. 14.)

Form rectangular; back slightly elevated, posterior margin high, lower margin straight. Shell covered with minute striations springing from the region of the attachment of the head shield. Head rather large, pigment fleck smaller than the eye. The antennæ have eight setæ and a circlet of spines on the second joint of the inner ramus, and a single thorn on its first joint. The post-abdomen is short and broad, rounded at the end, and is armed with about ten anal teeth and a lateral row of scales. Length 0.4 mm.-0.5 mm.

Sp. 13. *Alona porrecta*, Birge.

Sub-rectangular; ventral line nearly straight; valves marked by longitudinal striæ; beak short. Post-abdomen truncate, with about twelve teeth, three or four of which at the end are larger, and a row of hairs above the teeth. Male similar. Length 0.34 mm. Distinguishable from the following small species in the armature of the post-abdomen.

Sp. 14. *Alona spinifera*, Schoedler.

If not the young of *A. affinis*, this little species mimics it very closely. The head is less horizontal and more acute than in that species, otherwise almost identical excepting in size which is about one-third. The sensory setæ of the antennules are said to be nearer equal. Found by Birge in Massachusetts and Wisconsin, but not yet encountered in Minnesota.

Sp. 15. *Alona parvula*, Kurz.

The body is sub-quadrangular, arched above; ventral margin straight, rounded behind. Shell marked by longitudinal, feeble and irregular lines. The post-abdomen is narrower toward the end, with eight or more teeth; the row of scales is absent; at the end it is sharply truncate and incised; the claws have short basal spines. Hardly to be distinguished from the next.

(18) *Alona parvula*, var. *tuberculata*, Kurz.

Alona tuberculata, KURZ.

Alona verrucosa, LUTZ.

The species described by Kurz in 1874, and more at length by Lutz under a different name in 1878, appears to be simply a tuberculate variety of the above. Observations upon the American representatives of the two forms indicate a close relationship between them. The shell is covered with rows of tubercles (or depressions?) which vary in number greatly.

Sp. 16. *Alona glacialis*, Birge.

(Plate G. Figs. 2, 3 and 8.)

I do not know how to distinguish this certainly from *A. parvula*. It, however, seems to have the lower angle of the post-abdomen less squarely truncate and the incision less obvious. Birge says that the abdomen is rounded. I have found specimens which apparently belong here, with the post-abdomen rather sharply angled and deeply incised; there were about fourteen teeth with a row of hairs in front. The form is hardly to be distinguished from another variety which has a shorter post-abdomen, rounded below, and with only about seven or eight teeth and with a smooth shell. This form passes directly into a tuberculate variety, having the post-abdomen similar but the shell covered with numerous rows of tubercles. Sometimes a transition from a lined shell to a tuberculate shell is seen (as in plate G, fig. 14). *Alona tuberculata*, Kurz, is said to have a truncate and incised post-abdomen with no lateral row of hairs. Birge thinks these identical; if so, our form referred to *A. glacialis* is identical with *A. parvula*. There is also a form found with the above in which no markings are visible and the shell is considerably arched; these were, however, nearly all ephippial females or approaching that period.

(19.) Alona glacialis (?), var. tuberculata, (Var. n.)

(Plate G. Figs. 4—7 and 14),

will, then, be our tuberculated *Alona* with a lateral row of scales and a series of fine spines along the anus.

***Alona glacialis* (?), var. *lævis*, (var. n.)**

is the smooth form with higher dorsal margin.

The antennæ of the two last have spines at the end of the rami of the antennæ, a cirlet of spines on the outside of the second joint of the setose ramus, and a spine on the basal joint of the other ramus; two of the setæ at the end of the setose ramus have spines at the angles. The males found among the above small forms have the same characters as var. *lævis* and the abdomen is rounded at the end; the claw is situated in the middle of the lower margin, in front being the opening of the *porus genitalis* and behind a cluster of hairs; the spines are absent, but there is a lateral row of long bristles. A strong hook is found on the first foot. Length 0.3 mm

Sp. 17. *Alona intermedia*, Sars.

(Plate I. Fig. 15.)

Alona guttata, P. E. MUELLER.

Form sub-rectangular, rounded below; beak short; shell marked by longitudinal lines, which may be broken into indistinct rectangular meshes. Post-abdomen short and wide, rounded at the end, ornamented by clusters of minute spines behind as well as a lateral row of scales. About 0.3 mm. long.

Section B. ALONELLA, Sars.

In this group are included small species with a combination of characters, forming the link between *Alona* and *Pleuroxus*. An obvious character is the fact that the shell is usually partly marked by oblique striæ, which run in two directions: first, a set extending forward and upward from the lower posterior angle of the valves; second, a set springing from the anterior and lower angle, running across the others. At the central part where these two series intersect, they each become zigzag; the result is a series of hexagonal markings, which may extend to the middle of the lower margin.

The beak is short and the fornices broad; the shell is more or less rectangular, but somewhat elevated in the middle above.

There are usually but seven setæ on the antennæ, or the eighth is a minute hair; on the ramus having the lateral setæ one of the terminal setæ is frequently reduced. In many cases the whole shell is marked by minute striæ in addition to the proper markings, but this is also found in some species of the true *Pleuroxus*. Kurz gives, as a character of *Alonella*, the presence of but a single basal spine to the claw of the post-abdomen; but P. E. Mueller figures two spines on the claws of one of his species (*A. exigua*), and Schoedler figures eight setæ on the antenna of *A. excisa*. American specimens of *A. excisa* and of *A. pygmæa* both certainly have a very minute eighth seta. There remains, therefore, positively no point which can be relied upon to distinguish these little lynceids from *Pleuroxus* or *Alona*. Perhaps, however, these species, as a group, may be recognized by what has already been said. Three species are found in Minnesota.

A. Rostrum long, bent backwards.

1. *A. rostrata*, Koch.

B. Rostrum short.

I. Lower posterior angle toothed.

- (a) Shell more or less reticulate.

* Reticulated areas minutely striate.

2. *A. pulchella*, Herrick.

3. *A. excisa*, Fischer.

** Reticulated areas smooth.

† Head depressed.

4. *A. exigua*, Lilljeborg.

†† Head horizontal.

- (?) 5. *A. grisea*, Fischer.

- (b) Shell marked by lines running diagonally upward and backward.

6. *A. pygmæa*, Sars.

II. Lower posterior angle smooth, shell longitudinally striate.

7. *A. striata*, Schoedler.

Sp. 1. *Alonella rostrata*, Koch.

Lynceus rostratus, KOCH, LILLJEBORG, SCHOEDLER.

Alonella rostrata, SARS, KURZ,

Alona rostrata, P. E. MUELLER.

Body long, rapidly narrowed behind; dorsal line strongly arched in front toward the depressed head; the lower margin straight, with 0—3 small teeth at the angle. The fornices are broad, but the beak is sharp; the pigment fleck is but little smaller than the eye, to which it is three times nearer than to the beak. The post-abdomen is long, very much as in *A. excisa*, but longer. Length 0.4—

0.5 mm. Schoedler says the lower margin is concave and the angle unarmed, a condition not inconsistent with specific identity, as can be seen in many other species. The shell seems to be variably marked, but most conspicuous are the diagonal, curved striae. Schoedler compares the sculpture to *P. exiguus*; Kurz, however, leaves the impression that only slight reticulation is present in the female.

The male has the post-abdomen narrowed, ornamented with clusters of hairs behind, and the small claws have no basal spine, while the genital opening is in front of the claws.

Sp. 2. *Alonella pulchella*. (Sp. n.)

(Plate Q. Figs. 1—3.)

A minute form very recently obtained is described under the above name. Although closely allied to *A. exigua*, this species is more like *Graptoleberis* than any other member of the genus. It is the smallest of the lynceids, excepting *A. pygmæa*. The shell is high and rather strongly arched; the posterior margin is short and armed with four teeth below, which point in different directions as in *Graptoleberis*. The head is short and the antennules long. The pigment fleck is of moderate size, but smaller than the eye. The post-abdomen is short, rounded below, and armed with sharp and small anal teeth, besides which is an inconspicuous row of minute setæ. The claw is very small, and has a single very minute tooth. The shell is marked by reticulations, which below are regular hexagons but above pass into elongated meshes, and finally on the beak and head become longitudinal striations. The areas are lined as in *A. excisa*. Thus this species combines the form of abdomen of *A. exigua* with the teeth of *Graptoleberis* and the markings of *A. excisa*.

Length hardly 0.27 mm. Motion active. The specimen figured contained a single large ovum. The head may possibly have been somewhat protruded by pressure. Habitat, vicinity of Minneapolis.

Sp. 3. *Alonella excisa*, Fischer.

(Plate E, Fig. 6; and Plate G, Figs. 10, 11.)

Lynceus excisus, FISCHER.

Pleuroxus excisus, SCHOEDLER.

Alonella excisa, KURZ.

? *Pleuroxus insculptus*, BIRGE.

This species is closely allied to *Alonella exigua*; yet that species shows appreciable differences, (which can hardly be claimed, per-

haps, for *Pleuroxus insculptus*.) The various authors who have written of this lynceid have all laid emphasis upon the sculpture of the shell, almost to the exclusion of other points in the description. Prof. Birge has found a quite different form, apparently, which has the same peculiar markings; and even the common *Alona oblonga* has a part of the valves covered by minute striations. Schoedler's figure of this species is unrecognizable; but, as identified by Kurz, the species seems undoubtedly the same that is common in shallow pools in Minnesota, during autumn, and probably also in Massachusetts.

The variations to which this species is subject are considerable and may account for the marked disagreement in the accounts of our different authors. Schoedler gives his specimens a length of .20-.25 mm., while Kurz says .35 mm. Birge gives .27 for the length of *Pleuroxus insculptus*, and our specimens varied in the same gathering between .24 mm. and .40 mm. Schoedler figures three teeth at the lower posterior angle; Kurz says "several (4);" Birge describes one or two, and Minnesota specimens show gradual transitions from an inconspicuous angle to three or perhaps four teeth. These teeth are the extensions of some of the strong ridges or crenulations which mark the shell. P. E. Mueller's figures of the shell and abdomen of *P. exigua* would apply to our species perfectly, save the absence of minute striations; Kurz's statements with reference to the differences between these two forms seem to agree only in part with those of Schoedler. I must here express my suspicion that the *Pleuroxus aculeatus*, *P. exiguus* and *P. excisus* all belong under this species. I have seen a small form which lacked the fine striations; and there appeared to me to be, at times, a slight indication of a second series of hairs upon the post-abdomen.

The form is oblong, truncate behind, variously arched above, but usually with a rather low, evenly curved dorsal contour; the lower shell margin is either nearly straight or convex in front and concave along the posterior third, and is heavily beset with very long pectinate bristles. The head is moderately depressed, with a very broad, blunt and short beak (in some positions this beak seems acute, but it is an optical delusion); the fornices are very broad, covering the antennules completely; seen from above the head is broad and truncate in front; the eye is larger than the large pigment fleck, which is nearer it than the end of the beak. The antennæ have eight setæ, the last of which is minute; the five-

spined ramus has a strong thorn on the end, and the inner terminal seta is reduced. The post-abdomen is rather broad and truncate or somewhat rounded below; its length is very variable, being short in small individuals; its form is subject to concomitant variations. The seven to eleven anal spines extend in a series of minute bristles above the anus. The lower posterior angle of the shell bears one to four teeth; the marking consists of wavy ridges and striæ, producing, by the crossing of two sets springing from the two lower angles, a reticulation covering more or less of the entire shell. The head-shield and the spaces between these markings are densely striated. Color yellowish, often opaque. Length 0.24-0.40 mm. At times abundant. Birge alone has seen the males; his description agrees with Kurz's account of the male of *A. exigua*, save that the former speaks of spines, and the latter of thorns, along the post-abdomen.

Sp. 4. *Alonella exigua*, Lilljeborg.

Lynceus exiguus, LILLJEBORG, LEYDIG, FRIC.

Alonella exigua, SARS, KURZ.

Pleuroxus exiguus, SCHOEDLER, P. E. MUELLER.

? *Lynceus aculeatus*, FISCHER.

Aside from the differences in the male sex as above indicated, this form is said to have a convex lower margin, a rounded post-abdomen, and the pigment fleck nearer the end of the beak than the eye. The absence of the fine striation, finally, is the most marked characteristic. Length 0.30-0.33 mm. Not identified in America.

(?) **Sp. 5. *Alonella grisea*, Fischer.**

This species is included here on the authority of Kurz. The shell may or may not be toothed at the lower corner, and is partly lined and partly reticulate; but the only character which at all separates this species from the above seems to be the position and form of the head, which is said to be blunt and nearly horizontal, as in *Camptocercus rectirostris*. Is this a transition to *Graptoleberis*?

Sp. 6. *Alonella pygmæa*, Sars.

(Plate H. Fig. 7.)

Alona pygmæa, SARS.

Pleuroxus transversus, SCHOEDLER.

Alona transversa, P. E. MUELLER.

Lynceus nanus, FRIC.

Alonella pygmæa, KURZ.

The form is rotund, much like species of *Chydorus* in the highly arched dorsal outline; the beak is rather short and depressed; the lower outline of the valves is very convex in front, and barely sinuate behind, where it terminates in a minute spine. The shell is marked, as in no other lynceid, by lines running diagonally backward, and only on the lower part reticulated, if at all.

The post-abdomen is short, broad and rounded below; the claw has a single basal spine. Length 0.20 mm.—0.28 mm. This is the smallest member of the Cladocera. In form it so nearly resembles *Chydorus* that upon first sight the writer took it for a member of that genus. Our one specimen measured 0.25 mm. The shell is marked by plications rather than striæ, which arch over the back.

Sp. 7. *Alonella straiat*, Schoedler.

This species is said to resemble *A. exigua* in habit and sculpture of shell; the form is quadrangular and not greatly elevated in the middle; the lower margin is nearly straight and fringed with bristles; the posterior angle is rounded and unarmed. The antennules with their setæ extend beyond the beak; the pigment fleck is smaller than the eye and half way to the beak. The post-abdomen is long and narrowed toward the end; there are seven or eight anal spines, and two spines on the terminal claw. Length about 0.5 mm.

SUB-GENUS PLEUROXUS.

Section A. *Pleuroxus (verus)*, Baird.

This group of lynceids is most obviously defined by the long "beak", formed by the extension of the chitinous covering of the head. (There is rarely a beak in the sense of that word as applied in the case of *Scapholeberis* or *Daphnia*, but the antennules are simply attached to low prominences on the under side of a broad shield-like projection of the shell.) This beak-like projection is acute and often long and either curved backward or even bent forward. The fornices, or lateral projection of the head-shield, are narrow. The form varies much, but is almost always very strongly convex above, and the posterior margin is thus only a fraction of the whole height of the animal. In some American species the body is very much elongate, and these also depart from the characteristic habitus of the genus in having strong longitudinal striæ instead of reticulations. The lower posterior shell angle has teeth which, in a few cases, extend across the entire posterior margin. The post-

abdomen is slender, usually truncate and armed behind with a single set of sharp teeth on either side; the terminal claw has usually two spines and may be serrate.

The male has a shorter beak, the post-abdomen is more or less modified, and the first foot has a powerful hook. The winter eggs frequently have a true ephippium; and sometimes this structure is like that of *Chydorus*, toward which the round forms of this genus seem to lead. There are upwards of a dozen valid species, several of which are American.

KEY TO SECTION A, PLEUROXUS VERUS.

§ Beak not curved forward.

A. Shell reticulate.

(a) Post-abdomen very narrow.

1. *P. hastatus*, Sars.
2. *P. stramineus*, Birge.

(b) Post-abdomen not very slender.

* Terminal claws with two spines.

3. *P. trigonellus*, O. F. Mueller. (?)
7. *P. ornatus*, Schöedler.

** Terminal claws with a single spine.

4. *P. acutirostris*, Birge.

B. Shell smooth, except upon the front margin.

5. *P. adunctus*, Jurine.

C. Shell striped,

(a) Shell very long and low.

* With one tooth below.

10. *P. unidens*, Birge.

** Without a tooth; female with a hook upon the first foot.

8. *P. hamatus*, Birge.

*** Without a tooth on the shell or claw on the foot.

9. *P. affinis*, Herrick.

(b) Shell high.

* Lower angle spined.

+ Antennæ with eight setæ, anterior margin of valves toothed.

7. *P. denticulatus*, Birge.

†† Antennæ with seven setæ.

6. *P. bairdii*, Schoedler.

** Whole posterior margin of shell spined (*Percantha*.)

11. *P. truncata*, O. F. Mueller.

§§ Beak procurved (*Rhyphophilus*.)

A. Shell reticulate.

* Faintly and regularly.

13. *P. glaber*, Schoedler.

** Strongly and irregularly.

14. *P. personatus*, Leydig.

B. Shell striped.

* Posterior margin toothed.

12. *P. procurvus*, Birge.

** Only lower angle toothed.

15. *P. uncinatus*, Baird.

Sp. 1. *Pleuroxus hastatus*, Sars.

(Plate I. Fig. 16.)

Pleuroxus laevis, Sars.

Pleuroxus hastatus, P. E. MUELLER.

Form somewhat oval, dorsal line strongly curved, posterior margin short, with a tooth below; head short, beak very long, straightish; shell obscurely reticulate. Post-abdomen very long, narrow, with small teeth; claw with two basal spines. Color corneous. The sculpture consists of faint reticulations. The ephippium forms a truncation of the upper part of the shell. Length 0.50—0.55 mm. The male has a shorter beak; the first foot has a weak hook, and the spermatozoa are spherical.

? Sp. 2. *Pleuroxus stramineus*, Birge.

This form is the American representative of the preceding, if not identical with it. Birge mentions minute striæ in the meshes. *P. stramineus* is said to be lower than *P. hastatus*, while its beak is shorter. Undoubted specimens of *P. denticulatus* exhibit the same differences, an increase in the convexity of the shell accompanying an increase in the length of beak. The form of the abdomen appears nearly identical, if we compare P. E. Mueller's plate IV, fig. 18, with the outline given by Birge at plate II, fig. 11. The color in both is deep, especially during the period when the winter egg is forming. The direction of the reticulations is said to differ, but P. E. Mueller's figure does not furnish positive evidence of this. Length 0.6 mm.

Sp. 3. *Pleuroxus trigonellus*, O. F. Mueller.

Lynceus trigonellus, O. F. MUELLER, LIEVIN, LILLJEBORG, LEYDIG, FRIC.

Pleuroxus trigonellus, SCHOEDLER, P. E. MUELLER, KURZ.

? *Pleuroxus ornatus*, SCHOEDLER.

Dorsal line strongly arched; the beak rather long, straightish; pigment fleck smaller than the eye. Shell faintly reticulate, the markings consisting of transparent ridges. Post-abdomen widest in the middle, attenuated slightly toward the end, which is truncate; claw large, with one long and one very small basal spine. The anal

margin of the post-abdomen has a series of small spines, and the lower shell-margin is hairy. The post-abdomen of the male is somewhat as in *Crepidocercus*, and densely hairy; the first foot has a moderate hook.

To judge from Kurz's statements, *P. ornatus*, Schoedler, is not specifically distinct. Not yet identified in America.

Sp. 4. *Pleuroxus acutirostris*, Birge.

This form, with *Harporhynchus*, imitates in some respects the *Alonellæ*, from which they differ in having the beak elongated and recurved. Birge's description does not state what the form of the fornices is, but he intimates that the general resemblances are with *Pleuroxus*. The general shape is as in *P. hamatus*.

"The post-abdomen is broad, compressed, truncated, with numerous fine caudal teeth. The terminal claws have only one basal spine." "The valves are reticulated as in *P. [Alonella] insculptus*, although not so plainly." Length 0.35 mm. Southampton, Mass.

Sp. 5. *Pleuroxus adunctus*, Jurine.

Monoculus adunctus, JURINE.

Pleuroxus adunctus, SCHOEDLER, P. E. MUELLER, KURZ.

Very like *P. trigonellus*, but with the back more strongly arched. The anterior part of the shell is striped. The beak is shorter than in *P. trigonellus*, but no other permanent differences are discoverable. The temptation to believe this a mere varietal form of *P. trigonellus* is great. Indeed, four species (the two here noted, *P. bairdii* and *P. denticulatus*, Birge,) are very nearly related. The ephippium, where known, is marked by minute punctation and a darker color.

Sp. 6. *Pleuroxus bairdii*, Schoedler.

Pleuroxus trigonellus, BAIRD.

Pleuroxus bairdii, KURZ.

This form, so far as can be gathered from Baird's brief description and figures, differs from the others in having the shell marked by straight parallel lines running diagonally backward and upward, and in lacking one of the terminal bristles on the 5-setose ramus of the antennæ. The first is a possible but unusual structure, while the second might result from an overlooking of the very small seta which fills this place in the other forms. Baird himself did not distinguish it from *P. trigonellus*.

Sp. 7. *Pleuroxus denticulatus*, Birge.

(Plate G. Figs. 12—13.)

Resembling very closely *P. adunctus*, which, however, has a broader post-abdomen than the ordinary *P. denticulatus*. The posterior angle of the shell is armed with from one to four (generally three) teeth. The beak is very long.

The character most emphasized by Birge is a series of teeth along the anterior margin of the valves. The same thing is found in *P. procurvus*, as I have repeatedly satisfied myself. In certain positions these teeth do not show, or the smaller teeth on the lower margin only appear. *P. adunctus*, as figured by Schoedler, has similar teeth on the lower margin, and very likely has them anteriorly. The edges of the valves are heavily fringed with pectinate setæ. The male has a shorter beak and the post-abdomen simply rounded without the peculiar modification seen in *P. adunctus*.

There seem to be two varieties in Minnesota both of which have the characteristic irregular striations of the shell, which radiate from an irregularly marked or unmarked area in the center toward the edges; both have the toothed posterior angle and the serrated posterior angle and the serrated anterior margin. But the common form is much longer, with the dorsal margin less convex and the beak shorter. The robust form has a larger pigment fleck, while the post-abdomen is shorter and more robust, resembling more nearly Schoedler's figures of the abdomen of *P. adunctus*. There is another variation or abnormality, in which the lower margin is quite concave. The resemblance to *P. procurvus* is remarkable in some phases.

I have collected this species in Blount springs, Ala., in the St. Croix river, and at various intermediate points, as well as very often in Minnesota.

Sp. 8. *Pleuroxus hamatus*, Birge.

(Plate H. Fig. 1.)

This species is smaller than those of the preceding group and forms a transition to the two next to be described in the greater elongation of the shell, which is, however, higher and more strongly arched. The head and beak are much as in *P. denticulatus*. The lower margin is concave posterior to the middle and slightly convex at the posterior angle, which is unarmed. The lower margin is hairy. The markings are as in *P. denticulatus*, but, in addition,

there is a set of horizontal striæ all over the shell. The post-abdomen is widest in the middle and almost exactly as in *P. denticulatus*. The first foot bears a claw such as ordinarily distinguishes the males.

The only specimens which I have seen were from the Tennessee river, near Waterloo, and near Decatur, in Alabama. My notes contain no reference to the minute striations, which could perhaps be hardly seen with the instrument employed. The process of the labrum is long and rather acute, the beak moderate, and the pigment fleck very large. The markings on the anterior of the valves are irregular and are inter-connected by cross lines or anastomoses. Ova two. (The genus *Anchistropus* has a hook upon the first foot, but is like *Chydorus*.)

Sp. 9. *Pleuroxus affinis*. (Sp. n.)

(Plate H. Fig. 2.)

A small species with elongated shell and longitudinal striæ, forming a link between the preceding and the next, to which it is closely related. Shell broadest in front, upper contour nearly straight; anterior part of the lower margin evenly arched, posterior margin rather low. Head very short; beak very long, narrow and somewhat incurved; antennules and antennæ very small; eye evidently larger than the pigment fleck. The post-abdomen is as in *P. denticulatus*, or a little longer proportionately. The markings, so far as observed, consist of diagonal, faint, numerous and parallel lines posteriorly, and others springing from the anterior margin. There is no tooth behind; the teeth on the post-abdomen are small and not numerous. The upper margin of the shell is not sharp but rounded. Thus this pretty and unique form is clearly distinguished from all its allies although unfortunately only this very imperfect description and schematic figure can be given. Found in Weakly pond, Culbert county, near Florence, Alabama, where with an *Alona*, *Chydorus sphaericus* and *Scapholeberis*, it formed the cladoceran fauna of the pool.

Sp. 10. *Pleuroxus unidens*, Birge.

(Plate F. Fig. 15).

An extreme among these elongated species, the length of body falling little short of double the height. The dorsal line is very flat and slightly but evenly arched; the lower margin is evenly convex

or nearly straight, covered by long pectinate bristles. The head is short, and the beak is long and sharp; the antennules are of moderate size, with a lateral seta one-fourth from the end; pigment fleck less than the eye; antennæ rather long, with strong thorns on the terminal joints. The post-abdomen is long, as in *P. hastatus*, sides nearly parallel; anal teeth sharp, small and numerous; claws pectinate, with two strong basal spines. The shell is strongly striate with longitudinal striæ, which are parallel with the different margins. Birge says that there is a reticulated area. The lower angle is rounded, and anterior to it is a small tooth directed backward. This species is distributed throughout the Mississippi valley. I have notes of it from Swan lake, near Decatur, Alabama. It is often rather abundant about Minneapolis, but is thought by Birge to be absent from the eastern states. Almost all the specimens I have seen are very dark, often brown, so as to appear to the eye like dark specks as they swim about. The length varies from 0.55 mm. to 0.85 mm. About 0.60 mm. is a common size, according to my observation. Birge mentions a rudimentary sixth foot in this species. This organ is found in *Eurycercus* and other lynceids, according to Schoedler.

Sp. 11. *Pleuroxus truncata*, O. F. Mueller.

Lynceus truncatus, MUELLER, KOCH, ZADDACH, LIEVIN, FISCHER, LILLJEBORG, LEYDIG, FRIC.

Percanthea truncata, BAIRD, SCHOEDLER, KURZ.

Pleuroxus truncatus, F. E. MUELLER.

Percanthea brevirostris, SCHOEDLER.

This species is widely distributed in Europe, but is replaced in America by the following. The shell is high, the dorsal contour arched; beak rather long and straight; lower margin slightly convex, setose; posterior margin straight, armed with very strong teeth entirely across it; the anterior margin also is dentate, as in the next. The valves are covered with strong striæ, springing from the antero-central part and radiating toward the free margins. The post-abdomen is of moderate size and in form much as in the next. The ephippium causes a considerably change in form and coloration. In the male the beak is shorter, and the abdomen has finer teeth. The first foot has an extraordinarily large hook. The length is about 0.5 mm. to 0.6 mm. *Percanthea brevirostris*, Schoedler, differs in the length of the beak only.

Sp. 12. *Pleuroxus procurvus*, Birge.

(Plate E. Figs. 3, 4.)

In size and general appearance this most interesting species is similar to the above, and, especially, to *P. denticulatus*. The general form and even the details of structure agree almost to identify with the latter. The structure of the posterior margin is like *Percantha*, while the rostrum is bent abruptly upwards as in *Rhypophilus*. In small individuals the length is greater proportionally. The lower margin is slightly convex or nearly straight, and fringed by bristles which are strongly pectinate; the anterior and lower margins are toothed as in *Percantha*. The shell gland is more as in the *Daphnidæ* than most lyncoids. The number of posterior teeth is variable. The ephippium is as in *P. denticulatus*. Length 0.40 mm. to 0.50 mm. Not rare, but less common than *P. denticulatus*. The male post-abdomen is like that of *P. denticulatus*; the rostrum is as in the female.

Of the species following it may suffice to say that they are corpulent, filth-loving representatives of *P. trigonellus*, *P. adunctus* and *P. bairdii*, respectively, which have turned up their noses at a superficial existence and buried themselves in the mire and debris at the bottom of the pools. It might be fanciful to assume that the curved snout is used for "rooting," but the fact that these "Schmutz-peterchen" lyncoids would find a long straight beak in the way is suggestive.

Sp. 13. *Pleuroxus (Rypophilus) glaber*, Schoedler.*Pleuroxus personatus*, P. E. MUELLER.

The shell is high and squarish, the fornices narrow, the beak slightly pro-curved, the lower margin nearly straight, with two or more teeth at the posterior angle. The antennæ have seven setæ only. The male is almost exactly as that of *P. trigonellus*. Length 0.55 mm. to 0.65 mm.; male 0.5 mm.

Sp. 14. *Pleuroxus (Rypophilus) personatus*, Leydig.

That this species is really distinct is by no means certain; however, it is stated that the shell is less regularly and more markedly reticulated, and the markings lack the elevations described under *P. trigonellus*, which are present in the previous species. It lives in filth and covers itself with it.

Sp. 15. *Pleuroxus* (*Rypophilus*) *uncinatus*, Baird.

The shell is ridged with lines running upward and backward, as in *P. bairdii*; the lower angle of the shell has three teeth, and the beak is more horizontal than in the above. In size and characters this is almost identical with *P. bairdii*, with which it occurs in England.

This completes the list of swine-like members of the genus; these well deserve to be studied from a morphological stand-point.

Pleuroxus nasutus, Gay, is a poorly described form from Chili, resembling, according to Schoedler, *P. ornatus* = *trigonellus*.

A species of *Percantha* (*Lynceus armatus*, Gay) is found in Chili.

NOTE TO PLEUROXUS.—The two species *P. unidens* and *P. affinis* are quite diverse from the type of the genus and approach in some respects to *Leptorhynchus*. *P. affinis*, particularly, has a recurved beak. I am in doubt about *P. hamatus* and *P. acutirostris*, which is said to be reticulated; but it seems likely that the species above mentioned stand in closest relation to *Leptorhynchus*.

Section B. *Leptorhynchus*, Herrick.¹

The species for which Sars formed the genus *Harporhynchus* is of *Alona*-like habit, but has a beak which exceeds that of any known *Pleuroxus* in length, being simulated in this respect by the American *P. acutirostris*, which is, however, in other respects more nearly allied to *Pleuroxus*.

***Leptorhynchus falcatus*, Sars.**

Harporhynchus falcatus, SARS.

Alona falcata, SARS, P. E. MUELLER.

Body oblong, arched above; ventral margin nearly straight, setose, with a spine at the posterior angle; beak strongly curved, folded laterally; pigment spot larger than the eye. The post-abdomen is wide, sides nearly parallel, armed with a few strong teeth below and a lateral line of spines; caudal claw with a single small basal spine.

VIII.—GENUS PHRIXURA, P. E. Mueller.

Oblong, wide; posterior shell-margin little less than whole height. Post-abdomen terete, obtuse at the end, which is armed with a cluster of spines of which the terminal ones are similar to the others.

¹ *Harporhynchus* is preoccupied in ornithology.

Sp. 1. *Phrixura rectirostris*, P. E. Mueller.

(Plate I. Fig. 18.)

Beak acute; shell striated longitudinally, slightly arched above; ventral margin rounded, with a round and unspined angle behind. Length 0.5 mm. Not yet encountered in Minnesota.

IX.—GENUS *CHYDORUS*, Leach.

This genus, if it be really of generic value, contains minute rotund animals which appear in the water like animate pin-heads of small size. Their motion is a rolling, wavering hobble; and they live by preference upon vegetation, or in slime at the bottom of pools. Occasionally they may be seen in sunshiny weather, disporting themselves near the surface in immense numbers. There are two common species, and six more which are more rare or in part not valid.

The sexual period occurs at two different periods (i. e., May—June, and December), but in probability is not confined to any periods. The males, which only rarely are found even in these periods, have the abdomen narrowed or excavated to accommodate it to the peculiar alteration of the brood-cavity which takes place in the sexually mature female. The connection takes place by the insertion of the abdomen within this chamber, which is facilitated by the reduced size of the abdomen. The modification of the shell of the brood-cavity above referred to consists in the thickening of the wall posteriorly, which may or may not result in the deforming of the shell, as shown in plate F, fig. 7, taken from Kurz. This may be termed an ephippium, although it differs somewhat from the modified shell so called in *Daphnia*. The male element consists of nearly round nucleated cells, and the opening of the vas deferens is anterior to the terminal claws. The members of this genus are among the most minute forms of the family or the entire group. Concisely put, the characters are as follows:

Form globose, not obviously truncate behind; head terminating in a sharp, long, curved beak, which lies close upon the anterior margins of the valves; antennæ short; eye larger than the pigment fleck; abdomen flattened, excavated in the male; intestine with no anterior cæca, doubly convoluted, with an anal cæcum. Three species found in Minnesota.

Sp. 1. Chydorus sphæricus, Mueller.

(Plate F. Figs. 4, 7, 8 and 10.)

Lyneus sphæricus, O. F. MUELLER, M. EDWARDS, KOCH, ZADDACH, LIEVEN, FISCHER
LILLJEBORG, LEYDIG, TOTZ, ZENKER, FRIC.*Monoculus sphæricus*, JURINE.*Chydorus muelleri*, LEACH.*Chydorus sphæricus*, BAIRD, SCHOEDLER, P. E. MUELLER, LUTZ, KURZ, BIRGE.

Form nearly spherical, as seen from above broadly oval; in young specimens truncate behind; antennules of moderate size, in the male very large, with curved flagellum near the middle of anterior margin; pigment fleck often nearly as large as eye; beak of moderate length, blunt in the male; first foot strongly hooked in the male; post-abdomen short, broad, rounded at the end, armed with 8—9 sharp teeth; shell reticulated with polygonal meshes. Color light, unspotted. Length 0.50 mm.

This species occurs in Spring earlier than most forms, and is ranked as the most abundant of the micro-crustacea, being found over the whole circumpolar land-area. The ephippium for the winter egg was observed by Kurz, but the period at which it is formed seems variable.

C. sphæricus of a previous report seems to have been the following species which is more common in Minnesota in the clearer lakes. A small form in our large lakes measures 0.3 mm.; it may be distinct.

Sp. 2. Chydorus globosus, Baird.

(Plate F. Figs. 1, 2, 3 and 9.)

Chydorus globosus, BAIRD, LILLJEBORG, SCHOEDLER, LEYDIG, P. E. MUELLER, FRIC,
KURZ, BIRGE.

Form globose, very broad; antennules very large with a strong lateral seta on a small elevation; swimming antennæ exceedingly small; the shell gland is well developed; the pigment fleck is much smaller than the eye; beak very long and incurved; post-abdomen rather long, more slender than the last, broader near the end which is truncate, bearing about 20 spines on the margin near which is a lateral series of minute bristles; the terminal claws are straightish, spined along the basal half, and have an accessory spine; the shell is very indistinctly reticulated and spotted; color dark; length 0.7-0.8 mm.; male 0.55 mm. The males have the abdomen very narrow for the entire length.

This species is considered rare elsewhere, but is not infrequent in August near Minneapolis.

Sp. 3. Chydorus ovalis, Kurz.

(Plate F. Fig. 11.)

Form oval, nearly twice as long as high; beak long; antennules two-thirds as long as the beak, with two elongated sensory filaments above the others; pigment fleck nearly as large as the eye; antennæ small; shell margins heavily fringed anteriorly; post-abdomen of moderate size, rounded at the end, with about 8 teeth near the end; shell smooth. Length 0.4 mm.

This species is rather near *C. sphaericus*, differing in having the shell smooth, antennæ shorter, and beak longer. This species is not yet known in America.

Sp. 4. Chydorus cælatus, S. hoedler.

(Plate F. Fig. 12.)

Chydorus adunetus, SCHOEDLER.

This small species is about 0.4 mm. long, and resembles the young of *C. globosus* in form, from which as well as from all known species it is distinguished by the markings of the shell, which consist of series of rounded elevations (or depressions?) arranged parallel to the lower margins of the shell and head. The description is very incomplete, and the only other author who appears to have seen the animal is Kurz, who adds that the sensory filaments of the antennæ are unequal in height, and that the so called elevations are really depressions. A form with a few depressions about the edge and characters of this species was once seen in the vicinity of Minneapolis.

Sp. 5. Chydorus nitidus, Schoedler.

(Plate F. Figs. 5, 6.)

Shell smooth and regularly punctate; the head resembles *C. sphaericus*, but the pigment fleck is much smaller than the eye, to which it is much nearer than to the end of the beak; the post-abdomen is broader near the end, and bears a row of 10—12 teeth on either side.

(?) Sp. 6. Chydorus latus, Sars.

Very possibly a variety of *C. globosus*, from which it differs in the shorter beak and greater size. Length 0.66 mm.

Sp. 7. Chydorus piger, Sars.

Sub-rotund, prominent above, sinuate behind; lower and posterior margins rounded, lower margin ciliated. Head movably united to the body; beak long, separated by an indentation from the head shield. The shell is broad, as seen from above. Shell punctate anteriorly and marked below by indistinct oblique striæ. Antennules with seven setæ and two small thorns on the end of each ramus. Post-abdomen truncate; the terminal claws with a minute tooth at the base; posterior margin sinuated, rounded below and there densely armed with minute teeth. Abdominal setæ long and flexible. Pigment fleck of medium size, much nearer to the eye than to the beak. Length about 0.33 mm.

(?) **Chydorus latifrons**, Dana. (U. S. Exploring Expedition, Rep. on Crust., vol. II, p. 1274.)

Very tumid; in side view rotund, head not separate, very short-beaked; beak slender and close to the body, acute; in upper view animal very broad, truncate anteriorly, the front thereby nearly as broad as the body; behind low, triangular and obtuse. Feejee islands.

(?) **Chydorus albicans**, Gay,

from Chili, is imperfectly described; but it is interesting to note the occurrence of this genus there.

X.—GENUS ANCHISTROPUS, Sars. (?)

Very similar in form to *Chydorus*; valves gaping below anteriorly; antennules small; process of labrum rounded. Post-abdomen attenuated toward the end, densely covered with fine teeth; terminal claws denticulate. First foot with a powerful claw, protruding beyond the shell. Eye very large. Shell indistinctly reticulate. Sars says of his *Anchistropus emarginatus* that on cursory inspection it would be taken for the young of *Chydorus globosus*. He found but few specimens, about 0.35 mm. long. The suggestion is still possible that the young males of some *Chydorus* are here mistaken for a new genus. The males of *Chydorus globosus* were not known till 1878, and their early form is still unknown. The young females have a tolerably strong claw, though it is not much curved. I have once found a peculiar lynceid measuring 0.46 mm., with

unevenly but distinctly reticulate shell, slender abdomen, and a strong claw which was dentate. There were several young (more than two), and the shell in these was more regularly reticulate. All efforts to find a second specimen failed, and the one seen was somewhat mutilated; hence I am unable to determine its real position.

XI.—GENUS *MONOSPILUS*, Sars.

Head separated by a depression from the body; shell high, compressed, posterior margin somewhat less than the greatest height of the shell. Post-abdomen broad, ornamented with lateral and posterior spines; claws large, with a single basal tooth. The compound eye is absent, its place being taken by the pigment fleck, which is the functional eye.¹

Monospilus dispar, Sars.

(Plate I. Fig. 21.)

Lynceus tenuirostris, FISCHER, Abh. ueber einige neue Daph. und Lynceidæ. p. 427, tab. III, figs. 9—10 (*vide Sars*).

Monospilus dispar, SARS, Crust. Cladoc. i Omgn. af Christiania, p. 165.

Monospilus dispar, MUELLER, Danmark's Clad., p. 196.

Shell roundish; ventral margin setose; posterior angle rounded, marked above with numerous impressions. Antennules small; antennæ long, with seven setæ. Post-abdomen short and broad, bearing a series of spines along the excavated posterior margin, and ornamented on the sides with clusters of bristles. The shell in old individuals is not moulted but remains as in *Ilyocryptus*, covering the greater part of the new shell. The figure shows an old individual with its successive coverings still clinging to it. Like *Ilyo-*

¹ So much interest attaches to this species that we reproduce the Latin description of Sars. "Testa in adultibus valvulis composita pluribus, altera alteri imposita, a latere visa lata, latitudine maxima in parte antica sita; margine superiore antice valde prominente, posteriore et inferiore ciliato rotundatis. Caput mobile, parvum et valde depressum, supine impressione parva sed distincta, a testa cetera disjunctum, deorsum in rostrum rectum et breve apice obtuso exiens. Animal supra visum sat compressum, latitudine maxima capite majore ante medium sita. Pars superior testæ et capitis impressionibus numerosis rotundatis notata. Antennæ 1-mi paris minutæ structura ut in ceteris Lynceidibus; 2-di paris sat longæ, ramo altero setas 4 et aculeum unum apicalem, altero setas 3 et aculeos duos, quorum: alter longus articulo primo ejusdem rami adfixus est, gerunte. Postabdomen breve et latum, apicem versus truncatum; margine posteriore supra obtuse angulato, ad angulum inferiorem rotundatum seriebus duabus aculeorum inque lateribus setis vel spinulis brevibus numerosis præditum; unguis terminales ad basin aculeo longo armati. Intestinum, ut in ceteris Lynceidibus, in thorace laqueum fere duplicem format. Macula nigra unica minima prope basin antennarum 2-di paris; maculæ infra oculari in ceteris Lynceidibus simillima, in capite conspicitur, quæ, quum oculus verus compositus in omnibus ceteris Crustaceis Cladoceris distinctus omnino absit, organum quamquam rudimentare visus habenda est. Animal parum pellucidum, colore fulvescente. Longit. parum supra $\frac{1}{4}$ mm."

cryptus, this animal passes its life in filth at the bottom of pools, and rarely emerges to the light of day. What little visual function there may be is vested in the larval organ.

The specimen from which the drawing was made measured 0.45 mm. The first glance at this rarest of all entomostraca affords proof of its unique character. The strongly arched shell is so compressed as to bear little resemblance to Chydorus. The dorsal line passes with little angle into the high posterior margin. There is a rounded angle below, armed with two teeth—the shortened representatives of the fringing spines of the straight lower margin. The head is depressed and very short, but the narrow beak is produced to below the margin of the valves. It is rounded so as to resemble, as seen in front, a duck's bill. The fornices are narrow and flare so that the eye is left partly exposed upon the side. The antennules are not long but slender. The labrum has a very large lamella, which is crenulate in front and acute below, the labrum proper being large. The systematic position of this genus is a matter of considerable interest, for it is the only member of the whole order in which the larval eye is the only one developed, and the first thought would be that this must be a primitive synthetic type, in other words, historically the oldest of Cladocera. Closer study does not warrant the theory. There is much to indicate that, though essentially lynceid, it stands in close connection with the higher members of the family and perhaps has more than a superficial resemblance to such degraded lyncodaphnids as Ilyocryptus. All things considered, however, our diagram stands with this genus as a degraded offshoot of the more typical stem of Lynceidæ.

SUB-ORDER II.—GYMNOMERA.

This group is easily recognized by the almost entire absence of the shell, which forms so conspicuous a part in the greater number of the Cladocera. Here it serves simply to form a pouch or brood-sac for carrying the eggs and embryos. The feet are nearly terete and prehensile, with but slight indications of branchial appendages.

FAMILY POLYPHEMIDÆ.

Feet five pairs. Antennæ with the rami three- or four-jointed.

I.—GENUS POLYPHEMUS, De Geer.

Head very large, separated by a depression from the compact

body; shell covering but a part of the dorsal region. Feet all with an internal dentate, and an external lamellate appendage. Caudal seta upon a long process of the post-abdomen.

Sp. 1. Polyphemus pediculus, Linn.

(Plate B¹. Figs. 4—6.)

Monoculus pediculus, LINNÆUS, 1746. GMELIN, Linn. Syst. Nat. FABRICIUS, Ent. Syst., etc. SULZER, Insecten. MANUEL, Encyclop. Meth.

Monoculus pediculus ramosus, DE GEER, Mem. pour serv. a l'Hist. des Ins.

Polyphemus oculus, MUELLER, Zool. Dan. Prod. et Entomost. CUVIER, Tab. element LAITREILLE, Hist. Nat. Crust., etc. LEACH, Edin. Encyc.

Polyphemus stagnorum, LEACH, Dict. Sc. Nat. LAITREILLE, Cuv. Rig. An. DEMAREST, Cons. Gen. Crust.

Polyphemus pediculus, STRAUS, Mem. Mus. d'Hist., etc. M. EDWARDS, Hist. Nat. Crust.

Monoculus polyphemus, JURINE, Hist. Nat. Monoc.

Cephaloculus stagnorum, LAMARCK, Hist. An. Vert. BOSCH, Man. d'Hist. Nat. Crust.

Monoculus oculus, GMELIN, Linn. Syst. Nat.

Scalicerus pediculus, KOCH, Deutsch. Crust.

Polyphemus pediculus, BAIRD, Brit. Entom.

Polyphemus oculus, LIEVIN, Branch. d. Danz.

Polyphemus stagnorum, FISCHER, Ueber die in d. Umg. von St. Petersburg, vorkom. Crust.

Polyphemus pediculus, LILLJEBORG, De Crust. ex ord. trib.

Polyphemus oculus, LEYDIG, Naturg. d. Daph.

Polyphemus pediculus, SCHOEDLER, Neue Beitr. zur Naturg. d. Cladoceren.

Polyphemus kochii, " " " "

Polyphemus oculus, " " " "

Polyphemus pediculus, P. E. MUELLER, Danmark's Cladocera. KURZ, Dodekas neuer Cladoceren. WEISMANN, Beitr. zur Naturg. der Daphnoiden. BIRGE, Notes on Cladocera.

Polyphemus occidentalis,¹ HERRICK.

There are two well-marked varieties of this species: one is found commonly in the clear lakes; the other, which I have only once seen, was found in a very shallow weedy marsh. The difference in size is quite remarkable. Our ordinary form measures less than 1 mm. The larger form, including the stylets, is 1.6 mm. The ordinary variety, although highly colored, is yet transparent, while the large variety is deep red and quite opaque. The relationship between the two forms is quite like that maintaining between *Diaptomus stagnalis* and *D. sanguineus*. Some slight structural differences are observable between the two varieties, as in the form of the antennules, yet quite insignificant when compared with the striking difference in size and coloration. Number two may be called

¹ *Polyphemus occidentalis*, Dekay = *Limulus*.

Sp. 2. Polyphemus stagnalis. (Sp. n.)

In order to make the relation clear between these forms, I add measurements of this species, following each with the corresponding measurement of *P. pediculus* in parenthesis; animals of the same age, as far as possible, being chosen. Head (capsule of eye) 0.3 mm. (0.2 mm.); head and thorax 0.7 mm. (0.45 mm.); abdomen 0.7 mm. (0.56 mm.); caudal stylet 0.36 mm. (0.26 mm.); caudal filaments 0.36 mm. (0.3 mm.). Whole length of antennæ 0.54 mm. (0.42 mm.); first, second and third joints of the 3-jointed ramus 0.08, 0.06 and 0.10 mm., respectively. The formation of the resting eggs or "dauer-ei" seems to go on at the same time with the parthenogenetic reproduction.

II.—GENUS BYTHOTREPES, Leydig.

Much like *Polyphemus*, but the external appendage of the feet is rudimentary, and the abdomen extends out into a most enormous spine. The single species is that described by Leydig as *B. longimanus*, which was found in the stomach of *Coregonus wartmanni*. *B. cederstromii*, of Schoedler and P. E. Mueller, the latter author now identifies with the above, and concludes that the supposed differences arose from "l'etat de maceration des examplaires examines." (*Les Cladoceres des Grands Lacs de la Suisse*, p. 11.) This species may be looked for in the depths of the Great Lakes. (See plate U, fig. 10.)

III.—GENUS PODON.

IV.—GENUS EVADNE.

These are compact oval forms confined to the sea. See Claus, *Zur Kenntniss des Baues der Polyphemiden*, Vienna, 1877, for the best account of the anatomy.

FAMILY LEPTODORIDÆ.

Feet six pairs. Antennæ with both rami four-jointed. Body elongated, not curved; shell very much reduced.

Leptodora hyalina, Lilljeborg,

(Plate N. Figs. 6, 7),

the only species, is found rarely in the larger lakes of Europe and America.

See *Bau und Lebenserscheinung von Leptodora hyalina*, Weismann, 1874; also, *Om en dimorph Udvikling samt Generationsvexler hos Leptodora*, G. O. Sars, 1873; also, *Bidrag til Cladocerenes Forplantningshistorie*, P. E. Mueller.

The work of Sars is particularly valuable, showing that the young produced from the winter eggs pass through a metamorphosis not experienced by the summer or parthenogenetic brood. P. E. Mueller mentions the pathological condition induced by the plants of the Saprolegnia.

CHAPTER III.

ORDER COPEPODA.

This extensive order contains minute and predominatingly predaceous animals which constitute no inconsiderable part of the fauna of fresh and salt waters. They serve a beneficent purpose both as scavengers and as providing food-supply for the fry of fishes and other aquatic animals.

Copepods are never enclosed in a bivalved shell but ordinarily exhibit a more or less elongated cylindrical form composed of two obvious sub-divisions. There are a few species which, by the great prolongation and expansion of some of the tergites or dorsal shields, seem to simulate shelled crustacea. The anterior part of the body, or cephalothorax, is composed of ten somites which are frequently considerably united or fused. Five of these segments constitute the head and bear respectively the following appendages: first, a pair of several- to many-jointed antennæ which are never primarily sensory in function, although they usually are provided with sense hairs or other like organs; second, a pair of two-branched antennules, which sometimes become almost simple or prehensile; third, a pair of mandibles in the form of masticatory or piercing organs, these being usually provided with a palpus; fourth, a pair of maxillæ of various form and function; fifth, a pair of maxillipeds which not infrequently subdivide in later life to form what appear to be two distinct pairs.

The five thoracic segments have each a pair of swimming feet consisting typically of a two-jointed base and two like, three-jointed rami. The symmetry is frequently broken by the retardation of the development of the inner ramus, while the fifth pair of feet may become rudimentary and in various ways subserve the organs of sex. The five abdominal segments are nearly devoid of appendages and are continued posteriorly by two caudal stylets which bear strong setæ constituting, in many forms, a tail-fin or spring.

All copepods, even such as are, in later life, parasitic, begin their existence as free-swimming nauplii, such as are represented on plate S, fig. 13, and plate K, fig. 8.

Though the vast majority of genera and species are marine, it would seem that fresh-water copepods make up in the number of individuals what they lack in variety.

As we are dealing primarily with the fresh-water species, no lengthy description of the group is here necessary.

The earlier history of our knowledge of the animals of this order is given by Baird. According to this authority, the first to mention any fresh-water species of this group was *Stephan Blankaart*¹ in his *Schou-burg der Rupsen, Wormen, Ma'den, en vliegende Diekens tot Amsterdam*. *Leeuwenhoek* adds numerous interesting details and is accredited by Hoek with being the first to discover the relation between the remarkably diverse stages which occur in the history of the cyclops. However, it is evident that he had a very incomplete knowledge of the metamorphoses.

De Geer gives rather characteristic figures of a cyclops in *Memoires pour servir a l'Histoire des Insectes*, vol. vii, 1778.

Mueller, in his great work on *Entomostraca*, adds new facts, defines species and forms the genus *Cyclops*.

Randohr in 1805 gave sundry additions to the knowledge of these animals in his *Beitraege zur Naturgeschichte einiger Deutschen Monoculus-arten*. In this work the post-embryonic history is quite fully outlined.

Jurine, in his classic work *Histoire des Monocles qui se trouvent aux Environs de Geneve*, 1820, crystallized what previous authors as well as his own original experiments had brought to light of the anatomy and biology of these animals.

Ferussac (*Memoire sur deux nouvelles especes d'Entomostraces*) redescribes known species.

Gunner, Stroem, and Viviana, seem to have had little effect on the knowledge of the group, though they wrote prior to *Jurine*.

A recent author attempts to revive the names of *Jurine*, though hitherto it has been thought hazardous to attempt a specific identification.

The German author, *C. L. Koch*, who only incidentally studied this group, distinguished more or less perfectly, a variety of species which have been reinstated in our literature by *Rehberg*. Although

¹ Latinized *Stephanus Blanchardus*. Hoek recognized *Cyclops brevicaudatus* or *C. bicuspidatus* as the one described, chiefly through knowledge of the present inhabitants of the locality.

this proceeding seems quite unjust to the careful authors whose descriptions are recognizable in themselves, the law of priority must probably prevail. Koch's *Deutschlands Krustaceen* appeared in 1838.

Baird's British Entomostraca, without greatly extending our knowledge of this order, put in readable form and made available to English readers what was known, and added interesting facts. He distinguished two families of Copepoda, (1.) Cyclopidae, (2.) Diaptomidae. The first included the genera (1.) Cyclops, (2.) Canthocamptus, (3.) Arpacticus, (4.) Altheutha; and the second the general (1.) Diaptomus, (2.) Temora, (3.) Anomlocera.

Fischer, who contributed not a little to our knowledge of the distribution of fresh-water Cladocera, was the next to describe valid species. He described the species found near Moscow and St. Petersburg, Russia.

Ouchakoff is likewise a Russian author, but his writings are quite unknown to me.

The justly famous Swedish naturalist, *W. Lilljeborg*, who has left his mark on so many branches of natural science, has not neglected the microscopic crustacea of his fatherland. *Om de inom Skaane forekommande Crustaceer af ordningarne Cladocera, Ostracoda och Copepoda* is the somewhat formidable title of his work, published in 1855. He recognized the following genera of Copepoda: Diaptomus, Temora, Dias, Icthyophorba, Tisbe, Tachidius, Harpacticus, Canthocamptus, and Cyclops. A species each of Diaptomus and Canthocamptus is described, and two species of Cyclops. (It would seem from authors' quotations that other species are described in an appendix, but the copy I have seen lacks this.) The author who has done most for micro-carcinology in general is *Carl Claus*, of Vienna. His principal works are:

1. "Das Genus Cyclops," etc. In *Wiegmann's Archiv fuer Naturgeschichte*. 1857.
2. "Weitere Mittheilungen ueber die einheimischen Cyclopiden." The same, 1857.
3. *Die Freilebenden Copepoden*, 1863.

The later work especially is indispensable to the student of Copepoda, though in reality it is more important in respect to marine Copepoda.

In the meantime a work appeared in Norwegian, with Latin descriptions, from the pen of *G. O. Sars*. This has been largely overlooked. It is, unfortunately, unaccompanied by plates, but the descriptions bear the stamp of the naturalist.

A little later a second brief contribution from this author was published, but I have not seen it.

Sir John Lubbock in 1863 describes species of fresh-water copepods, but the publication seems no longer necessary.

Heller, in Tyrol, *Fric*, in Bohemia, and *Uljanin*, in Asia, have studied the copepod fauna.

A Russian paper by *Poggenpol* and *Uljanin* is quoted as "A Catalogue of the Copepoda, Cladocera and Ostracoda of the vicinity of Moscow," by *Rehberg*, and as from the *Protokolle der kais.-naturw. anthropol. und ethnogr. Ges. in Moskau*, but by *Cragin* who publishes a translation apparently of the same paper, in part, as from the "Bulletin of the Friends of Natural History."

Hoek, in the *Tijdschrift der Nederlandsche Dierkundige Vereeniging* (Magazine of the Zoological Society of the Netherlands) 1875, and later in German in the *Niederlaendisches Archiv fuer Zoologie*, gave excellent figures and descriptions of some species which *Claus* had too hastily treated.

In 1878 *A. Gruber* gave descriptions of "Two fresh-water Calanidæ."

In the same year the first volume of *Brady's* fine "*British Copeoda*" appeared. A purely technical work and briefly written, it is yet very comprehensive and in the main reliable. This is a worthy successor of the Ray Society's earliest publication on entomostraca—*Baird's* great work.

In the sixth vol. of the *Abhandlungen d. naturwissenschaftlichen Vereine zu Bremen*, *Herman Rehberg* gives a systematic review of synonymy, and in the revision unites several species in a manner that the present writer had independently been driven to do. It is probably impossible either to substantiate or positively deny some of this writer's identifications of the species of the older authors.

This paper also contains an observation of a hermaphroditic cyclops, which it is interesting to compare with similar anomalies, described by *Kurz* in Cladocera.

In the vii Band of the same periodical, *Rehberg* adds to and modifies some of the views expressed above. In the same number is a description of a new species of *Temora* by *Poppe*. (The same species occurs in the semi-saline waters of the Gulf of Mexico, and had well-nigh gone into print under a new name when this was seen.)

In the above review we have noticed only the more important foreign works on the Copepoda and those including fresh-water forms. *Dana's* magnificent *Crustacea of the Wilkes' Exploring*

Expedition is not included because it is essentially restricted to the marine species, the few descriptions of fresh-water species, being quite valueless. Among important contributors to the exclusively marine Copepoda, are *Boek* (*Oversigt over Norges Copepoder* and *Nye Slægter og Arter af Saltvands-Copepoder*), *Brady* and *Robertson*, *Lubbock* and *Claus*.

The history of the American literature can be quickly traced.

Say described imperfectly an American species of *Cyclops* in 1818. *Haldeman* describes in vol. viii, of the Proc. of Phila. Academy of Science, p. 331, *Cyclops setosa* (which may be *C. serrulatus*). *Pickering* very imperfectly described a new genus of copepods from lake Ontario in *DeKay's Zoology of New York*. This genus is, most likely, *Epischura* of *Forbes* and, in strictness, ought to rank it. In 1877 appeared "A List of Illinois Crustacea," by *Prof. Forbes*, in which two species of Copepoda were described which may rank as the first descriptions at all adequately framed of American members of the order. In the *annual report of the Minnesota state geologist* for 1878, a brief article by *C. L. Herrick* outlined, in the light only of the then English literature, the micro-crustacea of Minnesota. No attempt was made to treat the Copepoda, but two species of *Diaptomus* are indicated which will prove valid. Occasional papers in the *American Naturalist* and elsewhere follow till, in July and August of 1882, *Prof. Forbes* added two new genera and several species of Copepods, constituting by far the most considerable addition to the subject yet produced.

In the *report of the state geologist of Minn.* for 1881, *C. L. Herrick* makes a considerable addition to the knowledge of American Cyclopidæ, enumerating ten species, of which six seemed new. This writer also describes a new genus and several new species of Calanidæ, some of which unfortunately are identical with those described by *Forbes* and published about simultaneously.

Several articles in the *Naturalist* bring the bibliography up to May, 1883, when *F. W. Cragin* published in the *Trans. Kansas Academy of Science*, "A Contribution to the History of the Fresh-water Copepoda." In this paper ten species of *Cyclops* are described or mentioned. The author ignored previous American literature and thus adds somewhat to synonymy. The plates are lithographic, and are carefully, if not artistically, prepared. A valuable feature is the translation of the descriptions of *Poggenpol's* species from the Russian.

These papers, together with the outline presented beyond, it is hoped, will form a basis for future work.

Since writing the above, it is brought to my notice that in April, 1881, *V. T. Chambers* gave some account of a species of the Haptacticidæ referred by him to *Tachidius*. This species is particularly interesting on account of its novel habitat. *Tachidius* (?) *fonticola*, Cham., is found in the saline waters of Big Bone Springs, Ky., and thus is very distant from any marine congeners. It is perhaps doubtful if the generic reference can be sustained, but the species is worthy of further study. The *Diaptomus* described by the same author is hardly recognizable.

FAMILY CALANIDÆ.

This group is pre-eminently marine and contains diverse and graceful forms mostly with very elongated bodies and antennæ. Of the six genera here enumerated as more or less habituated to the use of fresh water, two are found as yet only in America and one is confined to Europe.

Heterocope, namely, is very near *Epischura*, both being restricted to fresh water. *Diaptomus* and *Osphranticum* are likewise only accidentally found in the seas, though their nearest allies are marine. The genus *Limnocalanus* is as yet found in America only in the Great Lakes.

In the distribution of genera we here follow Brady, whose definition of the family Calanidæ, including Calanidæ and Pontellidæ of authors, we quote: "Body elongated; composed of from ten to twelve [obvious] segments. Abdomen nearly cylindrical, much narrower than the cephalothorax and prolonged at the posterior extremity into two more or less cylindrical caudal branches [stylets]. First segment of thorax often anchylosed with the head; fourth and fifth segments also often coalescent. Head only rarely divided into two segments. Anterior antennæ very long and composed of twenty-four or twenty-five joints; that of the right side in the male often modified for grasping [geniculate]. Posterior antennæ large, composed of a basal joint, from which spring usually two branches, the primary branch consisting of two, the secondary of several joints. Mandibles strongly toothed at the apex, palp (usually) two-branched. Maxillæ strong, and provided with a many-lobed palp. Foot-jaws strongly developed: first pair very broad; the basal joints having on the inner margin wart-like processes, from which spring long ciliated bristles; the distal extremity divided into three short joints which are thickly beset with strong

and long, ciliated setæ; second pair longer and more slender, basal portion forming two long oval joints; apical portion usually 4-6-jointed. First four pairs of feet 2-branched, the outer branches always three-jointed. Fifth pair either like the foregoing, or much modified, unlike on the two sides, and in the male forming clasping organs. A heart is present. Eyes either median and stalked or paired (lateral) and sessile; in the latter case being often coalescent and composed of several lenses. Sexual organs in the female symmetrical, in the male asymmetrical. Ovisac single, borne in front of [below] the abdomen.

I.—GENUS HETEROCOPE, Sars.

Cephalothorax 7-jointed; abdomen of female three-jointed; caudal stylets short, with three large setæ and other small spines. Antennæ long, slender. 25-jointed; right male antenna geniculate, the six joints preceding the nineteenth swollen slightly, the previous ones coalescent; external ramus of the antennules 7-jointed; labrum tri-lobate; feet of the four anterior pairs with the inner rami one-jointed; fifth feet of female with a single ramus, three-jointed, with a terminal spine. The right foot of the male is cheliform, four-jointed, second joint extending into a long cylindrical process, the terminal joint with two apical claws.

The writer is familiar with but three species—*H. appendiculata*, Sars, *H. saliens*, Lilljeborg, (= *H. robusta*, Sars,) and *H. alpina*, Sars. None of these have as yet been positively identified in America* and their place seems supplied by the following genus.

II.—GENUS EPISCHURA, Forbes.

(= *Scopiphora*, Pickering?)

Undoubtedly the most remarkable of fresh water copepods are the two American species of this genus. It is not yet certain that the second species may not be a young stage of the first but it seems quite improbable.

Related with *Heterocope*, Sars. The antennæ are 25-jointed, the right of the male being geniculate. The thorax is 6-jointed, the last two segments being partially coalesced. The abdomen is five-jointed in the male and four-jointed in the female, one branched, in the male modified for prehension. Abdomen of male with a

**Heterocope* is said by Patten (Cragen) to be common at Watertown, Conn.

prehensile appendage on the left side, often more or less distorted. Inner rami of swimming feet one-jointed. Caudal stylets with three long setæ. The first mention of an animal of this genus seems to be Pickering's description of *Scopiphora vagans* from deep water in lake Ontario. It seems almost certain that the species so imperfectly described in Dekay's *Crustacea of New York*, is none other than a species of *Epischura*, but I hesitate to substitute for a name accompanied by good descriptions and figures, and one which has already been incorporated, to some extent, into our literature, one which is founded on a description so imperfect and general that one incidental character alone enables one to guess its application. The following is Pickering's description:

"Body small, eye single, near the anterior margin of the shield. Antennæ large, and as long as in the preceding genus [*Cyclops*], and has the same motions in the water. Abdomen terminating in two styles, each with three setæ; last or three last joints. Ovaries none; legs spiny."

What is meant by the "brush" fails to appear, unless the specimens were ornamented with some parasitic plants or animals. The three setæ of the caudal stylets and long antennæ will place this form in no American genus save *Epischura*. But even this statement of Pickering may be held doubtful.

Sp. 1. *Epischura lacustris*, Forbes.

(Plate Q. Fig. 15.)

"The second segment of the abdomen of the male is twice as long as the first, and produced to the right as a large, elongate, triangular process, somewhat hooked backwards at the tip. The third segment is similarly produced, but rounded and expanded at the tip, which is roughened before and behind.

From the right side of the fourth segment arises a stout process bearing at its apex a hatchet-shaped plate with seven broad obtuse serratures on its anterior margin. This process is roughened behind, where it is opposed to the concave side of the left ramus of the furca. From the same side of the fifth segment, a short flattened plate, of a spatulate or paddle-like form, extends forward above or beyond the toothed process just mentioned.

The antennæ are 25-jointed, and reach to the second segment of the abdomen. There are especially prominent sensory hairs on the

first and third joints, borne at the tips of long spines. The antennules are short, the ramus apparently but three-jointed, the short, median joints common in this appendage being only obscurely indicated. The mandible has but seven teeth, the first simple and acute, separated from the second by an interval about equal to the second and third, the second to the sixth bifid, the seventh entire and acute. The usual plumose bristle is replaced by a sharp, simple spine.

The outer ramus of the fourth pair of legs has two teeth at the outer tip of each of the two basal joints. The terminal joint of this ramus is armed as follows: a short simple spine at middle of outer margin and another at the distal outer angle; a single and long terminal seta, strongly and sharply toothed externally and plumose within, and four long plumose setæ attached to the inner margin.

The left leg of the fifth pair in the male, viewed from behind, has the basal joint very large, broader than long, with the inner inferior angle produced downwards as a long, stout, curved process or arm as long as the two remaining joints. The second joint is trapezoidal, shortest within. The third joint is about half as wide at base as the first, is straight without, with a sharp, small tooth at its distal third, and bifid at tip. On the inner margin this joint is at first dilated a little, and then deeply excavated to the narrow tip, to receive the lower end of the left leg, the lower two-thirds of this margin forming the segment of a circle.

The right leg is two-jointed, the first joint twice as broad, enlarged at the lower end, forming an auriculate expansion at its inner inferior angle. The second joint is conical in outline and about two-thirds as long as the first.

The terminal bristles of the rami are very broad and strong in the female, the outer one especially having an extraordinary size and thickness. There is also at the outer angle of each ramus a short, stout spine, that on the left ramus being inflated like the outer bristle. Length .065 in.

The legs of the fifth pair in the female are three-jointed and similar, the basal joint short and broad, the second two and one-half times as long as wide. The leg terminates by four diverging teeth, preceded by two others, one on each side.

Taken in the towing net abundantly in October, 1881, at Grand Traverse bay; also obtained rarely by Mr. B. W. Thomas, from the city water of Chicago."

Occurring in Minnesota, probably in lake Superior.

Sp. 2. *Epischura fluviatilis*, Herrick.

(Plate Q. Figs. 14 and 16.)

Similar to the above but smaller (.04 in.) The females are very similar, though the fifth feet are more elongate and differently spined. The abdomen is perfectly straight and the three caudal setæ are of nearly equal size. The claw is armed with eight teeth, all but the first of which are emarginate. The abdomen of the male is straight, but has a strong process on the left side which bears a movable claw laterally and a small second segment which terminates in two small spines. The fifth foot of the male is peculiar; the inner ramus (or the left foot) lamelliform, one-jointed, with two opposable claws; the right branch is simple and 3-jointed, in form like that of the female. Here we have the most marked difference between the two species. Found in Mulberry creek, Cullman county, Alabama. Although a considerable number were examined no oviferous females were found, while the males contained the spermatophores and can hardly be thought immature, and, as it is in the male that the most marked differences appear, the two species seem certainly distinct.

III.—GENUS TEMORA, Baird.

(Plate H. Figs. 8—16.)

This genus contains several marine forms and two which are found also in streams opening into the sea. The species seem to be as follows: *T. velox*, Lilljeborg, *T. longicornis*, Mueller, (= *T. finmarchia*, Baird, = *Diatomus longicaudatus*, Lubbock), *T. armata*, Claus, *T. inermis*, Boeck, and *T. affinis*, Poppe. *T. clausii*, Hoeck, is said by Poppe to be certainly identical with *T. velox*. Hoeck's figures are incomparably better than any of the preceding, but he seems to have been misled by errors in Lilljeborg. The species described by me before the Academy of Sciences of Minnesota (but still unpublished) as *T. gracilis*, from the brackish waters bordering the gulf of Mexico, agrees very closely with *T. affinis*, Poppe. (Abhandlungen v. naturw. Vereine z. Bremen, 1880, p. 55.) This name must therefore take precedence. This species has been found in the Rhine and rivers flowing into the gulf of Mexico, as well as in the marine or brackish waters into which these rivers flow. The occurrence of the genus in American fresh waters, justifies its mention here.

• IV.—GENUS OSPHRANTICUM, Forbes.

(=Potamoichetor, Herrick.)

First reported as Potamoichetor before the Minnesota Academy of Sciences in 1879, but owing to a disastrous fire, publication was prevented. Priority probably belongs to Forbes' name, since, although first printed in the tenth annual of this survey, the edition was not distributed till after the August issue of the American Naturalist of 1882, containing the description above alluded to. Forbes says this genus has antennæ 23-jointed; all the specimens we have gathered from Minnesota to Alabama had 24-jointed antennæ. The original description of "Potamoichetor" is appended.

"Cephalothorax six-jointed, distal segments evident; abdomen, in the male, five-jointed, in the female four-jointed; antennæ twenty-four-jointed, the right geniculated as in Centropages (=Ichthyophorbia); first pair of feet with the rami both three-jointed, like the following; feet of the fifth pair, in the female, like the preceding, but with a spine of the joint preceding the terminal one enlarged and divaricated somewhat as in Centropages; in the male, the right with a two-jointed outer ramus, the terminal joint of which is spined and bears near its base a blunt expansion of its inner margin; outer ramus of left foot three-jointed, armed with unequal spines; inner branches smaller, similar, three-jointed; the terminal joint bearing curved spines; ovary and testes as in Diaptomus, with which the mouth parts agree in the main; eyes median, confluent."

Our own experience is that the single species of this genus prefers estuaries of running water. Forbes, however, has taken it from swamps and wayside pools.

Sp. 1. Osphranticum labronectum, Forbes.

(Plate Q2. Figs. 1—8 and 13—14.)

Potamoichetor fucosus, HERRICK, Cyclopida of Minnesota, etc., p. 224.

"Rather slender, and in size, as well as general appearance, resembling the smaller forms of Diaptomus; antennæ rather stout, reaching but little beyond the feet, appendaged as in Diaptomus, in the male strongly geniculated, but somewhat variously so; the six joints preceding the terminal four are thickened; those preceding the joint or hinge are arcuate on the distal margins; the secondary antennæ are about as in Diaptomus; mandibular palp two-branched, the outer three-jointed, the inner two-jointed; the terminal joint of

the shorter branch bearing seven setæ, of the other four, the proximal joint of the former with three stout spines; the maxillæ nearly like *Diaptomus*; the processes have respectively the following numbers of setæ: the basal plate eight, the small processes at base of posterior branchial appendage one, the appendage itself twelve, terminal portion three groups, first containing nine, the second three, and the third four or five, the upper of the anterior processes two, and the lower three; fifth feet nearly like the others in size; the right in the male having the outer branch but two-jointed by the coalescence of the two outer to form an arcuate and deformed appendage, armed at the end with three stout equal spines; corresponding branch of left foot three-jointed; the terminal joint bearing three unequal spines, each of the preceding joints only one; inner branches similar, three-jointed; terminal joint being short and armed with three short lanceolate setæ and three longer ones, two of which are curved so as to be slightly prehensile; fifth foot of female with both rami three-jointed; inner ramus much smaller; antepenult segment of the outer ramus extending into a large lanceolate process; ova-sac long-ellipsoidal or spherical, reaching nearly to the end of the caudal setæ."

V.—GENUS *DIAPTOMUS*, Westwood.

The most widely distributed and well-known of fresh water Calanidæ, inhabiting in various species the smallest as well as the largest bodies of standing or sluggishly-flowing fresh water. Apparently a recently formed group whose nearest known ally is the curious *Pseudo-diaptomus*, found in the gulf of Mexico. The animals of this genus are apparently very susceptible to the influences of the environment, and are consequently extremely variable not only in color but in minor structural points. In America there is a curious fact, which is susceptible of different explanations, one of which was given in the *American Naturalist* at various times during the year past. The species or varieties fall in pairs, one of which is smaller and less highly differentiated, while the other is greatly enlarged and has the peculiarities emphasized. These sets occur in open and shallow water respectively. The large varieties are, as the rule, restricted to such shallow weedy pools as dry up during summer and freeze solid in winter. The forms intermingle slightly, but there are seasonal differences of greater or less extent.

The body is composed of an elongated thorax, with which the head is united, forming a six-jointed cephalothorax. The abdomen

is five-jointed, though in the female these joints are so united as to cause the abdomen to appear three-jointed. The antennæ are twenty-five-jointed, and the right male limb is modified by a coalescing of some of the terminal joints, a thickening of others and the development of certain spines, hooks, and knife-like ridges to form a prehensile organ. The first pair of feet has two-jointed inner rami. The remainder have both rami three-jointed, save the last. This fifth foot is differently formed in the sexes, the inner branch of the fifth foot being one or two-jointed. Terminal joint of the outer ramus of this limb in the female very small or apparently absent, second joint produced to form a stout curved claw. The left foot is reduced in the male, serving, in some species, to affix the spermatophore to the body of the female, while the abdomen is held by the right foot. The last segment of the thorax has one or two sharp spines below. The spermatophore, or sperm case, is a long tube with coagulating expansive lining, which forces out its contents on exposure to the water. The colors are frequently brilliant.

Three or four species of this genus are known in Europe, the first being *Diaptomus castor* which seems universally distributed. It can hardly be doubted that the six forms mentioned below belong among the varieties of this species; yet these forms can be distinguished very well, and are deserving of distinct names. Two other forms are nearest *D. gracilis* of Sars, but sufficiently distinct. These stand related as do the pairs of the other section, and can not be readily distinguished.

The following is the most convenient arrangement of the genus I have been able to devise.

KEY TO THE GENUS DIAPTOMUS.

I. Form robust; right antenna of the male with a hook, much swollen anterior to the geniculating joint.

A. Head not greatly dilated.

* Last segment of thorax prolonged into a sharp-spined angle or tooth.

† With but one tooth (?).

1. *D. castor*, Jurine.

++ With two teeth.

‡ Length under 3 mm.

§ Inner rami of fifth feet in the female 1-jointed.

2. *D. sanguineus*, Forbes.

4. *D. armatus*, Herrick.

§§ Inner rami 2-jointed.

3. *D. minnetonka*, Herrick.

‡‡ Length over 3 mm.

5. *D. stagnalis*, Forbes.

** Last segment of the thorax more or less united with the previous one, bearing very small spines.

6. *D. longicornis*, Herrick.

(a) Length under 2 mm.

var. *leptopus*, Forbes.

(b) Length over 2 mm.

var. *similis*, Herrick.

B. Head enlarged.

7. *D. laticeps*, Sars.

II. Form slender, elongate; head divided into two portions; antennæ long, slightly altered in the male.

A. Antenna of male with a hook.

8. *D. gracilis*, Sars.

B. Antenna of male without a hook.

9. *D. pallidus*, Herrick.

(a) Antennæ much longer than the body, inner rami of fifth pair of feet in the male 1-jointed.

var. *pallidus*, Herrick.

(b) Antennæ little longer than the body, inner ramus of fifth feet bi-articulate.

var. *stellis*, Forbes.

Sp. 1. *Diaptomus castor*, Jurine. [Sars.]

"Corporis forma sat robusta. Cephalothorax in femina postice parum antice vero magis attenuatus, angulis laminarum segmenti ultimi obtusis. Segmentum 1-mum abdominale absque mucrone laterali. Rami caudales brevissimi segmento antecedente vix longiores setis crassis et brevibus. Antennæ 1-mi paris mediocris longitudinis reflexæ segmentum 3-tium abdominale vix superantes, animali natante leviter arcuate adque latera vergentes; articulus ultimus (?) antennæ dextræ maris in hamulum exiens acuminatum. Ramus antennarum 2-di paris exterior interiore parum modo longior, articulo ultimo quam antecedentibus 5-junctis brevior. Articulus ultimus pedum 5-ti paris in femina perrudimentaris tuberculum solum minimum aculeo uno parvo instructum formans; unguis intus curvatus maximus validusque; appendix interna indistincte bi-articulata longitudinem articuli 3-ti superans; unguis terminalis pedis dextri maris longissimus leviterque arcuatus. Saccus oviferus parva et multa continet ova colore castaneo. Color animalis variat ex fulvo, cæruleo vel rubro. Longit. fem. interdum fere 3 mm. Habitat in aquis stagnantibus."

The description quoted above from Sars does not agree with Claus' or Brady's account of the same species. From what Brady says of the English *Diaptomi* one would conclude that the same variations occur there as here. *D. westwoodii*, which he unites with *D. castor*, is certainly as different from that species as our *D. stagnalis* is from *D. sanguineus*. An actual comparison of specimens will be necessary to clearly define the relation of the American and European species.

Sp. 2. *Diaptomus sanguineus*, Forbes.

(Plate Q. Fig. 12.)

A species found with us in stagnating pools in early spring, frequently following *D. stagnalis* and giving place to *D. leptopus*. It prefers pools less foul than those affected by the latter, though not rarely found with it temporarily. The species is quite variable, and the variations are in directions suggestive of other species. Measurements taken of specimens from a gathering from two pools, one being more stagnant than the other, showed the following results:—males from the less stagnant 1.7 mm.; males from the other pool 2.0 mm.; a difference of 0.3 mm. (Males of *D. stagnalis* from the latter gathering measured 3.4 mm., while the females of that species vary between 3.8—3.9 mm.) Females measure about 1.8 mm. on an average, of which 1.3 mm. is the length of the thorax. Such individuals have antennæ 1.7 mm. long. The greatest width is anterior to the middle, being about 0.5 mm.

This species differs from *D. stagnalis* of which, in most respects, is a miniature, by the long antennæ, short abdomen and peculiar armature of the fifth feet.

In the female the fifth foot is about 0.5 mm. long, and the outer ramus has two small spines on the terminal joint, while the segment before the last has a powerful toothed claw. The inner ramus is not evidently two-jointed. The first abdominal segment is spurred on either side. The last thoracic segment extends into a strong angle which bears a heavy spine terminally, and a smaller spine dorsally. On the dorsal median line is a protuberance or "hump" on this segment. In the male the outer ramus of the right foot of fifth pair is long, and terminates in a powerful curved, toothed claw. The inner ramus is small and narrowed toward the end; on the outside of the segment from which it springs is a blunt spine, which is nearly as large as the ramus itself, and has been mistaken for it. The left foot is very fleshy and its inner ramus very rudimentary. The color is brilliant red or purple but variable. Found in the southern states in autumn.

Sp. 3. *Diaptomus minnetonka*, (Sp. n.)

(Plate Q. Figs. 8—10.)

A small species, smaller than either *D. longicornis* or *D. sanguineus*, was gathered in a pool bordering lake Minnetonka, which contained also *D. longicornis*. It unites the characteristics of both

species. The antennæ reach beyond the stylets, the color is dark, the margins of the last segment of the thorax is rather strongly spined, very much as in *D. sanguineus*. The fifth feet of the female resemble very much those of *D. leptopus*, but the first segment of the abdomen has a strong spine. The fifth foot of male resembles that of *D. sanguineus* more than that of *leptopus*. This species was seen but once, and no measurements can be given save that of the male which was 1.4 mm.

Sp. 4. *Diaptomus armatus*, Herrick,

Is founded upon an imperfectly known form in which the antennæ do not reach the end of the abdomen; the thickened part of the male antennæ short; the antenna armed as in *D. sanguineus*; the terminal claw of the fifth foot of the male with a tooth near the base; the claw being nearly as long as the ramus.

Sp. 5. *Diaptomus stagnalis*, Forbes.

(Plate Q. Figs. 11 and 13.)

D. giganteus, HERRICK.

The largest species of the genus and, not improbably, too close to *D. westwoodii*, Lubbock. The general characters are like those of *D. sanguineus*, but the form is much more robust and the antennæ only moderately exceed the thorax. The proportions may be gathered from the measurements given. In the female the length of thorax is 2.5 mm.; abdomen 1.2 mm.; antennæ 2.3 mm.; stylets 0.1 mm. The caudal stylets are as broad as long, or nearly so. The last thoracic segment extends into an irregular process 0.1 mm. long, bearing a spine dorsally. The first abdominal segment is spurred on either side. The fifth feet in the female have two-jointed inner rami. The terminal segment of the outer ramus is more than ordinarily distinct, while the claw is biserrate. The right foot of the fifth pair in the male is very long, its claw being strongly toothed. On the inside of the second joint from the base is a disc-like appendage peculiar to this species. The left foot is short. The longer ramus is three-jointed, but the terminal joint is a mere curved spine, opposing a spine from the penultimate segment, which is covered with minute spines or teeth. The basal joint of the ramus has a bristly protuberance distally. The inner ramus is marked with oblique ridges. The right antenna has a powerful hooked spine on the antepenult segment, the two segments beyond which coalesce in

maturity as in the other related species. For measurements see above. Color deep opaque red or purple. Appearing in early spring as soon as the ice is melted from the pools which it inhabits. In the south it occurs in autumn. The name above given seems to have the priority, although this species was figured and described at about the same time in the annual of this survey.

Sp. 6. *Diaptomus longicornis*, Herrick

This name was applied somewhat loosely, the description given being incomplete, but re-examination of types shows it to belong unquestionably to the form since described as *D. leptopus*. In our state we have found another variety, in general, almost identical with the type specimens, but nearly twice as large. It is now proposed to extend the significance of this name so as to include both varieties, which will undoubtedly be found connected by intermediate forms, thus retaining the name given by Forbes for the variety to which it in particular applies.

(a) **var. *leptopus*, Forbes.**

This species is the commonest member of the genus in small lakes and clear pools. It is tolerably constant in coloration, but varies somewhat in size. The original description is insufficient to identify the species definitely, but taken in connection with the figure and the measurement, could hardly be referred to either of the other American forms. This species is characterized by the very compact thorax, the margin of the last segment of which has two very minute spines; and by the form of the fifth feet. The antennæ reach nearly to the end of the caudal setæ, while in the next they fall short of the length of the stylets. The outer spines of the swimming feet are denticulate on the outer margin and setose within. The fifth feet of the female are compact, the inner ramus is more or less obviously two-jointed; the third joint of the outer ramus is almost obsolete and has two short spines; the claw of second joint is strongly denticulate. The male fifth foot has a rather long inner ramus which is very imperfectly two-jointed; the left foot is rather long; the claw of the right foot is armed with crenulate teeth. Length 1.5—1.7 mm., without setæ. The body, which is broadest anterior to the middle, is bluish; the tips of the antennæ are deep purple. The eggs are not as numerous as in the next.

(b) **var. similis.** (Var. n.)

(Plate Q. Figs. 5—7.)

This form is twice as large as *D. leptopus*, but otherwise scarcely distinguishable. It occurs in autumn (and spring?) in shallow pools, which can but be frozen solid. The following differences are the only points yet noticed. Females of both of the species were placed side by side upon a slide and examined. *D. leptopus* measured 2.4 mm., exclusive of caudal setæ; the antennæ reached hardly to the base of the stylets; the eggs measured 0.12 mm., while those of *D. longicornis* measured 0.8 mm.; the egg-sac measured 0.8 mm., while that of *longicornis* was 0.5 mm. A few other minute differences were noticed, but the general form and color was identical. The peculiar doubling of the edge of the last segment is characteristic of these two forms; each has a small spine on either side of the abdomen. The base of the inner ramus of left foot of fifth pair of the male has a double series of spines.

Sp. 7. Diaptomus laticeps, Sars.

"Cephalothorax antice dilatatus, latitudine maxima in parte antica capitis sita, postice sensim attenuatus, segmento ultimo femine ad latera parum extante angulis lateralibus acuminatis. Segmentum 1-mum abdominale femine antice latum mucrone brevi laterali armatum, postice sensim attenuatum. Rami caudales sat magni segmenta antecentia 2 juncta longitudine æquantes setis brevissimis et robustis instructi. Antennæ 1-mi paris femine longitudinem corporis æquantes, animali natante recte et quam in *D. gracili* adhuc magis postice vergentes; articulus antepenultimus antennæ dextræ maris hamulo armatus. Ramus exterior antenarum 2-di paris interiore multo longior articulo ultimo longitudinem articulorum antecedentium 5 æquante. Pedum 5-ti paris femine articulus ultimus parvus, cylindricus, non vero tam rudimentaris quam in *D. castore*, aculeo uno brevi apicali instructus; appendix interna ne tertiam quidem longitudinis articuli 3-ti partem æquans et uniarticulata; pedis dextri maris articulus 3-tius extrorsum aculeo forti armatus, ungue terminali valde flexuoso et sub-sigmoides; sinister aculeis duobus rectis terminatus. Saccus oviferus sat multa continet ova. Color pleurumque læte cæruleus, interdum pallidior, albescens. Longit. femine circit. 1½ mm."

Sp. 8. Diaptomus gracilis, Sars.

"Corpus quam in *D. castore* gracilius, cephalothorace et antice et postice attenuato, latitudine maxima in medio sita. Anguli laminarum segmenti ultimi thoracalis femine in mucrones tenues et acuminatos producti, et mucrone simili sat magno segmentum 1-mum abdominale utrinque armatus est. Rami abdominales breves setis in femina valde divergentibus. Antennæ 1-mi paris femine perlongæ et tenues, longitudinem totius animalis longe superantes, animali natanti recte et aliquantum postice vergentes; articulus antepenultimus antennæ dextræ maris hamulo longior, articulo ultimo rami dimidium longitudinem æquante. Pedum 5-ti paris femine articulus ultimus distinctus, quadratus aculeis duobus apicalibus quorum interior apicem fere unguis articuli penultimi attingit instructus; appendix interna articulo 3-tio brevior; unguis terminalis pedis dextri maris apicem versus valde curvatus. Saccus oviferus semper ova continet paucissima et magna regulariterque distributa. Animal pleurumque pellici-

dum colore albido, interdum vero facia transversa lata coloris fusci saturati in medio cephalothorace ornatum. Longit. feminæ parum supra 1 mm."

The two forms following are sufficiently distinct from the above and form a closer link with the marine Calanidæ. It is doubtful if any absolute line of demarkation exists between these varieties, although they are here distinguished.

Sp. 9. Diaptomus pallidus, Herrick.

(Plate Q. Fig. 17.)

Length 1.20 mm.; length of antennæ 1.35 mm. Colorless. Head separated by a suture into two parts; form very slender. Antennæ with elongated setæ, which are very plumose. The right male antenna has no hook. The inner rami of the fifth feet are one-jointed in both sexes. Left foot of the fifth pair of the male of peculiar form (see plate Q, fig. 17, for an extreme instance). Entire Mississippi valley.

var. sticilis, Forbes.

(Plate Q. Fig. 18.)

Like the above, but larger. Length 1.45 mm. Length of antennæ 1.5 mm. Inner ramus of male feet of fifth pair two-jointed, those of the female one-jointed. The form of feet varies a little from the above. This species has been but once encountered in Minnesota, the previous species occurring abundantly in our larger lakes.

D. kentuckyensis, Chambers, is referable to one of the above species, probably *D. longicornis*.

For a full account of synonymy see Rehberg, *Beitrag z. Kenn. d. freileb. Süsswasser Copepoden*, p. 552.

VI.—GENUS LIMNOCALANUS, Sars.

Cephalothorax 6-jointed, slender; abdomen in the female 3-jointed, in the male 5-jointed. Antennæ shorter than the body, 25-jointed. Caudal stylets long. Feet of the four anterior pairs with both rami 3-jointed; external ramus of the fifth foot in the female 3-jointed, second joint produced into a spine; inner rami 3-jointed in both sexes and like those of the previous pairs; external rami 2-jointed in the male, the right and left dissimilar.

Sp. 1. *Limnocalanus macrurus*, Sars.

A species similar to *L. macrurus* has been found in lake Michigan, and probably occurs also in this state in lake Superior. We can do no better than quote Sars' description.

"Corpus gracile et angustatum. Cephalothorax supra visus elongato ovatus, latitudine maxima in medio sita antice et postice æqualiter attenuatus. Caput anulum unicum præbens, a latere visum parte antica altiore et convexa sinu distincto a posteriore disjuncta, margine antico oblique descendente. Segmentum ultimum thoracis parvum neque ad latera extans in femina et mare simile. Abdomen sub-cylindricum thorace longius. Rami caudales valde elongati et angustati tertium longitudinis abdominis partem superantes, supra et ad latera spinulis vel pilis brevibus obsiti, intus ciliati, setis 5 majoribus uniaarticulatis et ciliatis, quarum 2-da ab interiore numerata omnium longissima ceterarumque extus graduatim longitudine decrecentes, exteriori ceteris minore absque apice sat remota; seta adest præterea alia intus adfixa ut in generibus antecedentibus tenuissima et simplex. Frons a latere visa obtuse acuminata appendicibus tentaculiformibus duabus perbrevibus instructa. Antennæ 1-mi paris reflexæ segmentum penultimum abdominis minime attingentes, articulo ultimo setis 5, quarum posteriores 2 longissimæ, instructo, articulis antecedentibus 3 setæ simili postice vergente præditis; dextra maris articulatione inter articulum 18-mum et 19-mum geniculans. Antennarum 2-di paris ramus exterior inferiore et longior et latior, 7-articulatus, articulo 2-do omnium maximo, sequentibus 4 minimis junctis articulo ultimo brevioribus setisque longissimis instructis. Mandibulæ ad extremitatem inferiorem in dentes exeuntes 9, quorum exteriores 2 ceteris majores, interiores 2 tenues et setiferes sunt; palpus longus et angustatus 3-articulatus, articulis ultimis 2 brevissimis, ramo exteriori, vel appendice branchiale, parvo. Maxillæ 1-mi paris eadem fere structura ac in Diaptomo. Maxillæ 2-di paris validissimæ 8-articulatæ, articulis ultimis 5 in ungues exeuntibus longissimos et fortissimos margine altero sparsim pilosos, ad apicem falcatum vero nudos vel aculeis persubtile et dense obsitos; 3-tii paris [Maxillipedes] valde elongatæ et angustatæ antice vergentes articulis 7 setis pleurumque longis præditis compositæ. Pedes omnes biramosi natatorii, ultimo pari in mare bi-articulatus in pede dextro et sinistro dissimilis, articulo ultimo in illo brevi et robusto ad apicem quasi truncato dentibusque 3 parvis et obtusis armato intus vero in aculeum magnum et validum excurrente, in hoc valde elongato extus et ad apicem aculeato intus vero nudo. Oculus unicus propius marginem inferiorem capitis situs. Animal quamquam pellucidissimus et fere omnino hyalinum, facile tamen accumulatione in thorace sat magna liquoris oleosi læte fulvo-rubide colorati se prodit. Longit. circit. 2½ mm."

FAMILY CYCLOPIDÆ.

Contains five genera, viz: *Thorellia*, *Cyclops*, *Oithona*, *Lophophorus* and *Cyclopina*; passing, by the genera *Misophria* and *Pseudo-cyclops*, into the *Calanidæ* or marine copepods. The affinities of these little known genera need further study, as they are very interesting, the question being still open in how far the cyclopoid forms are altered by adaptation to saline habitat, if such an adaptation takes place at all.

Cephalothorax ovate and usually much more robust than the abdomen; anterior antennæ seldom longer than the cephalothorax, those of the male alike on both sides and modified for the purpose of clasping; posterior antennæ unbranched (i. e. palpus wanting);

palps of mandibles and maxillæ usually well-developed; foot-jaws mostly less developed than in *Calanidæ*; first four pairs of feet as in *Calanidæ*, fifth pair rudimentary, alike in both sexes, and usually one- or two-jointed; ovisacs two.

The circulatory system of this family is partly lacunal and has been thought to be entirely so in the genus *Cyclops*. closer observation, however, shows that there is something like an imperfect central organ at the point occupied by the heart of higher Copepods. This was figured in my previous report, plate V, fig. 1, but no mention was made of the discovery. It has since been verified. The apparatus referred to is a modification of that described under *Canthocamptus*. In the second thoracic segment there is a set of swaying membranes which constitute a valvular apparatus, chiefly moved by the action of the stomach.

GENUS CYCLOPS.

The sole representative of the genera of the Cyclopidæ here treated is the best known of the Copepoda. Every one is familiar with the "common cyclops," but few realize how many are the species included under this name. An attempt is here made to enable the student to recognize the more obvious distinctions upon which the genus is subdivided and to identify such of the species as seem valid and at the same time recognizable without recondite study of development. Without attempting a complete elucidation of the synonymy, which is practically an impossibility, a proximate classification of all the species known to me is attempted. Thirty sufficiently well marked species are enumerated, and the position of a number more is indicated.

Antennæ 18-jointed.

Sp. 1. *Cyclops elongatus*, Claus.

This species, cited hitherto, apparently, by but one other author than Claus, is distinguished from the *C. pulchellus* group by the 18-jointed antennæ, which are hardly longer than the first thoracic segment. The caudal stylets are longer than the two preceeding abdominal segments, and bear rather short setæ. *C. elongatus* has been found by Cragin near Cambridge. That this species, found thus far by but a single author in Europe, appears in America, may serve as a warning not to decide too hastily from its habitat that a copepod is new.

of equal width; caudal stylets longer than the last two segments of the abdomen terminal; setæ of moderate size, inner three times as long as outer, internal pair nearly equal. Antennæ as long as first two segments. The inner ramus of fourth foot has the exterior thorn very small. The second joint of the fifth foot is small and the external thorn very small. Length 1.5 mm.

Not seen in America.

B.—First joint of fifth foot of moderate size.

(a) Terminal segment of fifth foot with one long seta and a short thorn.

These small species pass into the above group and constitute one of the most difficult groups of the genus. The distinctions offered are very small and specific variation considerable.

Sp. 6. *Cyclops strenuus*, Fischer.

? *C. pictus*, KOCH.

C. brevicaudatus, CLAUS, LUBBOCK, HELLER, FRIC.

C. strenuus, SARS, BRADY.

Antennæ reaching about to the end of the third segment; caudal stylets slender, three times as long as the last segment; the outer of the caudal setæ shortest. The third seta is over once and one half the length of the stylet.

Sp. 7. *Cyclops lucidulus*, Koch.

C. lucidulus SARS.

C. furcifer, CLAUS.

C. vernalis, FISCHER.

This species is given on the authority of Rehberg. Claus considered *C. furcifer* a large variety of the above species.

The antennæ are as long as the first segment; the fifth foot is peculiar in form, with the second joint armed with a spine and a hook; length 1.3 mm.

Neither this nor the previous species is known in America.*

Sp. 8. *Cyclops robustus*, Sars.

Antennæ shorter than first segment, thick. Body depressed, first segment broad and rounded anteriorly, the others spreading; caudal stylets nearly parallel, long; inner median seta much the

**C. pulchellus*, Brady is not *C. pu'chellus*, Koch, and may be the above species.

longer, external setæ very short. Terminal joint of outer ramus with three spines externally and four setæ internally. Length 1.3 mm. I know nothing of this species save the description of Sars, a part of which is quoted above.

Sp. 9. *Cyclops parvus*, Herick.

(Plate R. Fig. 22.)

Cyclops parvus, HERRICK, Crustacea of Minnesota, p. 229; Plate VI., Figs. 12-15.

In form and general appearance greatly resembling *Cyclops thomasi*, which it nearly equals in size. The chief differences are found in the length of the caudal stylets and antennæ and in the form of the fifth foot. The antennæ are shorter than, or about as long as, the first thoracic segment. The formula expressing the length of the joints corresponds with that for *C. thomasi*. The antennules are shortish. The labrum is rather narrow, projecting below into obtuse angles, the middle of the lower face being occupied with nine rather small teeth. The terminal joint of the larger branch of the maxilliped bears four hairs. The second joint has a moderately large dactyl, the movable finger of which is small and sparsely spiny, the immovable finger is ornamented by an oblique series of blunt prominences and a small seta at its base. The first pair of feet has two terminal and two interior setæ and two external spines on the ultimate joint of the outer ramus, while the corresponding joint of the inner ramus bears one inner seta and large spine and three outer setæ. The fourth foot has, in the first case, two outer spines, a terminal spine and seta and three internal setæ, and, in the second, one external seta, two subequal terminal spines and two internal setæ. The fifth foot is two-jointed, bearing on the short basal joint a moderate seta and on the larger second joint a considerable seta and a small oval spine on its side. The caudal stylets are short and the lateral seta is near the end (about 1.5). The outer seta is but three-fourths the length of the inner. The inner of the median setæ is considerably longer than the outer. The shape of the operculum of the female is very characteristic, it being nearly oval. The last two joints of the thorax are acute. The entire length is about 1.5 mm.

Sp. 10. *Cyclops brevispinosus*. (Sp. n.)

(Plate S. Figs. 7-11.)

The form for which this name is proposed takes the place of the

above in the larger lakes. It appears to be but a modified condition of the above species, from which it differs in its slender form and especially in the very slender caudal stylets. The outer caudal seta is reduced to a short ciliate thorn. The fourth foot is also modified by the great enlargement of the spines and the reduction of the setæ. The number of the setæ is the same, but they are differently disposed. The form of the operculum vulvæ is also slightly different.

(?) **Sp. 11. *Cyclops uniangularatus*, Cragin.**

Cyclops uniangularatus, CRAGIN. A Contribution to the History of Fresh-water Copepoda, p. 6.

Cragin was not conversant with the description of *C. parvus*, with which his description agrees save in one point. It differs from *C. parvus* in having three inner setæ on the terminal joint of the outer ramus of the first foot. It would be officious to suggest a possible oversight here, but *C. parvus* has only two in type specimens (though in all this group the corresponding ramus of the second foot has three setæ), so that at present the two must be kept distinct.

Sp. 12. *Cyclops scutifer*, Sars.

Not having identified this and the following species it will be best to quote the descriptions.

C. strenuo affinis. Cephalothorax sat elongatus, segmentis ultimis duobus in femina ad latere valde prominentibus inque processos exeuntibus laminares et hyalinos utrinque inter se contiguos, quare thoracis pars posterior tamquam clypeo fornicato quadrangulari oblecta esse videtur. Segmentum 1-mum abdominale ad basin valde dilatatum latitudine quam ad marginem posteriorem duplo majore. Rami caudales segmentes antecedentibus duobus junctis parum longiores, introrsum ciliati, setis apicalibus brevissimis, intermediarum interiore ceteris multo longiore. Antennæ 1-mi paris 17-articulatæ, reflexæ segmentum 2-dum corporis superantes setis plurumque longis obsitæ. Pedum structura eidem in *C. strenuo* similis. Articulæ scilicet ultimus rami exterioris pedum natatoriorum setis 5 instructus in paribus anterioribus duobus 3, in sequentibus duobus 2 modo aculeis marginis exterioris armatus; aculeorum apicalium rami interiores pedum 4-ti paris exterior brevis et rudimentaris. Pedum 5-ti paris articulus ultimus sat magnus articulo basali parum minor extrorsum sparsim pilosus introrsum aculeo armatus ciliato setaque longa terminali. Sacci oviferi parvi globosi abdomen magna ex parte obtegentes. Longit. circit. 1½ mm.

Sp. 13. *Cyclops abyssorum*, Sars.

C. strenuo et scutifero sat affinis. Cephalothorax ovatus antice obtuse truncatus, segmentis parum ad latera extantibus. Rami caudales longi et tenues satisque divergentes, longitudinem segmentorum antecedentium 3 superantes, setis apicalibus longioribus intermediarum interiore duplam longitudinem furcæ superante, exterioriore quam illa parum brevior. Antennæ 1-mi paris 17-articulatæ longæ et fere rectæ distincte postici

vergentes, reflexæ segmentum 3-tium corporis fere attingentes. Pedum natatoriorum structura fere eadem ac in speciebus antecedentibus; aculeorum apicalium rami interioris pedum 4-ti paris exterior dimidiam fere interioris attingens longitudine. Pedum 5-ti paris articulus basalis minimus ultimo multo brevior parumque latior. Sacci ovi-feri mediocres rotundato-ovales abdominique appressi. Longit. circit. 2 mm.

(b) Terminal segment of fifth foot with two rather long setæ.

* External and internal caudal setæ not extremely short.

Sp. 14. *Cyclops oithonoides*, Sars.

(Plate S. Figs. 2-6.)

? *C. hyalinus*, REHBERG.

? *C. tenuissimus*, HERRICK.

This most interesting species occurs under peculiar circumstances. It is perhaps the rarest member of the genus and seems, beyond a doubt, nocturnal in its habits. It was first found by Sars in saline water and named, on account of its slender form, from the marine *Oithona*. A similar species which, though about half as large, is hardly distinct, was found by Rehberg near Bremen. Rehberg mentions particularly that it was found oftener at night than during the day. In America a similar species was described from near Paducah, Ky., under the name *C. tenuissimus*; but the possibility of identity with the Scandinavian species seemed excluded by the habitat. A gathering taken at night from one of the lakes near Minneapolis contained a few specimens of similar characters, and there no longer seems to be a doubt of the identity or very close relation between these forms.

The antennæ are longer than described for *C. tenuissimus*, nearly equalling the thorax. The last joint of the antennæ is short, but the toothed character was not noted. The fifth feet are small, the spines are very long and slender. The margins of the abdominal segments are irregularly toothed. The species will be confused with no other. It is marked with blue in spots. Length 0.5-1. mm.

Sp. 15. *Cyclops simplex*, Poggenpol.

Cyclops Leeuwenhoekii, ПОЕК (fide Rehberg).

This species is of more compact form than the last, which it resembles in the form of the caudal stylets and the fifth foot. The antennæ are nearly as long as the thorax, the last two joints being elongate and having a knife-like ridge which has at the end teeth like those figured in *C. tenuissimus*. Length 1.-2. mm.

** The two median setæ much longer than the external.

The species of this section are the most perplexing of the genus. The best that I can now do is to indicate the relations of the nominal species and express the conviction that most are of varietal value simply.

Sp. 16. *Cyclops pulchellus*, Koch.

C. bicuspidatus, CLAUS.

† Terminal joint of outer ramus of feet with two spines outwardly.

16 a. *C. thomasi*, Forbes.

16 b. *C. navus*, Herrick.

†† With three spines.

16 c. *C. bisetosus*, Rehberg.

= *C. bicuspidatus*, Sars.

= (?) *C. insectus*, Forbes.

There are at least three well marked varieties in America, which may probably rank as species and have been ranked as such by Forbes. I give verbatim Forbes' description.

(16a) *Cyclops thomasi*, Forbes.

(Plate U. Figs. 4, 5, 7 and 8.)

"Elongate, slender, broadest in front and tapering backward, antennæ 17-jointed, reaching the middle of the third segment.

The first abdominal segment in the female is broad in front and slightly emarginate on each side before the anterior angles, and the last segment has a terminal circlet of small spines. The rami of the furca are more than half as long as the abdomen, and each bears two short rows of transverse spinules outside, one at the anterior the other at the posterior third. With the latter a spine occurs about as long as the outer terminal seta. The inner seta at the tip of the ramus is about half the length of the furca, the outer still shorter. The inner median seta is as long as the abdomen and furca, and the outer about half as long.

In the outer ramus of the first pair of legs the terminal joint has one spine and two setæ at the tip, one spine on the outer margin and two setæ within.

In the second, third and fourth pairs the last joint has one spine and one seta at tip, two spines externally and two setæ within. The inner rami of the second and third pairs terminate in one spine and one seta, that of the fourth pair in two spines, the inner of which is only half as long as the other.

The legs of the fifth pair are two-jointed, with the basal joint

quadrate, broad, and bearing one long spine. The second joint is narrow and longer, parallel and truncate, with one terminal spine about equal to the preceding, and one about half that length.

From *C. bicuspidatus*, Claus, this species may be distinguished by the armature of the outer ramus of the first pair of legs, and from *C. bisetosus*, Rehberg, by the armature of the outer rami of the other legs.

It shares with *Diaptomus sicilis* the responsibility of affording to the young white-fish their earliest food."

(16 c) **Cyclops insectus**, Forbes.

(Plate U. Fig. 9.)

"Closely allied to the preceding, but more robust in all its parts, and with the second cephalothoracic segment widest. The abdominal segments are all bordered with spinules posteriorly. The two median caudal setæ are much more nearly equal than in *thomasi*, the outer and the inner are very short, but longer than in that species. The inner in our specimens is longer than the outer—the reverse being the case in *bicuspidatus* as described by Claus.

"The legs are armed nearly as in *thomasi*, but the last joint of the outer ramus of the first pair has two spines externally besides the one at the tip, and the terminal spines on the last segment of the inner ramus of the fourth pair of legs are about equal."

Both forms probably occur in Minnesota, though the second has been seen but once, and the identification lacks confirmation. The differences between the two are almost exactly those prevailing between *C. bicuspidatus* (= *pulchellus*) and *C. bisetosus*, Reh., if I correctly understand Sars. Claus' description does not agree with that of Sars. Further study of the European types will be necessary before a satisfactory settlement can be reached.

(16 b) **Cyclops navus**, Herrick.

Cyclops navus, HERRICK, Copepoda of Minnesota, p. 279.

This name, proposed at nearly the same time as *C. thomasi*, applies to a very closely related form which I can but regard as a variety of that species. It seems constant in its differential characters in given localities, but we are now familiar enough with the fact that changed conditions in the water occasion changes in forms in the copepods.

This form inhabits shallow pools. It is larger than *C. thomasi*,

minal three-spined division; caudal stylets twice as long as last abdominal segment; setæ all nearly terminal, inner one long. Length 2.5 mm.

Common in America, England, continental Europe, etc. *C. clausii*, Poggenpol, is known to me only from the citations of Rehberg and the translation given by Cragin, hence I can not judge authoritatively of its validity. Certain points in the translation are obviously erroneous, as where the larger branch of the fifth foot is spoken of. No distinctions sufficiently clear to enable us to separate it from *C. tenuicornis* can be gathered.

III.—FIFTH FOOT 3-JOINTED.

(See *Cyclops modestus*.)

Antennæ 16-jointed.

There are a few forms which, although they might more properly be ranked with the previous section, seem rarely or never to acquire more than sixteen joints.

Sp. 18. *Cyclops languidus*, Sars.

Thorax attenuated posteriorly, caudal stylets exceeding in length the two preceding segments, internal seta short, half as long as the outer, the inner of the median setæ as long as the abdomen. Both rami of the first foot and the inner of the second are two-jointed. Second joint of the fifth feet sub-linear, armed with a seta and a spine. The fact that some of the feet have two-jointed rami suggests a young stage of some other forms.

This species has not been seen in America.

Sp. 19. *Cyclops modestus*, Herrick.

(Plate R. Figs. 1—5.)

American Naturalist, 1883, p. 500 (May).

This small species, 1.0 mm. long, was first recognized in Cullman county, Alabama, but occurs also in our lakes. The color varies, but very characteristic is the peculiar shining or glaucous surface of the strongly arched thoracic shield and the evenly curved segments of the abdomen. The antennæ reach but little beyond the very long first segment; they are usually 16-jointed, but I have notes of a similar form in which the antennæ are 17-jointed. The feet are

all 3-jointed and are peculiar in their armature. The fifth foot is obscurely 3-jointed, the second joint bearing a short spine and the terminal joint two spines of varying length. The stylets are once and a half as long as the last segment and are peculiarly excavated for more than the lower third, from the point where the lateral spine is situated. The outer terminal seta is short, the others being sub-equal and also short. The opening of the spermatheca is elongated, oval. The antenna of the male is divisible into five regions, the third being formed by the thickening and coalescing of four or more segments.

Antennæ 14-jointed.

Sp. 20. *Cyclops insignis*, Claus.

The two forms here belonging might be considered atavic varieties of *Cyclops pulchellus*. Brady's figures and description of his *C. insignis* (= *C. lubbockii*) agree almost exactly with what Rehberg says of *Cyclops helgolandicus* (Abh. v. naturw. Vereine zu Bremen, vii. 1. pp. 62—64). Rehberg regards that species as an atavic sub-species or variety of *C. pulchellus*. With *C. insignis*, Claus, the case seems to be different. The occurrence of this species is not conditioned by marine influence. I found it abundant about Leipzig, Saxony. The differences between it and the *C. insignis* of Brady are, as the latter says, very slight. Figs. 11—14 of plate T are drawn from Leipzig specimens, from osmic acid preparations. The first foot, outer ramus, has three external spines on the distal segment, two setæ at the end, and three within; the inner ramus has one internal seta, a spine and a seta terminally, and three external setæ on the distal segment. The outer terminal segment of the fourth foot is like the first; the inner one has only two external setæ. The external setæ of the caudal stylets exceed half the length of the stylet and are pectinate. The fifth foot has a short basal joint armed with a single seta, the second joint being slender and armed with two unequal setæ. The gathering above mentioned, taken near Leipzig, Dec., 1881, contained scarcely a female among scores of males in various stages of development. This is so contrary to what is expected that, notwithstanding the apparently good characters on which the species is founded, an uncertainty exists in the mind of the writer as to the permanent adult characters of this species.

Antennæ 12-jointed.

I.—FIFTH FOOT 2-JOINTED.

A.—*Terminal segment of fifth foot with a seta and a small spine.*

Sp. 21. Cyclops capillatus, Sars.

“Cephalothorax sub-ovate; anteriorly uniformly rounded; segments projecting somewhat laterally, the last being scarcely wider than the first abdominal segment. Abdomen attenuated posteriorly; caudal rami almost as long as the last three abdominal segments, hardly divergent, the external and internal apical setæ short and nearly equal; the interior of the median setæ as long as the abdomen; lateral seta about in the middle of the stylet. Antennæ of the first pair robust, slightly exceeding the first segment of the body when reflexed, with the twelve joints densely covered with long and divergent hairs. The last joint of the outer rami of swimming feet are elongated and armed externally with three spines, internally with four setæ; the interior apical spine of the interior rami of the fourth pair of feet longer than the exterior. Feet of the fifth pair large, with a large and thick basal segment and a small oval second joint bearing one long seta and a short spine. Ova-sacs small, narrow and divergent. Eye very small. Length nearly 2 mm.”

Very close to *C. viridis* in many points. Found only in Scandinavia.

Sp. 22. Cyclops crassicaudis, Sars.

Cephalothorax elongate-ovate; segments produced laterally, especially the last, which extends into a somewhat procurved process. Abdomen short and thick, first segment somewhat excavated; caudal rami equalling the last two segments of the abdomen. External apical seta longer than the internal, both short; median setæ long. Antennæ of the first pair 12-jointed, scarcely longer than the first segment. Swimming feet short and thick, spines and setæ short; the interior apical spine of the last joint of the inner ramus of the fourth foot almost twice as long as the exterior spine. Terminal joint of the fifth foot small, armed with a spine and a seta; seta of the basal segment short. Ova-sacs oval, somewhat divergent. Length 0.75 mm.

Found only in Scandinavia.

one margin and bristled on the other; the next seta is as long as the abdomen, being somewhat exceeded by the following one; inner seta as long as the outer, but feeble; upper seta nearly as long, approximated; length less than 1 mm.

A well marked variety of the above occurs in America, which might rank as a species, were it not probable that it is simply a post-imago form occurring only under favoring circumstances. This variety has no connection with Brady's var. *montanus*.

***Cyclops serrulatus*, var. *elegans*. (Var. n.)**

Distinguished from the type by the greater size, and the elongation of antennæ and caudal stylets. We will first of all give the measurements which afford a criterion for judging of the form and proportions.

Total length 1.34 mm.; thorax 0.76 mm.; abdomen 0.40 mm.; stylets 0.18 mm.; greatest width 0.42 mm.; inner median caudal seta 0.60 mm.; outer median seta 0.36 mm.; inner seta 0.08 mm. The first segment of the thorax is long proportionally (0.40 mm.) The antennæ are very long, reaching to the base of the third segment (.68 mm.). The egg-sacs are elongate-oval, being more slender even than in typical *C. serrulatus*; in the animal measured they were 0.50 mm. long, by 0.19 mm. wide. The caudal stylets are slightly shorter than the last two segments of the abdomen. The antennules are very short, and each joint has its series of fine teeth. The free lower margins of the thorax are ornamented with series of prominences, while the last segment is extended into a blunt angle bearing long teeth. The last segment of the abdomen is spiny-margined and is ornamented with a double row of spines at the anus. The armature of the stylets as well as that of the feet is identical with that in typical *C. serrulatus*. The last two joints of the antennæ measure 0.1 mm. each, while the two previous measure unitedly 0.12 mm. The color is not opaque as in the smaller form usually. Brady's var. *montanus* has shorter stylets than the type, but seems nearest the small dark form found in peaty waters in America. *Cyclops pectinifer*, Cragin, has no distinctive points, it being typical *C. serrulatus*.

Sp. 25. *Cyclops macrurus*, Sars.

Cyclops macrurus, BRADY.

Closely allied with *C. serrulatus*. Cephalothorax ovate, rounded

anteriorly; last segment fringed at the angles with numerous fine hairs. Antennæ much shorter than in *C. serrulatus*, about as long as the first thoracic segment, otherwise similar. Abdomen attenuated, penultimate segment margined posteriorly with spine-like setæ, the other segments pectinated. Caudal stylets very long and slender, about equal in length to the three segments preceding, bearing a group of four to five spines on the outside near the end, otherwise unarmed. Length 1.3 mm.

Here is the natural place for *C. spinulosus*, of Claus, but there is strong reason to suspect the validity of the species so very imperfectly characterized.

Sp. 26. *Cyclops fluviatilis*, Herrick.

(Plate Q⁵. Figs. 1—9.)

Cyclops magnoctavus, CRAGIN.

This small species with twelve-jointed antennæ and conspicuous coloration is widely distributed through the Mississippi valley. The original description is appended.

"Body elongated; thorax very long; abdomen slender; stylets about as long or longer than last abdominal segment; setæ all very short, not [always] pectinate; lateral and dorsal setæ very small; outer one spine-like, short and stout; two median setæ short; inner one very small and inconspicuous; antennæ reaching nearly to the base of abdomen [or beyond]; formula $-\underset{\sim}{\sim}-\underset{\sim}{\sim}-\text{-----}$; the three joints following the six basal are much elongated, while the terminal ones are but moderately so, a character which is peculiar to this species; terminal segment slightly but evidently hinged and, together with pair preceding, somewhat curved; feet with the terminal spines strongly toothed; fifth foot very small, one-jointed, bearing three small setæ; operculum vulvæ heart-shaped; egg-sacs sub-quadrangular; eggs large; abdomen in the young much elongated. Color deep indigo. Length 0.7 mm."

The first foot has upon the last joint of outer ramus three external spines, two apical setæ and three internal setæ; the outer branch of fourth foot has three external spines, apically a spine and seta and internally four setæ.

Males of this species are slender, measuring about 0.75 mm.; the abdomen being 0.28 mm., stylets 0.6 mm., first thoracic segment 0.28 mm., and the longest caudal seta 0.24 mm. The antennæ are long and much modified so as to resemble superficially the antennæ of *Diaptomus*.

Antennæ 11-jointed.**Sp. 27. *Cyclops diaphanus*, Fischer.**

(Plate R. Fig. 12.)

? *Cyclops bicolor*, SARS.? *Cyclops minutus*, CLAUS, HELLER.

If not the young of other species, this is a widely distributed form, being known from Russia, Norway, continental Europe, Madeira, and America. The synonyms above given are upon the authority of Rehberg.

The following description applies to our American form found always in connection with *C. thomasi*, *C. parvus*, or *C. navus*.

Very small, measuring 0.81 mm., setæ not included. The thorax is .5 mm., the abdomen .31 mm., the stylets .06 mm., the longest caudal seta 0.4 mm., outer median seta .36 mm., the first thoracic segment 0.3 mm., and the egg-sacs sometimes 0.4 mm. The thorax is oval, the first segment being quite large, as in larval cyclops. The antennæ rarely reach the end of the first segment and are either 11-jointed or obscurely 12-jointed; their formula is $\text{---}\text{---}\text{---}\text{---}\text{---}\text{---}\text{---}\text{---}\text{---}\text{---}\text{---}\text{---}$. The first joint is very large.

The second antennæ are of rather small size; the maxillipeds are armed as in *C. navus*. The feet have usually but 2-jointed rami, but in large individuals some of the rami are obscurely 3-jointed. The first foot has the terminal joint of the outer ramus armed with three exterior spines, two terminal setæ and three interior setæ; the inner branch has one internal spine, a terminal spine and seta and three external setæ. The fourth foot has the terminal joint of the outer ramus with two external spines, a terminal spine and seta and four internal setæ; the inner ramus has one internal spine, two unequal spines and three internal setæ. There is also a series of teeth at the place where the middle joint should appear. The fifth foot consists of a broad, basal segment nearly fused with the abdomen and bearing laterally a long spine; the terminal segment is terete and small, having a single terminal spine. The caudal stylets are but little longer than the last abdominal segment, which bears teeth below; the sides are parallel, and the lateral seta is $\frac{2}{3}$ from base. The median setæ are long and toward the end show false jointing. The inner seta is longer than the outer which is, however, heavier. Eggs eight to twenty, in narrow elongate sacs. Not uncommon, everywhere.

Sp. 28. *Cyclops phaleratus*, Koch.

(Plate R. Figs. 6—10.)

(var. a.)

C. canthocarpoides, FISCHER, CLAUS, LUBBOCK, FRIC.*C. phaleratus*, KOCH, SARS, ULJANIN, BRADY, REHBERG.

(var. b.)

C. affinis, SARS.*C. pygmæus*, REHBERG.*C. adolescens*, HERRICK. (= *C. perarmatus*, CRAGIN.)? *C. lascivus*, FOGGENPOL.

That the two varieties here united are very closely allied must be admitted; that they are merely age forms is possible. Claus in figure 2 of his plate II (Freilebenden Copepoden) figures some other species than the one described as *C. canthocarpoides*, as can be gathered from the elongated stylets and the eight-jointed antennæ. Our Minnesota specimens combine the eleven-jointed antennæ of *C. affinis* with the short stylets and peculiar form of the fifth feet of the first mentioned. Rarely one is found with ten-jointed antennæ and at the same time sexually mature. The characteristic oblique lines of spines at the base of the stylets may be absent. Rehberg's figures of *C. pygmæus* agree very well with our species, but he has decided that it is not specifically distinct from *C. affinis*.

It appears to me undesirable to institute a new species for the American form, neither is it possible to sufficiently identify it with any of the above.

I here append a brief description of *Cyclops adolescens*, Herrick (= *C. perarmatus*, Cragin,) for comparison with the description of *C. affinis* as transcribed below. Thorax oval, broad, acute anteriorly; last segment large and separated by a constriction from the anterior ones. The head is beaked below; first throacic segment large and long (.36 mm.); last thoracic segment wide, united closely with the first abdominal segment, armed with series of teeth. Abdomen short, especially the last segment, which is toothed behind; stylets very short. The antennæ are much shorter than the first segment, eleven-jointed. The maxillipeds are very small. All the feet are armed with a row of very large teeth or lanceolate spines down one side; fifth foot one-jointed, with three spines, the outer being smooth, the others spiny; egg-sacs variable, narrow, appressed; eggs large, color usually dark. The animal moves like *Canthocamptus*, and is able to progress out of water better than other species. The following measurements will give an idea of the proportions: Length 1.26 mm.; thorax, 0.76

mm.; abdomen, 0.44 mm.; stylets, .06 mm.; longest seta, 0.34 mm.; antennæ, 0.28 mm.; width of thorax, 0.44 mm.

Cyclops affinis, Sars.

"Antecedenti [C. phalerato] simillimus. Corpus autem minus robustum colore caeruleo vel potius glauco sat saturato insigne. Segmentum ultimum thoracicum ad marginem posteriorem extrosam pilis vel spinulis subtilissimis peetenatim exornatum. Rami caudales quam in C. phalerato aliquanto longiores, setarum apicalium interna quam externa multo brevior, intermediarum interiore altera fere triplo longiore longitudinemque abdominis superante, in medio aculeata dein vero subtile ciliata. Antennæ 1-mi paris segmento 1-mo corporis multo breviores, tenues, articulis 11 compositæ. Pedes 5-ti paris distincti, uniaarticulati, setis 3, quarum interior ceteris multo major et ciliata, instructi. Sacculi oviferi parvi abdomini appressi. Longit. circit. $\frac{1}{4}$ mm."

Cyclops ornatus, Poggenpol (= *C. clausii*, Heller, fide Rehberg,) is almost certainly, in our judgment, a young or atavistic condition.

C. helleri, Brady, though not identical, is no more worthy a specific name. If every form with eleven-jointed antennæ and egg-sacs be worthy a distinct name, it will be possible to duplicate all the seventeen-jointed forms. Fortunately, however, many species agree together in this condition, so that the number of spurious species derived from this source is rather small; among these is to be reckoned *C. nanus*, Sars, which is obviously very near the pulchellus group.

Antennæ 10-jointed.

No valid species have permanently 10-jointed antennæ. *C. phaleratus* is frequently found with 10-jointed antennæ. *C. kaufmanni* is without much doubt an immature form.

Antennæ 8-jointed.

Sp. 29. *Cyclops fimbriatus*, Fischer (fide Rehberg.)

(Plate R. Fig. 11.)

C. crassicornis, Sars, Brady, Herrick.

C. greideri, Heller.

C. pauper, Fric.

C. poppei, Rehberg.

(? *C. magniceps*, Lilljeborg.)

Our American species corresponds to that described by Rehberg as a new species. The differences mentioned in the previous report (see Cyclopidae of Minnesota, p. 233) are just those which have led Rehberg to establish the *C. poppei*, which, by the way, was

found with the type. I see no reason, especially in view of the latter fact, to regard it as even a well marked variety.

C. crassicornis is widely distributed in America as well as Europe, but is never very common. The color is always reddish.

Antennæ 6-jointed.

Sp. 30. *Cyclops æquoreus*, Fischer.

A brackish-water species, .85 mm. long, which in a number of characters departs from the type of the genus. Those who have the opportunity to search the brackish pools along our coast would do science a service by looking for this interesting species.

NOTE.—*Cyclops navicularis*, Say, is perhaps *C. viridis* of this report. *C. setosus*, Haldeman, (Phila. Acad. Sci., Vol. VIII, p. 331) is referred in my notes to *C. serrulatus*, I do not now know with how much reason.

The reader is referred also to *Cyclops latissimus*, Poggenpoel, as quoted by Cragin which, although belonging to the section having seventeen-jointed antennæ, and having feet like *C. tenuicornis*, is said to have a disc-like body, long-jointed antennules with no armature, and the basal joint of the abdomen very long.

Cyclops ornatus is quoted by Cragin, but we are left in doubt as to the number of segments in the antennæ, a point quite essential to the definition of species.

(See under *C. phaleratus*.)

Cyclops longicaudatus and *C. igneus* are thought to be simply prematurely gravid young of known species.

(See Cragin, l. c., (pp. 12—13.)

Cyclops fisheri of the same author agrees with *C. æquoreus* in having six-jointed antennæ, but in nothing else apparently. It is, if correctly described, a very remarkable form, with no setæ on the antennæ.

FAMILY HARPACTICIDÆ.

Numerically the largest of the families of the Copepoda, this group contains predominately marine and mostly minute animals, frequently of strange and grotesque form. A few of the marine forms, inhabiting the gulf of Mexico, are figured in the report of the Minnesota Academy of Sciences for 1881. Of the over thirty genera of the family less than a half dozen are not exclusively marine, and of these most are brackish-water residents. The genus *Bradya* contains blind copepods living in slime.

The name was proposed by Dana, but was dropped in the final report. Again revived by Claus, it is now in use by the best authors. The general form and structure closely resembles that of the Cyclopidæ. The following characters are the more important ones in distinguishing the family from the other families of the order:

Body flattened or sub-cylindrical. Abdomen usually not much smaller than the thorax, from which it is not separated by a sudden constriction; antennæ rather short, 4- to 10-jointed; mandibles strongly toothed, palpate; maxillæ well developed, palpate; first pair of maxillipedes with strong teeth at the end, second pair usually forming a claw. The first pair of feet are often turned forward or prehensile; fifth pair one- or two-jointed, serving as egg supports in the female.

Most species live among sub-aquatic vegetation.

THE SUB-FAMILY CANTHOCAMPTINÆ,

to which our sole genus belongs, is further distinguished from the other sub-families of Harpacticidæ by the fact that the second maxilliped has a prehensile hook. The feet of first pair are not clawed, but have the inner branch elongated, and the palp of the mandible is one-branched.

GENUS CANTHOCAMPTUS, Westwood.

These little animals may be secured in considerable numbers by gathering a supply of water from among weeds in shallow ponds, and permitting the debris to settle in a spot where light only touches the jar from one side, when the *Canthocampti* congregate on the exposed side.

Canthocamptus is an elongated animal, with the body divided rather obscurely into two portions, of which the first, or anterior portion, is largest. This part of the body has five segments, each of which has at least one pair of appendages. The first, consisting of the head proper with one of the somites of the body or thorax, as is discovered by observing that a pair of legs is attached to it, is the largest segment of the body.

As seen from above, it is triangular and extends in front into a short, stout beak or snout, like the rostrum of a cray-fish. Above the beak, in the center of the forehead, is the eye, consisting of pigment and two lenses, showing that we really have to do with two eyes confluent on the median line. This is the simplest form of a compound eye. The same method of compounding the eyes is exhibited in a more complicated manner by *Daphnia* and other Cladocera. On either side of the beak springs an antenna with six to nine joints of unequal size. The first three joints are profusely

covered with hairs. The fourth joint is more slender than the preceding, and terminates in a process below, which bears besides a long hair a peculiar blunt bristle, that serves some unknown purpose—probably being sensory in function like the similar hairs on the antennæ of some Cladocerae. The next joint is shorter than the rest, while the remaining three are spined at definite points. The antennæ of the male are curiously altered, or *geniculate*, on both sides, as in Cyclops. The three basal joints are shortened, while more or fewer of the following ones are coalescent, followed by a hinge joint and two elongated segments.

The second antennæ or antennules are two-jointed, and the basal joint has a two-jointed branch or palp; the terminal joint is covered with spines; at the end are longer and curved spines, jointed in the middle.

The mandible is a flattened plate with digitate teeth at the end, on one side of which springs a two-jointed palp, and from the other a blunt process. The maxilla is somewhat like it, but has rudiments of other elements.

The first pair of feet have two three-jointed rami. The outer ramus is shorter and with the longer branch is directed forward. The fourth foot has the inner branch two-jointed. The inner branch of the third foot of the male is peculiarly modified to form a prehensile organ, as it is this foot which fastens the spermatophore to the female. The fifth feet are composed of two flat plates.

The second division of the body, the abdomen, consists of five segments, of which, however, the first two are united in the female. The last segment of the abdomen bears two stylets, which are sometimes considered as together constituting an additional segment. Each of these stylets has, with several small spines, two elongated caudal setæ, one of which is usually as long or longer than the entire abdomen. The stylets are usually considerably longer than wide, but the proportions vary somewhat in different species.

Viscera. The body cavity is traversed by the alimentary canal, which is a straight tube with no lateral cæca or blind sacs, as in some other Copepoda. The canal is divided into four more or less distinct portions; the first section is a slender, muscular tube, extending from the mandibles nearly through the first segment, opening into the stomach proper, which is a muscular and glandular sac or tube, filling the greater part of the thorax; at the beginning of the abdomen, the sac is constricted and becomes the intestine proper; near the extremity again there is another change and the intestine loses its glandular character, and, by a peculiar

adaptation becomes a sort of force-pump, which, during life, is constantly pumping water in and out, serving as a means of respiration. This anal respiration is quite common among aquatic animals in this as well as other orders. This latter section of the canal is the rectum, and opens beneath a toothed anal plate, above and between the stylets. No special divarications or cæca are appended to the digestive tract, and the only other organ which is at all considered to belong to the alimentary system, is what is known as the "shell-gland," present in most crustacea, but till recently thought to be absent in *Canthocamptus*. It is a coiled tube found in the lower part of the first segment of the thorax. It is impossible to find this organ in *Canthocamptus*, in every case, it being very obscure; and its office is uncertain, though it is supposed, perhaps with little reason, to be hepatic in function.

There is no functional heart in this animal, but its place is taken by a peculiar apparatus, hitherto undescribed; this consists of a tube, surrounding the posterior portion of the alimentary canal. This sac around a sac is open in front, and serves by a double mechanism the office of a pulsating heart, though in a very imperfect manner.

There are no true hæmatic or lymph corpuscles in this animal; so far, at least, none have been discovered. The place of these blood corpuscles is taken by globules of yellowish or red color of the most diverse size. These nutritive globules, or fat globules, as they have been called, are undoubtedly reservoirs of nutriment in a shape convenient for the animal's use, and equally certainly are derived from the contents of the intestine. In those Copepoda which have a functional heart, it is open anteriorly into a general body-cavity in the same way as in this animal. That a portion of the vascular system should surround the alimentary canal, is no unexampled thing, for in *Daphnia* a large sinus embraces a portion of the canal. The same provision as this described in *Canthocamptus* occurs in the Cyclopidæ. The nutritive globules are often very large, and are frequently extremely abundant, especially in females soon to become gravid. Three-hundredths mm. is not a large measurement for the diameter of such drops.

The nervous system is very hard to trace, consisting of a large pear-shaped ganglion just below the eye, from which extend commissures around the œsophagus, connecting them with the ventral ganglia lying between the bases of the feet. The senses are not apparently well developed, for, excepting the eyes, we cannot locate with certainty the organs of any sense. There are,

however, two spots which are evidently devoted to special sense: first, the processes on the fourth joint of the antennæ, which may be simply the seats of tactile sense, or may have nerves suitable for perceiving chemical stimuli; second, the area on the forehead bordered by a raised line and covered with little pits, each with a small bristle. The character of this organ can be but conjectured; it may be homologized with the frontal nervous organs of the Cladocera.

The sexual organs are quite extensively developed, and periodically obscure the remaining viscera. In the male the simple testis is situated in the second segment, and the single vas deferens after numerous windings through nearly the entire length of the body, opens at the base of the first abdominal segment under a spined plate. A part of the vas deferens is of a glandular character and secretes an elongate tube, the *spermatophore*, which serves to contain the spermatozoids, and is fastened by the male at the opening of the median pore of the female; on contact with the water this tube, which is at first soft, contracts and presses the contents into the opening of the female organs. So long is the vas deferens that as many as three spermatophores are sometimes seen in the body at once. The spermatozoids are very small. The geniculated male antennæ are used in grasping the setæ on the tail of the female, and the curiously modified inner branch of the third foot of the male may assist in fastening the spermatophore upon her body. The ovary occupies the same position as the testes, and the two ducts are coiled in the body from end to end, opening in the median pore behind the fifth pair of feet. When the eggs are ready to be laid, they are forced out, carrying with them a film of the secretion of the lower, glandular portion of the ducts, which is of a collodion-like consistency, and which forms the enclosing sac. The young become fully developed sexually before they assume their final form, and it is not unusual to find ova-bearing females which are not only much smaller than the parent, but with considerable differences in the various organs.

This sort of heterogenesis is not uncommon among lower crustacea, for the young may differ much from the mother till after they have themselves produced young.

Four species have been recognized in America, of which one is certainly identical with a widely distributed European form, and a second is probably identical with an English species. *C. palustris*, Brady, seems to depart considerably from the norm of the genus and may prove a type of a marine genus. No true *Canthocamptus* is more than accidentally marine.

The ten species below enumerated are all that have fallen under the author's notice, though others may have been mentioned.

KEY TO THE GENUS *CANTHOCAMPTUS*,

Inner ramus of 4th foot:	2-jointed.	In. ram. of 1st foot	2-jointed.	1 mm. long; basal joint of 5th foot small..... <i>C. gracilis</i> , Sars.	
				0.5 mm. long; basal joint of 5th foot long. <i>C. brevipes</i> , Sars (?).	
			3-jointed.	Inner ramus of 2d foot 2-jointed.	Antennæ thick <i>C. crassus</i> , Sars.
					Antennæ slender. { <i>C. trispinosus</i> , ¹ Brady. <i>C. northumbriticus</i> , Brady.
3-jointed.	Inner ramus of 2d foot 3-jointed.	Stylets rather long. <i>C. minutus</i> , Mueller.			
		Styl. short, oval, <i>C. illinoensis</i> , Forbes			
3-jointed.	3-jointed.	Male antenna normal	<i>C. hibernicus</i> , Brady.		
		Male antenna reduced, hooked at the end	<i>C. ? palustris</i> , Brady.		

Canthocamptus elegantulus, *C. mareoticus* and *C. horridus* are uncertain, probably referred to the wrong genus. *C. stromii*, Baird (= *Dactylopus stromii*), *C. rostratus*, Claus (= *Stenhelia ima*), *C. virescens*, *C. linearis*, and *C. roseus* of Dana, are marine Harpacticidæ of uncertain affinities. *C. minutus* of Claus is not sufficiently described, but appears to be the earlier condition of *C. minutus*, Mueller (*C. staphynalis*, Jurine).

Sp. 1. *Canthocamptus gracilis*, Sars,

Is elongated linear, with the abdominal segments smooth. Caudal stylets long and slender; external caudal seta about one-fourth the inner. All the feet with two-jointed inner rami; outer branch of fourth foot longer than the others, inflexed; basal process of fifth foot slightly expanded. Length 1 mm.

At Decatur, Alabama, was found a species of *Canthocamptus* which is different from any American species, and seems in many points nearest the above but, unfortunately, only a hasty sketch could be made at the time, and the notes are insufficient to define it. The form is not remarkably slender; the first and second abdominal segments are very large. The caudal stylets are slender and elongated, the inner seta being very long and curved, while the outer is quite short. The anal plate is covered with hairs only. The antennæ are normal, of moderate length, and the fifth foot has but a narrow process at the base.

¹ Distinguished from the following by the presence of only three spines on the process of the basal joint of the fifth foot.

If this form be worthy a distinctive name, it may be called

Sp. 2. *Canthocamptus tenuicaudis.* (Sp. n.)

(Plate O. Figs. 15 and 16.)

? Sp. 3. *Canthocamptus brevipes*, Sars.

This small form is almost certainly the young stage of some other species; yet I transcribe the description.

"Corporis forma et magnitudine *C. pygmæo* non dissimilis. Segmenta abdominalia vero postice magis attenuata seriebusque aculeorum destituta. Rami caudales elongati duplo longiores quam latiores, setis apicalibus brevisculis parumque divergentibus, exteriori dimidiam longitudinem interioris non attingente. Operculum anale absque dentibus. Antennæ 1-mi paris breves, articulis ultimis duobus in unum confluentibus articulum. Pedes natatorii brevissimi, ramo exteriori intus setis destituto, interiore biarticulato in pedibus 1-mi paris longitudinem exterioris æquante, in sequentibus multo brevior. Pedum 5-ti paris articulus basalis intus in processum foliiformem, sat magnum et angustatum, articulum ultimum elongato-ovatum aliquanto superantem, exit. Color albidus. Longit. parum supra $\frac{1}{2}$ mm."

Sp. 4. *Canthocamptus crassus*, Sars.

Robust; segments margined with pectinate bristles. Caudal stylets oval, contorted, constricted at the base. Antennæ thick, densely covered with long setæ. Fifth feet with long setæ; basal process rather small. All the feet excepting the first, with bi-articulate inner rami. Length 0.75 mm.

Sp. 5. *Canthocamptus trispinosus*, Brady.

(Plate O. Figs. 6—14.)

This species with the last and next has all the feet save the first with bi-articulate inner rami. Very near the next, from which it differs in the form of the fifth foot of the female, which has the basal process smaller, bearing only three spines, while the next has six, the second joint being longer and narrow. The male is unknown. Not yet identified in America.

Sp. 6. *Canthocamptus northumbricus*, Brady.

Body robust; antennæ long as first segment, nine-jointed; mandibular palp minute. In the male the inner branch of the third foot is three-jointed and dactylate, as in *C. minutus*.

Canthocamptus northumbrius, var. americanus. (Var. n.)

(Plate O. Figs. 6—14, 20—22.)

One of our most common species is very near the English form, so near, in fact, that I dislike to remove it from it. A few points of divergence, however, may be mentioned.

The form and proportions are much like those of *C. minutus*. The head is large and ends in a prominent bent beak. The antennæ are rather long and slender and have a well marked flagellum. (Brady figures no flagellum). The palp of the antennule is as in *C. minutus*. The mandibular palp is small. The first pair of feet normal, rather small; all the other swimming feet with two-jointed inner rami, save in the case of the male third foot. The fifth feet are exactly as figured by Brady, save that there is a prominence or tooth of the basal segment near the point of attachment of the terminal joint which is quite long. The sensory area of the head is oval and pointed. The male antenna has a long flagellum, not, as figured by Brady, a very short one. The egg-sac is very large, oblong. The animal seems to fall short of the size of the English species, though measuring upwards of 0.65 mm. Our form is very well distinguished from any other species. It is found in lake Minnetonka, lake Calhoun, and elsewhere.

Sp. 7. Canthocamptus minutus, Mueller.*Monoculus staphylinus*, JURINE.*Canthocamptus minutus*, LILLJEBORG, BAIRD, SARS, ULJANIN, BRADY, HERRICK.*Canthocamptus staphylinus*, CLAUS, FRIC.*Canthocamptus minutus, var. occidentalis*, HERRICK.

A well known species which has been frequently described and seems quite circumpolar in its distribution.

First mentioned from America in a paper by the writer in 1878. A pretty full description will also be found in the author's *Types of Animal Life*. A very abundant species, frequent in muddy pools, but somewhat variable in abundance. It may frequently be found in great numbers in winter.

Sp. 8. Canthocamptus illinoisensis, Forbes.

(Plate O. Figs. 1—5.)

This robust and pretty species was first taken near Minneapolis, by Mr. A. W. Jones, a student of the University, who found it in a peaty ditch. Forbes' description is appended.

"Length 1 mm. Head and first segment united; five abdominal

segments in male, four in female. The suture between the first and second segments is not wholly obliterated above in the female.

Last abdominal segment is deeply and acutely emarginate. Branches of *furca* as wide as long, inner bristle plumose, a little longer than abdomen; outer plumose only on outer side, about half the length of the inner. The second to fifth *abdominal segments* have each a row of spinules along ventral portion of posterior.

Male with *anterior antennæ* composed of seven joints, the fourth joint very short. The front outer angle of the third is produced, the blunt process bearing three long bristles surrounding a slender olfactory club which is as long as the three following joints. The penultimate joint bears a strong spine or slender appressed process at the middle of its posterior margin. The five outer joints constitute the grasping organ. The *posterior antennæ* bear five long bristles at tip, three of which are made prehensile by the occurrence of from eight to twelve short articulations in the middle of the hair, allowing it to be bent forward. At the base of these articulations on the outer bristle, are two short spinules. Two nearly longitudinal rows of five or six strong, short spines each appear on the under surface of the outer joint of the antennule. The secondary flagellum, borne as usual on the middle of the basal joint, is not articulated, and bears four long bristles, two terminal and two on distal half of inner side. The outline of the *mandible* is exactly like that figured by Claus, but it bears about ten teeth, the upper thick and blunt, the inner sharp, slender and longer. Several are notched at tip. The lower angle bears a long simple bristle. *Mandibular palpus* two-jointed, second joint with three long terminal hairs and a shorter spine attached at basal third of anterior margin, jointed at base and directed towards tip, like a dactyl. The *maxilla* and *maxillary palpus* are scarcely to be distinguished from those of *C. staphylinus*.

The first maxillipeds are three-lobed, the outer lobe constituting a long, strong claw. The second and third are about one-third as long as the first, and bear each one strong simple spine and one weak branched hair. The inner lobe is widest, about two-thirds as wide as long. The dactyl of the *posterior maxilliped* is spinous on its inner edge, and the same edge of the hand is ciliate and bears a short, stout, sparingly plumose bristle at its base, just beyond the tip of the closed dactyl. The width of this joint (the second) is nearly half its length.

Basal joint of inner ramus of *first pair of legs* nearly or quite as long as outer ramus, the second wider but only half as long as the

third, and obliquely truncate. Inner ramus of *third pair of legs* in male is three-jointed, [the outer two-jointed,]* chelate. The finger is ovate, truncate, terminating in two long plumose hairs. The dactyl is linear, curved at base, and twice as long as finger. The inner ramus of the *fourth pair of legs* is about half as long as outer, two-jointed, basal joint short, terminal joint about as long as middle joint of outer ramus. The *fifth pair of legs* is best developed in the female. In the male the length is not over one-third the width. The basal portion bears three plumose hairs on its very broadly rounded anterior margin, of which the innermost is longest. The outer plate is nearly orbicular and bears five spines on its terminal margin, of which the second from the internal angle is the longest. *Genital plates*, found in male at posterior border of first abdominal segment, beneath, are short, slightly expanded internally, with internal angles rounded, and externally bear three sub-equal bristles, jointed at base, the inner largest and strongest and semi-plumose. The *antennæ* of the female are eight-jointed, extending backward to the first free segment. The basal joint of the *fifth pair of legs* is sub-elliptical in outline, with the basal half produced externally into a broad, triangular process which bears the second joint on its posterior margin. The free end of the basal joint bears six large plumose bristles of which the inner is longest. The greatest width of the joint is nearly equal to its greatest length. The second or outer joint is ovate, sub-truncate, spined on each margin, and bears four plumose bristles at tip and one at the middle of its outer margin. Its length is about twice its breadth."

Sp. 9. *Canthocauptus hibernicus*, Brady.

A small species differing from all others save the next in having a three-jointed inner ramus of the fourth foot.

"Anterior antennæ of the female slender, 8-jointed, about as long as the first body segment, and much like that of *C. minutus*. Inner branch of the second antenna very small, 1-jointed. Posterior foot-jaw having a broad hand armed with a long apical claw. Inner branch of the first pair of feet scarcely twice as long as the outer; first joint longer than the entire outer branch, and nearly twice as long as the united second and third joints, both of which are extremely small. Inner branches of the second, third and fourth pairs shorter than the outer, and 3-jointed, the first joint

* Evidently a misprint, for it is the inner ramus which is chelate.

being very small. Inner segment of the basal joint of the fifth pair of feet in the *female* elongated, fringed, bearing two long and three short apical setæ; second or outer joint sub-ovate, finely fringed internally; externally bearing six long marginal setæ. In the *male* the limb is smaller, the basal joint short, broad and having six short setæ of equal length; second joint nearly like that of the female. Caudal segments somewhat longer than broad; inner seta about twice as long as the outer; anal operculum denticulate. Length .65 mm." Not found in America.

Sp. 10. *Canthocamptus palustris*, Brady.

(Plate K. Fig. 5.)

A brackish-water species about .9 mm. long, found in a number of places in the British Isles. The species presents several anomalies.

The antennæ of the female are 8-jointed; those of the male robust, the last joint forming a hook. The first four pairs of feet have both branches 3-jointed; the fifth pair in the *female* are 2-jointed, with a short and broad basal joint, the second joint being sub-ovate, bearing five long apical setæ; in the male the fifth pair is obsolete, being reduced to a minute setiferous lobe. Caudal segments short, bearing two principal setæ, the outer half as long as the inner.

Sp. 11. *Canthocamptus minnesotensis*. (Sp. n.)

(Plate T. Figs. 1—6.)

Since the manuscript of this genus was finished, a small species has been found which seems undoubtedly distinct from any of the above. A single pair were taken in a gathering from Bassett's creek containing *C. minutus* in abundance. Unfortunately the characters of the swimming feet are not certainly known, but they were apparently all three jointed save the last. The antennæ are very short and thick, 8-jointed, with a long flagellum; the antennules are of the usual form, and the mouth parts rather large. The first pair of feet have the two rami of nearly equal length. The form is moderately elongate. The caudal stylets are very short, quadrate in outline and well armed with spines. The fifth foot of the female has four long and two short spines on the inner lamina, and the terminal joint has five unequal spines. In the male the fifth foot has two spines on the lamina and six on the second joint,

one being a small bristle. The male antenna is of peculiar form. The teeth of the anal plate are large and emarginate (see fig. 4.)

The swimming feet are all armed with very strong spines, aside from the usual quota of spines at the end of each joint. Length .65 mm.

NOTE.—*C. frontinalis*, Rehberg. This author seems to have parted with his usual acumen in the remarks upon this species. After describing a *Canthocamptus* with the inner ramus of the first foot "reichlich doppelt so lang wie die beiden Grundglieder des Aussennasts," he draws a moral on the mutability of genera from the fact that Brady founded the genus *Attheyella* "auf grund der Eingliede des innenastes am flerten Fusspaare und einer derartigen Bildung des ersten Fusses, wie er bei *C. frontinalis* beschreiben ist." Brady says (Brit. Copepoda, p. 58): "inner branch of first pair of feet scarcely at all elongated, and either 2- or 3-jointed," etc. The distinctive characters being the 1- or 2-jointed 2d and 3d feet and the 1-jointed inner ramus of the fourth foot, it is doubtful if *C. frontinalis* is really new.

II. GENUS ATHEYELLA, Brady.

This genus, the diagnostic characters of which have been above indicated, contains three nominal species. It is quite difficult to say what differences exist between Sars' "*Canthocamptus*" *pygmaeus* and *Attheyella spinosa*. Brady did not seem to recognize the fact that his diagnosis included that species. The third species is the blind *A. cyrptorum*, of Brady, which it is interesting to compare with the blind *Bradya limicola* of the coast of the gulf of Mexico.

PÆCILOSTOMATA.

This group, consisting of animals more or less like *Cyclops* in appearance, but, during part of their existence, semi-parasitic, has been very little studied in America. Most of the fresh-water species inhabit the gill-cavities of fishes. The gills of fishes should always be examined (if practicable, microscopically) for these interesting animals.

The mouth parts are greatly reduced and their homologies uncertain.

GENUS ERGASILUS, Nordmann.

Body shaped much as in *Cyclops*; anterior antennæ short; antennules in the female large, four-jointed, terminating in a strong claw. Mouth opening in the center of the very large head, which is not beaked in front. The mouth parts are inconspicuous, but the maxilliped is a stout organ terminating in a long claw. The three anterior pairs of feet are bi-ramose, and each ramus is three-

jointed; the outer ramus of the fourth foot is two-jointed; the fifth pair is absent or rudimentary. The abdomen is four or five-jointed, and the stylets are rather short. Ova-sacs two, large.

Ergasilus depressus, Sars.

(See Forhandlinger i Videnskabs-Selskabet, 1862.)

The form figured in plate S., fig. 1, is known from a gathering taken under the same circumstances as Sars' specimens, and consisted only of males. The animal is very transparent with deep blue markings below, especially between the bases of the feet. Sars thinks the males are always free, while the females early retire to the gill-cavities of fishes. This species may be distinct from the Norwegian form, but there is no reason for declaring that it is so.

E. depressus is probably the young of the widely distributed E. sieboldii.

NOTE.—As the systematic part of this work draws to a close, a note is received from Prof. Birge, who was so kind as to glance through advance sheets of the portion upon Cladocera. Prof. Birge informs me that his *Scapholeberis nasuta* is the same as S. (*Daphnia*) *aurita*, Fischer, as published in 1849 in the *Bull. Naturforsch. Gesellsch. in Moskau*, Bd. 22. This paper I have not seen. At Prof. Birge's suggestion, then, read on page 43.

Sp. 4. Scapholeberis aurita, Fischer.

Daphnia aurita, FISCHER.

Scapholeberis nasuta, BIRGE.

CHAPTER IV.

COLLECTING, PRESERVATION AND MISCELLANEOUS
NOTES.

The appliances employed in the capture and study of Entomostraca are, in the main, those employed by the student of aquatic vegetation. The first in order of importance is the hand-net and its accompaniment, long rubber boots, such as cover the entire leg being preferable. Thus equipped, the student can collect by far the greater number of fresh-water crustacea. The net is best made by obtaining an ordinary gaff or dipping net of extra strength but small size. If jointed, the ferrule must be unusually strong, not, indeed, because of the weight or activity of the prizes, but because it is often necessary to lift a net full of water, which is a greater strain than the strongest fish would produce in a net with open meshes. The ring of such a net is furnished with a medium-sized bag of some porous but still rather close fabric. The writer usually uses for this purpose the thinner variety of flour sacking. This material fulls a little when wet, and permits the water to pass rather too slowly, but this is a good fault. The net is used in shallow water and among weeds. After the net has been repeatedly filled and permitted to drain nearly empty, the bottom of the net is seized and the small remaining amount of water is thrown by a dexterous movement of the hand into a large-mouthed jar, several of which are needed. By this method the animals can be secured in any desired degree of concentration, so to speak, provided care is taken to avoid fouling the net with fine mud or debris. A single jar should usually contain only a gathering from a single locality. In case the collection is not to be examined at once, the gathering, which must now be quite free from admixture of mud and filth, is concentrated as much as possible,

and then poured into a thin filter-paper or a thin muslin bag. When nearly dry, the funnel is held over a small bottle, an opening is made in the apex of the filter, and the contents washed through with slightly dilute glycerine. Soon after pure glycerine is added so as to bring up the whole to the required degree of concentration. A sufficiency must be used to well cover up the whole. In case of haste the end of the filter containing the gathering may be torn off and placed at once in a bottle of glycerine or alcohol.

For the collection of Cypridæ it is recommended to use a very thin fine net, and gather as much as possible of the finely comminuted debris which settles in weedy pools. Spread this material in shallow pans and in an hour or so skim the surface with a small spoon-like hand-net, and transfer with the addition of clear water to shallow porcelain plates. Such gatherings may contain *Ilyocryptus*, *Monospilus*, the hook-nosed *Pleuroxids* (= *Percantha*) and, perhaps, also species of *Canthocamptus*.

The entomostraca of the larger lakes must be sought by a different method. A net of larger size, and composed of very thin material is drawn after a boat which is kept moving in different parts of the lake. Such a net should be so weighted as to receive water from the surface as well as from several inches below it. The net is emptied occasionally with plenty of water into large bottles, which may preferably be placed in the dark if to be unexamined for some time. Water kept in the dark will preserve its animal life for a much longer time than if exposed to the sunlight.

A similar net may be placed in a rapid stream in such a way that it remains partly full, but does not overflow. The accumulations of a day may be thus gathered into little space. The faucets of the city water will frequently afford a good supply of animal life, and unfortunately in Minneapolis a rather large number of forms are worms of a suspicious and unpleasant appearance. It must be observed that for this purpose the faucet must be well open so that a good current is secured, otherwise most of the impurities will be dropped on the way. A friend mentioned that very little life was found in the city water after long and careful experiment, during which, however, a very small stream was allowed to trickle through the complicated set of graduated screens. But the writer at the same time secured a rather large supply both of entomostraca and vegetable forms by simply permitting the water from the hydrant faucet to flow with full head through a muslin net.

But our methods are not yet exhausted. The dipping bottle

frequently brings up animals quite different from those collected by the towing net at the surface. This consists of a large bottle weighted by a suitable bit of lead or iron and fitted with a tight-fitting cork or wooden stopple. The stopple is attached to the line fastened at the neck of the bottle in such a way that a sudden twitch of the cord opens the bottle when it has sunk to the required depth. Another method, when one does not object to mingling forms from all depths, is to lower a net weighted with a heavy ring to the bottom, there agitating it slightly and drawing it vertically upward. This serves in a poor way in the place of a dredge and will secure a larger gathering than the dipping bottle, and is quite as easily rigged. The collections secured in either of the above ways are placed in large shallow porcelain plates and, the microscope being ready, the study may begin. With a rather large hand-magnifier, with which, however, the student will soon be able to dispense entirely, the various forms seen swimming or creeping or springing about are scanned, chiefly for the purpose of noting their motions. The little black, brown or yellow imps springing on the surface are rapidly skimmed off as hindrances, and (if the student is interested in the *Poduræ*) consigned to a bottle of spirits. Next a great *Belostoma*, *Corixa*, *Water-skater*, *Ranatra*, or *Dysticus* requires the same treatment. Perhaps a half dozen "whirligig-beetle" require more time to dispose of, and then a careful removal of the dragon-fly larvæ and "water-tigers" leaves the coast comparatively clear save for sand-fleas and dipterous larvæ which must be endured as necessary evils.

With a narrow slip of paper folded trough-wise the desired animal is captured by a quick movement and the water permitted to drain off, when the specimen is placed on the object-carrier, and a square cover glass, one corner of which has been armed with a bit of wax, is placed over the animal and then adjusted so as to give the requisite amount of pressure to quiet its restless motions. The slip of paper is, in every way, more convenient than a dipping tube and avoids flooding the object-carrier. With a half-inch objective and suitable eye-piece the whole animal is drawn in as natural a position as possible, either with the aid of a camera or free hand, by the assistance of careful measurements and a given scale. A one-fifth inch objective is now substituted and all possible details added. If any dissections are necessary, the cover glass may be removed, the slide placed upon a slip of black paper and the parts separated as far as possible by the aid of a watchmaker's glass or dissecting microscope.

Up to the present time almost the only reagent which could be employed for the instantaneous killing of Entomostraca with the body in its natural position and the preservation of the same was osmic acid, which partly on account of its expense, perhaps, seems rarely to find its way into our laboratories. And even this is but partially successful or causes such a dark color as to obscure what one most desires to see. The desideratum seems to have been supplied by the discovery of Prof. Hermann Fol that ferric perchloride produces not only an instantaneous death but a fixation of all the parts with very little coloration or shrinkage. The alcoholic solution is diluted to about 2 per cent. and applied to a small quantity of water in which the animal is swimming, or a more concentrate solution is added at once to the water of a vessel containing numerous Entomostraca. The water is poured off and the animals washed with alcohol of 70 per cent., to which a few drops of nitric acid may be added to remove the ferric salts. According to Fol, in transparent animals the appearance is very little changed by this process. Specimens thus prepared may be preserved in alcohol and afford preparations for making thin sections. They do not take color well, but may be stained with gallic acid without difficulty.

As a preservative, glycerine does admirably for Copepoda, but no known fluid works satisfactorily for the Cladocera unless after such treatment as above indicated. Sections may be made by imbedding in soap, but the tissues of the Cladocera are so delicate that the writer never succeeded in making permanent preparations of such sections. Either the alcohol or the balsam as it flows in almost inevitably disturbs the natural position. 50 grammes of soap are dissolved in 200 cu. cent. heated alcohol of 96 per cent. The soap should be shaved very thin. A shallow paper trough is prepared and filled with the still warm mixture, and the animal, which lies in concentrated alcohol, is transferred into the solution and agitated till its tissues are permeated with the soap. When cold, the bit of soap is cut into the required form and is ready to be placed in the microtome.

As a preservative medium for Copepoda, Carpenters' gelatine answers well. It consists of clarified gelatine, one ounce to six fluid dramchs of pure glycerine. The preparations mounted in this require no cement, as the gelatine is quite firm when cold.

APPENDIX.

The previous pages refer to the fresh-water crustacea simply and will give a tolerable idea of the variety exhibited in the fauna of the lakes and rivers of America. The majority of Copepoda are marine and the coasts of the United States will afford the student of marine entomostraca a rich harvest of curious forms. These animals are now being investigated, it is understood, by competent naturalists. In the meanwhile any notes may be of a temporary interest. The following jottings, which are the result of a few days stay on Mississippi sound, will give an idea of the fauna of the gulf of Mexico. They are extracted from a paper offered the Minnesota Academy of Natural Sciences.

FAMILY CALANIDÆ.

GENUS PSEUDO-DIAPTOMUS. (Gen. n.)

Resembling *Metrida* and *Diaptomus*; compactly framed; cephalothorax 6-jointed, last two segments coalescent above; head rounded in front, beaked; eye small; antennæ appearing 22-jointed in both sexes, longer than the thorax; the right male antennæ geniculate as in *Diaptomus*; antennules bi-ramose, both rami rather short, inner one seeming but two- or three-jointed; mandible ten-toothed; maxillipedes well developed; feet all bi-ramose save the last, both rami 3-jointed; first feet smaller; fifth feet with inner ramus obsolete, in the male nearly as in *Diaptomus*, in the female rather slender, simple, three-jointed; abdomen in the female 3-jointed, in the male 5-jointed; stylets in the female longer; ova-sac single; spermatophore pear-shaped.

This genus is of unusual interest on account of its close approach to the fresh-water section of the family.

The spermatophore in this genus is large and swollen and, as

seen through the body of the male, is liable to be mistaken for eggs.

Pseudo-diaptomus pelagicus. (Sp. n.)

Rather compact; thorax alike in the sexes, antennæ short, seeming 22-jointed; first foot small, both rami 3-jointed; fifth feet in the male with but small rudiments of the inner rami, basal portion heavily armed with short teeth, otherwise almost as in *Diaptomus*; fifth feet of female slender, alike; abdomen in male very slender, with short stylets armed with five terminal setæ and a series of bristles on the inner margins, distal margin of segments of abdomen toothed; a series of spines also ornaments the middle of the first segment below; abdomen of female short and very spiny, first joint thick, second slender, oblong, third joint short; length of abdomen supplemented by that of the elongated stylets, which are spinulous on their edges; ova-sac ovoid, eggs numerous; opening of operculum vulvæ with lateral projecting lips.

This species is ornamented with irregular markings of brownish color which give it a strange appearance not observed in any other copepod. The size is like *Temora velox*, which the female resembles a little, a resemblance enhanced by the elongated stylets. By some changes in the definitions of *Metrida* and *Pleuromma* these three genera could be united, but there would then be no valid excuse for not admitting *Diaptomus*, so that, on the whole, it may be well to let matters stand until we reach some better understanding of the natural generic affinities of these animals.

Habitat, Mississippi sound, gulf of Mexico.

GENUS DIAS, Lilljeborg.

Slender; cephalothorax very long, narrow in front; abdomen with five segments in the male, in the female with three; antennæ 20-jointed, nodose; secondary branch of antennules one-jointed, small; labrum large; posterior maxillipeds short; swimming feet with 2- and 3-jointed rami; fifth feet with a single ramus.

Dias longiremis, Lilljeborg ?

Unfortunately the gathering was insufficient to determine with certainty the identity of our species with the above, but the female agrees quite well; and those points in the young males seen

which could be compared with the descriptions of *D. longivemis* were sufficiently concordant. This species ranges, in the eastern hemisphere, from the North sea to the Mediterranean, and could be expected here. It is a very active animal and represents a well differentiated type.

GENUS TEMORA, Baird.

Elongate; thorax five-jointed, fourth and fifth segments closely combined; abdomen with four segments in the male, three in female; antennæ 24- or 25-jointed; right antenna of the male geniculate; mouth parts as in *Calanus*; inner branches of second, third and fourth pairs of feet two-jointed, of first one- or two-jointed; fifth feet with but one branch, prehensile in the male.

Temora affinis, Poppe.

= *T. gracilis*, HERRICK, MS.

The shallow bays and estuaries along the Gulf of Mexico swarm with a species of *Temora* but little unlike *T. velox*.

The body is much less compact, it being rather slender in both sexes; in like manner the caudal stylets are very much elongate, being nearly as long as in *T. longicornis* of Mueller, from which it is clearly distinguished by many obvious characters, and which seems to show an approach to *Metrida*.

The antennæ in male and female are just as in *T. velox*, and the fifth feet are little, if at all, dissimilar; the spine on the second joint in the female is not serrated, however, and the basal joint of the abdomen in this sex has three teeth on either side. The caudal stylets are about six times as long as broad in the female and densely spined, as is the last abdominal segment. The stylets are more slender in the male and have few spines, but the last abdominal segment has three larger spines on either side. Inner ramus of the first foot one-jointed. The animal is generally colorless, in autumn at least, but may be variously ornamented with prismatic colors, the most constant of which markings are a band about the stylets and across the thorax and between the bases of the feet. The ova are very numerous and carried as in *Diaptomus*. This species is littoral in habitat and ranges from salt-water bays to the fresh waters of rivers, along with several varieties of *Cyclops*, *Sida*, etc.

FAMILY HARPACTICIDÆ.

GENUS AMYONE, Claus.

Body much compressed; dorsal margin strongly curved; head very large, produced and angled below; antennæ 6- to 8-jointed; antennules palpate, 3-jointed; second maxillipeds long, chelate at the end; last thoracic and anterior abdominal segments enlarged; fifth feet leaf-like, large.

A very small crustacean, little over $\frac{1}{2}$ mm. long, occurs in the gulf of Mexico in shallow water among vegetation. Insufficient material prevented its complete study, but it is nearly allied to *A. spherica*, Claus, from which it differs in several particulars.

I can do no better than quote the remarks of Claus, the original discoverer of this peculiar genus.

"The body of this highly remarkable form, represents, in its general form, an intermediate stage between the nauplius (cyclops larvæ) and the mature copepods. The oval, almost spherical form, the slight development of the abdomen and the enlargement of the anterior thoracic segment recall the structure of the larva, while the almost complete segmentation of the body, the jointing of the antennæ and the swimming feet, as well as development of the reproductive organs, make the maturity of the creature certain." (Beitr. zur Kenntniss der Entomostraken.)

GENUS LAOPHONTE, Philippi.

Rather slender; antennæ 4-, 8-jointed; palp of antennules 1-jointed; mandibular palp 1- or 2-jointed; maxillæ palpate; first pair of feet slender, outer branch short, 3-jointed, inner branch elongated, 2-jointed; three following pairs with one ramus 3-, the other 2-jointed.

Laophonte similis, Claus?

The small crustacean which is referred to the above species occurs sparingly in the brackish waters of Mobile bay, and with *Temora* seems to be the only entomostracean not also found in the fresh waters adjacent.

From the few specimens found it could not be certainly determined that our species is identical with the European. The differences are, however, such as might be expected in immature speci-

mens. Brady figures a similar reduction in the number of joints of the antennæ as that seen in our specimens. The fifth foot too, is less well armed with spines, but otherwise the agreement is tolerably close.

GENUS HARPACTICUS, Milne-Edwards.

Elongate or expanded laterally; head united with the first thoracic segment; first and second abdominal segments coalescent; antennæ 8-, 9-jointed; mandibular-palp 2-branched, large; second pair of maxillipeds strongly developed; outer ramus of the first pair of feet 2- or 3-jointed, inner ramus 2-jointed; first and second joints of outer ramus elongated, second joint of inner ramus short; both rami of following pairs of feet 3-jointed; ova-sac single.

Harpacticus chelifer, Mueller. (var. n. ?)

The species inhabiting the gulf of Mexico resembles *H. gracilis*, Claus, in the length of the setæ and some other peculiarities; but the antennary palp is more like *H. chelifer*, with which it closely agrees in most respects. Remembering that the entomostraca have their highest development in temperate and arctic regions, the small size and greater proportional length of setæ and stylets may be explained. *H. gracilis* from the Mediterranean takes the place of the true *H. chelifer* of the North sea, and is regarded by Brady as the same species. Our form would, in this case, stand more nearly related to the typical form. Both branches of the first feet are two-jointed and the antennary palp has three spines on its distal segment.

GENUS BRADYA, Boeck. (1872.)

Antennæ very short, 6-, 7-jointed; antennules of moderate size longer than antennæ, with a 2- or 3-jointed palp; mandibular palp large; maxillipeds rather large, outer branch (first foot-jaw of Brady?) much as in *Calanidæ*; first four pairs of feet nearly alike; fifth pair small, not lamellate.

This peculiar genus is not yet well circumscribed and defined, and it is much to be regretted that lack of time prevented from ascertaining how far the western species agrees with the generic characters of the European form and thus determining the validity of the assumed generic criteria. That our species is a member of the genus can not be doubted, but the hurried examination which could be devoted to it failed to cover the entire structure.

Bradya limicola. (Sp. n.)

Body flattened; free margins of the segments of the dorsal carapace rather long; little separation between abdomen and thorax; abdomen cylindrical, rather long; stylets short; distal margin of the segments spined; antennæ very short, 6- or 7-jointed, hardly longer than the movable beak; second antennæ much longer, 3-jointed; palp long, two-jointed; mandibles palpate, teeth fine, much as in Calanidæ; palp bi-ramose, second ramus very small; maxillæ of moderate size; maxillipeds large, outer one as in Calanidæ; first four pairs of feet bi-ramose, each ramus 3-jointed; fifth foot small, with two terminal digitate processes and a seta on either side. The male is at least a third smaller and has longer caudal stylets; the antennæ are modified, but very short. *The eyes are wanting in both sexes.* This very interesting species was collected in the brackish water of a ditch shaded by high sedges so that the sun could hardly penetrate. I did not find any representative of the genus in the open waters neighboring, but it is hardly to be doubted that such exist. This species is quite distinct from *Bradya typica* of north Europe.

The only other blind copepod with which I am familiar is *Attheyella*, which is circumstanced somewhat as the above.

The European *B. typica* is pelagic; ours dwells in darkened ditches and seems to furnish another illustration of the effects of seclusion upon the visual organs. Brady seems to have transposed the maxillipeds; these are really but branches of the same organ, as shown by the development, and the outer ramus is, probably, what Brady usually calls second foot-jaw but here first foot-jaw. In the characters of the mouth parts and fifth feet our species seems to show an affinity with the elongated higher copepoda.

Ocean Springs, Mississippi.

Caligus americanus, Dana and Pickering ?

A species of *Caligus* was collected at dusk far out in Mississippi sound in considerable numbers. The animals were floating in a bank of vegetation and swam freely. They seem not to differ greatly from the species described by Dana and Pickering in 1838 from the cod near New York. The fish lice are remarkable for their flattened bodies and the paired sucking organs on the head.

A species of *Corycæus* allied to *C. varius* of Dana was also collected.

NOTE.—Prof. Forbes, to whom advance sheets of the portion on Copepoda were sent, writes me that he somewhat questions the identity of the Minnesota species of *Diaptomus* referred to *D. leptopus* with the species for which that name was proposed. I do not know of any facts casting doubt upon the reference, but wish to call the reader's attention to the suggestion of Prof. Forbes.

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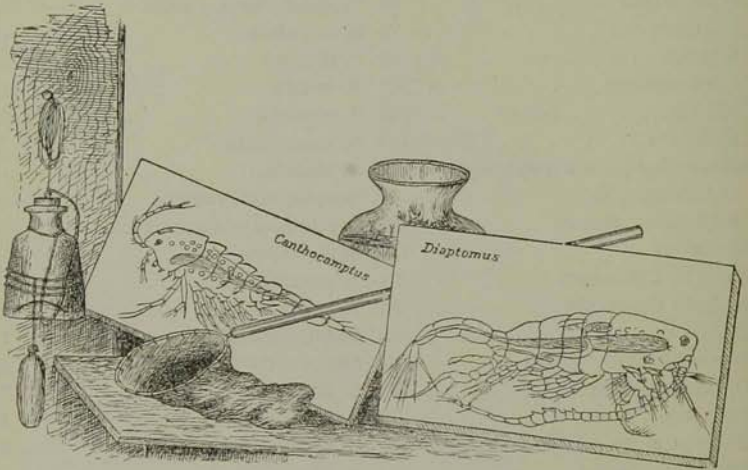
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PLATES OF PART V.

PLATE A.

- Fig. 1. abdomen of *Moina paradoxa*, female, from Minnesota.
Fig. 1a. spine from post-abdomen.
Fig. 2. post-abdomen of *Moina rectirostris*.
Fig. 3. head of *M. paradoxa*, female, showing (a) eye with pigment and lenses, (b) supra-cesophagal ganglion, antennule with (c) its muscle, (d) its nerve, and (e) its terminal sensory filaments, (f) the cæcum of stomach, (g) optic ganglion, (h) stomach; (i) œsophagus, (j) the muscles which move the eye, also part of the labrum.
Fig. 4. antennæ of same.
Fig. 5. ephippium of *M. rectirostris*.
Fig. 6. " of *M. paradoxa*.
Fig. 7. seminal cell of *M. paradoxa*; 7a, a group less magnified.
Fig. 8. seminal cells of *M. rectirostris*.
Fig. 9. first foot of male of *M. paradoxa*.
Fig. 10. " " " " " *M. rectirostris* (from Weismann).
Fig. 11. male *M. rectirostris* (from Weismann).
Fig. 12. head of *Ceriodaphnia rotunda*. (This and the following numbers after P. E. Mueller.)
Fig. 13. head of *C. punctata*.
Fig. 14. " *C. pulchella*.
Fig. 15. " *C. reticulata*.
Fig. 16. " *C. quadrangula*.
Fig. 17. " *C. quadrangula*.
Fig. 18. post-abdomen of *C. quadrangula*.
Fig. 19. " *C. pulchella*.
Fig. 20. " *C. megops*.
Fig. 21. " *C. reticulata*.
Fig. 22. " *C. laticaudata*.
Fig. 23. " *C. rotunda*.

MINNESOTA CRUSTACEA.

PLATE A.

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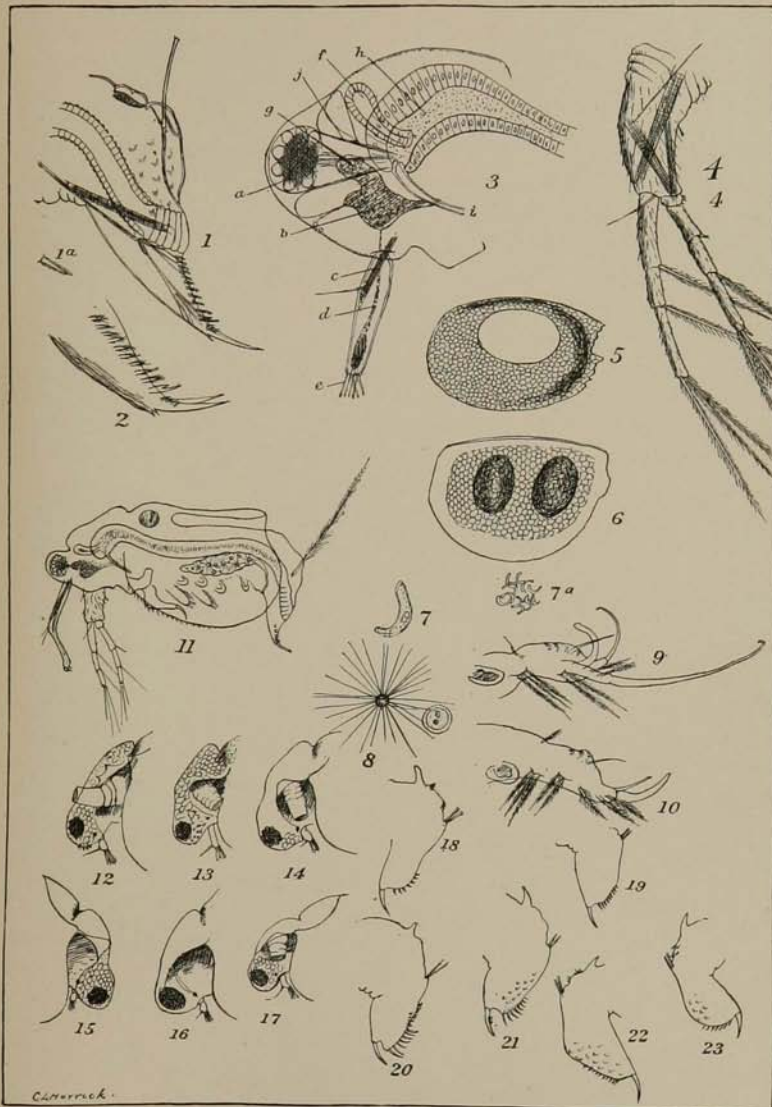


PLATE B.

- Fig. 1. *Ceriodaphnia rotunda*, male (after Kurz).
Fig. 2. *C. alabamensis*, female.
Fig. 3. *C. reticulata*, post-abdomen of male with opening of vas deferens (after Weismann).
Fig. 4. *C. consors* ? ?
Fig. 5. *C. scitula*, head of female.
Fig. 6. do., post-abdomen.
Fig. 7. do., antennule of male.
Fig. 8. do., semen cell of male.
Fig. 9. *Scapholeberis angulata*, adult female; 9a. first foot.
Fig. 10. *Scapholeberis armata*, "
Fig. 11. do., view from below.
Fig. 12. *Lyncodaphnia macrothroides*, young.
Fig. 13. do., labrum.
Fig. 14. do., antennule.
Fig. 15. do., last foot, purple pigment in lower part.

MINNESOTA CRUSTACEA.

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PLATE B.

Geol. & Nat. Hist. Sur. Minn.

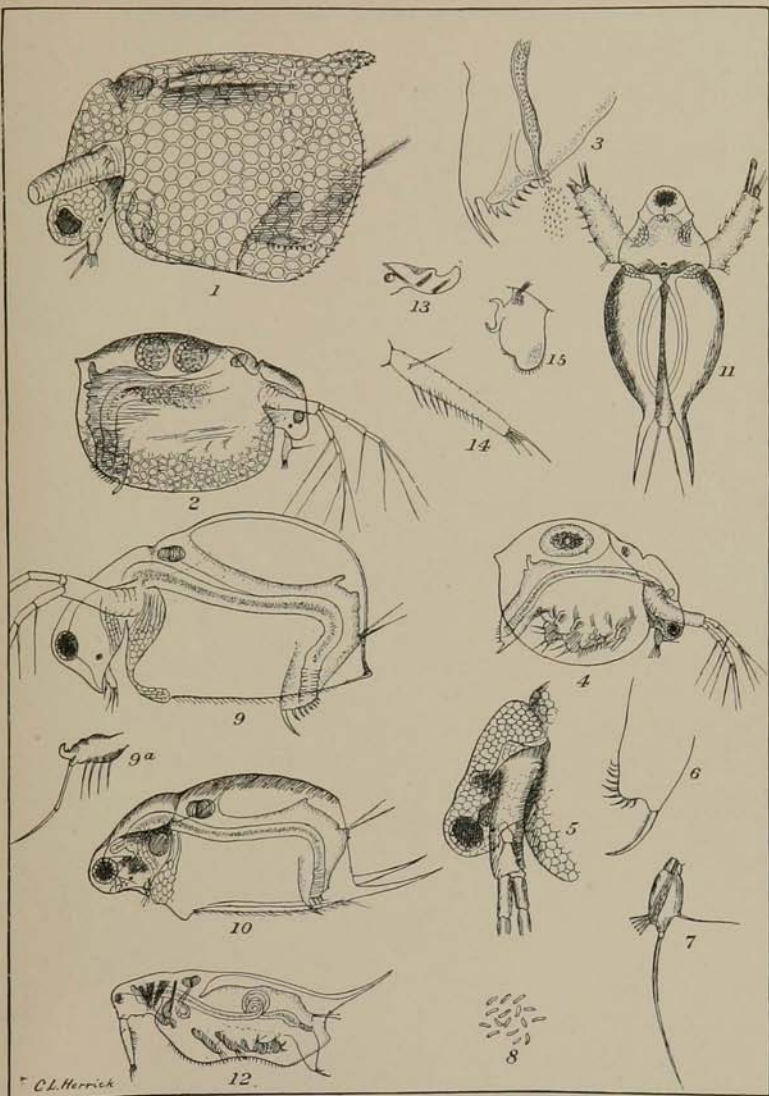


PLATE B¹.

- Fig. 1. *Lyncodaphnia macrothroides* (= *Ofryoaxus?*), adult female, showing coiled intestine, elevated anus, long antennules, elongated seta of second antennæ, anterior cæca, etc.
- Fig. 2. post-abdomen of the same.
- Fig. 3. antennule.
- Figs. 4—6. *Polyphemus pediculus*, young and adult females.

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PLATE B¹.

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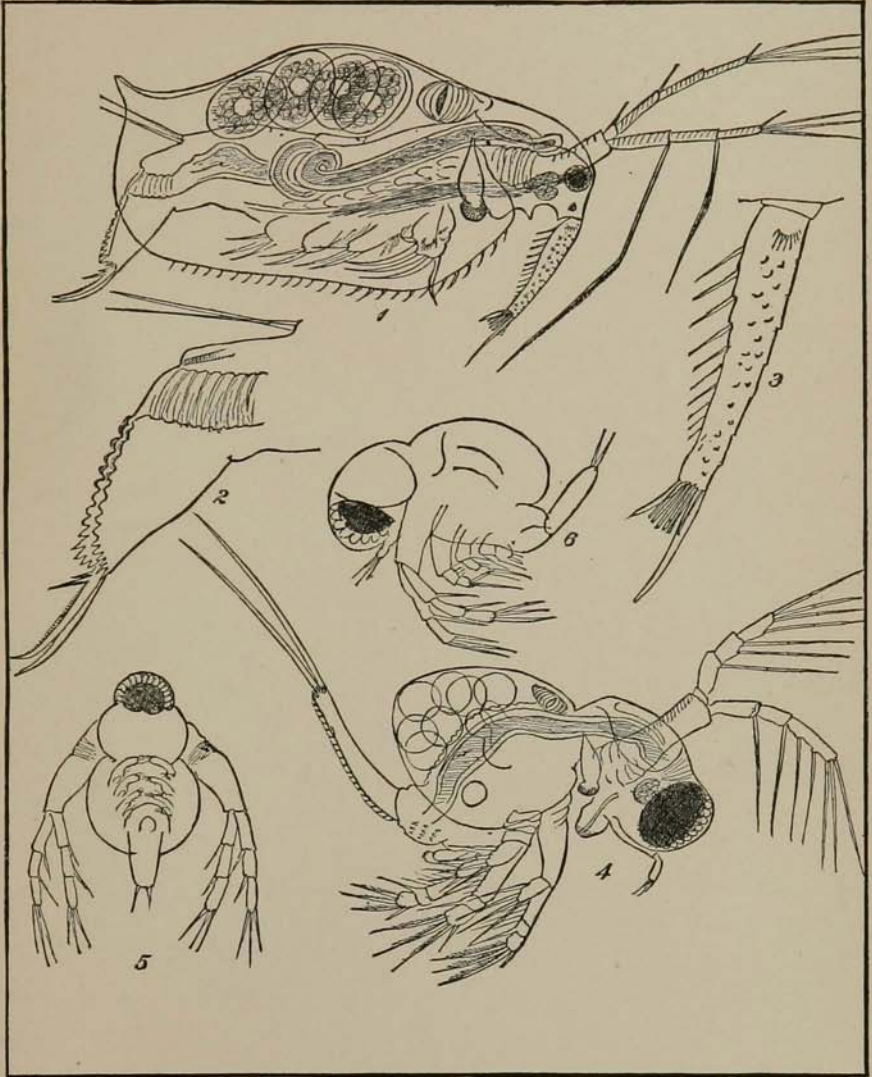


PLATE C.

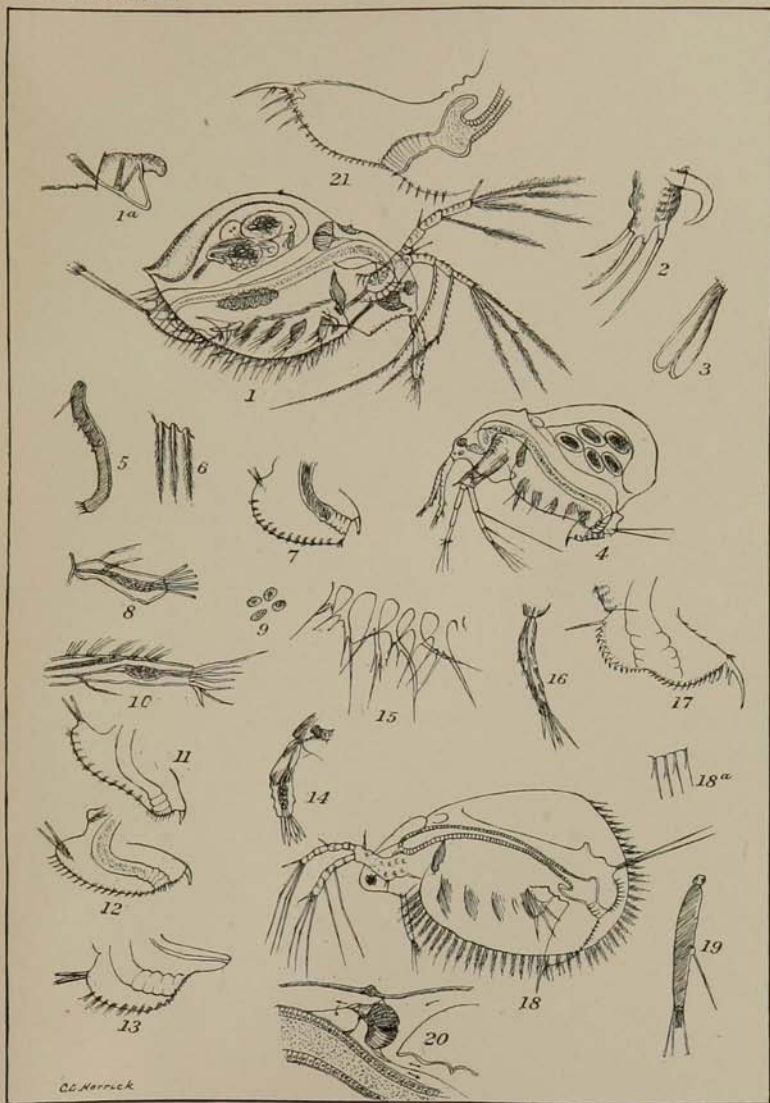
- Fig. 1. *Macrothrix tenuicornis*, 1a. labrum.
Fig. 2. do., first foot.
Fig. 3. do., antennæ of young.
Fig. 4. *Macrothrix pauper*.
Fig. 5. *Macrothrix rosea*, antenna of male.
Fig. 6. do., spines of shell-margins.
Fig. 7. do., post-abdomen.
Fig. 8. *Macrothrix laticornis*, male.
Fig. 9. do., semen cells.
Fig. 10. *Pasithea rectirostris*, male antenna.
Fig. 11. *Macrothrix rosea*, post-abdomen.
Fig. 12. *Macrothrix tenuicornis*, "
Fig. 13. *Macrothrix rosea*, post-abdomen of male.
Fig. 14. *Drepanothrix dentata*, antenna.
Fig. 15. *Ilyocryptus sordidus*, marginal spines.
Fig. 16. do., antenna.
Fig. 17. do., post-abdomen.
Fig. 18. *Ilyocryptus spinifer*, 18a. marginal spines.
Fig. 19. do., antenna.
Fig. 20. *Macrothrix tenuicornis*, heart and accompanying vessels.
Fig. 21. *Ilyocryptus spinifer*, post-abdomen.

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PLATE C.

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PLATE D.

- Fig. 1. *Lathonura rectirostris*.
female, from above. a. eye. b. optic ganglion. c. muscles of eye. d. muscles of antenna. e. dorsal sucking disc. f. stomach. g. young in brood cavity.
- Fig. 2. female, from side.
- Fig. 3. head seen from below.
- Fig. 4. maxillæ.
- Fig. 5. first foot.
- Fig. 6. ovary.
- Fig. 7. antennule.
- Fig. 8. last foot.

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PLATE D.

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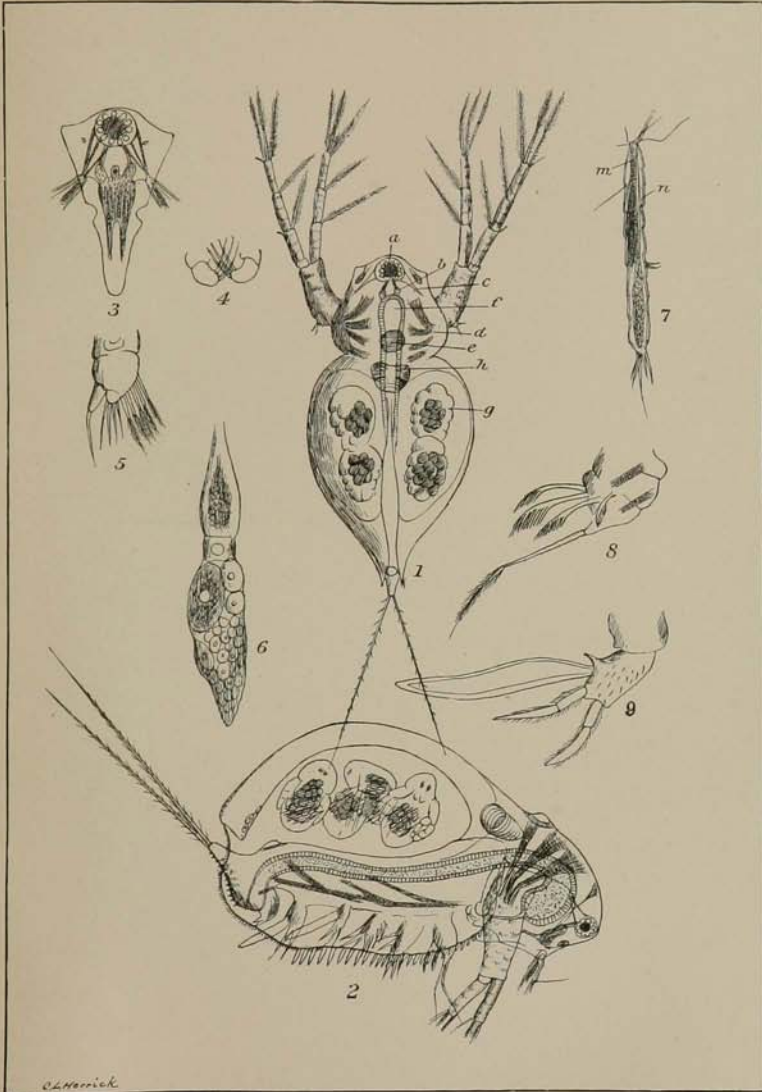


PLATE E.

- Fig. 1. *Alona quadrangularis*, female.
A. antennule. Lb. labrum. Md. mandible. P-a. post-abdomen. An. anus. F. c. musculus flexor caudalis. E. c. musculus extensor caudalis. A. g. anal gland. n. g. nutritive globule in embryo. t. tail of embryo. I, II, III, IV, V. five pairs of feet of embryo. mx. maxilla of embryo. at². antennæ of embryo. at¹. antennules of embryo. H. heart. Sh. g. shell gland. Ov. ovary. Md. m. muscle of mandible. At.² m. muscle of antennæ. E. eye. s. œ. g. supra-œsophagal ganglion. P. F. pigment fleck.
- Fig. 2. brain, eye and pigment fleck of same.
- Fig. 3. *Pleuroxus procurvus*, female.
- Fig. 4. foot of same.
- Fig. 5. *Acroperus leucocephalus*.
- Fig. 6. *Alonella excisa*, female; 6a. shell of same.
- Fig. 7. antennæ of same.
- Fig. 8. *Alonopsis latissima*, female.
- Fig. 9. *Alonopsis media*, female.
- Fig. 10. *Camptocercus macrurus*, post-abdomen.
- Fig. 10a. lower angle of shell of same.

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PLATE E.

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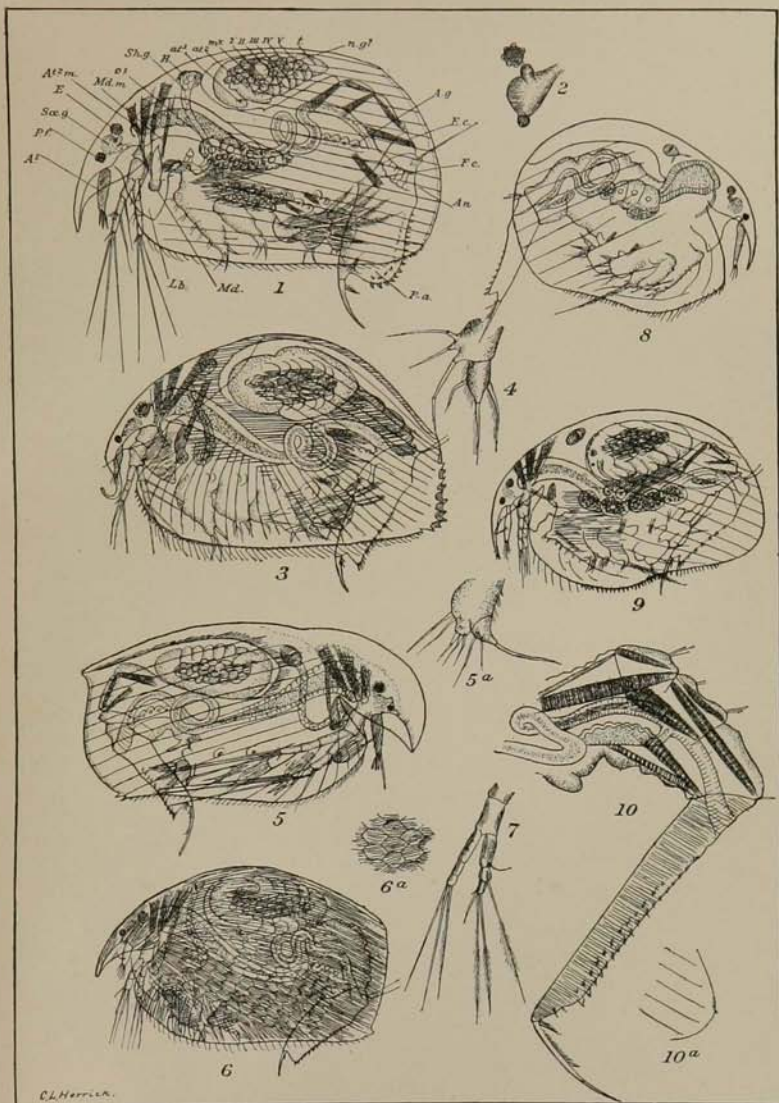


PLATE F.

- Fig. 1. *Chydorus globosus*.
Fig. 2. do., first foot.
Fig. 3. do., end of post-abdomen.
Fig. 4. *Chydorus sphaericus*, male.
Fig. 5. *Chydorus nitidus*, post-abdomen of female.
Fig. 6. *Chydorus nitidus*, head.
Fig. 7. *Chydorus sphaericus*, ephippial female.
Fig. 8. do., female.
Fig. 9. *Chydorus globosus*, post-abdomen of male.
Fig. 10. *Chydorus sphaericus*, from above.
Fig. 11. *Chydorus ovalis*.
Fig. 12. *Chydorus caelatus*.
Fig. 13. *Crepidocercus setiger*.
Fig. 14. *Alona affinis*.
Fig. 15. *Pleuroxus unidens*; 15a. antenna.

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PLATE F.

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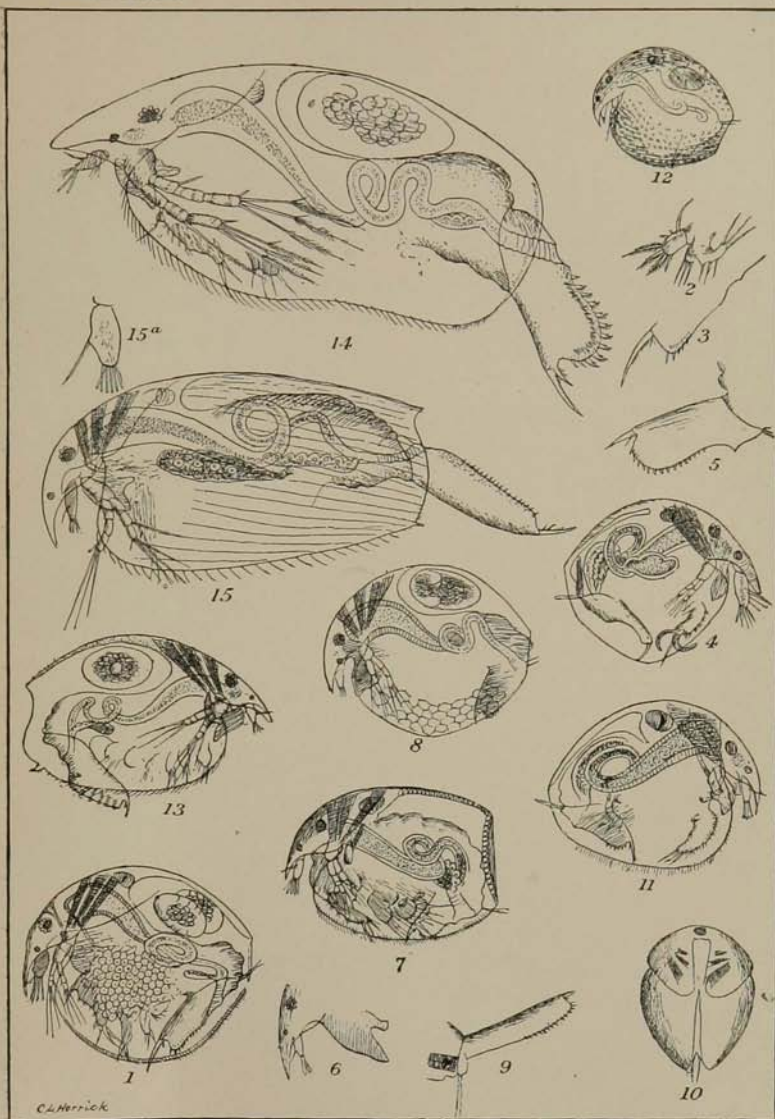


PLATE G.

- Fig. 1. *Alonopsis latissima*, male.
Fig. 2. *Alona glacialis* ? female.
Fig. 3. do., male.
Fig. 4. *Alona tuberculata*.
Fig. 5. do., post-abdomen.
Fig. 6. do., labrum.
Fig. 7. do, antenna, setose branch.
Fig. 8. *Alona glacialis*, antenna.
Fig. 9. *Alonopsis latissima*, feet.
Figs. 10, 11. *Alonella excisa*, details of shell sculpture.
Fig. 12. *Pleuroxus denticulatus*, female; 10a. outline of ephippium.
Fig. 13. do., common variety.
Fig. 14. *Alona tuberculata*, var.

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PLATE G.

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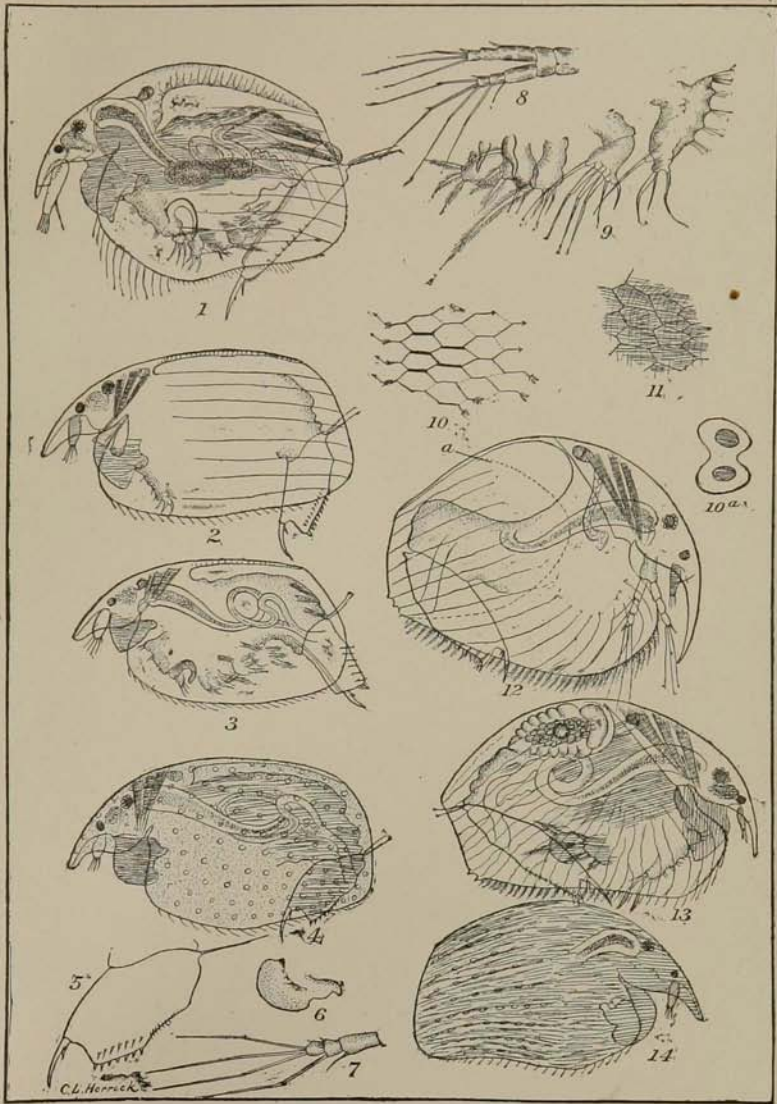


PLATE H.

- Fig. 1. *Pleuroxus hamatus*, post-abdomen and antenna.
Fig. 2. *Pleuroxus affinis*.
Fig. 3. *Alona modesta* (= *lineata*?)
Fig. 4. *Leydigia quadrangularis*.
Fig. 5. *Eurycercus lamellatus*, male; 5a. posterior margin.
Fig. 6. do, antenna of female.
Fig. 7. *Alonella pygmaea*.
Fig. 8. *Temora affinis*, Poppe. female.
Fig. 9. do., abdomen of female.
Fig. 10. do., male.
Fig. 11. do., abdomen of male.
Fig. 12. do., fifth feet of male.
Fig. 13. do., " " of female.
Fig. 14. do., jaw.
Fig. 15. do., antennule.
Fig. 16. Nauplius larva of this or a related species.

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PLATE H.

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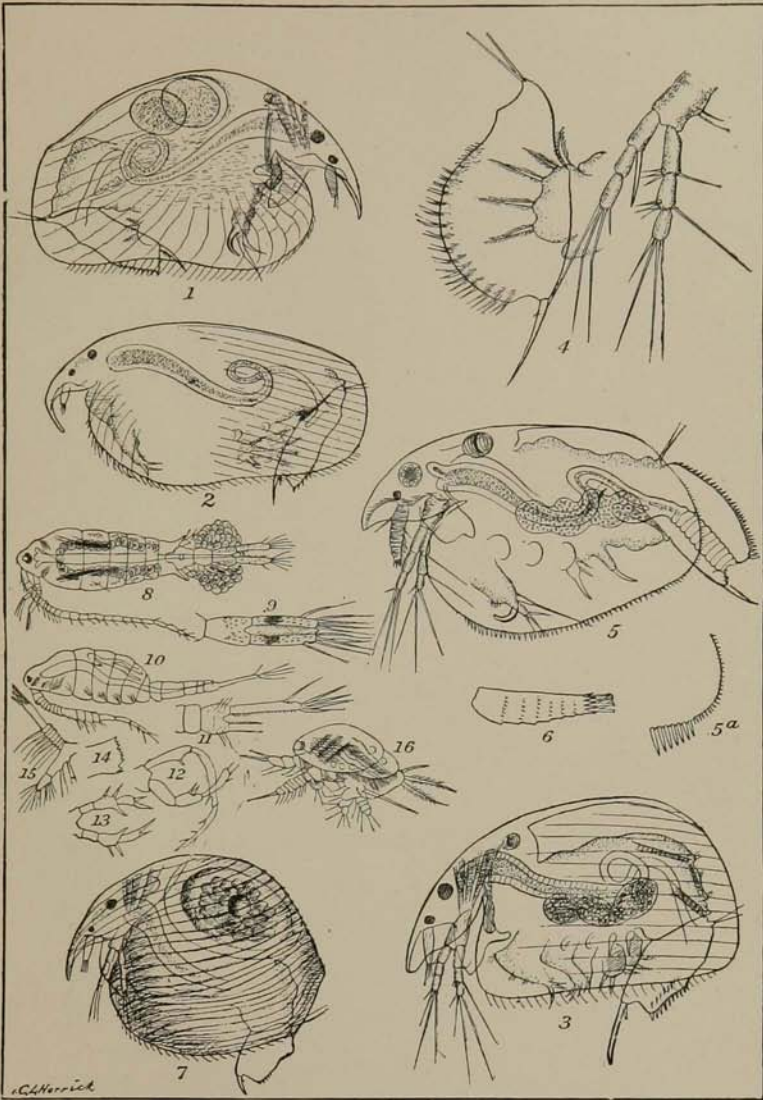


PLATE I.

- Fig. 1. *Camptocercus rectirostris*, post-abdomen of female.
Fig. 2. do. post-abdomen of male.
Fig. 3. do. male.
Fig. 4. *Camptocercus biserratus*, head.
Fig. 5. *Camptocercus latirostris*, head of male.
Fig. 6. do., head of female.
Fig. 7. *Camptocercus lillgeborgii*, head.
Fig. 8. do., post-abdomen of female.
Fig. 9. *Acroperus leucocephalus*, post-abdomen of male.
Fig. 10. *Acroperus angustatus*, " "
Fig. 11. *Alona tenuicaudis*, post-abdomen.
Fig. 12. *Alona dentata*, post-abdomen.
Fig. 13. do. female.
Fig. 14. *Alona elegans*.
Fig. 15. *Alona intermedia*.
Fig. 16. *Pleuroxus hastatus*.
Fig. 17. *Leptorhynchus falcatus*.
Fig. 18. *Phrixura rectirostris*.
Fig. 19. *Eurycercus lamellatus*, first foot of female.
Fig. 20. *Alona sanguinea*? shell markings.
Fig. 21. *Monospilus dispar*; 21a. do., head seen from in front.

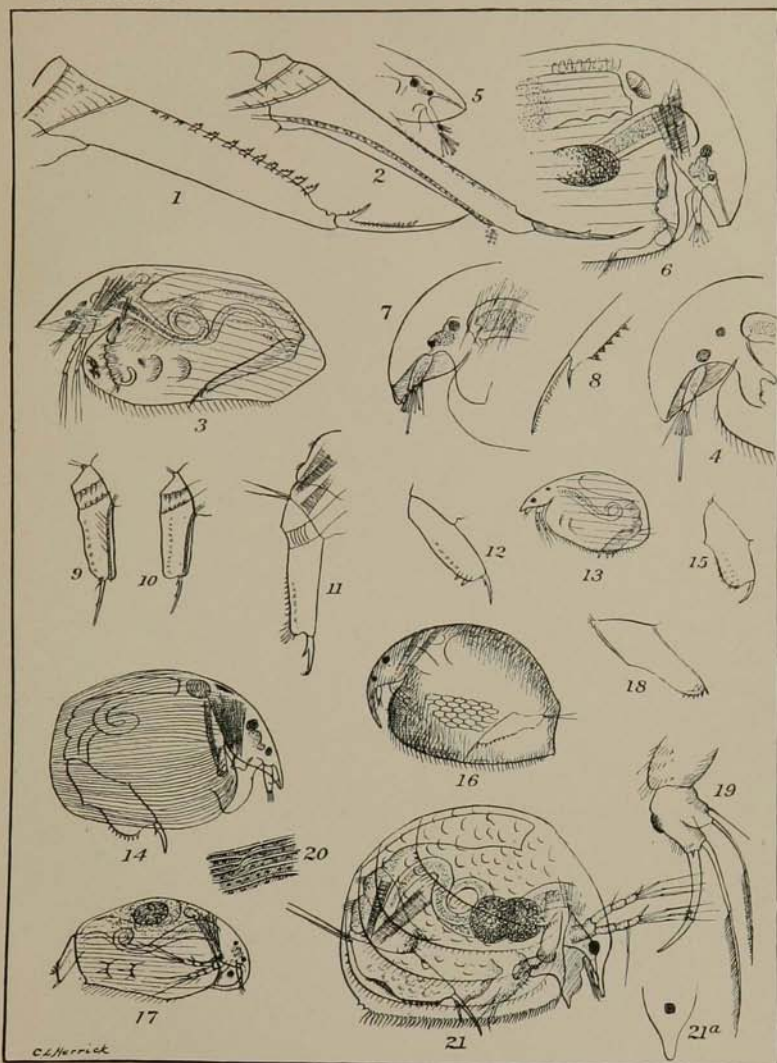
Figures 19-21 original, others from Kurz, P. E. Mueller and Schoedler.

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PLATE I.

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PLATE J.

- Fig. 1. *Ceriodaphnia scitula*, (small var.) ehippial female.
- Fig. 2. *Bosmina longirostris*.
- Fig. 3. *Bosmina liljeborgii*. After P. E. Mueller.
- Fig. 4. *Bosmina*, hook on the first foot of male.
- Fig. 5. *Scapholeberis mucronata*.
- Fig. 6. *Scapholeberis cornuta*, head.
- Fig. 7. *Scapholeberis angulata*, head; 7a. angle of shell.
- Fig. 8. *Pleuroxus denticulatus*, male.
- Fig. 9. *Simocephalus americanus*, head of female.
- Fig. 10. *Bosmina*, post-abdomen of male (after Weismann).

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PLATE J.

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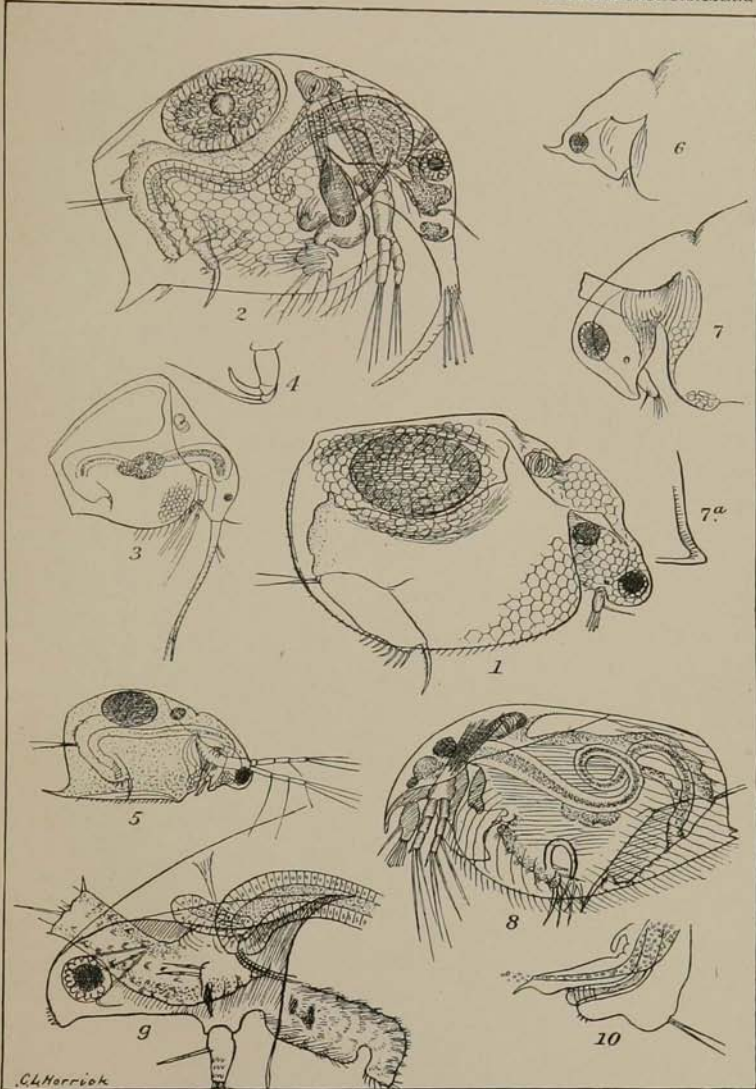


PLATE J¹.

- Fig. 1. *Bosmina striata*.
Fig. 2. *Bosmina longirostris*. (See plate J, fig. 2.)
Figs. 3-5. *Bosmina cornuta*.
Figs. 6, 7. *Pleuroxus procurvatus*.
Fig. 8. *Graptoleberis inermis*.
Fig. 10. *Acroperus* sp.
Figs. 11, 12. *Graptoleberis inermis*.

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PLATE J 1.

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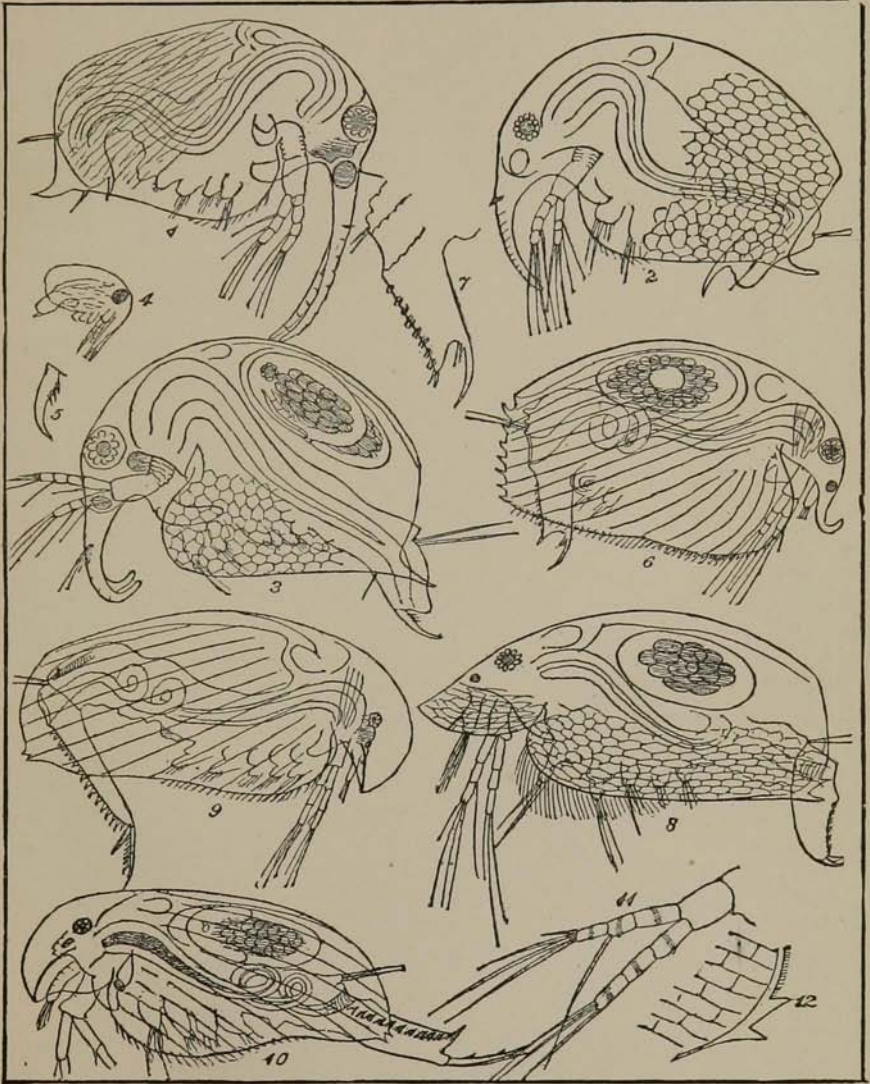


PLATE K.

- Fig. 1. *Daphnia minnehaha*, male.
Fig. 2. " " part of feet of first and second pair.
Fig. 3. *Canthocamptus hibernicus*, antenna of female.
Fig. 4. " " fifth foot of female.
Fig. 5. " *palustris*, antenna of male.
Fig. 6. " *trispinosus*, fifth foot of female.
Fig. 7. " *minutus*, young.
Fig. 8. " " nauplius form.
Fig. 9. *Pseudo-sida bidentata*, adult female, antennule, labrum,
angle of shell and post-abdomen.
Fig. 10. *Daphnia rosea*, young female.
Fig. 11. " " post-imago.
Fig. 12. " " beak.

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PLATE K.

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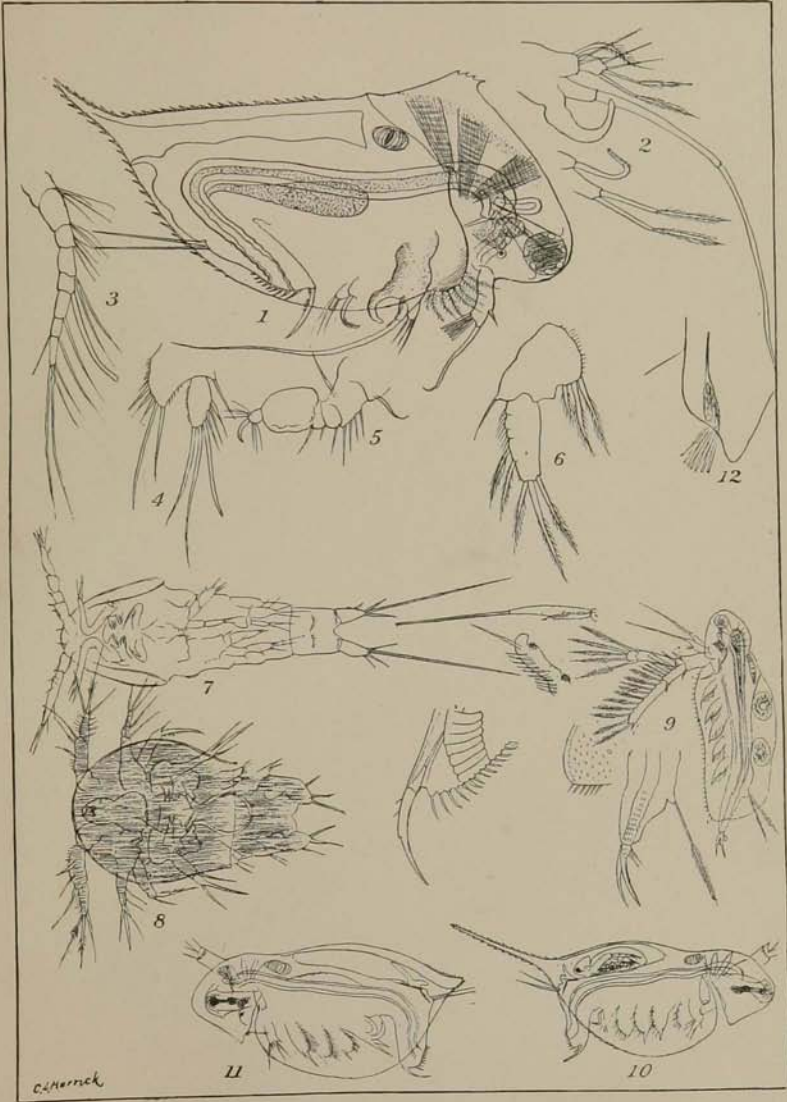


PLATE L.

- Fig. 1. *Daphnia minnehaha*, young female.
Fig. 2. " " head of female; 2a. post-abdomen.
Fig. 3. " *hyalina*, young female.
Fig. 4. " " young.
Fig. 5. " " post-imago.
Fig. 7. " *dubia*, young.
Fig. 8. " " older female.

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PLATE L.

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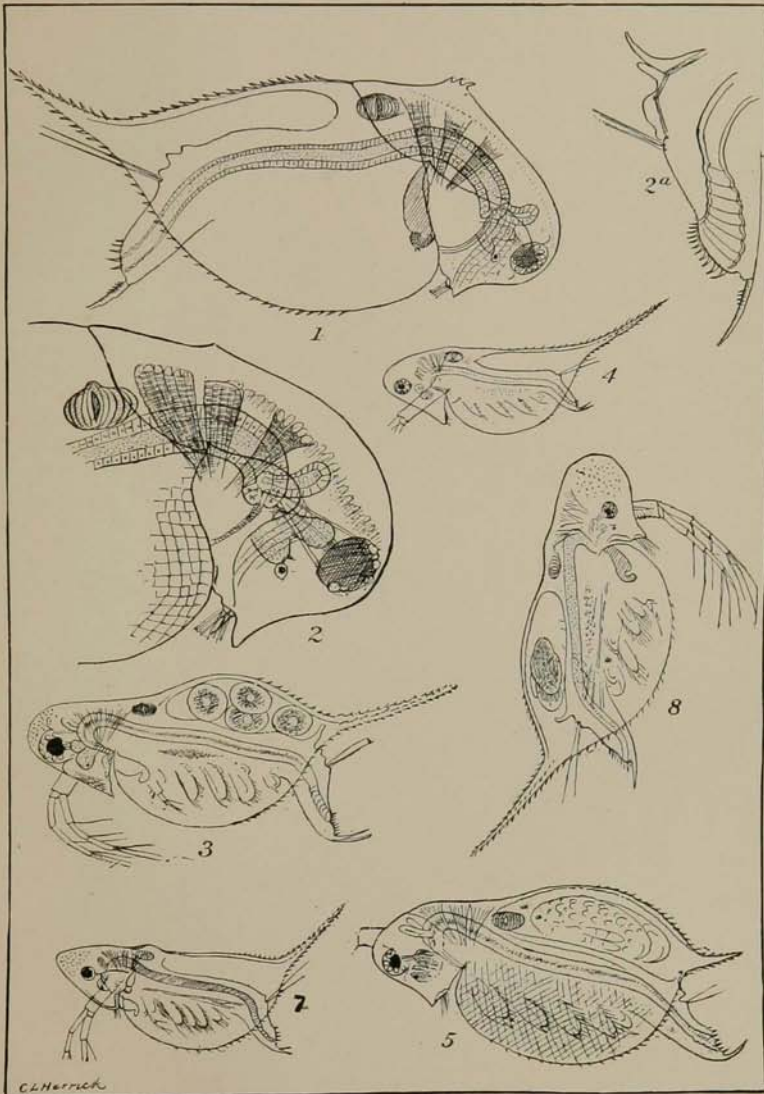


PLATE M.

Fig. 1. *Daphnia schæfferi*, post-abdomen of female.

Fig. 2. " " " " male.

Fig. 3. " " male antennule.

Fig. 4. " " brain and nerves.

inf. œ. g. infra-œsophagal ganglion with nerves to antennæ; œ. œsophagus; n. f. frontal nerve; g. opt. optic ganglion; m. opt. muscles which move the eye; p. f. pigment fleck; n. opt. optic nerve.

Fig. 5. *Daphnia schæfferi*, posterior part of embryo.

Fig. 6. *Eurycercus lamellatus*, heart, showing the anterior bifid portion between the lobes of which is the arterial opening and valve. The vaned arrows represent deeper currents while the unvaned indicate superficial ones. The dotted line represents the position of the pulsating membrane separating the venous from the arterial currents and seen in section at (a).

Fig. 7. *Daphnia similis*, anterior part of the nervous system seen from below. a. optic nerve; b. optic ganglion; c. frontal nerve; d. nerve to antennules; e. commissure connecting upper and lower œsophagal ganglion; f. nerves to antennæ and mandibles.

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PLATE M.

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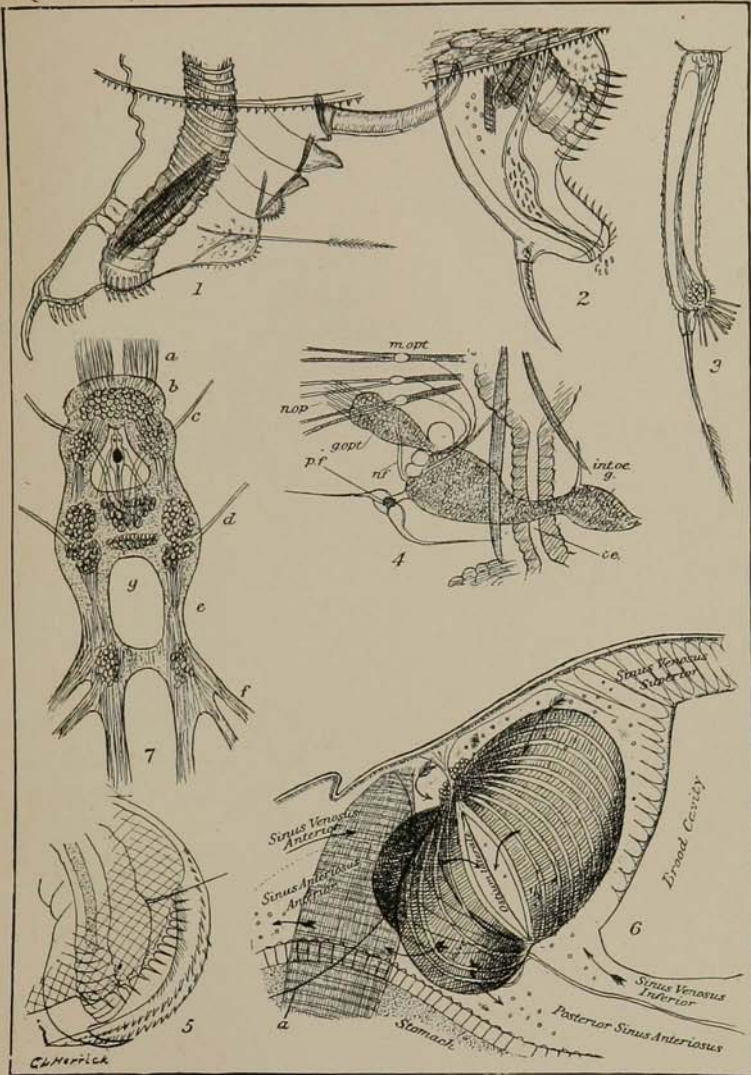


PLATE N.

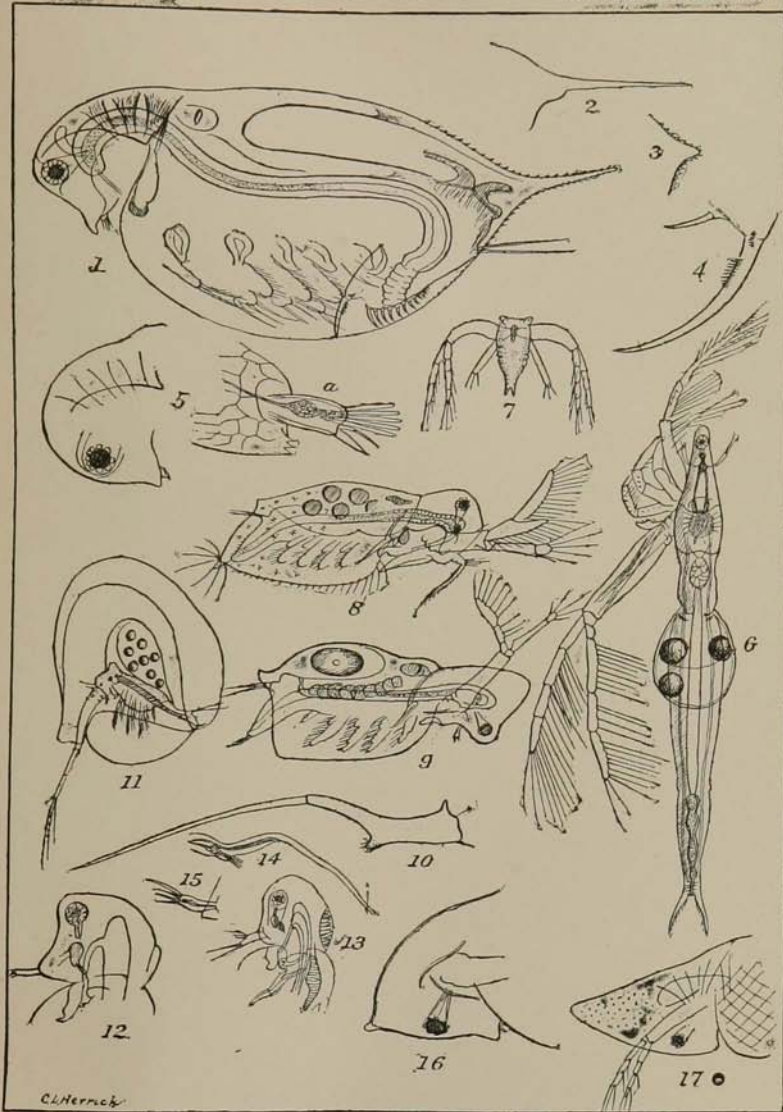
- Fig. 1-4. *Daphnia pulex*, var. *nasutus*.
Fig. 5. outline of head and (a) beak of *D. similis*.
Fig. 6. *Leptodora hyalina*, seen from above.
Fig. 7. " " larva.
Fig. 8. *Latona setifera*, female.
Fig. 9. *Limnosida frontosa*, female.
Fig. 10. " " antennule of male.
Fig. 11. *Holopedium gibberum*, female.
Fig. 12. *Sida elongata*, head outline.
Fig. 13. *Sida crystallina*, head outline of young female.
Fig. 14. " " antennule of male.
Fig. 15. " " " of female.
Fig. 16. *Daphnia galeata*, outline of head.
Fig. 17. " "*vitrea*" " " "

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PLATE N.

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PLATE O.

- Fig. 1. *Canthocamptus illinoisensis*, antenna of female.
Fig. 2. " " fifth foot of female.
Fig. 3. " " antennule.
Fig. 4. " " first foot.
Fig. 5. " " caudal stylet.
Fig. 6. *Canthocamptus northumbricus*, var. *americanus*, fifth
foot of female.
Fig. 7. " " antenna of female.
Fig. 8. " " maxilliped.
Fig. 9. " " caudal stylet.
Fig. 10. " " antenna of male.
Fig. 11. " " first foot.
Fig. 12. " " fourth foot.
Fig. 13. " " fifth foot of male.
Fig. 14. " " frontal area.
Fig. 15. *Canthocamptus tenuicaudis*, stylets.
Fig. 16. " " fifth foot of female.
Fig. 17. *Cyclops serrulatus*, fifth foot.
Fig. 18. " " fourth foot.
Fig. 19. " " outer ramus of first foot.
Fig. 20. *Canthocamptus northumbricus*, inner ramus of third
male foot.
Fig. 21. " " beak.
Fig. 22. " " maxilla.

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PLATE O.

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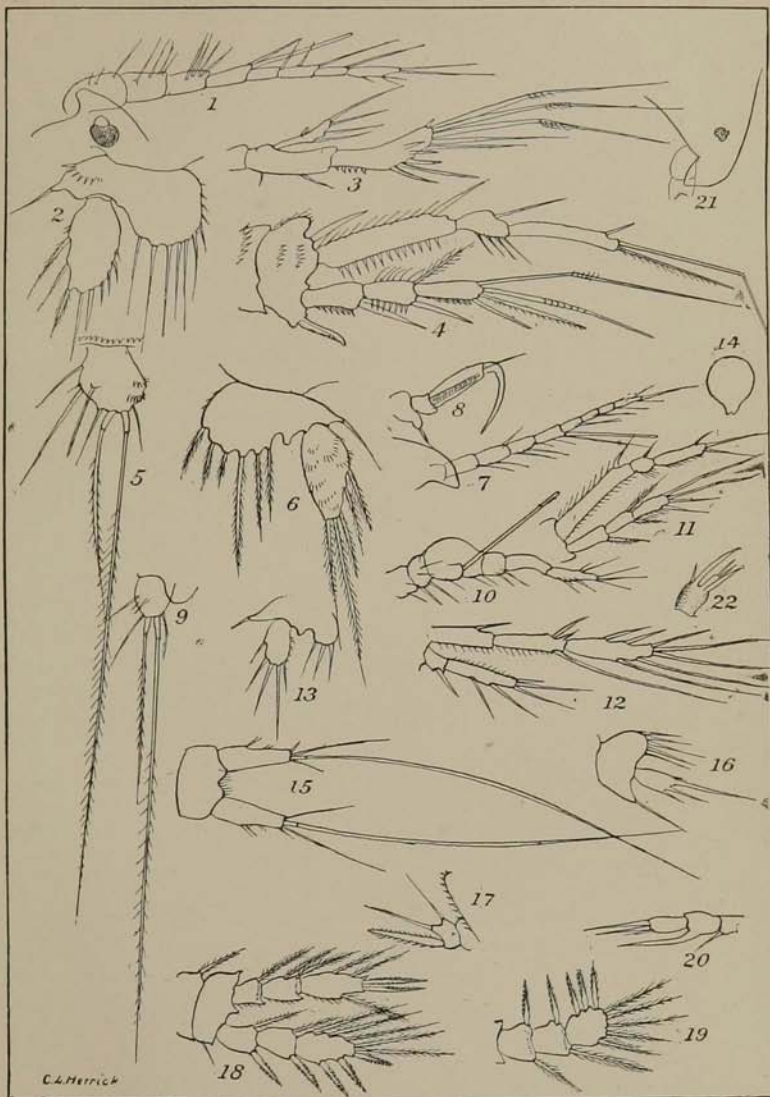


PLATE P.

- Fig. 1. Heart of *Simocephalus vetulus*. a, tendons attached to lateral walls of heart. b, venous opening of heart. c, muscular bands supporting the abdomen, connected by transverse bands. d, cells of nutritive matter hiding the arterial opening. e, thin membrane seen in section which separates the venous from the arterial blood currents, is in focus near the side, but its situation in the center is shown by the dotted line. Above this or outside it is the attachment of the powerful antennary and mandibular muscles. f, posterior arterial sinus. g, brood-sac. h, alimentary canal with thick glandular cell walls. i, shell gland or excretory organ. j, powerful muscles supporting and moving the abdomen.
- Fig. 2. An early stage of the embryo of *Daphnia schæfferi*. a, anus. n, nutritive globules or fat drops characteristic of the summer embryo. m¹, m², outer and inner envelope of the embryo. This is a nauplius stage, but not the first or proper nauplius. The portion darkly shaded is nutritive yolk.
- Fig. 3. A well advanced winter embryo of *D. schæfferi*. a, shell growing over the eyes. b, c, inner shell. d, outer shell. e, lateral part of the head. f, antennules. g, labrum. h, mandibles. i, maxilla. j, second maxilla? k, l, m', n', branchial appendages of the 2d-5th pairs of feet. represented by k, l, m, n. o, first foot. p, antenna. q, anus and intestine partly completed. s, shell growing out from the maxillary region.
- Fig. 4. Older embryo bursting outer shell.
- Fig. 5. Egg after extrusion into the brood cavity.
- Fig. 6. Head of young embryo. a, lenses in formation. b, eyes appearing as dark flecks. c, shell growing over the head. d, labrum. e, antennule.
- Fig. 7. Longitudinal section through an ephippium.
- Fig. 8. Vertical section through an ephippial *Daphnia schæfferi*.
- Fig. 9. Somewhat oblique section through the ephippium (a, b, c), heart (h), mandibles (m), and labrum (l).
- Fig. 10. A vertical section through the ephippium and its egg.

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PLATE P.

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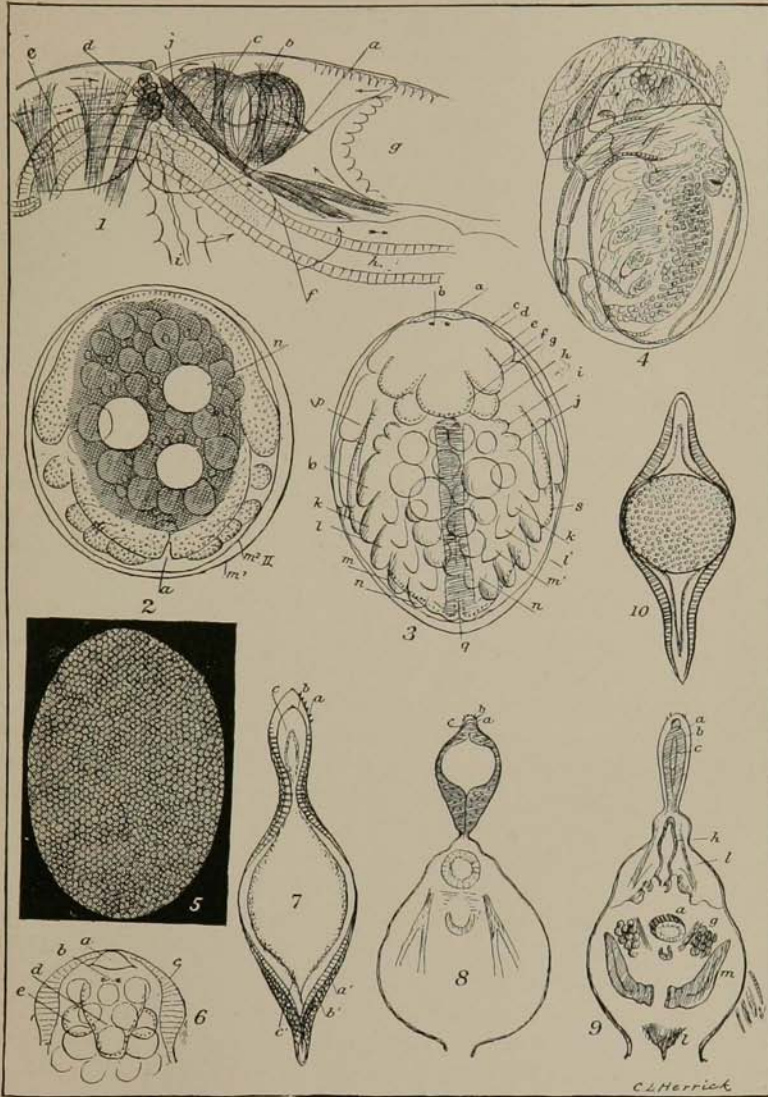


PLATE Q.

- Fig. 1. *Alonella pulchella*, female.
 Fig. 2. " " reticulations.
 Fig. 3. " " post-abdomen.
 Fig. 4. *Alona modesta*, male.
 Fig. 5. *Diaptomus similis*, female. 5a. jaw.
 Fig. 6. " " fifth foot of male.
 Fig. 7. " " " " " female.
 Fig. 8. " *minnetonka*, fifth foot of male.
 Fig. 9. " " " " " female.
 Fig. 10. " " abdomen of female.
 Fig. 11. " *stagnalis*, margin of last thoracic segment.
 Fig. 12. " *sanguineus*, " " " " "
 Fig. 13. " *stagnalis*, fifth foot of the male.
 Fig. 14. *Epischura fluviatilis*, abdomen of male.
 Fig. 15. " *lacustris*, fifth feet of male.
 Fig. 16. " *fluviatilis*, " " " "
 Fig. 17. *Diaptomus pallidus* " " " " inner ramus.
 Fig. 18. " *sicilis* " " " " " "

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PLATE Q.

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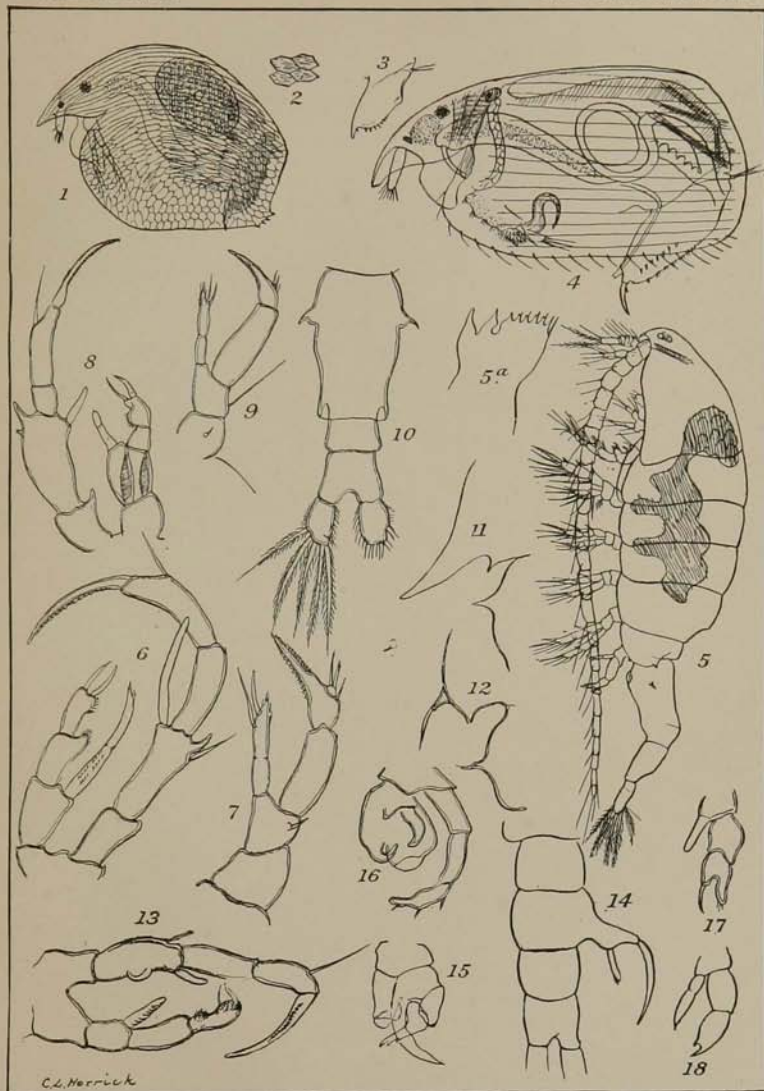


PLATE Q¹.

- Fig. 1. *Diaptomus* sp. Young male; external parts as yet but partly developed showing alimentary and reproductive systems as well as a portion of the muscular system. The looped tube is the vas deferens. The small irregularly coiled tube anteriorly is the shell-gland or kidney.
- Fig. 2. female with ovary, oviducts and heart.
- Figs. 3-4. Nauplius larva of same.
- Figs. 5-6. fifth pair of feet of male and female.
- Fig. 7. mouth appendages, anteriorly the base of antennæ followed by antennule, labrum, mandible with palp, maxilla and maxilliped.

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PLATE Q¹.

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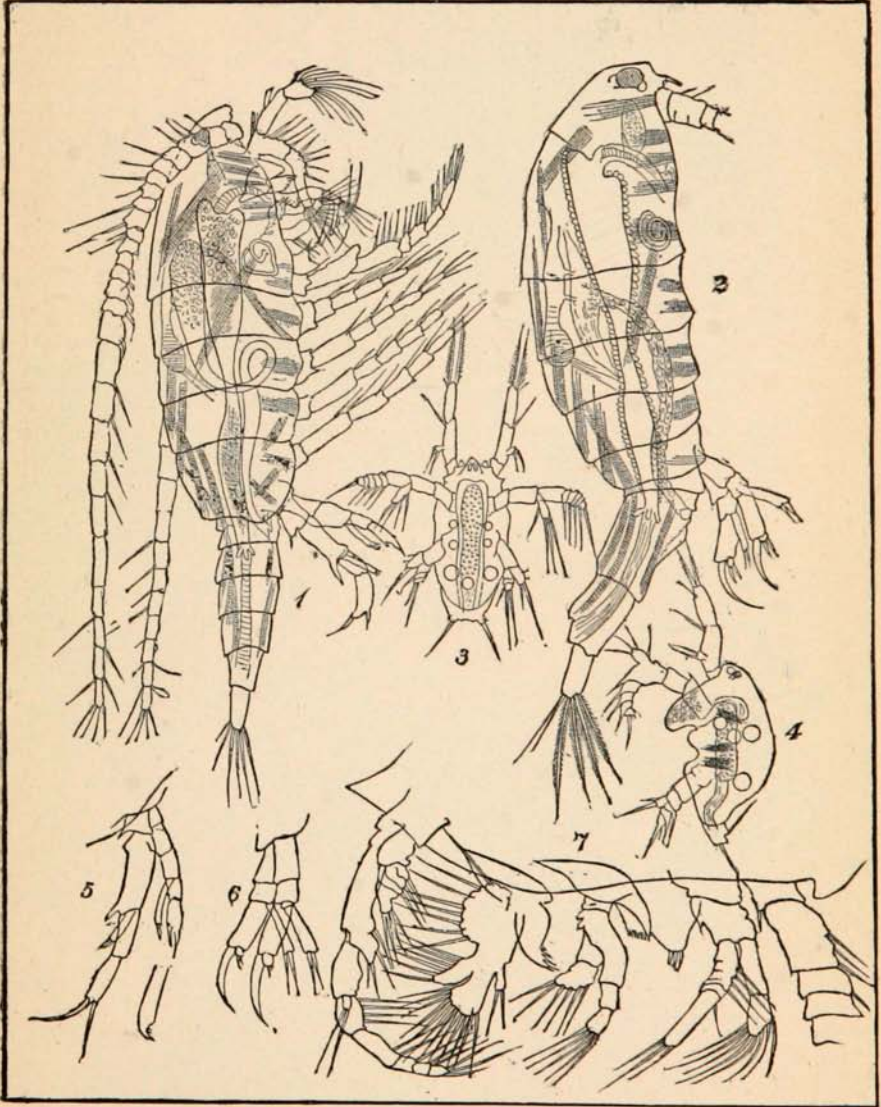


PLATE Q².

- Fig. 1. *Osphranticum labronectum* (*Potamoichetor*), male.
Fig. 2. antennule.
Fig. 3. maxilliped.
Fig. 4. fifth feet of male.
Fig. 5. palp of mandible.
Fig. 6. end of abdomen.
Fig. 7. feet of first pair.
Fig. 8. eye.
Fig. 13. maxilla.
Fig. 14. mandible.
Fig. 9. *Cyclops ater*, female.
Fig. 10. abdomen.
Fig. 11. maxilliped.
Fig. 12. antenna.

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PLATE Q².

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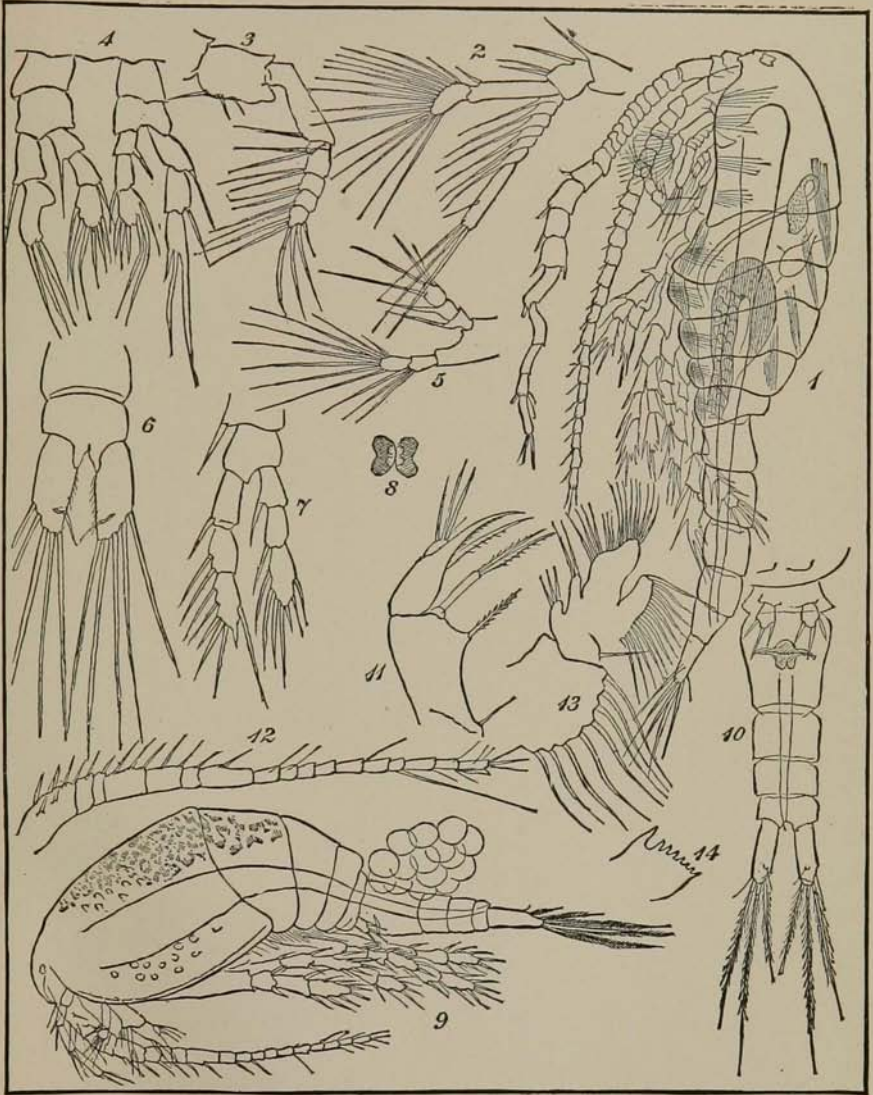


PLATE Q³.

- Fig. 1. *Cyclops ingens*, first segment of abdomen of female.
- Fig. 2. antenna.
- Fig. 3. fifth foot.
- Fig. 4. antenna of young male.
- Fig. 5. stylets of mature female.
- Fig. 6. stylets of young male.
- Fig. 7. maxilliped.
- Fig. 8. mandible.
- Fig. 9. *Cyclops fimbriatus*, female.
- Fig. 10. antenna.
- Fig. 11. terminal portion of abdomen.
- Fig. 12. female fifth foot.
- Fig. 13. second antenna.
- Fig. 14. Nauplius form.

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PLATE Q³.

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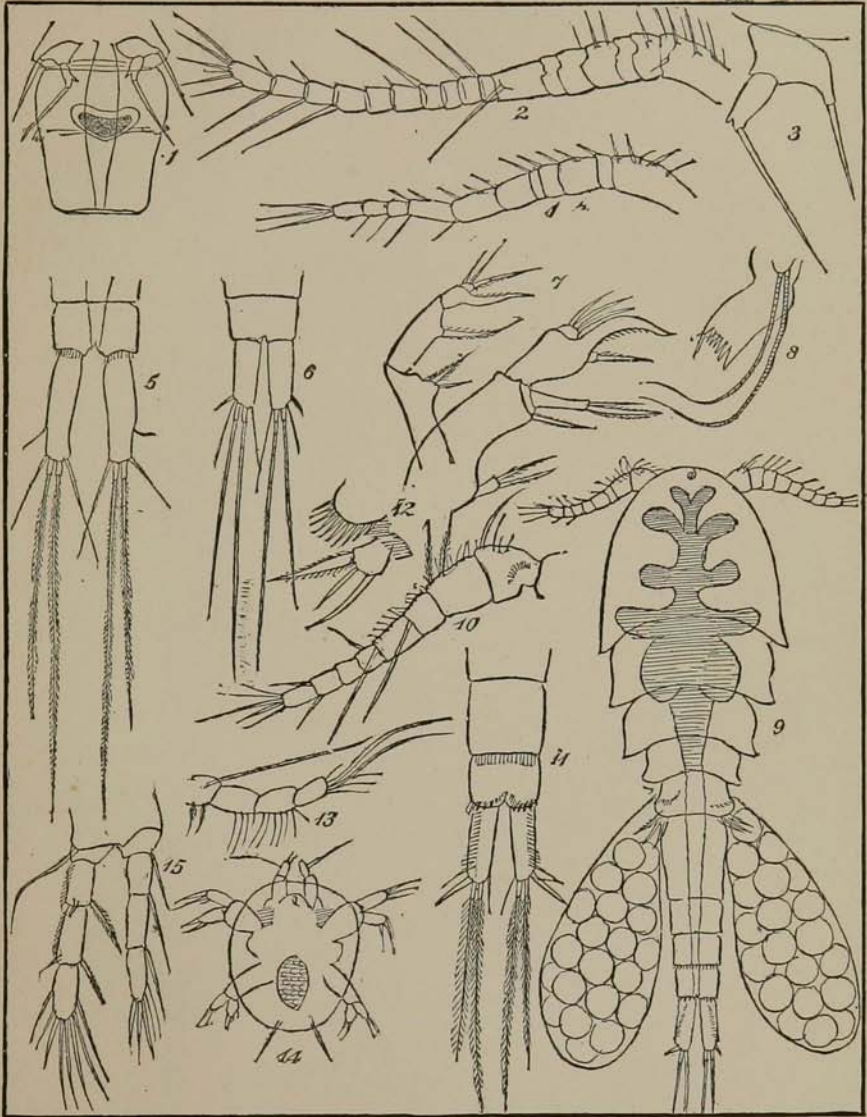


PLATE Q⁴.

- Fig. 1. *Cyclops tenuicornis*, female.
Fig. 2. mandible.
Fig. 3. maxillæ.
Fig. 4. stylet.
Fig. 5. fifth foot.
Fig. 6. maxillipedes.
Fig. 7. antennæ.
Fig. 8. *Cyclops "signatus,"* abdomen.
Fig. 9. antenna.
Fig. 10. fifth foot.
Fig. 11. male antenna.
Fig. 12. *Cyclops parvus*, abdomen.
Fig. 13. antenna.
Fig. 14. fifth foot.
Fig. 15. *Cyclops "adolescens,"* opening of spermatheca and cement gland.
Fig. 16. *Cyclops "adolescens,"* abdomen.
Fig. 17. foot.
Fig. 18. antenna of female.
Fig. 19. eye.
Fig. 20. antenna of male.
Fig. 21. *Cyclops "signatus,"* end of antenna.

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PLATE Q⁴.

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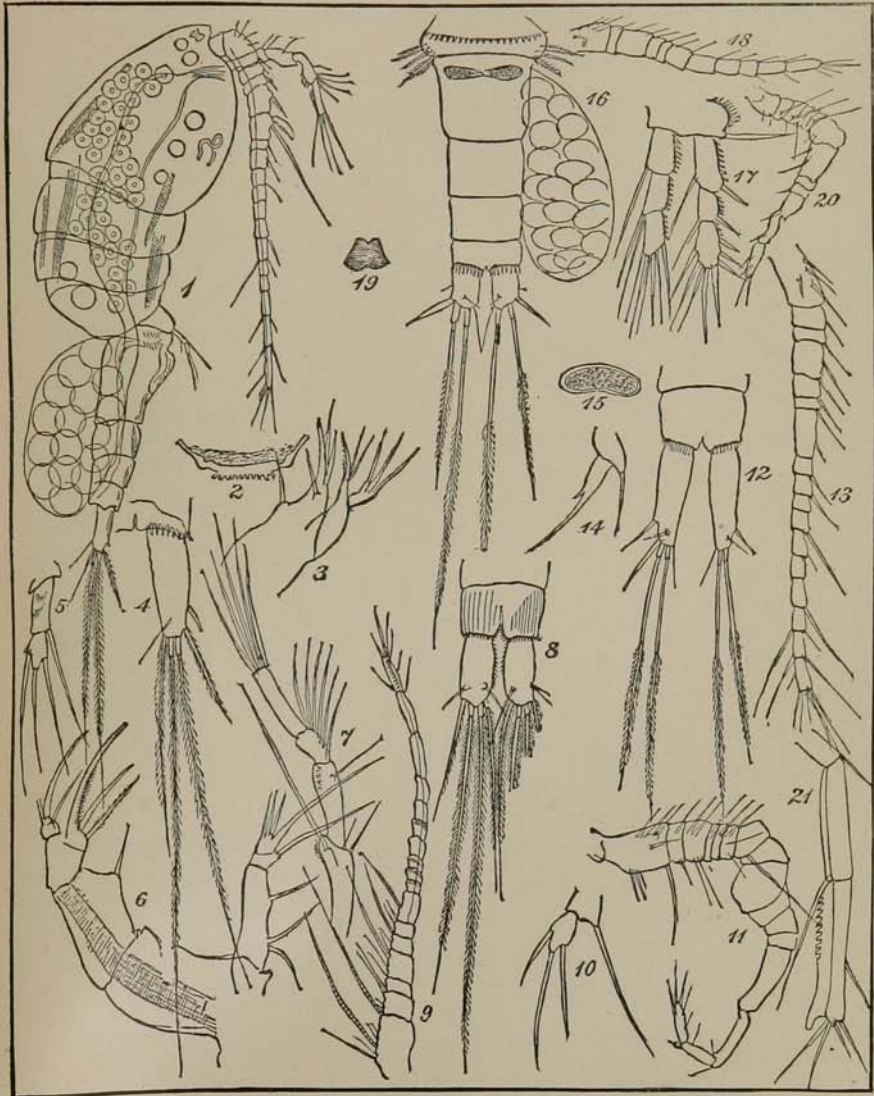


PLATE Q 5.

- Fig. 1. *Cyclops fluviatilis*, female.
Fig. 2. antenna.
Fig. 3. antenna of young.
Fig. 4. abdomen of young.
Fig. 5. foot of young.
Fig. 6. foot of adult.
Fig. 7. fifth foot.
Fig. 8. eye.
Fig. 10. *C. serrulatus*, young.
Fig. 11. *Daphnella brachyura*, female.
Fig. 12. *Daphnella brachyura*, male.
Fig. 13. edge of valves.
Fig. 14. abdomen of male.
Fig. 15. abdomen of female.
Fig. 16. antenna of male.

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PLATE Q⁵.

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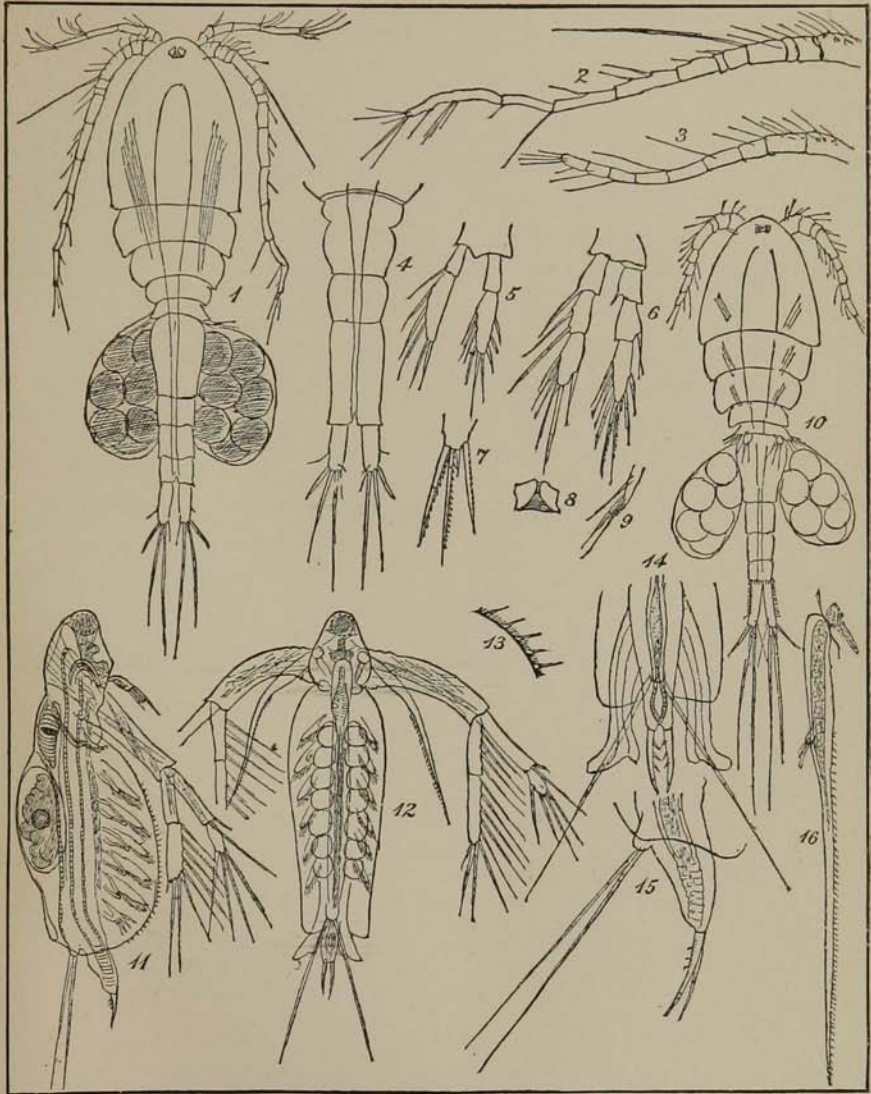


PLATE R.

- Fig. 1. *Cyclops modestus*.
Fig. 2. " " end of abdomen.
Fig. 3. " " outer ramus of first foot.
Fig. 4. " " " " " second foot.
Fig. 5. " " fifth foot.
Fig. 6. " *phaleratus*, fourth foot.
Fig. 7. " " outer ramus of first foot.
Fig. 8. " " fifth foot.
Fig. 9. " " caudal stylets.
Fig. 10. " " antenna of young otherwise perfect.
Fig. 11. " *fimbriatus*, end of abdomen.
Fig. 12. " *diaphanus*, abdomen.
Fig. 13. " *ater*, inner ramus of first foot.
Fig. 14. " " outer " " " "
Fig. 15. " " " " " fourth foot.
Fig. 16. " "*signatus*," fourth foot.
Fig. 17. " *ater*, inner ramus of fourth foot.
Fig. 18. " " stylet.
Fig. 19. " *sp.?* first foot.
Figs. 20, 21. " " terminal segments of fourth foot.
Fig. 22. " " fifth foot.
Fig. 23. *Chydorus globosus*, first foot of male.

MINNESOTA CRUSTACEA.

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PLATE R.

Geol. & Nat. Hist. Sur. Minn.

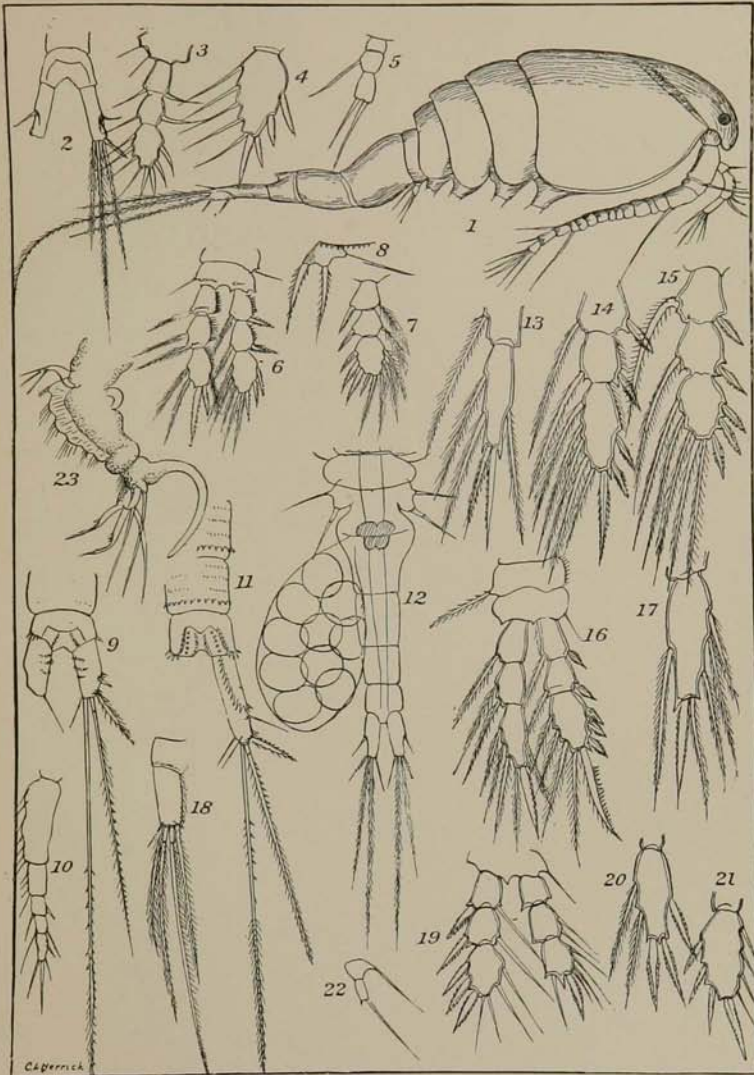


PLATE S.

- Fig. 1. *Ergasilus depressus*, male.
Fig. 2. *Cyclops oithonoides* (Amer. C. tenuissimus, var.), stylets.
Fig. 3. " " fifth foot.
Fig. 4. " " antennules.
Fig. 5. " " fourth feet.
Fig. 6. " " antenna of male.
Fig. 7. " " *brevispinosus*, stylet.
Fig. 8. " " " inner maxilliped.
Fig. 9. " " " swimming foot.
Fig. 10. " " " fifth foot.
Fig. 11. " " " antennule.
Fig. 12. " " " opening of spermatheca.
Fig. 13. *Cyclops sp.?*, nauplius.

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PLATE 5.

Geol. & Nat. Hist. Sur. Minn.

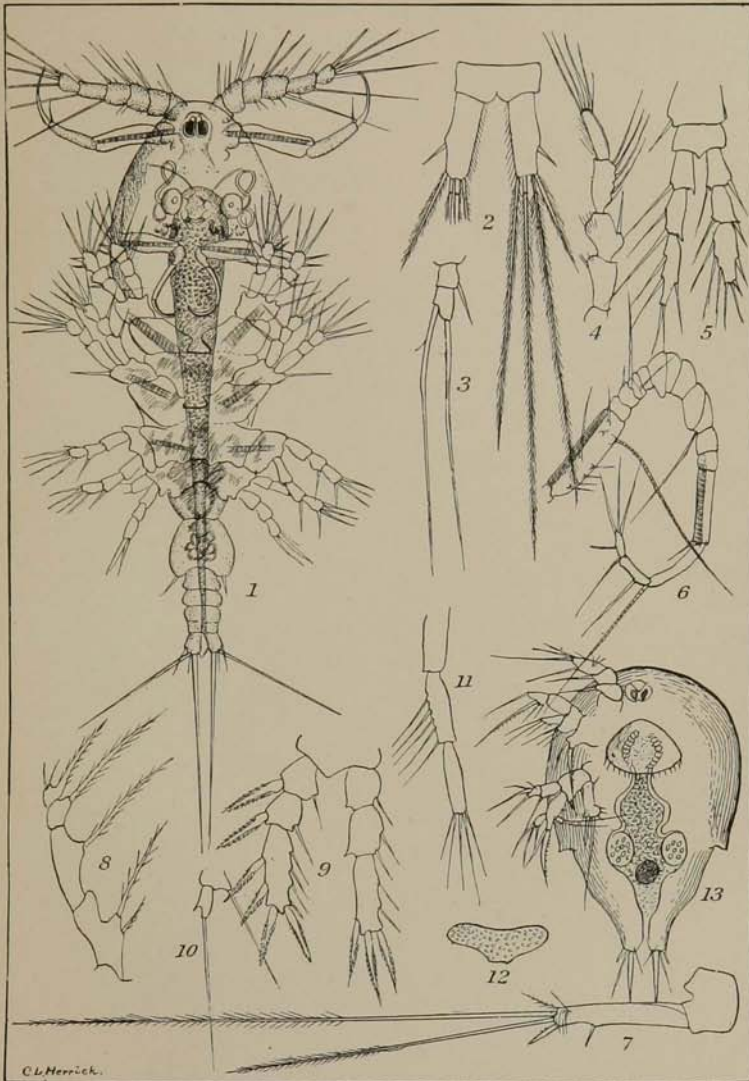


PLATE T.

- Fig. 1. *Canthocamptus minnesotensis*, first foot.
Fig. 2. " " stylets.
Fig. 3. " " antenna of female.
Fig. 4. " " fifth foot of female.
Fig. 5. " " " " " male.
Fig. 6. " " antenna of male.
Fig. 7. *Daphnia galeata*, young.
Fig. 8. " " male.
Fig. 9. *Camptocercus leucocephalus*, male.
Fig. 10. *Alonella excisa*, male.
Fig. 11. *Cyclops insignis*, first foot, outer ramus.
Fig. 12. " " fifth foot.
Fig. 13. " " fourth foot.
Fig. 14. " " stylet.
Fig. 15. Worm parasitic in arterial sinus of *Daphnia schæfferi*.

NOTE. On pages 43 and 44, for " Plate T," read Plate J.

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PLATE I.

Geol. & Nat. Hist. Surv. Minn.

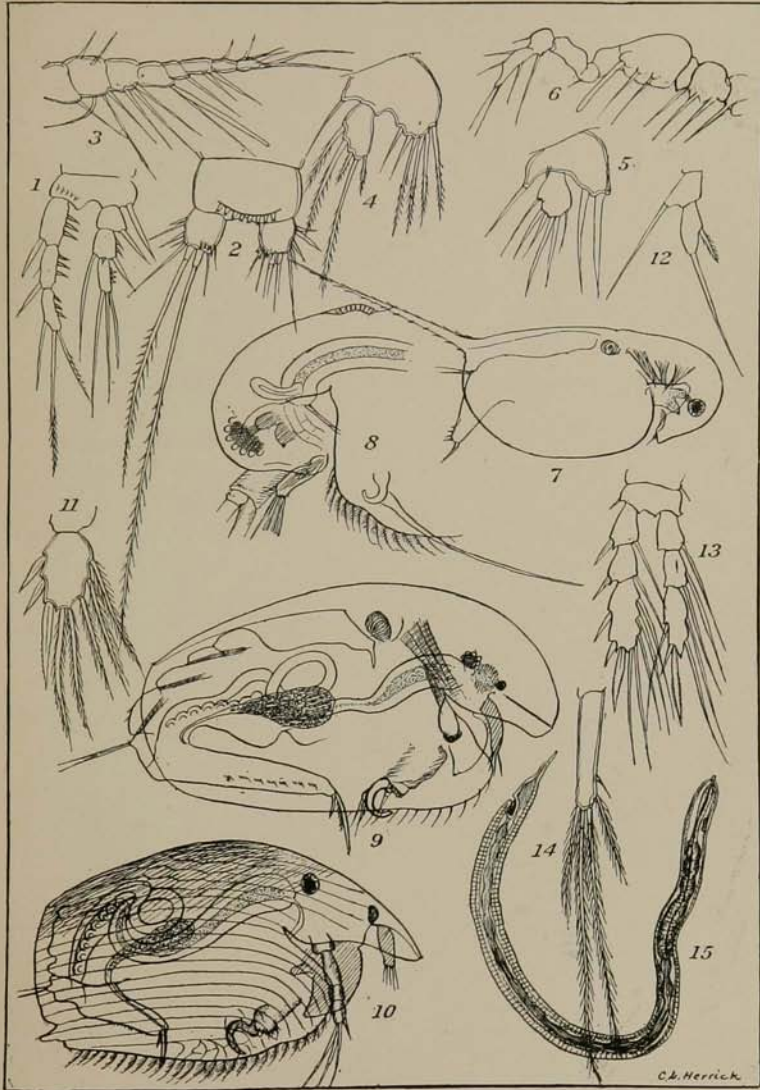


PLATE U.

- Fig. 1. *Daphnia kalbergensis*, of moderate size.
Fig. 2. " " antennule of male.
Fig. 3. " " head of var.
Fig. 4. *Cyclops thomasi*, fourth foot.
Fig. 5. " " outer ramus of first foot.
Fig. 6. *Daphnia galeata*, typical form.
Fig. 7. *Cyclops thomasi*, fifth foot.
Fig. 8. " " stylet.
Fig. 9. *Cyclops (insectus?)*, fourth foot.
Fig. 10. *Bythotrephes longimanus*, female.
Fig. 11. A curious large protozoan; a. infundibulum frame work
b. pulsating vacuole; c. nucleus; d. food and digested matter;
e. protective rods; 11a. spicules of the infundibulum.

MINNESOTA CRUSTACEA.

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PLATE U

Geol. & Nat. Hist. Sur. Minn.

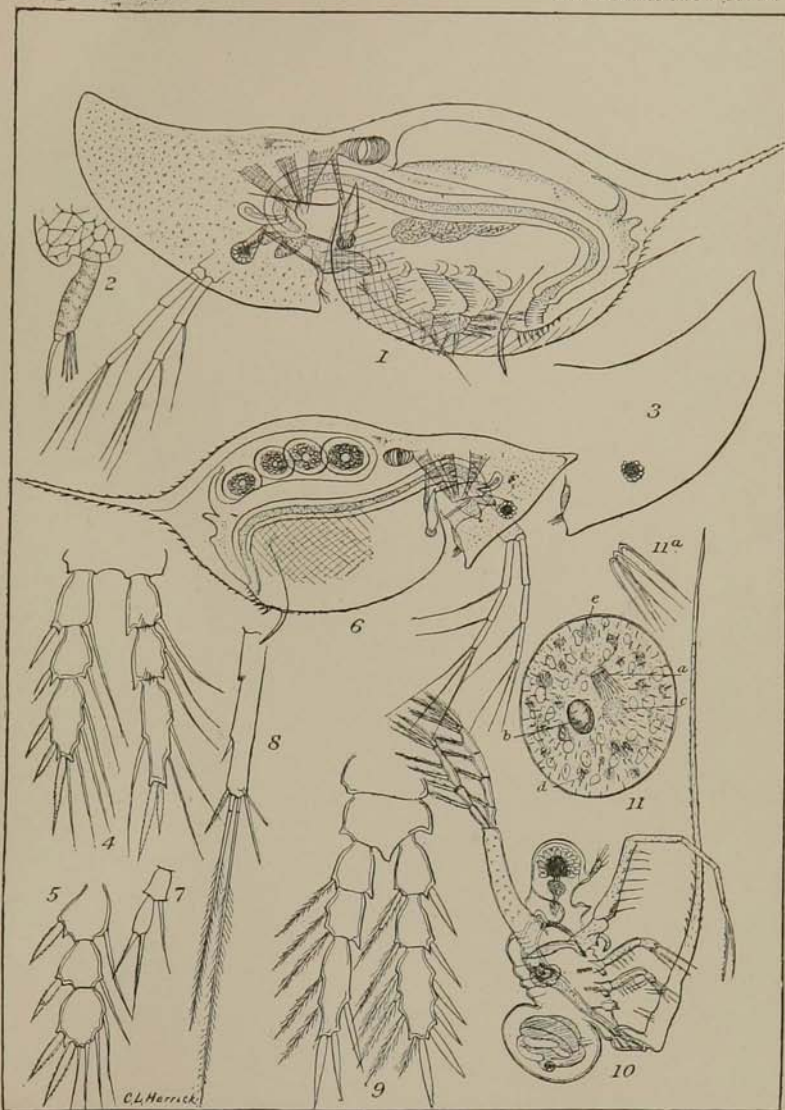


PLATE U.

- Figs. 1-14.** *Limnetes gouldii*, Baird.
Fig. 15. *Daphnia magniceps*, female.
Fig. 16. *Daphnia minnehaha*, female.

MINNESOTA CRUSTACEA.

From the 10th Annual Report.

PLATE U¹.

Geol. & Nat. Hist. Sur. Minn.

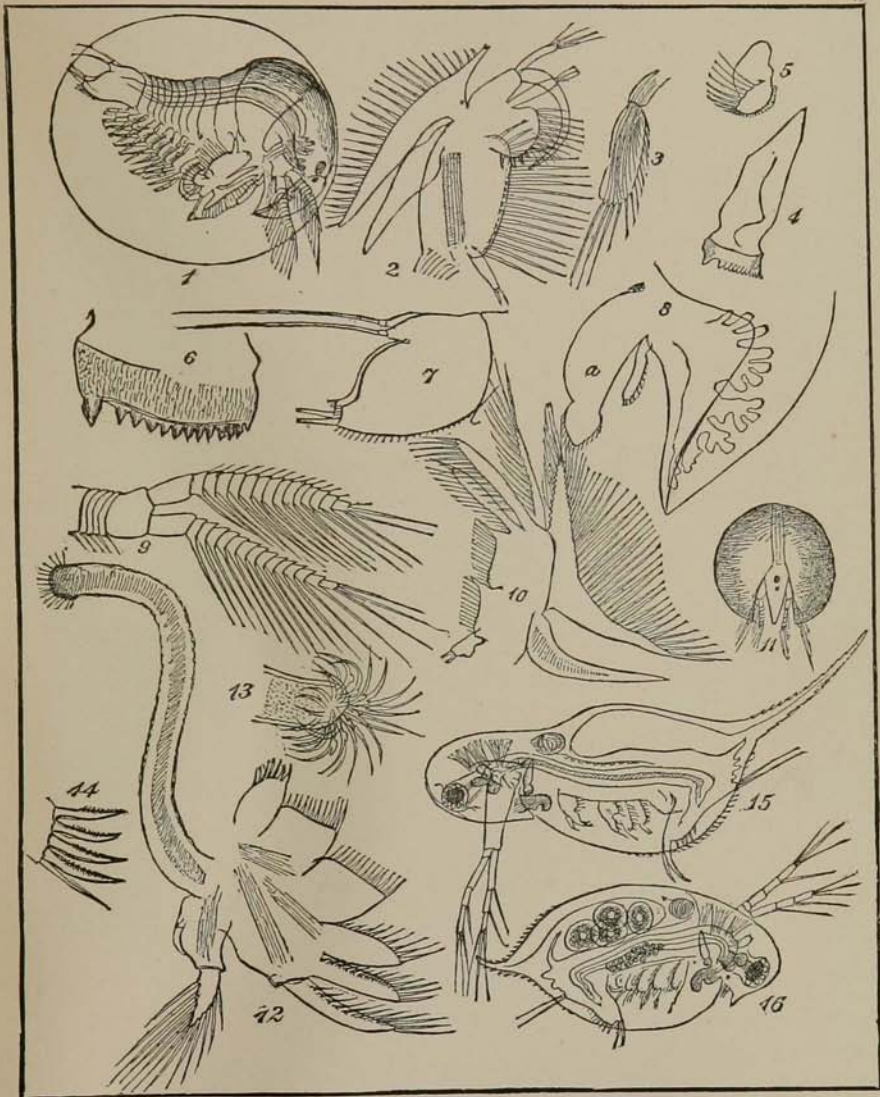


PLATE V.

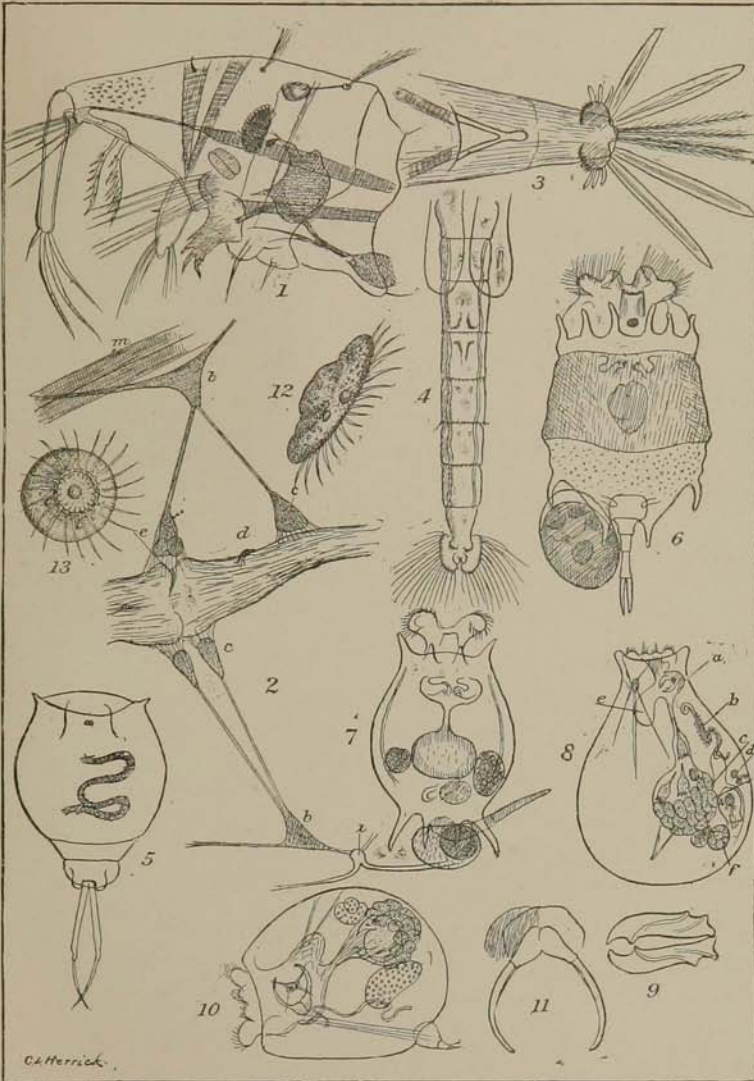
- Fig. 1. *Corethra appendiculata*, head of larva.
Fig. 2. " " portion of heart with its muscles.
a. chitinous projection of the body wall to which are attached two muscular threads; b. peripheral muscle; c. proximal muscle attached to the wall of the heart; d. muscles scattered over the surface of the heart, serving as contractors; e. venous opening.
Fig. 3. do., extremity of body.
Fig. 4. do., abdomen of the pupa.
Figs. 5, 6, 7. Rotifera found with entomostraca in Minnesota.
Fig. 8. Flask-shaped rotifer, hermaphrodite, with eggs and sperm.
a. jaws and head; b. shell gland; c. glandular portion of the stomach; d. testes; e. oesophagus; f. one of several embryos.
Fig. 9. jaws of the above.
Fig. 10. similar animal, female, deadly enemy to *Chydorus*.
Fig. 11. jaws of same.
Figs. 12, 13. ? pedicularis, ecto-parasite of *Diatomus*.

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PLATE V.

Geol. & Nat. Hist. Sur. Minn.



VI.

BOTANY.

BY WARREN UPHAM.



THE GEOLOGICAL AND NATURAL HISTORY SURVEY OF MINNESOTA.

N. H. WINCHELL, STATE GEOLOGIST.

CATALOGUE

OF THE

FLORA OF MINNESOTA,

INCLUDING ITS

PHENOGAMOUS AND VASCULAR CRYPTOGAMOUS PLANTS.

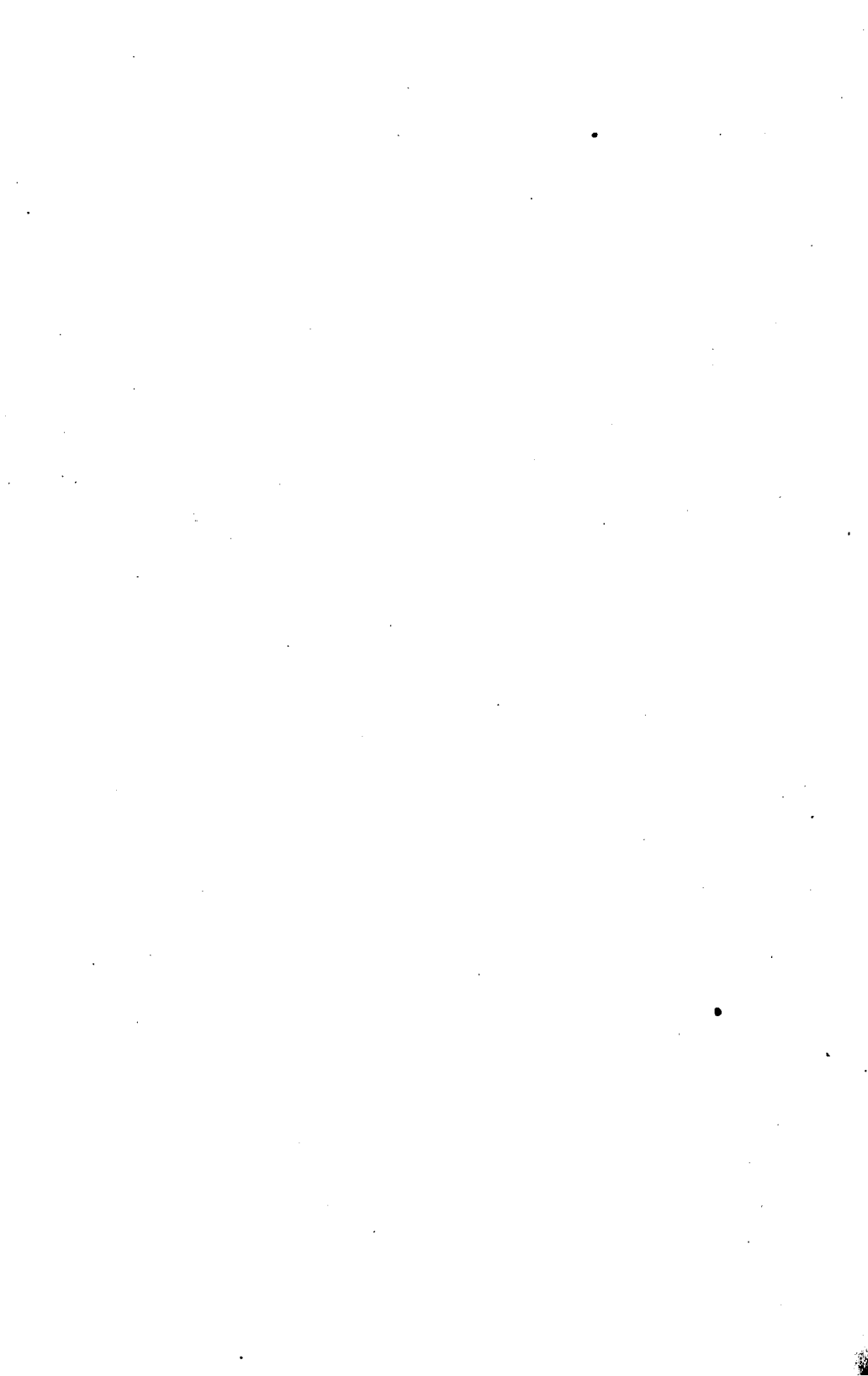
INDIGENOUS, NATURALIZED, AND ADVENTIVE.

BY WARREN UPHAM.

Part VI of the Annual Report of Progress for the Year 1883.

MINNEAPOLIS :
JOHNSON, SMITH & HARRISON.

1884.



THE FLORA OF MINNESOTA.

The following catalogue of the plants of Minnesota is presented as a report of progress in this department of the geological and natural history survey of the state. It includes not only the observations of the state geologist and his assistants upon this survey, but also those of earlier botanic collectors and explorers, enumerating all the species that are known to have been found in Minnesota by all observers up to the present time. Grateful mention of the various sources, in chronologic order, from which this list is largely a compilation, is therefore its most appropriate preface.

Hennepin, Carver, Pike, and other early explorers of this state, occasionally refer to some of its forest trees, wild fruits and berries, and plants used for food or medicine by the Indians. Carver, who traveled to the upper part of the Minnesota river in 1767, wrote of the region through which it flows:—"Wild rice grows here in great abundance; and every part is filled with trees bending under their loads of fruits, such as plums, grapes, and apples; the meadows are covered with hops, and many sorts of vegetables; whilst the ground is stored with useful roots, with angelica, spikenard, and ground-nuts." On the uplands bordering the river he saw "such amazing quantities of maples, that they would produce sugar sufficient for any number of inhabitants."

The first published list of plants, so far as known to the writer, that includes species found in Minnesota, is in the *American Journal of Science*, vol. iv, 1822, pages 56 to 69, entitled "Notice of the Plants collected by Professor D. B. Douglass, of West Point, in the expedition under Governour Cass, during the summer of 1820, around the Great Lakes and the upper waters of the Mississippi: the arrangement and description, with illustrative remarks, being furnished by Dr. John Torrey." This includes 115 species, 26 of which were from Minnesota.

The appendix of Keating's *Narrative of Major Long's Expedition* in the year 1823, along the Minnesota river and the Red river of

the North to lake Winnipeg, and thence by the lake of the Woods and Rainy lake to lake Superior, contains in pages 105 to 123, "a Catalogue of Plants collected in the North-western Territory by Mr. Thomas Say", who accompanied this expedition. These plants were determined and the catalogue prepared for publication by Lewis D. de Schweinitz, excepting the first five species which were by Nuttall. The flowering plants and ferns in this list include 124 species, 30 of which are referred definitely to Minnesota. Both the foregoing lists are arranged according to the Linnæan system.

In Schoolcraft's *Narrative of an Expedition through the upper Mississippi to Itasca lake, in 1832*, pages 160 to 165 are entitled "Localities of Plants collected in the Northwestern Expeditions of 1831 and 1832; by Douglass Houghton, M. D., Surgeon to the Expeditions." The genera in this list are arranged alphabetically, and include 247 species, 115 of which are referred to this state.

Nicollet's report, describing the basin of the upper Mississippi river, from explorations during the years 1836 to 1839, contains in pages 143 to 165, a "Catalogue of plants collected by Mr. Charles Geyer, under the direction of Mr. J. N. Nicollet, during his exploration of the region between the Mississippi and Missouri rivers: by Professor John Torrey, M. D." Of the 446 species in this catalogue, about 60 were collected in Minnesota, most of the others being from Dakota.

Owen's geological report presents in its appendix, in pages 606 to 622, a "Systematic Catalogue of Plants of Wisconsin and Minnesota, by C. C. Parry, M. D., made in connexion with the Geological Survey of the Northwest, during the season of 1848." The author states that "the number of plants comprised in this list is seven hundred and twenty-seven, included in one hundred and six natural orders." Many of them are particularly mentioned as occurring in this state, and often interesting descriptive notes are added, some of which are quoted in the following pages.

The next contribution to our knowledge of the flora of the state is by Mr. Thomas Clark, on the "Botany of the Northeastern Geological District of Minnesota", forming pages 73 to 82 of the report of the state geologist, Aug. H. Hanchett, M. D., in 1865. About a hundred species are here enumerated. Some thirty of them, however, only occur in cultivation, being mostly the common grains and garden vegetables, noted to show the agricultural capability of the region. The other species of this list include chiefly the most important forest trees, and such shrubby and herbaceous plants as seemed of special interest because of their fruit or medi-

cial qualities, accompanied with remarks respecting the size of the trees, and the abundance and geographical limits of the native species.

The most valuable of all the publications concerning the botany of Minnesota, and the only attempt, before the present, to give a complete list, so far as known, of our flora, was "a Catalogue of the Plants of Minnesota, by I. A. Lapham, LL. D., of Milwaukee, Wis.", which he prepared in 1865. Eight years later, soon after the initiation of the present survey of the state, he generously sent this manuscript to professor Winchell, as state geologist. It was published in the report of the State Horticultural Society for 1875. In the preface, Dr. Lapham states that he had consulted the lists of plants already enumerated from Douglass to Parry; but that his catalogue, nevertheless, rests chiefly upon his "own observations and collections made during several excursions into the State; one of which, in the spring of 1857, was extended to the waters of the Red River of the North." Dr. Lapham refers to his additional sources of information, as follows:—"In 1858 Mr. Robert Kennicott made collections of plants and animals in the Red River country which are preserved by the Northwestern University at Evanston, Illinois. Mr. Charles A. Hubbard collected expressly for me a large number of plants, including mosses and lichens, while on a tour from Lake Superior to Lake Winnipeg and Pembina, as well as while on his return by way of St. Paul. In 1861 Mr. T. J. Hale, while prosecuting geological investigations along the Mississippi river in connection with the Wisconsin State survey, made some collections of plants in Minnesota, a list of which he has kindly furnished to me. Several species are introduced upon his authority." The flowering plants and vascular cryptogams in this catalogue comprise 896 species, besides which it also enumerates 55 species of mosses, liverworts and lichens found in Minnesota. It is without notes, in respect to the part of the state where plants of limited range occur, and does not indicate whether the species are common or rare.

Mr. George M. Dawson's report to the British North American Boundary Commission, on the *Geology and Resources of the region in the vicinity of the Forty-ninth Parallel, from the Lake of the Woods to the Rocky Mountains*, published in 1875, contains in pages 351 to 379, a list of plants collected in this survey during the summers of 1873 and 1874, with notes of their localities and dates of collection, stating whether they were found in flower or in other stages of growth. This enumerates 636 phænogams and

vascular cryptogams, of which 289 were collected on the northern border of Minnesota, from the lake of the Woods to the Red river. Twenty-three species of mosses and lichens were also collected on this part of the international boundary. The rushes, sedges and grasses of this list were determined by Prof. John Macoun; by whom, as also by Mr. Dawson, some additional notes respecting their identifications of species and more recent collections in the same region and thence eastward to lake Superior, have been kindly furnished.

Another collection of plants, numbering about 300 species, was made on the same survey, along its extent from the Red river to the Rocky mountains, in connection with the U. S. Northern Boundary Commission, by Dr. Elliott Coues, who submitted them to Prof. J. W. Chickering for determination and report. With these were also incorporated the species of Mr. Dawson's list (excepting mosses and lichens), so far as they were not included in Dr. Coues' collection, making a catalogue of 692 species, besides several varieties; which was published in 1878 in the *Bulletin of the United States Geological Survey*, vol. iv, pages 801 to 830. Ninety-six species are stated to have been found at Pembina, situated on the Red river, adjoining Minnesota.

A few species of *Carex*, collected by Sir John Richardson at Rainy lake and the lake of the Woods, and determined by Dr. Francis Boott, are included in the botanical appendix of Richardson's *Arctic Expedition in Search of Sir John Franklin*; which also gives much valuable information as to the geographic limits northward of many of our plants.

A list of the ferns of Minnesota, collected by Miss E. W. Cathcart, comprising thirty species and three varieties, was published in 1877 in the *Bulletins of the Minnesota Academy of Natural Sciences*, vol. i, pages 303 and 304. This list includes two especially interesting species, the very rare *Phegopteris calcarea*, Fée, and *Woodsia scopulina*, Eaton, which here reaches its eastern limit.

The Report of the Minnesota Horticultural Society for 1884 contains, in pages 83 to 116, a valuable paper by Miss Sara Manning, on "The Wild Flowers of the Lake Pepin Valley", including a catalogue of 504 species.

In the same report, on pages 361 to 367, are "Notes on the Flora of western Dakota and eastern Montana adjacent to the Northern Pacific railroad," by John B. Leiberger, in which are frequent incidental references to Minnesota.

In the annual reports of the present *Geological and Natural Hist.*

ory Survey of Minnesota, notices of the botany of portions of the state have been published as follows:—

In the first annual report, for the year 1872, a "List of Plants, mostly herbaceous, in the neighborhood of St. Anthony, Minnesota; principally found on the University Grounds. 1869—1872. By Professor E. H. Twining." This includes 230 species.

In the report for 1873, lists of the trees and shrubs of the Big Woods, and of Big Stone lake, by Prof. Winchell.

In the report for 1874, lists of the trees and shrubs of Freeborn and Mower counties, by Prof. Winchell.

In the report for 1875, the trees and shrubs of Fillmore county, by Prof. Winchell; and of Olmsted, Dodge and Steele counties, by Prof. M. W. Harrington.

In the report for 1876, the trees and shrubs of Houston and Hennepin counties, by Prof. Winchell.

In the report for 1877, the trees and shrubs of Ramsey county, by Prof. Winchell; and of Rice county, by Prof. L. B. Sperry.

In the report for 1878, pages 35 to 46, "The Plants of the North Shore of Lake Superior. By B. Juni." This is a list, with numerous notes of localities and relative abundance, and occasional descriptive remarks, of 218 species collected by Mr. Juni, in the summer of that year, in connection with the party there engaged in geological exploration; with 58 additional species, collected in the vicinity of the University, at Minneapolis, including 25 species of *Carex*, while 23 others of this genus are in the list preceding.

In the report for 1879, pages 138 to 149, another list of "Plants of the North Shore of Lake Superior, collected by T. S. Roberts", in connection with the geological survey in that year, from July 26 to Sept. 2; including 220 species, with frequent notes of locality, relative abundance, and other description; 100 of these species being in addition to Mr. Juni's list.

And, in the report for 1880, pages 201 to 216, lists of 76 species of forest trees, 31 shrubs, and 259 herbaceous plants, identified by Mr. O. E. Garrison in the region of the head-waters of the Crow Wing river, the White Earth reservation, Itasca lake, and the upper Mississippi, during an exploration in the summer of that year for the Forestry Department of the United States Census.

Besides these publications, very important contributions of notes and specimens have been received from botanists throughout the state. Mr. John B. Leiber, of Mankato, supplied a list of about 750 species, collected in 1882, mostly in Blue Earth county, but

including also a considerable number from the southwest part of the state. Many specimens collected in Blue Earth county, and others from Dakota and Montana, have been donated by Mr. Leiberger to the State Museum. A list of about 500 species, observed chiefly in the vicinity of Minneapolis by the Young Naturalists' Club, was communicated by Mr. Thomas S. Roberts, by whom nearly all these species were determined, others being by Clarence L. Herrick, F. S. Griswold, and R. S. Williams. I am also indebted to Mr. Roberts for much further assistance in the preparation of the following catalogue. Manuscript lists, to which references are frequently made in stating the geographic range of species or localities of rare or local plants, were received from Mr. George B. Aiton, of Owatonna; Miss Franc E. Babbitt, of Little Falls; Miss F. S. Beane, of Faribault; Mrs. C. H. Bennett, of Pipestone City; Mrs. A. C. Blaisdell, of Saint Cloud; Mr. and Mrs. C. W. Blake, of Cannon River Falls; Miss Eloise Butler, of Minneapolis; Rev. E. V. Campbell, of Saint Cloud; Mrs. M. C. Carter, of Hesper, Iowa; Miss E. W. Cathcart, of Washington, D. C.; Prof. L. W. Chaney, Jr., of Northfield; Mr. R. I. Cratty, of Armstrong's Grove, Iowa; Miss Phebe A. Field, of Stillwater; Mr. Lewis Foote, of Worthington; Mr. O. E. Garrison, of Saint Cloud; Prof. C. J. Gedge, of Moorhead; Mr. H. F. Gibson, of Wabasha; Mr. W. H. Hatch, of Rock Island, Illinois; Dr. V. Havard, surgeon at Fort Pembina, Dakota; Mr. C. L. Herrick, of Minneapolis; Prof. John M. Holzinger, of Winona; Mr. B. Juni, of New Ulm; Mr. J. C. Kassube, of Minneapolis; Dr. and Mrs. H. C. Leonard, of Fergus Falls; Miss Sara Manning, of Lake City; Rev. John Pemberton, of Saint Paul; Mrs. J. W. Ray, of Lake City; Dr. J. H. Sandberg, of Red Wing; Rev. John Scott, of Emerson, Manitoba; Rev. H. M. Simmons, of Minneapolis; Mrs. E. H. Terry, of Saint Paul; and Prof. N. H. Winchell, of Minneapolis. Many observations in respect to the relative abundance and geographic range of species have been also noted by the writer during explorations for this survey.

Though not within the province of this catalogue, it seems desirable to mention here the lists of 775 species of Fungi, by Dr. A. E. Johnson, of Minneapolis, in the *Bulletins of the Minnesota Academy of Natural Sciences*, vol. i. These were nearly all collected by Dr. Johnson within the limits of Hennepin, Ramsey, Wright and Anoka counties. The fifth annual report of this survey, for the year 1876, contains the same, but with the notes somewhat abbreviated, to the number of 558 species, the extent to which the work had been carried at the date of that report. Dr. Johnson has also given much

attention to the study of the fresh-water algæ, determining a large number of species.

Another successful student of fresh-water algæ, especially of the Desmids, is Miss Eloise Butler, of Minneapolis. An article respecting these microscopic plants, by Mr. Francis Wolle, in the *Bulletin of the Torrey Botanical Club* for February, 1883 (vol. x, pages 13 to 21), enumerates eighteen species new to the United States, collected by Miss Butler in the vicinity of Minneapolis, including eight forms (three species and five varieties) new to science.

CONDITIONS DETERMINING THE CHARACTER OF THE FLORA.

In considering the botany of any district, its geographic position, elevation and contour, the climate, and the diverse rocks and soils which it presents, need to be briefly stated, since these circumstances control the development of the flora.

Minnesota lies in the middle of the North American continent, almost midway between the Atlantic and Pacific oceans and between the gulf of Mexico and the Arctic ocean, being distant a thousand miles or more from each of these grand bodies of water. The extent of the state from south to north is 380 miles, and its average width about 220 miles. It lies between 43° 30' and 49° north latitude, and between 90° and 97° west longitude. Its area is 84,286 square miles.

The topographic features of Minnesota may be briefly summed up for its western three-quarters, as being a moderately undulating, sometimes nearly flat, but occasionally hilly expanse, gradually descending from the Coteau des Prairies and from the Leaf hills, respectively about 2000 and 1700 feet above the sea, to half that height, or from 1000 to 800 feet, in the long flat basin of the Red river valley, and to the same height along the valley of the Mississippi from Saint Cloud to Minneapolis. The only exceptions to this moderately undulating or rolling and rarely hilly contour, are the southeast part of the state where the Mississippi river and its tributaries are enclosed by bluffs from 200 to 600 feet high, and the northwest shore of lake Superior and the part of the state lying north of this lake and east of Vermilion lake. A very bold rocky highland rises 400 to 800 feet above lake Superior, within from one to five miles back from its shore-line, all along the distance of 150 miles from Duluth to Pigeon point, the most eastern extremity of Minnesota; while farther north are many hill-ranges, 200 to 500 feet higher, mostly trending from northeast to southwest or from east to west.

Lake Superior is 602 feet above the sea. The shore of this lake is the lowest land in Minnesota, while its highest land is the Mesabi range, which, south of Vermilion lake and eastward, is found by Prof. Winchell to exceed 2000 feet above sea-level. Itasca lake, the head of the Mississippi, is about 1500 feet above the sea; and this river at the southeast corner of Minnesota, 620 feet. Professor Winchell estimates the average elevation of the entire state to be approximately 1275 feet above the sea.

Climate is the most important of the factors by which a flora is modified, and this depends chiefly on geographic position, elevation and contour, if a sufficiently large area is taken into account. The warmest days of summer in Minnesota have a temperature of about 90° Fahrenheit, but such days are rare; and the greatest cold of winter is — 30° or sometimes — 40°. The annual precipitation of moisture as rain and snow is from 25 to 30 inches. It is distributed somewhat equally throughout the year; damaging droughts or excessive rains seldom occur. In winter the snow in the south half of the state is commonly about a foot deep during two or three months; but farther north it attains an average depth of two or three feet.

The soil throughout the greater part of Minnesota consists of glacial drift, a mixture of clay, sand, gravel and boulders, clay being the principal ingredient, and boulders being usually infrequent. This deposit has been gathered from diverse formations of granite and gneiss, sandstone, limestone, and shales. Enriched at the surface by the decay of vegetation through centuries, the black soil on areas of the glacial drift has ordinarily a depth of one or two feet, and is very fertile. Other varieties of soil are found in tracts of gravel and sand, also generally quite fertile, which in many places border the large rivers and spread widely upon the region drained by the St. Croix and Crow Wing rivers and the upper Mississippi; in the lower alluvial bottomlands, which are mostly overflowed by the highest water of spring; on the cliffs of sandstone and limestone which border the rivers in the southeast part of the state; and on the hills of granite and crystalline schists north of lake Superior. Each peculiarity of soil affords a congenial location for plants which are absent or can not thrive elsewhere.

FOREST AND PRAIRIE.

The most important and conspicuous contrast presented by the vegetation covering different parts of Minnesota, is its division in forest and prairie. Forest covers the northeastern two-thirds of

the state, approximately; while about one-third, lying at the south and southwest, and reaching in the Red river valley to the international boundary, as also the part of this valley farther north to lake Winnipeg, is prairie. The line dividing these areas, having an almost wholly timbered region on its northeast side, and a region on its southwest side that is chiefly grassland, without trees or shrubs, excepting in narrow belts along the larger streams and occasional groves beside lakes, runs as follows. Entering the state from the north about fifteen miles east of Emerson and St. Vincent, it extends south-southeastward to Red Lake Falls, thirty-six miles east of Grand Forks; thence southeast and south, to the east end of Maple lake; thence southwesterly along this lake, and from it south to the Sand Hill river; thence southeasterly to the White Earth Agency; thence southerly, by Detroit and Pelican Rapids, to Fergus Falls, which is situated half-way from the north to the south line of the state; thence southeasterly, in a less direct and regular course, through Douglas, Stearns, Meeker, McLeod and Sibley counties, to the Minnesota river, and along that stream to Mankato and South Bend; thence easterly by Janesville, Waterville and Morristown, to Faribault; thence northerly, turning backward, to Minneapolis and Anoka, the loop thus formed, enclosing Wright, Carver, Scott, Le Sueur, and parts of adjacent counties, being the boundary of the area well known as the Big Woods; thence easterly, passing through Ramsey and Washington counties to Stillwater and Hudson, where it enters Wisconsin.

The Big Woods are principally made up of the following species of trees, arranged by Prof. Winchell in the estimated order of their abundance: white or American elm, basswood, sugar maple, black and bur oaks, butternut, slippery or red elm, soft or silver maple, bitternut, white and black ash, iron-wood, wild plum, June-berry, American crab-apple, common poplar or aspen, large-toothed poplar, tamarack (in swamps), box-elder, black cherry, cottonwood (beside rivers and lakes), water beech, willows, hackberry, paper or canoe birch, yellow birch, white oak, and red cedar. Farther northward white, red and jack pines, black and white spruce, balsam fir and arbor-vitæ are conspicuous in the forest, intermingled with deciduous trees. Its shrubs include prickly ash, smooth sumach, frost grape, Virginian creeper, climbing bitter-sweet, red and black raspberries, choke-berry, prickly and smooth gooseberries, black currant, and species of cornel, wolfberry, honeysuckle, elder, viburnum, and hazel-nut.

The most abundant species of grass found upon the prairies of southwestern Minnesota, are as follows: beard-grass (*Andropogon furcatus*, Muhl.), commonly here called "blue-joint," Indian grass (*Chrysopogon nutans*, Benth.), muskit-grass (*Bouteloua racemosa*, Lagasca), and porcupine grass (*Stipa spartea*, Trin.), common on land neither very dry nor very moist; another species of beard-grass (*Andropogon scoparius*, Michx.), and a second muskit-grass (*Bouteloua hirsuta*, Lagasca), common on dry swells; the fresh-water cord-grass (*Spartina cynosuroides*, Willd.), in sloughs, making the principal mass of their hay; and rice cut-grass (*Leersia oryzoides*, Swartz), with the last. The prairies also bear a great variety of flowers, including numerous species of aster, golden-rod, sunflower, blazing-star or button snakeroot, and prairie clover, and the rose, lily, harebell, phlox, gerardia, fringed gentian, and many others. Sometimes the view across miles of the prairie is made yellow and purple by the multitude of sunflowers, blazing-stars, and gerardias.

LIMITS OF SPECIES.

Gradual changes in the flora are observable in crossing the continent either from east to west or from north to south. Many species disappear as the traveler advances, while others, not before present, are met with. A large majority of the plants in the Pacific states are not found east of the Mississippi; and such limitation prevails almost without exceptions between the arctic and tropical zones. The central position of Minnesota therefore makes this a most interesting field for the notation of the limits of species.

Among our forest trees, the white and red pine, arbor-vitæ ("white cedar"), yellow birch, black ash and sugar maple reach their western limit at the east side of the Red river valley.

No tree of exclusively western range extends east into Minnesota, and the only shrubs thus noted are *Elæagnus argentea* (silver-berry), *Oenothera albicaulis* and *Amorpha microphylla*; but about fifty herbaceous plants belonging to the flora of the western plains and the Rocky mountains, and not yet known to occur east of the Mississippi river, are found within our limits. These include species of *Ranunculus*, *Aquilegia*, *Vesicaria*, *Linum*, *Astragalus*, *Oxytropis*, *Potentilla*, *Gaura*, *Peucedanum*, *Cymopterus*, *Gutierrezia*, *Aplopappus*, *Grindelia*, *Lepachys*, *Helianthus*, *Gaillardia*, *Senecio*, *Troximon*, *Plantago*, *Pentstemon*, *Orthocarpus*, *Echinosperrum*, *Collomia*, *Gentiana*, *Asclepias*, *Suæda*, *Comandra*, *Euphorbia*, *Allium*, *Carex*, *Sporobolus*, *Aristida*, *Buchloe*, *Elymus*, and *Beckmannia*.

A group of species, most notably represented in the pine and heath families, including our three pines, black spruce, balsam fir, tamarack and arbor-vitæ, huckleberry, blueberry, cranberry, snow-berry, aromatic wintergreen or checkerberry, Labrador tea, and the clintonia and dwarf cornel, extends through the northeast part of the state to limits approximately coinciding with the Mississippi river, Red lake and the lake of the Woods.

The northern limits of yellow birch, bur oak, sugar maple and basswood here coincide nearly with the international boundary. The red cedar, cottonwood, hornbeam, white, black and red oaks, butternut, bitter-nut or swamp hickory, hackberry, box-elder, frost grape and prickly ash reach their general northern limits in the north half of this state; but several of them, like many herbaceous species of similar range, continue somewhat farther northwestward into Manitoba. The shell-bark hickory, black walnut, red mulberry and Kentucky coffee-tree attain their most northern range in the south half of the state.

The accompanying map shows the portions of Minnesota respectively occupied by forest and prairie, and the approximate limits of many of our trees.*

INTRODUCED PLANTS.

About eight per cent. of the plants growing without cultivation in this state are introduced species, distinguished in the catalogue by being printed in Italics. Most of them are such as follow civilized man, and grow in his cultivated fields and gardens, in spite of all efforts to banish them. Among the most notable introduced weeds in this state may be mentioned mustard, cow-herb and cockle, specially troublesome in wheat-fields; shepherd's purse, purslane, mallow, May-weed, burdock, mullein, pigweeds, tumbleweed, black bindweed, curled or yellow dock, sheep sorrel, hemp, barnyard-grass, and foxtail or pigeon-grass, frequently too plentiful in cultivated ground, about dwellings, by the road-side, or on pasture-land. The ox-eye daisy or white-weed, Canada thistle and cheat or chess are sparingly established, and may become very common bad weeds here, as farther east. It should be added that, besides these immigrants, a considerable number of weeds native to this country are also common, including species of *Lepidium*, *Iva*, *Ambrosia*, *Helianthus* and *Stachys*. Up to the present time, only

*Its method of delineation is similar to that of Dr. Robert Bell's map, recently published by the Geological Survey of Canada, showing the general northern limits of the principal forest trees of Canada.

about half as many naturalized and adventive species are known in Minnesota as in the eastern states, the difference being due to the shorter time since the settlement of this state and the proportionately less numerous opportunities for them to gain a foot-hold here.

PRELIMINARY REMARKS ON THE CATALOGUE.

Under each species is a statement whether it is abundant, common, frequent, infrequent, or rare, and whether its geographic range extends throughout the state or to limits which are indicated approximately; or, when the observations are insufficient for such statement, the localities where the species has been noted are mentioned, with the names of the observers.

The arrangement of families, genera and species strictly follows the fifth edition of Gray's *Manual*; and wherever a synonym replaces any name that occurs in the *Manual*, the latter also is given, enclosed by marks of parenthesis.*

The popular names are mostly such as appear in Gray's *Manual* and Wood's *Class-Book*; but in a few instances other names, in general use in this state, and often specially significant, are inserted.

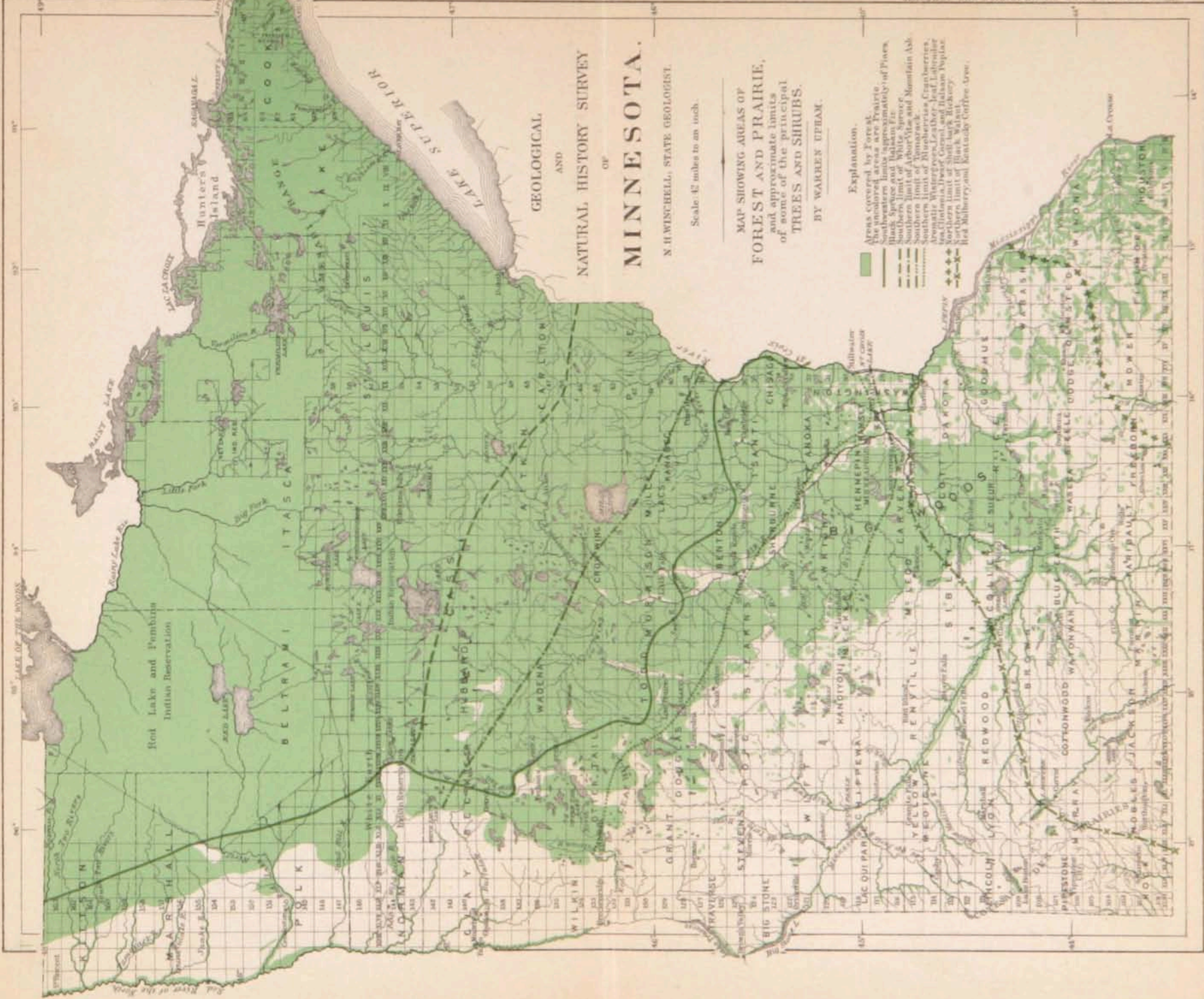
Introduced species are distinguished from the indigenous, as before mentioned, by being *Italicized*.

For the species of our flora that are not described in Gray's *Manual*, which only included those found east of the Mississippi, descriptions are quoted from other authorities.† The present work thus supplies, with Gray's *Manual*, the means of identifying all the flowering plants and ferns known to occur in Minnesota.

Determinations of numerous difficult species, and notes concerning them, have been kindly supplied by Prof. Asa Gray, Mr. Sereno Watson, Mr. William Boott, Dr. George Engelmann, Mr. M. S. Bebb, Rev. T. Morong, and other specialists; and I am indebted to Dr. George Vasey for the description of the new *Aristida basiramea*, Engelmann, posthumously published.

* The sources of improved nomenclature have been Watson's *Bibliographical Index to North American Botany* (Part I; Polypetalæ: 1878); Gray's *Synoptical Flora of North America* (Vol. II, Part I; Gamopetalæ after Compositæ: 1878); various papers by Professor Gray in the *Proceedings of the American Academy of Arts and Sciences*; Bailey's *Catalogue of North American Carices* (1884); Vasey's *Grasses of the United States* (1883); Eaton's *Ferns of North America* (1880); and notes in the *American Naturalist*, the *Botanical Gazette*, and the *Bulletin of the Torrey Botanical Club*.

† Chiefly from Watson's report on the Botany of King's *Exploration of the Fortieth Parallel*; Porter and Coulter's *Synopsis of the Flora of Colorado*; Rothrock's report on the Botany of Wheeler's *Surveys west of the One Hundredth Meridian*; Torrey and Gray's *Flora of North America*; and Gray's *Synoptical Flora*.



GEOLOGICAL
AND
NATURAL HISTORY SURVEY
OF
MINNESOTA.

N. H. WINCHELL, STATE GEOLOGIST.

Scale: 4" = 1 mile to an inch.

MAP SHOWING AREAS OF
FOREST AND PRAIRIE,
and approximate limits
of some of the principal
TREES AND SHRUBS.
BY WARREN UPRAM.

- Explanation.**
- Areas covered by Forest.
 - Unforested areas are Prairie.
 - Black Spruce and Balsam Fir.
 - Southern limit of White Spruce.
 - Southern limit of Arborvitae and Mountain Ash.
 - Southern limit of Mimuscaus, Crataegus, Aconitum, Wintergreen, Leather-leaf Labrador-tea, Clintonia, Deer, Ginseng, and Balsam Poplar.
 - Southern limit of Black Walnut.
 - Red Mulberry and Kentucky Coffee-tree.

CATALOGUE.

RANUNCULACEÆ. CROWFOOT FAMILY.

CLEMATIS, L. VIRGIN'S-BOWER.

C. verticillaris, DC. Virgin's-Bower.

Shady rocks at the head of lake St. Croix, *Parry*; St. Croix Falls, *Miss Field*; lake Pepin, *Miss Manning*; Winona County, *Holzinger*. Rare.

C. Virginiana, L. Common Virgin's-Bower.

Common, or abundant, southward; frequent northward; at Beaver Bay and summit of Black Point mountain north of lake Superior, *Roberts*.

ANEMONE, L. ANEMONE. WIND-FLOWER.

A. patens, L., var. *Nuttalliana*, Gray. Pasque-flower (i. e. Easter-flower). Pulsatilla. "Hartshorn-plant." "Headache-plant." "Gosling." "Prairie Smoke." "Crocus."

Abundant in all the prairie portion of the state. Its bruised leaves have a very pungent smell. This earliest flower of spring has received an unusual variety of popular names.

A. decapetala, L. (A. Caroliniana, Walt.) Carolina Anemone.

Frequent in the south part of the state, as in Hennepin, Goodhue, Blue Earth and Pipestone counties; extending north to Saint Cloud, *Campbell*, *Mrs. Blaisdell*, and Appleton, Swift county, *Miss Elwell*. South.

A. parviflora, Michx. Small-flowered Anemone.

Minneapolis, *Winchell*; upper Mississippi river, *Garrison*; Red river valley, *Gedge*. North.

A. multifida, DC. Many-cleft Anemone Red Wind-flower.

Dayton's bluff, Saint Paul, and between Saint Paul and Fort Snelling, *Miss Cathcart*; lake Superior to the lake of the Woods, *Macoun*. North.

A. cylindrica, Gray. Long-fruited Anemone.

Frequent throughout the state.

A. Virginiana, L. Virginian Anemone.

Common throughout the state.

A. dichotoma, L. (A. Pennsylvanica, L.) Pennsylvanian Anemone.

Common, often abundant, throughout the state.

A. nemorosa, L. Wind-flower. Wood Anemone.

Frequent, or common, throughout the state.

A. Hepatica, L. (*Hepatica triloba*, Chaix.) Liver-leaf. Round-lobed Hepatica.

Frequent southward, extending north at least to Duluth, *Miss Cathcart*, upper Mississippi river, *Garrison*, and Fergus Falls, *Leonard*.

A. acutiloba, Lawson. (*H. acutiloba*, DC.) Sharp-lobed Hepatica.

Common southward, extending north to Duluth, *Miss Cathcart*, and Mille Lacs county, *Upham*.

THALICTRUM, Tourn. MEADOW-RUE.

T. anemonoides, Michx. Rue-Anemone.

Often common southward, extending north to Stillwater, *Miss Field*, Anoka county, *Juni*, Stearns county, *Campbell*, and Fergus Falls, *Leonard*. Flowers nearly always purplish. (Abundant at Marine Mills, Washington county, often having more than one row of sepals and occasionally with all the stamens and pistils changed to sepals. *Miss Field*.)

T. dioicum, L. Early Meadow-Rue.

Common, or frequent, throughout the state.

T. purpurascens, L. Purplish Meadow-Rue.

Common, extending north at least to Morrison county, *Upham*, the St. Louis river, *Mrs. Herrick*, and in the Red river valley to Pembina, *Chickering*. (Specimens collected by *Prof. Gedge* at Glyndon, Clay county, have the shining upper surface of the very large leaflets waxy, as if varnished, but the lower surface minutely pubescent or glabrous, not waxy.)

T. Cornuti, L. Tall Meadow-Rue.

Common, or frequent, throughout the state.

RANUNCULUS, L. CROWFOOT. BUTTERCUP.

R. aquatilis, L., var. **stagnatilis**, DC. (*R. divaricatus*, Gray's *Manual*.) Stiff Water-Crowfoot.

Ponds near Mankato, *Leiberg*; Minneapolis, *Roberts, Herrick*; Stearns county, *Upham*; Alexandria, *Mrs. Terry*. Infrequent.

R. aquatilis, L., var. **trichophyllus**, Chaix. Common White Water-Crowfoot.

Frequent throughout the state.

R. multifidus, Pursh. Yellow Water-Crowfoot.

Common throughout the state.

R. ambigens, Watson. (*R. alismæfolius*, in *Manual*.) Water Plantain Spearwort.

Stearns county, *Campbell*. Infrequent. North.

R. Flammula, L. Small Spearwort.

Minneapolis, *Roberts*. Rare.

R. Flammula, L., var. **reptans**, Meyer. Creeping Spearwort.

Stillwater, *Leonard*; Minneapolis, *Roberts*; Anoka county and New Ulm, *Juni*; lake of the Woods, *Dawson*. Frequent.

R. Cymbalaria, Pursh. Sea-side Crowfoot.

Common, or frequent, throughout the state, excepting southeastward. Grand Portage, lake Superior, also at New Ulm (common), *Juni*; Little Rock, upper Minnesota river, *Parry*; Nicollet county, *Aiton*; Stearns county, and the Red river valley (common), *Upham*; Fergus Falls, *Leonard*; Worthington (common), *Foote*.

- R. affinis**, R. Br.* Rough-fruited Crowfoot.
Lake of the Woods, *Dawson*. Northwest.
- R. affinis**, R. Br., var. **cardiophyllus**, Gray.†
In the Red river valley at Pembina, *Chickering*. West.
- R. rhomboideus**, Goldie. Rhomboid-leaved Crowfoot. Dwarf Buttercup.
Frequent, or common, throughout the state.
- R. abortivus**, L. Small-flowered Crowfoot.
Frequent, or common, throughout the state.
- R. abortivus**, L., var. **micranthus**, Gray.
Minneapolis, *Winchell*; Pipestone county, *Mrs. Bennett*. Infrequent.
- R. sceleratus**, L. Cursed Crowfoot.
Frequent, or common, throughout the state.
- R. recurvatus**, Poir. Hooked Crowfoot.
Frequent throughout the state; reaching its northwestern limit at the lake of the Woods, *Macoun*.
- R. Pennsylvanicus**, L. Bristly Crowfoot.
Common throughout the state.
- R. fascicularis**, Muhl. Early Crowfoot.
Frequent, or common, throughout the south half of the state; infrequent northward.
- R. repens**, L. Creeping Crowfoot.
Abundant throughout the state.
- R. repens**, L., var. **hispidus**, Torr. & Gray.‡ (*R. hispidus*, Michx.)
Red river valley near Saint Vincent (in a swamp), *Dawson*; common from Manitoba westward, *Macoun*.
- R. bulbosus*, L. *Bulbous Crowfoot or Buttercups*.
Northfield, *Chaney*; Minneapolis, *Mrs. Terry*. Rare.
- R. acris*, L. *Tall Crowfoot or Buttercups*.
Infrequent, but noted at many places, as Lake City, Faribault, Northfield, Minneapolis, Northern Pacific Junction, Carlton county, and on the upper Mississippi river. "Becoming common in the eastern part of Manitoba," *Macoun*.

***RANUNCULUS AFFINIS**, R. Br. Radical leaves petioled, usually pedately multifid; cauline ones sessile, digitate, with broadly linear lobes; stem erect, few-flowered; carpels with recurved beaks, in oblong cylindrical heads; more or less pubescent throughout. *Watson's Rep. in King's Expl. of the Fortieth Parallel*.

†**R. AFFINIS**, R. Br., var. **CARDIOPHYLLUS**, Gray. Hirsutely pubescent, radical leaves round-cordate, undivided or many-cleft; cauline ones palmately many-cleft; flower 1 inch in diameter. *Porter and Coulter's Flora of Colorado*.

‡**RANUNCULUS REPENS**, L., var. **HISPIDUS**, Torr. & Gray. Stem erect, 1½ to 2 feet high, branching and, with the petioles, very pilose with spreading hairs; leaves trifoliate; leaflets distinctly petiolulate, oval, acute, lacinate; pedicels with the pubescence appressed; flowers as large as in *R. acris*; calyx appressed; carpels smooth, pointed with a very short style. *Torrey and Gray's Flora of N. A.*, vol. 1, pp. 22 and 658.

ISOPYRUM, L. ISOPYRUM.**I. biternatum, Torr. & Gray. False Rue-Anemone.**

Frequent, or common, throughout the south half of the state; extending north at least to Fergus Falls, *Leonard*

CALTHA, L. MARSH MARIGOLD.**C. palustris, L. Marsh Marigold. "Cowslip."**

Abundant, or common, throughout most of the state; less frequent westward.

COPTIS, Salisb. GOLDTHREAD.**C. trifolia, Salisb. Three-leaved Goldthread.**

Common northward; extending south to Minneapolis, *Roberts*, and Lake City (rare), *Miss Manning*.

AQUILEGIA, Tourn. COLUMBINE.**A. Canadensis, L. Wild Columbine. "Honeysuckle."**

Common, or frequent, throughout the state.

Found, according to *Miss Babbitt*, with white flowers during several years in the south edge of the village of Little Falls, Morrison county, not associated at that locality with the usual type; also some with flowers clear white, others cream-colored, and yet others of the ordinary kind, all growing together west of the Mississippi river, opposite to Little Falls, and likewise near Fort Ripley, in the same county.

A. brevistyla, Hook.* Short-styled Columbine.

In the Red river valley at Pembina, *Clickering*. West.

DELPHINIUM, Tourn. LARKSPUR.**D. exaltatum, Ait. Tall Larkspur.**

Frequent through the south half of the state; extending north to the upper Mississippi river, *Garrison*, and Fergus Falls, *Leonard*.

D. tricorne, Michx. Dwarf Larkspur.

St. Paul, *Miss Cathcart*; Pipestone county, *Mrs. Bennett*. Infrequent. South.

D. azureum, Michx. Azure Larkspur.

Common southward; extending north to the upper Mississippi river, *Garrison*, and Manitoba, *Macoun*.

D. Consolida, L. Field Larkspur.

Rarely adventive. Minneapolis, *A. W. Jones*.

HYDRASTIS, L. ORANGE-ROOT.**H. Canadensis, L. Orange-root. Yellow Puccoon.**

Stearns county, *Garrison*. Rare. Southeast.

***AQUILEGIA BREVISTYLA, Hook.** Stems low, 6 to 8 inches high, spreading; leaves bi-tri-ovate; leaflets 3-lobed, crenate, 6 to 9 lines [twelfths of an inch] long, crenatures ovate, rotund; flowers small, blue, about 6 lines long, including the spur; sepals oblong, ovate; petals a little exceeding the stamens; spurs hooked at the tip; styles shorter, included. *Porter and Coulter's Flora of Colorado*.

ACTÆA, L. BANEBERRY.

A. spicata, L, var. **rubra, Ait.** Red Baneberry.
Common through the wooded portions of the state.

A. alba, Bigelow. White Baneberry.

Common, with same extent as the last. Berries frequently borne on slender, green pedicels.

NIGELLA, L. FENNEL-FLOWER.

*N. Damascena, L.** Fennel-flower.

Escaped from cultivation, Mankato, *Leiberg*.

MENISPERMACEÆ. MOONSEED FAMILY.**MENISPERMUM, L. MOONSEED.**

M. Canadense, L. Canadian Moonseed.

Frequent, often common, southward; extending north to Todd county and the northwest side of Mille Lacs, *Upham*; also in the Red river valley near Saint Vincent, *Dawson, Harvard*. (Its long, slender, bitter, yellow root is used by the Sioux as a medicine, being called *Pejuta zizi*; and from this came the name *Pejuta zizi*, or Yellow Medicine river. *T. M. Young*.)

BERBERIDACEÆ. BARBERRY FAMILY.**BERBERIS, L. BARBERRY.**

B. vulgaris, L. Common Barberrry.

Spontaneous in old fields, Mankato, *Leiberg*.

CAULOPHYLLUM, Michx. BLUE COHOSH.

C. thalictroides, Michx. Blue Cohosh. Pappoose-root.

Common, or frequent, excepting northeastward.

PODOPHYLLUM, L. MAY-APPLE. MANDRAKE.

P. peltatum, L. May-Apple. Mandrake.

Common southeastward, extending north to Goodhue and Rice counties.

NYMPHÆACEÆ. WATER-LILY FAMILY.**BRASENIA, Schreber. WATER-SHIELD.**

B. peltata, Pursh. Water-Shield.

Rainy lake and lake of the Woods, *Macoun*; Pleasant lake, near Saint Cloud.

**Nigella Damascena, L.* Flowers bluish, rather large, surrounded and overtopped by a finely divided leafy involucre, like the other leaves; succeeded by a smooth inflated 5-celled pod, in which the lining of the cells separates from the outer part. *Gray's Field, Forest, and Garden Botany.*

Campbell; Benton county, *Uphan*; shallow lakes near St. Croix river, *Parry*; White Bear lake, Ramsey county, *Simmons*; Minneapolis, *Herrick*; Excelsior, *Mrs. Terry*; Fergus Falls, *Leonard*. Infrequent.

NELUMBIUM, Juss. **NELUMBO**. SACRED BEAN.

N. luteum, Willd. Yellow Nelumbo. Water Chinquapin. "Rattle-box."

Upper Mississippi river, *Houghton*; lake Minnetonka (north end of Halsted's bay), *Roberts*; Mendota, *Mrs. Terry*; Mississippi river at Red Wing. *Sandberg*, near Dresbach, Winona county, *Winchell*, and at La Crosse, *Swezey*. Rare.

NYMPHÆA, Tourn. **WATER-NYPH**. **WATER-LILY**.

N. odorata, Ait. Sweet-scented Water-Lily.

Plentiful in lakes along the international boundary northwest of lake Superior, *Winchell*. Abundant throughout Quebec and Ontario and extending west ward to the lake of the Woods, *Macoun*. This species probably occurs also in central and southern Minnesota, in company with the following. *Mr. Leiberg* reports the examination of a great number of *Nymphæa* rootstalks, none of them bearing tubers, at Lake Crystal, Blue Earth county.

N. odorata, Ait., var. **minor**, Sims. Smaller Sweet-scented Water-Lily.

Turtle lake, Otter Tail county (flowers only one and a half inches broad), *H. B. Ayres*. Rare.

N. tuberosa, Paine. Tuber-bearing White Water-Lily.

The white lilies common or frequent in ponds or lakes throughout the state, excepting near its west side, which have been called *Nymphæa odorata*, are believed to belong instead, for the most part, to this species. "Flowers large and delicately beautiful, fragrant." (*Wheeler and Smith*.) "This is really the water-lily of the Great lakes, as the true *N. odorata* seems to be confined to the northern waters, both lakes and rivers." (*Macoun*.)

NUPHAR, Smith. **YELLOW POND-LILY**. **SPATTER-DOCK**.

N. advena, Ait. Common Yellow Pond-Lily.

Common throughout the state.

N. luteum, Smith. Smaller Yellow Pond-Lily.

In small lakes east of the lake of the Woods, *Macoun*.

N. pumilum, Smith. (*N. luteum*, Smith, var. *pumilum*, Gray.) Small Yellow Pond-Lily.

Plentiful in Duluth harbor, *Roberts*; north shore of lake Superior, *Agassiz*; east shore of Rainy lake (rather rare), *Macoun*; Morrison county, *Miss Babbitt*.

SARRACENIACEÆ. **PITCHER-PLANT FAMILY**.

SARRACENIA, Tourn. **SIDE-SADDLE FLOWER**.

S. purpurea, L. Pitcher-Plant. Huntsman's Cup.

Common northward, extending south to Minneapolis, *Roberts*, *Winchell*; rare farther southeast.

PAPAVERACEÆ. POPPY FAMILY.

PAPAVER, L. POPPY.

P. somniferum, L. *Common Poppy. Opium Poppy.*
Adventive in old gardens, Mankato, *Leiberg*.

SANGUINARIA, Dill. BLOOD-ROOT.**S. Canadensis**, L. Blood-root.

Common, or abundant, throughout most of the state; less frequent westward, as at Fergus Falls, *Leonard*, and Pembina, *Havard*; rare north of lake Superior, *Clarke*.

FUMARIACEÆ. FUMITORY FAMILY.

DICENTRA, Bork. DICENTRA.**D. Cucullaria**, DC. Dutchman's Breeches.

Common southward; extending north at least to Stillwater, Anoka and Stearns counties, and Fergus Falls.

D. Canadensis, DC. Squirrel Corn.

Saint Paul, *Miss Cathcart*; Minneapolis, *Twining*; Faribault, *Miss Beane*; Blue Earth county, *Leiberg*.

CORYDALIS, Vent. CORYDALIS.**C. glauca**, Pursh. Pale Corydalis.

Common north of lake Superior, *Roberts*; extending south to Stearns and Benton counties, *Upham*, and to the falls of the St. Croix river, *Parry*, *Miss Field*.

C. flavula, DC. Yellow Corydalis.

Thomson, Duluth and Taylor's Falls, *Miss Cathcart*; upper Mississippi river, *Garrison*; Red river valley, *Gedge*; Blue Earth county, *Upham*.

C. aurea, Willd. Golden Corydalis.

Common, or frequent, through the north half of the state; less frequent southward.

C. aurea, Willd., var. **micrantha**, Engelm.

Martin county, Minnesota, and Emmet county, Iowa (rare), *Cratty*.

FUMARIA, L. FUMITORY.*F. officinalis*, L. *Common Fumitory.*

Adventive, Winona, *Holzinger*.

CRUCIFERÆ. MUSTARD FAMILY.

NASTURTIUM, R. Br. WATER-CRESS.*N. officinale*, R. Br. *True Water-Cress.*

Stearns county, *Mrs. Blaisdell*; New Ulm, *Juni*; cold springs, Kasota, *Leiberg*; Tuttle's creek, Minneapolis, *Kassube*; lake Pepin, *Miss Manning*. Infrequent.

N. sinuatum, Nutt. Water-Cress.

Upper Mississippi river, *Garrison*; New Ulm, *Juni*; Pipestone county, *Leiberg*;
lower Minnesota river, *Parry*; lake Pepin, *Miss Manning*.

N. sessiliflorum, Nutt. Water-Cress.

Lapham. Winona county, *Holzinger*. South.

N. palustre, DC. Marsh Cress.

Common, or frequent, throughout the state.

N. palustre, DC., var. **hispidum**, Fisch. & Mey.

Redwood Falls, *Pemberton*. Perhaps the prevailing form of the species in this state.

N. lacustre, Gray. Lake Cress.

Lapham. Southeast.

N. Armoracia, Fries. Horse-radish.

Adventive, Mankato, *Leiberg*; Northfield, *Chaney*.

DENTARIA, L. TOOTHWORT. PEPPER-ROOT.**D. diphylla**, Michx. Two-leaved Pepper-root.

Freeborn and Blue Earth counties, *Upham*; lake Superior, *Whitney*. East.

D. laciniata, Muhl. Toothwort.

Frequent southeastward; extending northwest to Saint Paul, *Miss Cathcart*, Mar-
tin county, *Cratty*, and Fergus Falls, *Leonard*.

CARDAMINE, L. BITTER CRESS.**C. rhomboidea**, DC. Spring Cress.

Frequent, or common, throughout the state.

C. pratensis, L. Cuckoo Flower.

Lake Superior to the sources of the Mississippi, *Houghton*. North.

C. hirsuta, L. Small Bitter Cress.

Common through the north half of the state; less frequent or rare southward.
Glabrous specimens are sent by *Mr. Cratty* from Emmet county, Iowa. "A peculiar
form grows on the height of land west of lake Superior, which seems to connect the
species with the following variety," *Macoun*."

C. hirsuta, L., var. **sylvatica**, Gray.

Lake Minnetonka, *Roberts*, *Herrick*; Martin county (in woods), *Cratty*, deter-
mined by *Watson*.

ARABIS, L. ROCK CRESS.**A. lyrata**, L. Rock Cress.

Common, or frequent, through the north half of the state; extending thus south to
Red Wing (common), *Sandberg*, and Winona, *Holzinger*; wanting southwestward.

A. dentata, Torr. & Gray. Rock Cress.

Woods. Blue Earth county, *Leiberg*; Martin county (plentiful), *Cratty*. South.

A. hirsuta, Scop. Hairy Rock Cress.

Frequent throughout the state.

A. lævigata, Poir. Smooth Rock Cress.

Lake Pepin, *Miss Manning*; Goodhue county, *Sandberg*; Minneapolis, *Twining*, *Roberts*; Isanti and Sherburne counties, *Upham*; Stearns county, *Garrison*; lake Superior, *Whitney*.

A. Canadensis, L. Sickie-pod.

Frequent through the south half of the state; extending north to the upper Mississippi river, *Garrison*.

A. perfoliata, Lam. Tower Mustard.

Poplar river, lake Superior, *Juni*; upper Mississippi river, *Garrison*; Stearns county, *Campbell*; Blue Earth county, *Leiberg*; lake Pepin, *Miss Manning*.

A. Drummondii, Gray. Drummond's Tower Mustard.

Frequent, often common, throughout the state.

THELYPODIUM, Endl. ROCK CRESS.**T. pinnatifidum**, Watson. (*Arabis hesperidoides*, Gray). Rock Cress.

Northfield, *Chaney*. South.

BARBAREA, R. Br. WINTER CRESS.**B. vulgaris**, R. Br., var. *stricta*, Regel. Winter Cress. Yellow Rocket.

Put in bay, lake Superior, *Juni*; upper Mississippi river, *Garrison*; Minneapolis, *Roberts*.

ERYSIMUM, L. TREACLE MUSTARD.**E. cheiranthoides**, L. Worm-seed Mustard.

Frequent, or common, throughout the state.

E. asperum, DC.* Prairie Rocket. Western Wall-flower.

Abundant at Walthalla, Dakota, thirty miles west of the Red river, *Scott*; "a very prominent object on dry, gravelly soil throughout the prairie region" of Manitoba, *Macoun*, and ranging thence south to Mexico; doubtless extending sparingly into the west edge of Minnesota; also found by *Rev. J. Pemberton* at Redwood Falls, and by *Dr. Sandberg* on the limestone bluff of Belle creek opposite to the mill in Vasa, Goodhue county, occurring (like *Vesicaria Ludoviciana* in the same county) far east from its general limit.

E. parviflorum, Nutt.† Small-flowered Prairie Rocket.

Red river valley, *Dawson*, *Scott*; Minneapolis (beside railroad a mile southeast from the university: determined by *Mr. Watson* as this species; having light yellow "petals but half longer than the (3 to 4 lines long) sepals"; yet much branched near the base, numerous stems of nearly equal height (1 to 1½ feet) being thus sent up from a single root; leaves narrowly lanceolate, mostly entire; pods about 1½ inches long, beaked with a stout style, erect on short pedicels), *Upham*. West.

***ERYSIMUM ASPERUM**, DC. Biennial, canescent with short appressed hairs: stems solitary and simple, rarely branched above, 1 to 3 feet high, or less; leaves oblanceolate or narrowly spatulate; the cauline linear to linear-lanceolate, entire or sparingly repand with short acute teeth, 1 to 3 inches long: sepals narrow, 4 to 6 lines long, strongly gibbous: petals 8 to 12 lines long, light yellow to deep orange or purple: pods 1 to 4 inches long, a line wide, beaked with a stout style, ascending on stout spreading pedicels 3 lines long. *Brewer and Watson's Botany of California*.

†See description of **ERYSIMUM PARVIFLORUM**, Nutt., on next page.

SISYMBRIUM, L. HEDGE MUSTARD.

S. officinale, Scop. *Hedge Mustard*.

A common or frequent weed through the south half of the state.

S. Thaliana, Gay. *Mouse-ear Cress*.

Minneapolis, *Winchell*, *Miss Butler*. Rare.

S. canescens, Nutt. *Tansy Mustard*.

Frequent, or common, throughout the state.

S. canescens, Nutt., var. **brachycarpum**, Torr. & Gray.*

Red river valley, *Dawson*. North.

BRASSICA, Tourn. MUSTARD.

B. Sinapisstrum, Boiss. *Charlock. Field Mustard*.

A common or frequent weed in grain-fields throughout the state; so troublesome in the Red river valley and southwestward that farmers allowing it to go to seed are subjected to a penalty by law.

B. alba, Gray. *White Mustard*.

Lake City, *Miss Manning*; Goodhue county, *Sandberg*; Blue Earth county, *Leiberg*; Stearns county, *Garrison*. Rare.

B. nigra, Koch. *Black Mustard*.

A common or frequent weed through the south half of the state.

B. campestris, L.† *Kale*.

Common in fields in Manitoba and around Winnipeg, *Macoun*; doubtless also in the Red river valley in this state.

DRABA, L. WHITLOW-GRASS.

D. arabisans, Michx. *Whitlow-Grass*.

North shore of lake Superior, *Juni*. Infrequent. North.

D. nemorosa, L., var. **hebecarpa**, Lindb. (*D. nemoralis*, Ehrh.)

About Rainy lake, *Drummond* (*Macoun*). North.

ERYSIMUM PARVIFLORUM, Nutt. (*E. lanceolatum*, Hook.) Canescently scabrous with an appressed 2-parted pubescence; stem low (about a foot high) and nearly simple; leaves remarkably narrow, all linear or somewhat lanceolate, almost wholly entire, densely clustered at the base of the stem; siliques long, erect; stigma emarginate; flowers small, sulphur yellow; claws of the petals longer than the calyx. Distinguished from *E. cheiranthoides* by its more pubescent leaves, [longer] siliques and larger flowers. *Torrey and Gray's Flora of N. A.*

***SISYMBRIUM CANESCENS**, Nutt., var. **BRACHYCARPUM**, Torr. & Gray. Lobes of the leaves somewhat acute, and, with the stem, furnished with minute stipitate glands; petals rather longer than the calyx; siliques scarcely attenuate at the base, somewhat longer than the pedicels. *Torrey and Gray's Flora of N. A.*

†*Brassica campestris*, L. Annual weed in cultivated fields and waste places; stem 1½ to 3 feet high, with a few scattered, reversed hairs below; leaves somewhat fleshy and glaucous, lower lyrate-dentate, subciliate, 3 to 7 inches long, one-third as wide, the upper ones smaller, entire with rounded clasping lobes at base, tapering to an obtuse point; raceme 1 to 2 feet long; sepals erect, spreading; corolla yellow, 4 to 5 lines in diameter; siliques 1½ inches long, with the style ½ inch; seeds small, dark brown. *Wood's Class-Book*.

D. nemorosa, L., var. **leiocarpa**, Lindb.* (D. lutea, Gilib. [DC.]

Stearns county, *Campbell*; near Glyndon, *Gedge*; Pipestone county, *Mrs. Bennett*.
Rare. North and west.

D. Caroliniana, Walt. Whitlow-Grass.

Frequent southward, extending north to Stearns county, *Mrs. Blaisdell*, and west to Pipestone county, *Mrs. Bennett*.

D. Caroliniana, Walt., var. **micrantha**, Gray.

Common in Iowa, *Arthur*; doubtless occurring also in Minnesota.

D. verna, L. Whitlow-Grass.

Saint Paul, *Miss Cathcart*. Rare. South.

ALYSSUM, Tourn. ALYSSUM.*A. calycinum*, L. *Alyssum*.

Minneapolis, *Juni, Roberts*; Lake County, *Miss Manning*; Nicollet county, *Aiton*.
Infrequent.

VESICARIA, Tourn. BLADDER-POD.**V. Ludoviciana**, DC.† Bladder-pod.

Red river valley, *Scott*, determined by *Watson*; also, Mississippi river bluffs, Red Wing, *Sandberg*. West.

CAMELINA, Crantz. FALSE FLAX.*C. sativa*, Crantz. *False Flax*.

Minneapolis, *Juni*; along railways, Blue Earth county (introduced in flax-seed), *Leiberg*; Emmet county, Iowa (rare), *Cratty*; Pipestone county, *Mrs. Bennett*; Red river valley, *Dawson*. Infrequent.

SUBULARIA, L. AWLWORT.**S. aquatica**, L. Awlwort.

Found in about three feet of water, on sandy bottom in Vermilion bay, on Eagle lake, Canadian Pacific railway, Manitoba, near Rainy lake; abundant both in flower and fruit, Sept 13, 1882, *Fletcher, Macoun*. This rare species probably also occurs, and should be looked for, in northern Minnesota.

CAPSELLA, Vent. SHEPHERD'S PURSE.*C. Bursa-pastoris*, Mœnch. *Shepherd's Purse*.

A very abundant weed throughout the state.

***DRABA NEMOROSA**, L., var. **LEIOCARPA**, Lindb. Pubescent; stem branching, leafy, 6 to 15 inches high, very slender, sometimes branching from the base; pubescence simple or forked; leaves oval, cauline ones lanceolate, toothed; flowers very small, yellow; petals about twice as long as the calyx; style none; silicles oblong-elliptical, rather obtuse, glabrous, about 4 lines long, one-third to one-half the length of the slender spreading pedicels. *Porter and Coulter's Flora of Colorado*.

†**VESICARIA LUDOVICIANA**, DC. Canescent with a stellate pubescence; stem 6 to 8 inches high, simple, or somewhat branched above; radical leaves spatulate, entire, obtuse, cauline linear; flowers golden yellow; petals obovate; style slender, longer than the ovary and nearly as long as the obovate, globose, hairy silicle. *Porter and Coulter's Flora of Colorado*.

THLASPI, Tourn. PENNYCRESS.

T. arvense, L. *Field Pennygrass. Mithridate Mustard.*

Lapham. Pembina, Havard. "Abundant on the Red river near the older settlements" [in Manitoba]; "not yet common as far south as the forty-ninth parallel, but rapidly spreading. A most noxious weed." *Dawson.*

LEPIDIUM, L. PEPPERWORT. PEPPERGRASS.

L. Virginicum, L. Wild Peppergrass.

Common, or frequent, throughout the state, excepting perhaps northward.

L. intermedium, Gray. Wild Peppergrass.

Abundant (petals usually wanting) throughout the state. Both species are native weeds.

CAKILE, Tourn. SEA-ROCKET.

C. Americana, Nutt. American Sea-Rocket.

"Abundant on the sandy south shore" of lake Superior, *Whitney*; at Thunder bay, *Macoun*; doubtless also on the shore of lake Superior in Minnesota.

CAPPARIDACEÆ. CAPER FAMILY.

POLANISIA, Raf. POLANISIA.

P. graveolens, Raf. Heavy-scented Polanisia.

Common through the south half of the state, extending north at least to Douglas county, *Mrs. Terry*; probably also in the Red river valley. (Two varieties are common at Minneapolis, one bearing yellowish, and the other pinkish flowers. *Herrick.*)

CLEOME, L. CLEOME. SPIDER FLOWER.

C. integrifolia, Torr. & Gray.* Cleome. Spider Flower.

Mankato. Upham, Leiberg. An immigrant from the plains west of Minnesota. Southwest.

VIOLACEÆ. VIOLET FAMILY.

VIOLA, L. VIOLET.

V. rotundifolia, Michx. Round-leaved Violet.

North of lake Superior (common), *Roberts*; upper Mississippi river, *Garrison*; extending south to Minneapolis, *Griswold*, and Saint Paul, *Miss Cathcart.*

***CLEOME**, L. Sepals distinct or somewhat united. Stamens 6 or rarely 4. Torus minute. Pod linear or oblong, sessile or stipitate. Annual herbs, or shrubs, with digitate or simple leaves and racemed or solitary flowers. *Benth. & Hook.*

CLEOME INTEGRIFOLIA, Torr. & Gray. Annual, somewhat glaucous, 2 to 3 feet high, widely branching; leaves 3-foliolate; leaflets lanceolate (the lowermost oblong), entire, submucronate; racemes sometimes nearly 1 foot long; flowers large, showy, reddish purple, rarely white; sepals united to the middle, persistent; segments triangular-acuminate; petals with very short claws; stamens equal; pods oblong-linear, compressed, much longer than the stipe. *Porter and Coulter's Flora of Colorado.*

- V. lanceolata**, L. Lance-leaved Violet.
Near Saint Paul, *Mrs. Terry*. Rare. South.
- V. primulæfolia**, L. Primrose-leaved Violet.
Near Saint Paul, *Mrs. Terry*; Pipestone county, *Mrs. Bennett*. Rare. South.
- V. blanda**, Willd. Sweet White Violet.
Frequent throughout the state.
- V. renifolia**, Gray.* Kidney-leaved Violet.
Abundant in cedar swamps and mossy woods from northern New England through Canada and Manitoba to British Columbia, *Macoun*; doubtless in northern Minnesota.
- V. Selkirkii**, Pursh. Selkirk's Violet. Great-spurred Violet.
Upper Mississippi river, *Garrison*. Rare. North.
- V. cucullata**, Ait. Common Blue Violet.
Common, often abundant, throughout the state.
- V. cucullata**, Ait., var. **palmata**, Gray. Hand-leaf Violet.
Lake Pepin, *Miss Manning*; Minneapolis, *Herrick*, *Griswold*; Worthington (common). *Foote*.
- V. cucullata**, Ait., var. **cordata**, Gray.
Near Minneapolis, *Mrs. Terry*; Nicollet county, *Aiton*.
- V. sagittata**, Ait. Arrow-leaved Violet.
Frequent southeastward; extending north to Minneapolis, *Roberts*, Marine Mills, Washington county, *Miss Field*, and Anoka county, *Juni*; and northwest to Fergus Falls, *Leonard*.
- V. delphinifolia**, Nutt. Larkspur Violet.
Frequent, often common, through the south half of the state; extending north to Morrison county, *Upham*, and along the Red river valley.
- V. pedata**, L. Bird-foot Violet.
Abundant, or common, through the south half of the state and in the Red river valley.
- V. canina**, L., var. **sylvestris**, Regel. Dog Violet.
Frequent, but not common, throughout most of the state; rare southward.
- V. striata**, Ait. Pale Violet.
Hennepin county, *Herrick*; Alexandria, *Mrs. Terry*. Infrequent.
- V. Canadensis**, L. Canada Violet.
Frequent northward, and found more rarely throughout the south half of the state; extending southwest to Martin county (very scarce), *Cratty*, and Pipestone county, *Mrs. Bennett*. Flowers light pink.
- V. pubescens**, Ait. Downy Yellow Violet.
Common, or frequent, throughout the state.
- V. pubescens**, Ait., var. **eriocarpa**, Nutt.
Frequent in the vicinity of Hesper, Iowa, at the southern boundary of Minnesota, adjacent to Houston and Fillmore counties, *Mrs. Carter*.
- V. tricolor**, L. Pansy. *Heart's Ease*.
Rarely adventive, Stearns county, *Garrison*.

***VIOLA RENIFOLIA**, Gray. Rootstock and flowers as in *V. blanda*, or somewhat larger; leaves reniform (when fully grown usually two inches wide), on both sides, as also the petiole, villous-pubescent; scape pubescent. *Gray in Proc. Am. Acad. of Arts and Sciences*, 1870.

CISTACEÆ. ROCK-ROSE FAMILY.

HELIANTHEMUM, Tourn. ROCK-ROSE.**H. Canadense**, Michx. Frost-weed.

Common, or frequent, throughout the state, excepting near its west side and far northward; extending north to the upper Mississippi river, *Garrison*, and Fort Francis, Rainy river, *Macoun*.

HUDSONIA, L. HUDSONIA.**H. tomentosa**, Nutt. Downy Hudsonia.

Fifteen-mile point, Rainy lake, and Hungry Hall, entrance to the lake of the Woods, *Macoun*; Minnesota point, near Duluth, and on sand dunes in Anoka county, *Roberts*; on sand hills in section 21, Orrock, Sherburne county (plentiful, with short-peduncled flowers and narrow leaves), *Upham*; near Rockford, Wright county, *Hatch*; barren ridges of the St. Croix, *Parry*; Castle Rock, Dakota county, *Geyer*; White Rock, Goodhue county, *Sandberg*; lake Pepin, *Miss Manning*. Local.

LECHEA, L. PINWEED.**L. minor**, Walt. Small Pinweed.

Sturgeon lake (near the international boundary east of Rainy lake), *Macoun*; upper Mississippi, *Houghton*; St. Croix river, *Parry*; Steele county, *Upham*.

DROSERACEÆ. SUNDEW FAMILY.

DROSERA, L. SUNDEW.**D. rotundifolia**, L. Round-leaved Sundew.

Common, or frequent, northward; extending south to Minneapolis, *Roberts*.

D. intermedia, Drev. and Hayne, var. **Americana**, DC. (*D. longifolia*, in *Manual*.) Long-leaved Sundew.

Similar in range with the last, but less frequent. North shore of lake Superior at Little Marais, *Juni*; between the lake of the Woods and Red river (common), *Dawson*; extending south to sections 17 and 19, Ham Lake, Anoka county (with the leaves scattered along the stem or caudex), *Roberts*.

D. linearis, Goldie. Slender Sundew.

Lake Superior to Roseau river, *Burgess*, *Macoun*; extending south to Hennepin county (frequent), *Roberts*.

HYPERICACEÆ. ST. JOHN'S-WORT FAMILY.

HYPERICUM, L. ST. JOHN'S-WORT.**H. pyramidatum**, Ait. Great St. John's-wort.

Rare or local northward, but frequent southward; extending north to Todd county, *Upham*, the upper Mississippi and Minnesota rivers, *Parry*, and northwest to the plains of the Saskatchewan, *Bourgeau*, *Macoun*.

[*H. Kalmianum*, L., probably occurs on the north shore of lake Superior in this state.]

- H. prolificum**, L. Shrubby St. John's-wort.
Vasa, Goodhue county, *Sandberg*. Southeast.
- H. ellipticum**, Hook. St. John's-wort.
Lapham. Upper Mississippi river, *Garrison*. [Devil's lake, Dakota, *Geyer*.]
Infrequent. North.
[*H. perforatum*, L., may be expected as a weed southeastward.]
- H. corymbosum**, Muhl. St. John's-wort.
Lapham. Lake Pepin, *Miss Manning*; Hesper, Iowa, adjacent to the south line of Houston and Fillmore counties, *Mrs. Carter*. Rare.
- H. mutilum**, L. Slender St. John's-wort,
Throughout the state; common northward, less frequent southward.
- H. mutilum**, L., var. **gymnanthum**, Gray.
Minneapolis, *Roberts*.
- H. Canadense**, L. Canadian St. John's-wort.
St. Croix river, *Parry*; Stearns county, *Campbell*; Sibley county, *Leonard*; Martin county (rare), *Cratty*.
- H. Canadense**, L., var. **major**, Gray.
Lake Superior, *Robbins*, and in Iowa, *Arthur*; doubtless also in Minnesota.

ELODES, Adans. MARSH ST. JOHN'S-WORT.

- E. Virginica**, Nutt. Marsh St. John's-wort.
Throughout the state; common northward, frequent southward.

CARYOPHYLLACEÆ. PINK FAMILY.

SAPONARIA, L. SOAPWORT.

- S. officinalis**, L. Common Soapwort. Bouncing Bet.
Blue Earth county, *Leiberg*; Lake City, *Miss Manning*; Wabasha, *Gibson*.
- S. Vaccaria**, L. (*Vaccaria vulgaris*, Host.) Cow-Herb.
Seldom plentiful, but reported at many places throughout the state. *Mr. Leiberg* writes: "This is becoming a common weed in the grain-fields of Blue Earth county, where the farmers call it 'cockle', and complain very much of it. It will doubtless become as plentiful as the true cockle (*Lychvis Githago*). Most of the seeds are just small enough to pass through a wheat-screen, and they can thus be separated; but, as the largest seeds will be left in whenever the grain is cleaned, the result will be that in time, through this process of selection, the seeds can no more be cleaned out of the wheat than true cockle."

SILENE, L. CATCHFLY. CAMPION.

- S. stellata**, Ait. Starry Campion.
Common through the south part of the state; extending north at least to Minneapolis, *Herrick*, and Redwood Falls, *Miss Butler*.
- S. nivea**, DC. Campion.
Upper Mississippi river, *Garrison*; Goodhue county, *Sandberg*; Hesper, Iowa, adjoining Houston county, *Mrs. Carter*. Rare. Southeast.
- S. Virginica**, L. Fire Pink. Catchfly.
Nicollet county, *Leiberg*. Rare. Southeast.

S. antirrhina, L. Sleepy Catchfly.
Frequent, or common, throughout the state.

S. noctiflora, L. *Night-flowering Catchfly*.
Frequent throughout the state.

LYCHNIS, Tourn. LYCHNIS. COCKLE.

L. vespertina, Sibth. *Evening Lychnis*.
Minneapolis, *Juni*, *Kassube*, *Moulton*. Rare.

L. Githago, Lam. *Corn Cockle*.
A common weed in wheat-fields throughout the state.

ARENARIA, L. SANDWORT.

A. serpyllifolia, L. *Thyme-leaved Sandwort*.
Northfield, *Chaney*. Rare.

A. Michauxii, Hook. (*A. stricta*, Michx.) Strict Sandwort.
Rooting on detached rocks, head of lake St. Croix, *Parry*; lake of the Woods, *Macoun*. Rare.

A. lateriflora, L. Showy Sandwort.
Frequent throughout the state.

STELLARIA, L. CHICKWEED. STARWORT.

S. media, Smith. *Common Chickweed*.
Frequent throughout the state.

S. longifolia, Muhl. Long-leaved Stitchwort.
Common throughout the state.

S. longipes, Goldie. Long-stalked Stitchwort.
Minneapolis, *Griswold*, *Kassube*; Anoka county and Duluth, *Juni*. [Devil's lake, Dakota, *Geyer*.] North.

S. crassifolia, Ehrh. Starwort.
Cannon Falls, Goodhue county, *Blake*, *Sandberg*; Minneapolis (plentiful in ditches in swamps), *Roberts*, *Upham*; and northward.

S. borealis, Bigelow. Northern Stitchwort. Starwort.
Common, or frequent, in the north half of the state. [The var. *alpestris*, Gray, has been found on the north side of lake Superior, at Pie island, by *Macoun*.]

CERASTIUM, L. MOUSE-EAR CHICKWEED.

C. viscosum, L. (*C. vulgatum*, L., in *Manual*.) *Mouse-ear Chickweed*.
Winona county, *Holzinger*; lake Pepin, *Miss Manning*. [Lake Superior, *Whitney*.]
Infrequent.

C. vulgatum, L. (*C. viscosum*, L., in *Manual*.) *Large Mouse-ear Chickweed*.
Common, or frequent, throughout the state, excepting perhaps westward.

C. nutans, Raf. Nodding Mouse-ear Chickweed.
Frequent, or common, throughout the state, excepting southwestward.

C. oblongifolium, Torr. Mouse-ear Chickweed.
Winona county, *Holzinger*; Fergus Falls, *Leonard*. Rare. Southeast.

C. arvense, L. Field Chickweed.

Frequent, or common, through the north half of the state and southwestward; rare southeastward.

SAGINA, L. PEARLWORT.**S. nodosa**, E. Meyer. Pearlwort.

North shore of lake Superior, doubtless in Minnesota; Isle Royale, *Whitney*; island of St. Ignace, *Macouin*.

PARONYCHIEÆ. WHITLOW-WORT FAMILY.

ANYCHIA, Michx. WHITLOW-WORT. NAILWORT.**A. dichotoma**, Michx. Forked Chickweed. Whitlow-wort.

Lapham. Infrequent.

FICOIDEÆ. ICE PLANT FAMILY.

MOLLUGO, L. INDIAN-CHICKWEED.**M. verticillata**, L. Carpet-weed.

Common, or frequent, southward. Exposed rocks and sandy fields, St. Croix river, *Parry*; abundant in Hennepin county on sandy river-banks, appearing indigenous, *Roberts*.

PORTULACACEÆ. PURSLANE FAMILY.

PORTULACA, Tourne. PURSLANE.**P. oleracea**, L. Common Purslane. "Pusley."

A very common garden weed.

P. retusa, Engelm.* Western Purslane.

Upper Minnesota river, *Parry*; Yellow Medicine county, *Upham*; upper Mississippi river, *Garrison*. (Surely indigenous; yet possibly to be referred to the foregoing species.) West.

TALINUM, Adans. TALINUM.**T. teretifolium**, Pursh. Talinum.

Rare, occurring only on ledges of rock (trap, syenite, granite and quartzite); absent far northward. Taylor's Falls (of St. Croix river), *Houghton*, *Miss Field*; Duluth, *Miss Cathcart*; Watab, Benton county, and at numerous places in Stearns and Morrison counties, *Upham*; upper Minnesota river, *Parry*; Redwood Falls, *Miss Butler*; "plentiful on most of the ledges in Rock and Pipestone counties (a handsome little plant, extremely easy of cultivation)," *Leiberg*.

***PORTULACA RETUSA**, Engelm. Like *P. oleracea*, L., but greener, and the stem more ascending, sometimes covering a space several feet in diameter; leaves usually smaller than the common species; sepals obtuse, broadly carinate-winged; petals yellow; stigmas 3 or 4; capsule $2\frac{1}{4}$ to 3 lines long, broader in proportion; seeds more strongly tuberculate than in *P. oleracea*. *Brewer and Watson's Botany of California*.

CLAYTONIA, L. SPRING-BEAUTY.**C. Virginica, L. Narrow-leaved Spring-Beauty.**

Throughout the state, but rare in most portions; frequent, or common, southeastward.

C. Caroliniana, Michx. Wide-leaved Spring-Beauty.

Lake City, *Mrs. Ray*. Southeast.

MALVACEÆ. MALLOW FAMILY.**MALVA, L. MALLOW.****M. rotundifolia, L. Common Mallow.**

Common southward, and as far north as Morrison and Todd counties, *Upham*; but not yet common westward.

M. sylvestris, L. High Mallow.

Fort Francis, *Rainy river, Macoun*; Minneapolis, *Herrick*; Goodhue county, *Sandberg*; lake Pepin, *Miss Manning*; Blue Earth county, *Leiberg*.

M. crispa, L. Curled Mallow.

Adventive, Lake City, *Miss Manning*.

CALLIRRHŒ, Nutt. CALLIRRHŒ.**C. triangulata, Gray. Callirrhoe.**

Lapham. South.

NAPÆA, Clayt. GLADE MALLOW.**N. dioica, L. Glade Mallow.**

Lapham. *Vasa*, Goodhue county, *Sandberg*. Rare. Southeast.

MALVASTRUM, Gray. FALSE MALLOW.**M. coccineum, Gray. Prairie Mallow.**

Minnesota, *Gray's Manual*. West. Its eastern limit scarcely reaches into this state.

ABUTILON, Tourn. INDIAN MALLOW.**A. Aricennæ, Gærtn. Velvet-Leaf.**

Anoka, Hennepin, Ramsey, Wabasha and Blue Earth counties. Infrequent.

HIBISCUS, L. ROSE-MALLOW.**H. militaris, Cav. Halberd-leaved Rose-Mallow.**

Banks of the Mississippi river between Saint Paul and Mendota (abundant), *Mrs. Terry*. South.

H. Trionum, L. Bladder Ketmia. Flower of an Hour.

Adventive, Minneapolis, *Kasube*, *Upham*; Goodhue county, *Sandberg*; Martin county, *Gedge*. [This 'has become abundant in many parts' of Nebraska, *Aughey*.]

TILIACEÆ. LINDEN FAMILY.

TILIA, L. LINDEN. BASSWOOD.

T. Americana, L. Basswood. Bass. Linden. Lime Tree. Whitewood.

Very abundant in the Big Woods, and generally common throughout the state; not found near the Minnesota shore of lake Superior, but frequent north of this lake, on maple ridges 400 feet and more above it, attaining a height of 70 feet and diameter of 20 inches, *Clark*; also, not found in Rock county, but very plentiful at Bear lakes in Murray county, *Upham*; extending north to Basswood lake on the international boundary, *Winchell*.

†The northern limit of this species is found just south of Thunder bay, from which it nearly follows the international boundary to the lake of the Woods. It extends farther north in Manitoba, nearly to lake Winnipeg, and northwest to Fort Ellice. *Dr. Robert Bell*.]

(The leaves of this and many other species of trees, in their first few years of growth from the seed, are often remarkably large. The following measurements were made in Todd county, September 16th: leaf of basswood, blade, $14\frac{1}{2}$ inches long and 12 inches wide, borne on a petiole 3 inches long; of large-toothed aspen, blade, 10 by $7\frac{1}{2}$, and petiole, 4 inches; of balsam poplar, blade, 11 by 7, and petiole, 2 inches; and of elm, blade, 9 by 6 inches, with petiole only a half inch long.)

*Basswood lumber is much used in cabinet work for boxes, shelves, etc., whenever a wood is desired which is soft and easily worked, and, at the same time, tough and not liable to split." It decays more quickly than most kinds of lumber, when exposed to the weather, unless it is thoroughly painted; but is sufficiently durable, if kept dry.

LINACEÆ. FLAX FAMILY.

LINUM, L. FLAX.

L. perenne, L.* Wild Flax. Prairie Flax.

At Pembina, and thence westward, *Chickering*; Stearns county, *Mrs. Blaisdell*. West.

L. sulcatum, Riddell. Wild Flax.

Common from Minneapolis, *Roberts*, southward, and westward to the Red river valley, *Upham*; Pipestone quarry, *Mrs. Bennett*.

L. rigidum, Pursh.† Wild Flax.

From Winona county, *Winchell*, Minneapolis, *Twining*, and Anoka county, *Juni*, westward to Pipestone county, *Leiberg*, and the Red river valley (common in Clay county), *Upham*. South and west.

***LINUM PERENNE**, L. Perennial, glabrous; leaves scattered, linear, acute; flowers nearly opposite the leaves and terminal; peduncles becoming elongated and nodding in fruit; sepals oval with membranous margins, shorter than the globose capsule; petals free, blue, retuse, 3 to 4 times exceeding the calyx; styles 5; capsule 5-celled, with bearded dissepiments. Stems $\frac{1}{2}$ to 3 feet high; flowers large. May to September. *Watson's Rep. in King's Expt. of the Fortieth Parallel*.

†**LINUM RIGIDUM**, Pursh. Dwarf; glaucous; styles united almost to the top. *Gray's Manual*.—Stems 5 to 15 inches high, angled, much branched; branches strict, ascending; leaves alternate, linear, pungently acute, rigid, with scabrous margins; flowers paniced or corymbose; pedicels thickened at the end, and forming an exterior cup-shaped calyculus; sepals ovate-lanceolate, cuspidate, strongly 3-nerved, glandular spinulose-scabrous on the margins, longer than the globose capsule; petals sulphur-yellow. *Porter and Coulter's Flora of Colorado*.

L. usitatissimum, L. Common Flax.

Sometimes adventive in fields : Minneapolis ; Blue Earth county ; Redwood Falls ; Luverne.

GERANIACEÆ. GERANIUM FAMILY.

GERANIUM, L. CRANESBILL.

G. maculatum, L. Wild Cranesbill.

Common, often abundant, through the south half of the state ; extending northwest to Clay county, *Gedge*, the upper Mississippi river, *Garrison*, and the mouth of Rainy river, *Macoun*.

G. Carolinianum, L. Carolina Cranesbill.

Common, or frequent, throughout the state ; most plentiful northward.

G. Robertianum, L. Herb Robert.

Falls of the St. Croix, *Parry* ; Fergus Falls, *Leonard* ; extending west to the lake of the Woods, *Macoun*. North.

ERODIUM, L'Her. STORKSBILL. HERON'S-BILL.

E. cicutarium, L'Her. Storksbill. Heron's-bill.

Minneapolis, *Juni*, *Kassube*, *Roberts*. Rare. An abundant weed in the Pacific states and in some districts eastward.

IMPATIENS, L. BALSAM. JEWEL-WEED. TOUCH-ME-NOT.

I. pallida, Nutt. Pale Touch-me-not.

Throughout the state ; in many portions infrequent or rare ; common at New Ulm, *Juni*, and in Blue Earth county, *Leiberg* ; abundant in Martin county, *Cratty*, and on the south shore of Red lake, *Miss Babbitt*.

I. fulva, Nutt. Spotted Touch-me-not.

Common throughout the state. ("At Beaver Bay a spotless variety, with less reflected spur, was common and grew intermingled with the ordinary form, without showing any signs of intergradation." *Roberts*.)

OXALIS, L. WOOD-SORREL. OXALIS

O. Acetosella, L. Common Wood-Sorrel.

Common north of Lake Superior, *Roberts* ; lake of the Woods, *Macoun* ; extending northwest to the Saskatchewan, *Richardson*. North.

O. violacea, L. Violet Wood-Sorrel.

Common through the south half of the state to Pipestone county, *Mrs. Bennett* ; extending north to the upper Mississippi river, *Garrison*, and in the Red river valley at east to Clay county, *Gedge*. (*Herrick* reports, besides the type, a variety that bears white flowers, occurring quite frequently in the vicinity of Castle Rock, Dakota county ; and *Miss Babbitt* finds the same at Little Falls. Succulent flower-bearing scapes, not accompanied by leaves, are occasionally seen in September [*Upham*]. "The usual occurrence of a white, carrot-shaped root beneath the ordinary scaly bulb" of [this species is noticed by *Roberts*, in the *American Naturalist* for August, 1879. See also *Am. Nat.*, vol. xvi, pp. 13-19.]

O. corniculata, L., var. **stricta**, Sav. (*O. stricta*, L.) Yellow Wood-Sorrel. Ladies' Sorrel.

Common throughout the state.

RUTACEÆ. RUE FAMILY.

XANTHOXYLUM, Colden. PRICKLY ASH.

- X. Americanum**, Mill. Northern Prickly Ash. Toothache-tree.
Very abundant southward; extending north to Pine, Aitkin, Cass and Polk counties.

PTELEA, L. SHRUBBY TREFOIL. HOP-TREE.

- P. trifoliata**, L. Shrubby Trefoil. Hop-tree. Wafer Ash.
Layham. Southeast.

ANACARDIACEÆ. CASHEW FAMILY.

RHUS, L. SUMACH.

- R. typhina**, L. Staghorn Sumach.

Limited to the east side of the state and the region from the upper Mississippi river northeastward, as follows: in Houston and Fillmore counties, rare; in Winona county the most frequent species on the bluffs of the Mississippi ("at Winona samples were seen eight inches in diameter", *Winchell*), but rare farther west; common in Ramsey and Hennepin counties, extending west into the Big Woods, and to Martin county. *Cratty*; rare in Benton county; common in Pine county and westward to Mille Lacs, Little Falls and lake Alexander, Morrison county; at Fish-hook lake in southwestern Cass county. *Garrison*; and occasional northeastward, being reported by *Clark* at Sandy lake, Fond du Lac, Grand Portage and Pigeon river.

- R. glabra**, L. Smooth Sumach.

Common throughout the state, excepting north of lake Superior, where it is rare.

- R. copallina**, L. Dwarf Sumach.

Houston county, near La Crescent, also in Winona county, *Winchell*; lake Pepin. *Miss Manning*; Goodhue county, *Sandberg*; Saint Paul, *Miss Cathcart*; Blue Earth county, *Lebery*; Worthington, *Footo*; Pipestone county, *Mrs. Bennett*. Rare. South.

- R. venenata**, DC. Poison Sumach. Poison Dogwood.

Observed, like the preceding, in Houston county, near La Crescent, and in Winona county, by *Prof. Winchell*; Hennepin county, *Simmons*; Anoka county, *Juni*; upper Mississippi river, *Garrison*. Rare.

- R. Toxicodendron**, L. Poison Ivy. Poison Oak.

Common, often abundant, throughout the state. (Erect or decumbent, 1 to 3 feet high; not climbing.)

- R. Toxicodendron**, L., var. **radicans**, Torr.* Climbing Poison Ivy.

This variety (or species) occurs sparingly in the southeast part of the state. *Mrs. Carter*, *Miss Manning*.

- R. aromatica**, Ait. Fragrant Sumach.

Maligne river (near the international boundary east of Rainy lake). *Macoun*. Rare.

*RHUS TOXICODENDRON, L., var. RADICANS, TORR. (*R. radicans*, L.) Stems climbing by means of innumerable radicating tendrils; leaflets 3, ovate, dark green, smooth and shining, entire, the lowest rarely angular; flowers greenish, racemed in axillary panicles; berries dull white. A vigorous woody climber, ascending trees and other objects 10 to 40 or 50 feet. The stem becomes 1 to 2 inches [or more] in thickness, covered with a greenish, scaly bark, and throws out all along its length myriads of thread-like rootlets, which bind it firmly to its support. *Wood's Class-Book*.

VITACEÆ. VINE FAMILY.

VITIS, Tourn. GRAPE.

V. Labrusca, L. Northern Fox-Grape.

Occurs frequently, according to *Clark*, in the east part of the state, as far northward as southern Pine county, and rarely on the St. Louis river; lake Pepin, *Miss Manning*.

V. æstivalis, Michx. Summer Grape.

Lapham. St. Croix Falls, *Miss Field*; Anoka county, *Juni*; Big Stone lake, *Winchell*; Fergus Falls, *Leonard*. Infrequent. South.

V. cordifolia, Michx.* Winter or Frost Grape.

Frequent in the south half of the state; also in the Red river valley, near Emerson, Manitoba, *Dawson*.

V. riparia, Michx.† (*V. cordifolia, Michx., var. riparia, Gray.*) Winter or Frost Grape.

Common throughout the state, excepting north of lake Superior.

AMPELOPSIS, Michx. VIRGINIAN CREEPER.

A. quinquefolia, Michx. Virginian Creeper. Five-leaf Ivy. American Ivy. "Woodbine."

Common through the south half of the state and in the Red river valley; probably less frequent northeastward. "A very desirable climber, often cultivated."

RHAMNACEÆ. BUCKTHORN FAMILY.

RHAMNUS, Tourn. BUCKTHORN.

R. alnifolia, L'Her. Alder-leaved Buckthorn.

St. Croix river, *Parry*; Minneapolis, *Winchell, Kassube*; beach of lake Superior, *Juni*; lake of the Woods, *Dawson*. Rare southward; common far northward.

*VITIS CORDIFOLIA. Michx. Tall (or more rarely low), climbing high, trunks not rarely 6 to 9 inches in diameter; leaves middle-sized or small (2¼ to 3 or 4 inches in diameter), heart-shaped, mostly entire or very slightly tri-lobed on the edges, with broad, shallow teeth, usually smooth and shining, more on the upper than on the lower side, the young ones sometimes, and very rarely the old ones, with short hair on the ribs below; berries small, in large, mostly loose bunches, black, without a bloom, maturing late in the fall, usually only with a single short and thick seed, marked by a prominent raphe.— This grows more especially in fertile soil, and is common in river and creek bottoms. *Engelmann*, in *Sixth An. Rep., Insects of Missouri*; also in *Bulletin of the Torrey Botanical Club*.

†VITIS RIPARIA, Michx. Mostly a smaller plant than the last, but with larger (3 to 5 inches in diameter) and more or less incisely 3-lobed, glabrous, shining (or rarely when young, slightly hairy) leaves, the lobes long and pointed, the teeth also more pointed than in *V. cordifolia*; berries usually larger than in the last, mostly with a bloom, in smaller and often more compact bunches, commonly 1-to 2-seeded; seeds with a less prominent raphe.— This species prefers thickets or rocky soil on river-banks; the northern form has fewer and larger berries in a bunch, and is easily distinguished from *V. cordifolia*. The fruit ripens earlier than the former and is pleasanter. *Engelmann*, in *Insects of Mo.*, and in *Bull. Torr. Cl.*

CEANOTHUS, L. NEW JERSEY TEA. RED-ROGT.**C. Americannus, L.** New Jersey Tea. Red-root.

Common throughout the state, excepting far northward; especially abundant on sandy tracts in the region of the upper Mississippi river. Though only a small shrub, one to three feet high, its root is a mass of gnarled wood, sometimes six or eight inches in diameter, "a troublesome obstacle in first breaking the soil."

C. ovatus, Desf. (*C. ovalis*, Bigelow.) Red-root.

Sandy ridges of the St. Croix, "seeming to take the place of the preceding species and an indication of a more barren soil," *Parry*; New Ulm, *Juni.* [Kaministiquia river (very abundant), *Macoun.*] Local.

CELASTRACEÆ. STAFF-TREE FAMILY.

CELASTRUM, L. STAFF-TREE. SHRUBBY BITTER-SWEET.**C. scandens, L.** Climbing Bitter-sweet. Wax-work.

Common through the south half of the state, extending north to the sources of the Mississippi, and to Polk county; less frequent north to Emerson, Manitoba, *Scott.*

EUONYMUS, Tourn. SPINDLE-TREE.**E. atropurpureus, Jacq.** Burning-Bush. Waahoo.

Frequent southward; extending north to Anoka county, *Juni*, Lake Elizabeth, Kandiyohi county, *Mrs. Terry*, and Clay county in the Red river valley, *Geddy.*

E. Americanus, L., var. obovatus, Torr. & Gray. Trailing Strawberry Bush.

Minneapolis, *Winchell*; lake Pepin, *Miss Manning.* Rare.

SAPINDACEÆ. SOAPBERRY FAMILY.

STAPHYLEA, L. BLADDER-NUT.**S. trifolia, L.** American Bladder-Nut.

Frequent southward; extending north to Minnehaha falls, *Roberts*, and New Ulm, *Juni.*

ACER, Tourn. MAPLE.**A. Pennsylvanicum, L.** Striped Maple. Moose-wood.

Common northeastward, extending south to the upper Mississippi river and to southeastern Pine county; rare and local farther south to lake Pepin, *Miss Manning.*

A. spicatum, Lam. Mountain Maple.

Abundant north of lake Superior and along the international boundary; extending south to Mille Lacs, *Upham*; rare and local farther southward on the Mississippi bluffs at lake Pepin, *Miss Manning*, and in section 22, Richmond, Winona county, *Winchell.*

A. saccharinum, Wang. Sugar Maple. Rock Maple. Hard Maple.

Common, often abundant, throughout the state, excepting near its west side. Not found close to the shore of lake Superior, but common two or three miles from it, 400 feet or more above the lake, attaining a height of 75 feet, *Clark.* The northern limit of this tree, according to *Bell*, extends from the lower part of the valley of the Kaministiquia river westward, a little to the north of the boundary line, to the lake of the Woods, where it turns south. The Chippewa Indians, who are yet the principal inhab-

itants of the wooded region north of the Northern Pacific railroad, make considerable maple sugar, their ordinary product in the region of lake Superior, according to *Clark*, being from 100 to 500 pounds for each lodge.

A. saccharinum, Wang., var. **nigrum**, Torr. & Gray. Black Sugar Maple.

Houston county, *Winchell*; upper Mississippi river, *Garrison*. Mr. J. C. Arthur reports this variety common at Waterville, Le Sueur county, and believes it to be the prevailing form of the species at least through the south part of the state.

A. dasycarpum, Ehrh. White or Silver Maple. River Maple. Soft Maple.

Common southward, extending north to the upper Mississippi and the White Earth reservation, *Garrison*. More frequently cultivated for shade than the next, each of these species being often called soft maple.

A. rubrum, L. Red Maple. Swamp Maple. Soft Maple.

Common through the east part of the state; extending west to Mud Portage on the Dawson route (north of lake Superior), *Macoun*, the White Earth reservation, *Garrison*, and Redwood Falls, *Pemberton*; abundant in Winona county, *Winchell*. This and the two preceding species, especially the sugar maple, are valuable for furniture and cabinet work, and are fine shade and ornamental trees, for which purpose they are extensively raised from the seed or transplanted from the woods.

NEGUNDO, Moench. ASH-LEAVED MAPLE. BOX-ELDER.

N. aceroides, Moench. Box-Elder.

Common through the south half of the state, extending thus north to Kanabec, Mille Lacs and Wadena counties; less frequent farther north to the St. Louis river near Fond du Lac, *Winchell*, Kaministiquia river, *Macoun*, and the upper Mississippi river, *Garrison*; also abundant throughout the Red river valley and northwestward, reaching east to the lake of the Woods, *Dawson*. "Destined to be the shade tree of all the prairie cities" of Manitoba (*Macoun*). Along the Minnesota river, it sometimes exceeds three feet in diameter (*Winchell*). Sugar and syrup are made from it at Big Stone lake.

POLYGALACEÆ. MILKWORT FAMILY.

POLYGALA, Tourn. MILKWORT. POLYGALA.

P. sanguinea, L. Purple Milkwort.

Frequent, or common, southward; extending north to the upper Mississippi river, *Garrison*, and Polk county, *Upham*.

P. cruciata, L. Milkwort.

Margins of swampy lakes, St. Croix river, *Parry*; Minneapolis (frequent), *Roberts*; Stearns county, *Mrs. Blaisdell*.

P. verticillata, L. Milkwort.

Frequent, or common, in the south and west portions of the state; extending north to Minneapolis, *Simmons*, New Ulm, *Juni*, and the Red river valley, *Upham*.

P. Senega, L. Seneca Snakeroot.

Common, or frequent, throughout the state. Several tons of this medicinal root are dug and sold yearly by the Chippewa Indians in the region of Mille Lacs, the Crow Wing river and the White Earth reservation, the price which they receive for it, when dried, being from 35 to 50 cents per pound.

P. polygama, Walt. Pink Polygala.

Sandy soil, St. Croix river, *Parry*; lake Pepin, *Miss Manning*; Saint Cloud, *Garrison*; Anoka county and Brainerd, *Upham*; lake of the Woods, *Dawson*.

P. paucifolia, Willd. Fringed Polygala.

Faribault, Rice county, *Miss Beane*. [Kaministiquia river, north of lake Superior, *Macgreg.*] Rare.

LEGUMINOSÆ. PULSE FAMILY.

LUPINUS, Tourn. LUPINE.**L. perennis**, L. Wild Lupine. Perennial Lupine.

Common on light, sandy land from lake Pepin to the sources of the Mississippi river; also, Fergus Falls, *Leonard*. Rarely found with white flowers.

TRIFOLIUM, L. CLOVER.**T. arvense**, L. Rabbit-foot or Stone Clover.

Saint Cloud, Stearns county, *Campbell*. Rare.

T. pratense, L. Red Clover.

Frequently adventive throughout the state.

T. repens, L. White Clover. Shamrock.

Occurring like the last, already very abundant in many districts; also quite certainly indigenous through the north half of the state, *Clark, Upham*.

T. hybridum, L.* Alsike Clover.

Adventive, but scarcely established, Saint Cloud (sandy soil, on the grounds of the Normal School), *Campbell*. Rare.

T. procumbens, L. Yellow Clover. Low Hop-Clover.

Stearns county (both the type and the var. minus, Koch), *Campbell*; Saint Paul, Minneapolis and lake Minnetonka (sparingly adventive), *Roberts*; lake Pepin, *Miss Manning*. Rare.

MELILOTUS, Tourn. MELILOT. SWEET CLOVER. HART'S CLOVER.**M. officinalis**, Willd. Yellow Melilot.

Goodhue county, *Sandberg*; Minneapolis (frequent), *Roberts*; Stearns county, *Garrison*; Blue Earth county, *Leiberg*. South.

M. alba, Lam. White Melilot.

Throughout the south half of the state. More frequent than the preceding.

MEDICAGO, L. MEDICK.**M. sativa**, L. Lucerne. Alfalfa.

Escaped from cultivation, Blue Earth county, *Leiberg*; Minneapolis, *Winchell*.

**Trifolium hybridum*, L. Almost glabrous; leaflets obovate or oblong; stipules oblong, tips triangular; heads axillary, peduncled, globose; pedicels elongate, at length reflexed; flowers [whitish, rose-tinted] drooping; calyx-tube campanulate, gibbous; teeth subulate, nearly equal, unaltered in fruit. *Hooker's Students' Flora of the British Islands*. (See *Botanical Gazette*, vol. vii, pp. 121 and 135.)

HOSACKIA, Dougl. **HOSACKIA**.**H. Purshiana**, Benth.* **Hosackia**.

Gravelly shore of Swan lake, section 7, Underwood, Redwood county (leaves about ½ inch long, very short-petioled, of three oblong acute leaflets, the lateral ones oblique in their lower half), *Upham*. Southwest.

PSORALEA, L. **PSORALEA**.**P. tenuiflora**, Pursh. (*P. floribunda*, Nutt.) **Psoralea**.

Cottonwood county, *Holzinger*. Southwest

P. argophylla, Pursh. Silvery-leaved **Psoralea**.

Abundant in all the prairie portion of the state; extending northeast to the upper Mississippi river, *Garrison*. (See note in *American Naturalist*, vol. xvii, p. 414.)

P. esculenta, Pursh. Dakota Turnip. Pomme blanche. Pomme de Prairie. Pomme de Terre.

Common southwestward; extending east to the rising ground east of Red river prairie, *Dawson*, the Roseau river, *Scott*, Morrison county, *Upham*, Minneapolis (rare, found close east of lake Calhoun), *Griswold*, *Roberts*, and Blue Earth county, *Leiberg*. "Pomme de Prairie of the French voyageurs; *Tipsinah* of the Sioux Indians. It occurs over a wide range of country between the Mississippi and the Rocky Mountains, and is a characteristic plant of the Coteau des Prairies. The root, frequently attaining the size of a hen's egg, is of a regular, cylindrical, ovoid shape, consisting of a thick, leathery envelope, easily separating when fresh from its smooth internal part. The latter is of a friable texture, except towards the axis, where some ligneous fibres are intermixed. When dry, it acquires a sweetish taste, and is easily pulverized, affording a light, starchy flour, suitable for all the uses of the ordinary article. When growing its aspect is that of a Lupine. It selects a dry, gravelly, but not barren soil." *Parry*.

The Dakota (Sioux) name of the river in western Minnesota, well known as the Pomme de Terre, refers to this plant. *Riggs' Dakota Dictionary*, p. 171.

DALEA, L. **DALEA**.**D. alopecuroides**, Willd. **Dalea**.

Spirit lake, Iowa, *Geyer*; and doubtless in the adjoining portions of Minnesota. Southwest.

PETALOSTEMON, Michx. **PRAIRIE CLOVER**.**P. violaceus**, Michx. Purple Prairie Clover.

Abundant in all the prairie portion of the state; extending northeast to the upper Mississippi river, *Houghton*.

* **HOSACKIA**, Dougl. Calyx-teeth nearly equal. Petals free from the stamens, nearly equal; standard often remote from the rest, ovate or roundish; keel curved, obtuse or somewhat acutely beaked. Stamens diadelphous; anthers uniform. Pod linear, compressed or nearly terete, sessile, several-seeded, with partitions between the seeds. Herbaceous or rarely woody, with pinnate 2- to many-foliolate leaves; stipules mostly minute and gland-like; flowers in axillary sessile or pedunculate umbels, yellow, often becoming brownish.

HOSACKIA PURSHIANA, Benth. Annual, usually a foot high or more, and more or less silky-villous: leaflets 1 to 5, ovate to narrowly lanceolate, 2 to 9 lines long; stipules gland-like; flowers small, yellow, on peduncles exceeding the leaves, bracteate with a single leaflet; calyx-teeth linear, much exceeding the tube, about equalling the corolla; pod linear, straight, smooth, an inch long, 5- to 7-seeded. *Watson* in *Botany of Wheeler's Surveys west of the One Hundredth Meridian*.

P. candidus, Michx. White Prairie Clover.

Abundant, with same range as the last; excepting that it is less common in the north part of the Red river valley, *Upham*.

P. villosus, Nutt. Silky Prairie Clover.

Common on sandy land, from lake Pepin, *Miss Manning*, Goodhue county, *Sandberg*, and the barrens of the St. Croix river, *Parry*, to Minneapolis, Lac qui Parle, and Polk county, *Upham*.

AMORPHA, L. FALSE INDIGO.**A. fruticosa**, L. False Indigo. "River Locust."

Common through the south half of the state, in the Red river valley, *Upham*, and to the upper Mississippi river, *Garrison*.

A. caulescens, Nutt. Lead-ant. "Shoe-strings."

Abundant, with the same range as the last. The common name alludes to its long tough roots, which are troublesome in plowing.

A. microphylla, Pursh.* (*A. nana*, Nutt.) Dwarf False Indigo.

Common from the Blue Earth river, *Parry*, and Chippewa, Swift and Grant counties, *Roberts*, southwestward; also common, or frequent, throughout the Red river valley, *Upham*.

ROBINIA, L. LOCUST-TREE.**R. Pseudacacia**, L. Common Locust-tree. False Acacia.

Adventive, Minneapolis, *Winchell*.

TEPHROSIA, Pers. HOARY PEA.**T. Virginiana**, Pers. Goat's Rue. Catgut.

Lapham. Hart, Winona county, *Winchell*; at head of lake Pepin, *Sandberg*, Washington county, *Judd*. South.

ASTRAGALUS, L. MILK-VETCH.**A. caryocarpus**, Ker. Ground Plum.

Common, often abundant in all the prairie portion of the state; extending north-east to the upper Mississippi river, *Garrison*. "When the pods, which are nearly solid, have reached the size of hazel-nuts, they prove a valuable addition to the list of early vegetables. Cooked like green peas, they make a pleasing dish, intermediate in taste and flavor between early peas and asparagus." *Arthur*.

A. Plattensis, Nutt., var. **Tennesseensis**, Gray. Ground Plum.

Grant county, *Roberts*; Fergus Falls, *Leonard*. Southwest.

A. Canadensis, L. Milk-Vetch.

Common, or frequent, throughout the state; abundant in the Red river valley, *Upham*.

***AMORPHA MICROPHYLLA**, Pursh. Nearly smooth, dwarf; leaves with very short petioles, obtuse at both ends; spikes short, solitary; calyx nearly naked, pedicellate, teeth all very acuminate; legumes 1-seeded. . . . From 1 to 2 feet high; flowers purple and fragrant. A very elegant little shrub. *Pursh's Fl. Amer.*, quoted by *Arthur* (*Contributions to the Flora of Iowa, No. V.*), who adds: "This compact little shrub is abundant on the dry prairies of northwestern Iowa. It flowers in May, and not in July and August as stated by Pursh. The leaflets are oblong, conspicuously punctate, and in 10-20 pairs."

A. adsurgens, Pall.* Milk-Vetch.Red river valley, *Scott, Macoun*. West.**A. hypoglottis**, L.† Milk-Vetch.Plains near Pembina, *Douglas, Chickering, Harvard*. Red river prairie, *Dawson*. West.**A. gracilis**, Nutt.‡ Milk-Vetch.Minnesota, *Watson*. Southwest.**A. Cooperi**, Gray. Cooper's Milk-Vetch.Upper Mississippi river, *Garrison*; lake Pepin, *Miss Manning*. Rare.**A. flexuosus**, Dougl.§ Milk-Vetch.Red river prairie, *Douglas, Macoun, Dawson, Scott*. West.**OXYTROPIS**, DC. OXYTROPIS.**O. Lamberti**, Pursh. Oxytropis.Frequent or common, westward; extending east to Worthington (rare) *Footc*, Cottonwood county, *Holzinger*. Glenwood (common, with flowers bright rose-purple, changing later to blue), *Upham*, Douglas county, *Mrs. Terry*, Fergus Falls, *Leonard*, and the Red river valley, *Douglas, Macoun*.

***ASTRAGALUS ADSURGENS**, Pall. Perennial, cinereous with minute appressed pubescence or glabrate; stems rather stout, 4 to 18 inches high, ascending or decumbent; stipules scarious, mostly united at base; leaflets 10 pairs, 6 to 9 lines long, narrowly or linear-oblong; spike dense, at length oblong or cylindrical; flowers purplish, medium sized, ascending; calyx-tube rather long-campanulate, twice exceeding the setaceous teeth, subvillous with light or dark hairs; pod coriaceous, pubescent, sessile, ascending, ovate-oblong (4 to 5 lines in length), straight, usually triangular-compressed, with a dorsal sulcus, and 2-celled by the intruded dorsal suture, many-ovuled. *Watson's Rep. in King's Expl. of the Fortieth Parallel*, following *Gray's Revis.*, *Proc. Amer. Acad.*, vol. vi.

†**ASTRAGALUS HYPOGLOTTIS**, L. Perennial, with a rather loose pubescence, or nearly glabrous; stems 6 inches to 2 feet long, slender, diffusely procumbent or ascending; stipules subfoliaceous and more or less sheathing; leaflets 7 to 10 pairs, oblong, obtuse or retuse; heads rather many-flowered; corolla violet, $\frac{1}{2}$ inch long; legume coriaceous, ovate and triangular, silky-villous, very shortly stipitate, 2-celled by the intruded dorsal suture, and but 6- to 8-seeded. From southern Colorado northward along the Rocky Mountains and Red River Valley to the Arctic Circle and Alaska. June to September. *Watson's Rep. in King's Expl. of the Fortieth Parallel*, following *Gray's Revision*.

‡**ASTRAGALUS GRACILIS**, Nutt. Perennial, somewhat appressed pubescent, slender, erect or ascending, a foot high or more; leaflets three to five pairs, narrowly linear, half an inch long or less; flowers very small, white or purplish, in an elongated open long-peduncled spike; calyx-teeth very short; pods coriaceous, sessile, pubescent and rugose, 2 or 3 lines long, ovate-oblong and obcompressed, 1-celled, concave on the back, and the ventral suture prominent. *Watson in Botany of Wheeler's Surveys west of the One Hundredth Meridian*.

§**ASTRAGALUS FLEXUOSUS**, Dougl. Ashy-puberulent; stems ascending, 1 foot high, flexuose; leaflets oblong or cuneate-linear, obtuse or retuse; peduncles exceeding the leaves; racemes mostly elongated, loose; flowers 4 lines long, white or purplish; calyx hoary-pubescent, teeth three times shorter than the tube, pod cylindrical, 8 to 11 lines long, 2 lines broad, puberulent, thinly coriaceous, straight or sub-incurved; stipe very short, not evident. *Gray's Revision of Astrag.*, *Proc. Amer. Acad.*, vol. vi.

O. splendens, Dougl.* Silvery Oxytropis.

"A most elegant plant, with its crowded, silvery, silky-villous foliage and spikes, and deep blue corollas. It was gathered on the Chippewa river" [in Minnesota]. *Gray* in *Pacific Railroad Report*. Glenwood, Pope county, *Upham*; Pembina, *Douglas*, *Harvard*. West.

GLYCYRRHIZA, Tourn. LICORICE.**G. lepidota**, Pursh. Wild Licorice.

Abundant westward, from St. Vincent to Iowa; extending east to lake Pepin, *Miss Manning*, Freeborn county and Minneapolis, *Upham*, the St. Croix river, *Parry*, Stearns county, *Campbell*, and the lake of the Woods at the mouth of Rainy river, *Macoun*; but not reported in the region of the upper Mississippi river and farther northeast.

HEDYSARUM, Tourn. HEDYSARUM.**H. boreale**, Nutt. HEDYSARUM.

Lapham. [North shore of lake Superior, *Agassiz*.] North.

DESMODIUM, DC. TICK-TREFOIL.**D. nudiflorum**, DC. Tick-Trefoil.

St. Croix river, *Parry*; Anoka county, also New Ulm, *Juni*; Blue Earth county, *Gedye*; Redwood Falls, *Pemberton*. Infrequent. South.

D. acuminatum, DC. Tick-Trefoil.

Common southward; extending north to the upper Mississippi river, *Garrison*; Fergus Falls, *Leonard*.

D. rotundifolium, DC. Round-leaved Tick-Trefoil. Trailing Tick-Trefoil.

Upper Mississippi river, *Garrison*. Infrequent. South.

D. canescens, DC. Tick-Trefoil.

Otter Tail county, *Upham*; Nicollet county, *Aiton*; Blue Earth county, *Leiberg*; lake Pepin, *Miss Manning*. Infrequent. South.

D. cuspidatum, Hook. Tick-Trefoil.

Lapham. Upper Mississippi river, *Garrison*. Infrequent. South.

D. Dillenii, Darlengt. Tick-Trefoil.

Stearns county, *Garrison*; Douglas county, *Mrs. Terry*; Minneapolis, *Kassabur*; Steele county (common), *Upham*. South.

D. paniculatum, DC. Tick-Trefoil.

Upper Mississippi river, *Garrison*; Winona county, *Holzinger*; Hesper, Iowa, *Mrs. Carter*. Infrequent. South.

D. Canadense, DC. Tick-Trefoil.

Common through the south half of the state, and perhaps northward; found at the lake of the Woods, *Dawson*, *Burgess*, and extending into Manitoba to the north end of lake Winnipeg, *Hooker*.

***OXYTROPIS SPLENDENS**, Dougl. Acaulescent, silvery, silky-villous throughout, 6 to 12 inches high; leaflets somewhat verticillate, 3 to 6 together, very numerous, lanceolate, very acute, usually 5 to 10 lines long; flowers in an oblong spike, erect, spreading, usually deep blue; peduncles exceeding the leaves; flowers not much surpassing the calyx; pod ovate, erect. *Porter and Coulter's Flora of Colorado*.

LESPEDEZA, Michx. BUSH-CLOVER.

L. repens, Barton. (Including *L. procumbens*, Michx.) Bush-Clover
Lapham. Rare. South.

L. violacea, Pers. Bush-Clover.
Blue Earth county, *Leiberg*; Brown county, *Juni*. Infrequent. South.

[*L. reticulata*, Pers. (*L. violacea*, Pers., var. *sessiliflora*, Don) probably occurs in the south part of the state.

L. reticulata, Pers., var. **angustifolia**, Maxim. (*L. violacea*, Pers., var. *angustifolia*, Torr. & Gray.) Bush-Clover.
Cottonwood county, *Holzinger*. Infrequent. South.

L. hirta, Ell. Bush-Clover.
Lake Pepin, *Miss Manning*; Cottonwood county, *Holzinger*. Infrequent. South.

L. capitata, Michx. Bush-Clover.
Common, or frequent, through the south half of the state; extending north at least to Cass county, *Uphum*.

L. leptostachya, Engelm.* Bush-Clover.
Southeastera Minnesota, *T. J. Hale*; Emmet county, Iowa (common), *Cratty*; Rock county (common), *Leiberg*. South.

VICIA, Tourn. VETCH. TARE.

V. sativa, L. Vetch.
Lake Pepin, *Miss Manning*. Rare.

V. Cracca, L. Blue Vetch.
Minneapolis, and Carlton county, *Roberts*; White Bear, Ramsey county, *Miss Field*. Rare. South.

V. Caroliniana, Walt. Pale Vetch. Carolina Vetch.
Frequent through the south half of the state; extending north to the upper Mississippi river, *Garrison*, and Fergus Falls, *Leonard*.

V. Americana, Muhl. Purple Vetch. American Vetch.
Common throughout the state.

LATHYRUS, L. VETCHLING. EVERLASTING PEA.

L. maritimus, Bigelow. Beach Pea.
Common on beaches of gravel and sand, north shore of lake Superior, *Juni*, *Roberts*; lake of the Woods, *Dawson*.

L. venosus, Muhl. Vetchling.
Common through the south half of the state, and in the Red river valley; extending northeast to the upper Mississippi river, *Garrison*, and Kaministiquia river, *Macoun*.

L. ochroleucus, Hook. Pale Vetchling.
Common, often abundant, throughout the state.

*LESPEDEZA LEPTOSTACHYA, Engelm. Clothed with appressed, silky pubescence; leaves linear; petiole longer than the terminal petiolule; spikes paniculate, slender, somewhat loosely flowered, rather longer than the peduncle; legume equal to or slightly longer than the calyx. . . . Has passed for *L. angustifolia*, from which its slender spikes and paniculate habit at once distinguish it. *Gray, Proc. Amer. Acad. of Arts and Sciences*, vol. xii.

L. paluster, L. Marsh Vetchling.

Common throughout the state.

L. paluster, L., var. **myrtifolius**, Gray. Marsh Vetchling.Blue Earth county, *Leiberg*; Stearns county, *Campbell*; Fergus Falls, *Leonard*.**APIOS**, Boerhaave. GROUND-NUT. WILD BEAN.**A. tuberosa**, Moench. Ground-nut. Dakota Potato. Pomme de Terre.Common, or frequent, through the south half of the state; extending north to the upper Mississippi river. "*Pomme de Terre* of the French voyageurs; *Mdo*, or wild potato, of the Sioux Indians." *Parry*.**PHASEOLUS**, L. KIDNEY BEAN.**P. perennis**, Walt. Wild Bean.Saint Paul, *Kelley*; St. Croix Falls, *Miss Field*; upper Mississippi river, *Garrison*; Pembina, *Havard*.**P. diversifolius**, Pers. Wild Bean.Minneapolis, *Twining*; Blue Earth county, *Leiberg*; New Ulm, *Juni*; Emmet county, Iowa (rare), *Cratty*. Southeast.**P. pauciflorus**, Benth. Wild Bean.Frequent through the south half of the state; extending north to the head-waters of the Mississippi river, *Garrison*.**AMPHICARPÆA**, Ell. HOG PEA-NUT.**A. monoica**, Ell. Hog Pea-nut.

Common throughout the state, excepting perhaps far northward.

BAPTISIA, Vent. FALSE INDIGO.**B. tinctoria**, R. Br. Wild Indigo.Anoka county, and White Bear, Ramsey county, *Juni*; near Saint Paul, *Mrs. Terry*; lake Pepin, *Miss Manning*. Infrequent. Southeast.**B. leucantha**, Torr. & Gray. White False Indigo.Frequent through the south half of the state; extending north to the upper Mississippi river, *Garrison*, and Fergus Falls, *Leonard*.**B. leucophæa**, Nutt. Yellowish Wild Indigo.Common in the most southern counties across the state; extending north to lake Pepin, *Miss Manning*, Rice county, *Upham*, and Minneapolis, *Kassube*.**CERCIS**, L. RED-BUD. JUDAS-TREE.**C. Canadensis**, L. Red-bud. Judas-tree.Southern Minnesota, *Sargent's Catalogue of Forest Trees, Tenth Census of U. S.* If found in this state, it must be rare or local, in the most southeastern counties.**CASSIA**, L. Senna.**C. Chamaecrista**, L. Partridge Pea. Sensitive Pea.Frequent, or common, throughout the southern third of the state; less frequent farther north to the upper Mississippi river, *Houghton*.

GYMNOCLADUS, Lam. KENTUCKY COFFEE-TREE.**G. Canadensis, Lam. Kentucky Coffee-tree.**

Houston county, near Dakota, Winona county, and Jordan, Scott county, *Winchell*; Lake City, *Miss Manning*; Nicollet county (forming groves in the woods opposite to Mankato; attaining a diameter of six inches; wood very hard, straight-grained, valuable), *Leiberg*; New Ulm, *Juni*; Sleepy Eye, Brown county, *Upham*. Infrequent. South.

DESMANTHUS, Willd. DESMANTHUS.**D. brachylobus, Benth. Desmanthus.**

Swan lakes, northwestern Redwood county, *Upham*; Spirit lake, Iowa, *Geyer*. South.

ROSACEÆ. ROSE FAMILY.**PRUNUS, TOURN. PLUM, CHERRY, ETC.****P. Americana, Marshall. Wild Plum.**

Common, often abundant, throughout the state. Usually from 10 to 20 feet high; but north of lake Superior seldom exceeding 12 feet in height, and often fruiting at 3 or 4 feet, *Clark*. Fruit valuable, pleasant-flavored, rarely bitter, mostly purple, but not infrequently varying from that color to yellow.

P. pumila, L. Dwarf Cherry. Sand Cherry.

Common on sandy land through the north half of the state, and south to Minneapolis; local and rare farther south, as at Castle Rock and in Goodhue county, *Sandberg*, lake Pepin, *Miss Manning*, and section 33, Hart, Winona county, *Winchell*.

P. Pennsylvanica, L. Wild Red Cherry. Bird Cherry.

Common throughout the state, excepting southwestward, where it occurs rarely. Usually 15 to 30 feet high; but north of lake Superior its ordinary height is about 12 feet, with a diameter of 2½ inches, *Clark*.

P. Virginiana, L. Choke-Cherry.

Common throughout the state.

P. serotina, Ehrh. Wild Black Cherry.

Common throughout the state, excepting far northward, where it is absent or rare. *Macoun* reports it as far west as the Kaministiquia river, lake Superior.

NEILLIA, Dob. NINE-BARK.**N. opulifolia, Benth. and Hook. (Spiræa opulifolia, L.) Nine-Bark.**

Frequent throughout most of the state, but rare southward and westward; abundant north of lake Superior, especially along the shore, "clinging to bare rocks, often within the sweep of the waves," *Juni, Roberts*; Rainy river and lake of the Woods, *Macoun*.

SPIRÆA, MEADOW-SWEET. SPIRÆA.**S. salicifolia, L. Common Meadow-Sweet. Willow-leaved Spiræa.**

Queen of the Meadow.
Common throughout the state.

S. tomentosa, L. Hardhack. Steeple-Bush.

Frequent, in some places plentiful, in Hennepin, Anoka, Chisago, Isanti and Kanabec counties, *Roberts, Juni, Upham*. East. [It is also found at lake Winnipeg, *Richardson*.]

AGRIMONIA, Tourn. AGRIMONY.

A. Eupatoria, L. Common Agrimony.
Frequent, often common, throughout the state.

GEUM, L. AVENS. GEUM.

G. album, Gmelin. White Avens.

Frequent, or common, throughout the state; extending northward to the north shore of lake Superior, *Juni*, and Pembina, *Heward*.

G. Virginianum, L. Virginian Avens.

Minnesota river, *Parry*; Blue Earth county, *Leiberg*; Goodhue county, *Sandberg*; Hesper, Iowa, *Mrs. Carter*. Infrequent. South.

G. macrophyllum, Willd. Large-leaved Avens.

Abundant north of lake Superior, *Roberts*; extending south to Sherburne county, *Upham*, Anoka county and New Ulm, *Juni*, and lake Minnetonka, *Roberts*.

G. strictum, Ait. Strict Avens.

Throughout the state; common northward, frequent southward.

G. rivale, L. Water Avens. Purple Avens.

Common, or frequent, through the north half of the state; extending south to lake Pepin, *Miss Manning*, Northfield, Rice county, *Chaney*, and Nicollet county, *Aiton*.

G. triflorum, Pursh. Three-flowered Avens.

This species, "attractive by reason of its long, plumose styles, and dissected, fern-like leaves," rare in states farther east, is common, or frequent, on dry somewhat sandy land throughout Minnesota, excepting northeastward, in which direction it extends at least to the head of lake St. Croix, Brainerd, and the upper Mississippi river.

WALDSTEINIA, Willd. DRY OR BARREN STRAWBERRY.

W. fragarioides, Tratt. Barren Strawberry.

Stearns county, *Garrison*; St. Croix Falls and Stillwater, *Miss Field*. Infrequent. East.

POTENTILLA, L. CINQUE-FOIL. FIVE-FINGER. POTENTILLA.

P. Norvegica, L. Cinque-foil.

Common throughout the state.

P. supina, L. (*P. paradoxa*, Nutt.) Cinque-foil.

Lake Pepin, *Miss Manning*; sandy shores of lake Minnetonka, *Roberts*, *Herrick*; Anoka county and New Ulm, *Juni*; Martin county (rare), *Cratty*; Stearns county, *Garrison*; Grant county, *Roberts*. [Devil's lake, Dakota, *Geyer*, and northwestward.] South and west.

P. Canadensis, L. Common Cinque-foil or Five-Finger.

Common, or frequent, throughout the state, excepting perhaps far northward.

P. Canadensis, L., var. **simplex**, Torr. and Gray. Cinque-foil. Five-Finger.

Lake Pepin, *Miss Manning*; New Ulm, *Juni*; Emmet county, Iowa (rare), *Cratty*; Minneapolis (common), *Roberts*; Sherburne county (common), *Upham*. [North of lake Superior, *Agassiz*.]

P. argentea, L. Silvery Cinque-foil or Five-Finger.

Winona county, *Holzinger*; Saint Paul, *Miss Cathcart*; Minneapolis, *Herrick*, *Upham*; Washington county, *Leonard*; St. Croix Falls, *Miss Field*; Anoka county, *Juni*; near Green lake, Kandiyohi county, *Mrs. Terry*. [Sheyenne river, Dakota, *Geyer*.] Infrequent.

P. Pennsylvanica, L., var. **strigosa**, Pursh.* Cinque-foil. *Potentilla*.

Granite knolls beside the Minnesota river in the west part of Nicollet county, *Parry*; Redwood Falls, *Pemberton*; Worthington (common), *Foote*; Luverne, *Leiberg*; Pipestone quarry, *Mrs. Bennett*; Fergus Falls, *Leonard*. [Pembina mountain, Dakota, *Havard*. "The common form in the prairie region" of Manitoba, *Macoun*.] West.

P. Pennsylvanica, L., var. **bipinnatifida**, Torr. & Gray.** Cinque-foil.

Pipestone county, *Mrs. Bennett*; plains of the Red river, *Douglas*, *Macoun*. West.

P. Hippiana, Lehm. † Cinque-foil. *Potentilla*.

Plains of the Red river, *Drummond*, *Macoun*. West.

P. effusa, Dougl. ‡ Cinque-foil. *Potentilla*.

Higher parts of the Red river valley, plentiful, *Douglas*, *Macoun*. West.

P. arguta, Pursh. Cinque-foil. *Potentilla*.

Common, often abundant, throughout the state.

P. Anserina, L. Silver-Weed.

Common, or frequent, throughout the north half of the state; extending south at least to Minneapolis and Murray county, *Upham*.

P. fruticosa, L. Shrubby Cinque-foil.

Abundant north of lake Superior, especially along its rocky shore, *Juni*, *Roberts*; also found near the Tamarack river in T. 158, R. 46, Marshall county, *Upham*, and at the eastern border of the Red river prairie near the international boundary, *Dawson*, *Scott*. (Not yet reported, but doubtless occurring rarely, in the south half of the state; found at Decorah, Iowa, *Arthur*.) North.

* **POTENTILLA PENNSYLVANICA**, L., var. **STRIGOSA**, Pursh. Low, 6 to 15 inches high; stems erect, leafy, rather stout; leaves mostly tomentose on both surfaces, paler beneath, deeply pectinate-divided or pinnatifid, segments linear, entire, with revolute margins; stipules laciniate. *Porter and Coulter's Flora of Colorado*, following *Watson's Revis., Proc. Amer. Acad.*, vol. viii.

** **POTENTILLA PENNSYLVANICA**, L., var. **BIPPINATIFIDA**, Torr. & Gray. Leaflets crowded (3 to 5) and often almost palmate, deeply pinnatifid (silky-pubescent but not canescent above); the segments linear, elongated, mostly spreading. *Torrey and Gray's Flora of N. A.*

† **P. HIPPIANA**, Lehm. Densely white-tomentose and silky throughout; the upper surface of the leaves a little darker; stems ascending, 1 to 1½ feet high, slender, branching above into a diffuse cyme, stipules usually entire; leaves pinnate, occasionally digitate; leaflets 5 to 11, cuneate-oblong, 1 to 2 inches long, obtuse, incisely toothed, at least towards the apex, margins not revolute; pedicels slender; bractlets narrow; petals 2½ to 3½ lines long, exceeding the calyx; styles filiform, not glandular at base, terminal; carpels 10 to 30. *Porter and Coulter's Flora of Colorado*, following *Watson's Revision*.

‡ **P. EFFUSA**, Dougl. Canescently tomentose with scattered villous hairs; stems ascending, diffusely branched above, 4 to 12 inches high; stipules lanceolate, entire or incised; leaflets 5 to 11, interruptedly pinnate, the alternate ones often smaller, cuneate-oblong, coarsely incised-serrate or dentate, the smaller leaflets 3- to 5-toothed; pedicels slender; sepals and the much smaller bractlets acuminate, 2 to 3 lines long, equaling or exceeding the obovate petals; carpels 10. *Porter and Coulter's Flora of Colorado*, following *Watson's Revision*.

P. tridentata, Sol. Three-toothed Cinque-foil.

Frequent through the north part of the state; common along the rocky north shore of lake Superior and on Minnesota Point, at the last named locality growing in the dry loose sand, *Roberts, Juni*; infrequent, or rare, southward to Stearns county, *Mrs. Blaisdell*, White Bear, Ramsey county, *Miss Field*, Lake City, *Mrs. Ray*, and Hesper, Iowa, *Mrs. Carter*.

P. palustris, Scop. Marsh Five-Finger.

Throughout the state; common northward, frequent southward.

FRAGARIA, Tourn. STRAWBERRY.**F. Virginiana**, Duchesne. Wild Strawberry.

Common throughout the state.

F. Virginiana, Duchesne, var. **Illinoensis**, Gray. Wild Strawberry.

Dakota county, *Winchell*; Anoka and Sherburne counties (common), *Upham*; abundant in Martin county (and in Emmet county, Iowa), *Cratty*.

F. vesca, L. Wild Strawberry. Wood Strawberry.

Mostly in woods; common through the north half of the state and southwestward, frequent southeastward.

RUBUS, Tourn. BRAMBLE.**R. Dalibarda**, L. (*Dalibarda repens*, L.) Dalibarda.

Lapham. Green Lake, Kandiyohi county, *Mrs. Terry*. Rare. East.

[*R. odoratus* L., which occurs in northern Michigan and Wisconsin, probably does not extend into Minnesota.]

R. Nutkanus, Mocino. White Flowering-Raspberry.

Abundant north of lake Superior, *Juni, Roberts*; and extending to the sources of the Mississippi, *Houghton*. "Its showy white blossoms are about as large as those of the wild rose. The fruit is large and looks tempting but has a peculiar acid flavor, which makes it inferior to that of *Rubus strigosus*." *Juni*. North.

R. arcticus, L.* Arctic Raspberry.

Peat bog, "northwest angle" of the lake of the Woods, *Macoun*. North.

R. triflorus, Richardson. Dwarf Raspberry.

Common, or frequent, through the north half of the state; extending south to New Ulm, *Juni*, Blue Earth county, *Leiberg*, and Hesper, Iowa, *Mrs. Carter*.

R. strigosus, Michx. Wild Red Raspberry.

Common throughout the state, excepting southwestward, where it occurs less frequently; very abundant northward.

R. occidentalis, L. Black Raspberry. Black-cap Raspberry. Thimbleberry.

Common through the south half of the state, and north to the White Earth reservation, the upper Mississippi river, and Pine county; rare or wanting northeastward. A variety bearing cream-colored fruit occurs on the bluffs of the Mississippi at Winona, *Winchell*.

***RUBUS ARCTICUS**, L. Stem low, herbaceous, sometimes diœcious, unarmed, somewhat pubescent, mostly erect, 1- to 2-flowered, leaves trifoliolate; leaflets rhombic-ovate or obovate, coarsely and often doubly serrate, petiolulate; stipules ovate; sepals lanceolate, acute, often shorter than the obovate entire or emarginate (reddish) petals. *Torrey and Gray's Flora of N. A.*

R. villosus, Ait. High Blackberry.

Frequent, occasionally plentiful, throughout most of the state; but rare or wanting in some districts, especially southwestward and far northwest. Local.

R. villosus, Ait., var. **frondosus**, Torr. High Blackberry.

Between lake Superior and lake Winnipeg, *Richardson (Macoun)*.

R. Canadensis, L. Low Blackberry. Dewberry.

Frequent, or common, through the east part of the state, extending west to Blue Earth county, *Leiberg*, Fergus Falls, *Leonard*, and the White Earth reservation, *Garrison*; north of lake Superior, *Agassiz, Macoun*.

R. hispidus, L. Running Swamp-Blackberry.

Similar in range with the last. Minneapolis, *Griswold*; Sherburne county (common), *Upham*; Fergus Falls, *Leonard*; upper Mississippi river, *Garrison*.

ROSA, Tourn. ROSE.**R. Carolina**, L. Swamp Rose.

Houston county, *Winchell*; Blue Earth county, *Leiberg*; Northfield, *Chaney*; Morrison county, *Miss Babbitt*. Infrequent.

R. parviflora, Ehrh. (*R. lucida*, in *Manual*.) Dwarf Wild-Rose.

North of lake Superior (common), *Roberts*; White Earth reservation, *Garrison*; Kanabe county (common), *Upham*; St. Croix Falls, *Miss Field*; Hennepin and Fillmore counties, *Winchell*; Rice county, *Sperry*; Goodhue county, *Blake, Sandberg*.

R. blanda, Ait., var. **pubescens**, Crépin.* Early Wild Rose.

Common, often abundant, in all parts of the state; the only species of rose (but occurring in two varieties) in our prairie region, there varying in height from about one foot, or sometimes two feet on the prairie, to three or four feet in groves and thickets, or even six feet, according to *Roberts*, in Grant county.

R. blanda, Ait., var. **setigera**, Crépin.† Early Wild Rose.

Specimens collected in Minneapolis are referred by *Watson* to this variety, which probably occurs, less frequently than the preceding, throughout the state, being most common northward.

CRATÆGUS, L. HAWTHORN. WHITE THORN.**C. coccinea**, L. Scarlet-fruited Thorn.

Frequent, occasionally common, through most of the state; extending "north to the international boundary, but not much beyond it," *Bell*. [Emerson and Winnipeg, Manitoba, *Dawson, Macoun*.]

C. tomentosa, L. Black Thorn. Pear Thorn.

Common, or frequent, throughout the state.

C. tomentosa, L., var. **pyrifolia**, Gray. Black or Pear Thorn.

Olmsted county, *Winchell*; American portage, near the international boundary west of lake Superior, *Macoun*.

C. tomentosa, L., var. **punctata**, Gray. Black or Pear Thorn.

Martin county, *Cratty*; Olmsted county and lake Minnetonka, *Winchell*; Minneapolis, *Upham*; Pembina, *Chickering*. Perhaps the typical species is less common than these varieties.

***ROSA BLANDA**, Ait., var. **PUBESCENS**, Crépin. Leaflets more or less pubescent on the under side; upper part of the stems, as well as the branches and flowering branchlets, unarmed or nearly so. *Crépin's Monograph*.

†**ROSA BLANDA**, Ait., var. **SETIGERA**, Crépin. Leaflets glabrous or pubescent on the under side; stem not ordinarily more than a foot high, entirely covered with setaceous prickles. *Crépin's Monograph*.

C. subvillosa, Schrader. (*C. tomentosa*, L., var. *mollis*, Gray.) Downy Thorn.

Blue Earth county (common, becoming a tree twenty feet high), *Upham*; New Ulm, *Juni*; Emmet county, Iowa (rare), *Cratty*; Pipestone quarry, *Mrs. Bennett*. [North of lake Superior, *Bell, Macoun*.]

C. Crus-galli, L. Cockspur Thorn.

Winona, Fillmore, Mower, Freeborn and Scott counties, and the Big Woods, *Winchell*; lake Pepin, *Miss Manning*; Dodge county, *Harrington*; Rice county, *Sperry*; Hennepin county, *Simmons*; Fish-hook lake, Cass county, and the White Earth reservation, *Garrison*. ["In Manitoba a thorn which appears to be identical with this species is abundant." *Bell*.]

PIRUS (*Pyrus*), L. PEAR. APPLE.

P. coronaria, L. American Crab-Apple.

Common in the southeast part of the state; extending west to the Big Woods, and north to Ramsey and Hennepin counties, *Winchell*, and to Crow lake in southwestern Stearns county, *Upham*. The fruit, though bitterish, is frequently used for sauce.

P. arbutifolia, L. Choke-berry.

Frequent from Olmsted county, *Harrington*, and Faribault, *Miss Beane*, to Minneapolis, *Roberts*, Anoka county, *Juni*, and the St. Croix river, *Parry*. East.

P. arbutifolia, L., var. **melanocarpa**, Hook. Choke-berry.

Pine county (common), *Upham*; north of lake Superior, extending west to Sturgeon lake, Dawson route, *Macoun*. East.

P. Americana, DC. American Mountain-Ash.

Common through the north part of the state; extending south to northern Pine county, and to Mille Laes. "A common tree north of lake Superior, attaining considerable size. *Professor Winchell* collected specimens where the trunk was at least 12 inches in diameter, and perfectly sound. Others, though unsound, were 15 and 16 inches." *Roberts*.

P. sambucifolia, Cham. & Schlecht. Elder-leaved Mountain Ash.

Common northward; extending south to Itasca lake, *Garrison*, and T. 137, R. 33, Wadena county, *Upham*; and rare farther south, as on the bluffs of the Mississippi at Winona, *Winchell*.

AMELANCHIER, Medic. JUNE-BERRY.

A. Canadensis, Torr. & Gray. (Including the var. *Botryapium*, Torr. & Gray.) Shad-bush. Service-berry.

Common throughout the state. (Usually from 10 to 30 feet high, but northeastward only attaining a height of 10 feet and diameter of 2½ inches; used by the Indians for snow-shoe frames. *Clark*.)

A. Canadensis, Torr. & Gray, var. **oblongifolia**, Torr. & Gray. Service-berry.

Common, or frequent, throughout the state.

A. Canadensis, Torr. & Gray, var. **oligocarpa**, Torr. & Gray. Service-berry.

Loon portage, Dawson route (near the international boundary), *Macoun*. North.

A. alnifolia, Nutt. (*A. Canadensis*, Torr. & Gray, var. *alnifolia*, Torr. & Gray.) Western June-berry.

Pembina, *Chickering*; White Earth reservation, *Garrison*; Hennepin county, *Roberts*; Faribault, *Miss Beane*; Lake City, *Mrs. Ray*. Frequent.

SAXIFRAGACEÆ. SAXIFRAGE FAMILY.

RIBES, L. CURRANT. GOOSEBERRY.**R. Cynosbati, L.** Prickly Wild Gooseberry.

Common, often abundant, throughout the state. Much used, (as also the following smooth species,) before fully ripening, for sauce.

[Of *R. setosum*, Liudl., Prof. Gray writes: "I suspect that this species inhabits the northwestern shore of lake Superior. Botanists visiting that district should look for a species with pure white flowers, a half inch or less in length, with cylindrical tube, and stamens decidedly shorter than the lobes. . . . It takes its name from the slender scattered prickles on the branches; but these are sometimes wanting, this being an inconstant character in all the species. The young berries are either perfectly smooth and naked, or beset with a few bristly prickles. This is the *R. oxyacanthoides* of Hooker's *Flora*, but certainly not of Linnæus. It belongs to the Saskatchewan region, extending into Montana and Wyoming." *American Naturalist*, vol. x, pp. 271-2.

R. oxyacanthoides, L. (R. hirtellum, Michx.) Smooth Wild Gooseberry.

Common throughout the state, excepting perhaps southward, in which direction it extends at least to Goodhue county, *Sandberg*, *Faribault*, *Miss Beane*, and *Fergus Falls, Leonard*.

R. rotundifolium, Michx. Smooth Wild Gooseberry.

Notes by observers using Gray's *Manual* give this as common through the south half of the state, and less frequent northward to the St. Louis river, *Mrs. Herrick*, and *Grand Marais*, north of lake Superior, *Roberts*. Further investigation is needed, however, to decide whether *R. rotundifolium* occurs in Minnesota. Just as this is being printed, I learn from Mr. Arthur that Prof. Gray decides specimens of the common smooth wild gooseberry in Iowa (before regarded as *R. rotundifolium*) to be *R. gracile*, Michx. "*R. rotundifolium* Michx. is a species of the Alleghany Mountains, ranging northward and eastward into New York and the western borders of Massachusetts." (Gray in *American Naturalist*, vol. x.) Probably most, or perhaps all, of the supposed observations of this species in Minnesota belong instead to the next.

R. gracile, Michx. (R. Missouriense, Nutt.)* Missouri Gooseberry.

Lapham. See remarks under the preceding species.

R. lacustre, Poir. Swamp Wild Gooseberry.

Lapham. North of lake Superior, *Juni, Roberts*. North.

R. prostratum, L'Her. Fetid Currant. Skunk Currant.

Common north of lake Superior, *Juni, Roberts*; *St. Louis river, Mrs. Herrick*; upper Mississippi river, *Garrison*. North.

R. floridum, L'Her. Wild Black Currant.

Common, or frequent, throughout the state.

R. rubrum, L. Red Currant.

Frequent through the north half of the state; extending south to southeastern Pile county and Benton county, *Upham*, *Fish-hook lake*, *Cass county, Garrison*, and *Fergus Falls, Leonard*.

R. aureum, Pursh. *Buffalo Currant. Missouri Currant.*

Escaped from gardens: *Mankato, Leiberg*; *Minneapolis, Kassube*.

***RIBES GRACILE, Michx.** Flowers 1 to 4 on the slender peduncle, white or whitish, narrow, with calyx-lobes longer than the tube and shorter than the half-inch stamens; filaments almost capillary, generally connivent or closely parallel, and soon conspicuously longer than the oblong-linear calyx-lobes; flower with barely a slight tinge of green; berry smooth, large, purple, prized in cultivation under the name of Missouri Gooseberry. It ranges from Tennessee and Illinois to the northern borders of Texas, and northwestward into the Rocky Mountains. Gray in *American Naturalist*, vol. x.

PARNASSIA, Tourn. GRASS OF PARNASSUS.**P. parviflora**, DC. Grass of Parnassus.

North shore of lake Superior, *Macoun*.

P. palustris, L. Grass of Parnassus.

North shore of lake Superior, *Juni*; Fort Francis, Rainy river, *Macoun*; common in the Red river valley, along the Pembina and Fort Garry trails, from Tamarack river northward into Manitoba, *Upham*; extending southward to Stearns county, *Garrison*, *Mrs. Blaisdell*.

P. Caroliniana, Michx. Grass of Parnassus.

Common through the south half of the state, and north to the upper Mississippi river, *Garrison*, and Polk county, *Upham*; also, lake of the Woods, *Burgess (Macoun)*, and between the lake of the Woods and Red river, "probably about the northwestern limit of the species," *Dawson*; Pembina, *Haward*.

SAXIFRAGA, L. SAXIFRAGE.**S. tricuspidata**, Retz. Saxifrage.

North shore of lake Superior, doubtless in Minnesota; Isle Royale, *Whitney*.

S. Aizoon, Jacq. Saxifrage.

North shore of lake Superior, *Macoun, Ellis*; Isle Royale, *Whitney*.

S. Virginiensis, Michx. Early Saxifrage.

Lapham. Hastings, Dakota county, *Mrs. Ray*. Rare.

S. Pennsylvanica, L. Swamp Saxifrage.

Common, or frequent, throughout the state.

SULLIVANTIA, Torr. & Gray. SULLIVANTIA.**S. Ohionis**, Torr. & Gray. Sullivantia.

Rock bluffs of the Mississippi river, near Dakota, Winona county, *Winchell*. Rare.

HEUCHERA, L. ALUM-ROOT.**H. Americana**, L. Common Alum-root.

St. Louis river, *Houghton*; Cass lake, *Schoolcraft*; Stearns county, *Campbell*; Stillwater, *Miss Field*; Goodhue county, *Sandberg*; lake Pepin, *Miss Manning*; Winona county, *Holzinger*. Infrequent.

H. hispida, Pursh. Alum-root.

Common through the south half of the state, and in the Red river valley; extending northeast to the lake of the Woods, *Dawson*, the east end of Rainy lake, *Macoun*, and the upper Mississippi river, *Garrison*.

MITELLA, Tourn. MITER-WORT. BISHOP'S-CAP.**M. diphylla**, L. Two-leaved Miter-wort.

Common, or frequent, through the south half of the state; extending north at least to Fergus Falls, *Leonard*, Saint Cloud, *Campbell*, and the north shore of lake Superior, *Agassiz*.

M. nuda, L. Naked Miter-wort.

Common through the north half of the state; extending south at least to Stearns county, *Campbell*, and Minneapolis, *Roberts*.

TIARELLA, L. FALSE MITER-WORT.

T. cordifolia, L. False Miter-wort.

Lapham. Lake City, *Miss Beane*; Blue Earth county, *Gedge*. Infrequent.

CHRYSOSPLENIUM, Tourn. GOLDEN SAXIFRAGE.

C. Americanum, Schwein. Golden Saxifrage.

Lake Superior to the Mississippi, *Houghton*, Stearns county, *Mrs. Blaisdell*. Infrequent. North.

CRASSULACEÆ. ORPINE FAMILY.

PENTHORUM, Gronov. Ditch Stone-crop.

P. sedoides, L. Ditch Stone-crop.

Common, or frequent, through the south part of the state; extending north to the upper Mississippi river, *Garrison*.

SEDUM, Tourn. STONE-CROP. ORPINE.

S. Telephium, L. Garden Orpine. Live-for-ever.

Occasionally escaped from cultivation, Minneapolis, *Upham*.

HAMAMELACEÆ. WITCH-HAZEL FAMILY.

HAMAMELIS, L. WITCH-HAZEL.

H. Virginiana, L. Witch-Hazel.

Lapham. Southeastern Winona county, between Richmond and Dakota, *Winchell*. Rare. Southeast.

HALORAGEÆ. WATER-MILFOIL FAMILY.

MYRIOPHYLLUM, Vaill. WATER-MILFOIL.

M. spicatum, L. Water-Milfoil.

Frequent, or common, throughout the state.

M. verticillatum, L. Water-Milfoil.

Lapham. Blue Earth county, *Leiberg*. [In Manitoba, *Macoun*.] Infrequent.

M. heterophyllum, Michx. Water-Milfoil.

Lapham. Common southwestward, *Upham*.

[*Proserpinaca palustris*, L., has not yet been observed, but it probably occurs in this state.]

HIPPURIS, L. MARE'S-TAIL.

H. vulgaris, L. Mare's-Tail.

Frequent, often common, through the north half of the state; extending south at least to Little Falls (plentiful), *Upham*, Stearns county (abundant), *Mrs. Blaisdell*, and the Minnesota river near Traverse des Sioux, *Parry*.

ONAGRACEÆ. EVENING-PRIMROSE FAMILY.

CIRCÆA, Tourn. ENCHANTER'S-NIGHTSHADE.

C. Lutetiana, L. Tall Enchanter's-Nightshade.
Common throughout the state.

C. alpina, L. Low Enchanter's-Nightshade.
Common through the north half of the state; extending south at least to Anoka county, *Juni*, Minneapolis, *Herrick*, and Lake City, *Mrs. Ray*.

GAURA, L. GAURA.

G. biennis, L. Gaura.
Lake Pepin, *Miss Manning*. Southeast.

G. coccinea, Nutt.* Gaura.
Herman, Grant county, *Upham*, *Roberts*; ridge east of the Red river, near the international boundary (infrequent), *Scott*; plains of the Red river, *Drummond*, *Douglas*. West.

EPILOBIUM, L. WILLOW-HERB.

E. spicatum, Lam. (*E. angustifolium*, L.) Great Willow-herb. Fire-weed.
Common, or frequent, through the forest portion of the state; conspicuous on tracts of burned woodland. A canescent variety, besides the type, occurs at the lake of the Woods, *Dawson*.

E. organifolium, Torr. (*E. alpinum*, L., var. *majus*, Wahl.) Willow-herb.
Winona county, *Holzinger*; Minneapolis, *Kassube*; Minneopa Falls, Blue Earth county, *Leiberg*. Rare southward, but probably frequent northward.

E. palustre, L., var. *lineare*, Gray. Linear-leaved Epilobium.
Common, or frequent, through the north half of the state, and southwestward; rare southeastward.

E. molle, Torr. Downy Willow-herb.
Blue Earth county, *Leiberg*; Minneapolis, *Simmons*; Anoka county, *Juni*. Infrequent.

E. coloratum, Muhl. Willow-herb.
Common throughout the state, especially northward.

CENOTHERA, L. EVENING-PRIMROSE.

C. biennis, L. Common Evening-Primrose.
Common throughout the state.

C. biennis, L., var. *grandiflora*, Lindl.
At the northwest side of Mille Lacs, *Upham*. [The var. *muricata*, Lindl., also quite certainly occurs in this state.]

***GAURA COCCINEA**, Nutt. Canescent, puberulent or glabrate; stems suffruticose and fastigiate branched from the base, 6 to 12 inches high, very leafy, ascending; leaves lanceolate, linear-oblong or linear, repand-denticulate or entire, 6 to 12 lines long, closely sessile; flowers in simple spikes terminating the leafy branches, rose-color, turning to scarlet; bracts linear, rather persistent, longer than the ovaries; calyx-segments linear-oblong, shorter than the narrow infundibuliform tube, as long as the roundish, unguiculate petals; fruit elliptical, sessile, short, terete, 4-sided above. *Porter and Coulter's Flora of Colorado*.

Æ. rhombipetala, Nutt. Evening-Primrose.

Frequent through the south part of the state; extending north to Minneapolis, *Roberts*, Anoka county, *Juni*, and Stearns county, *Garrison*; but not found in the Red river valley, *Upham*.

Æ. fruticosa, L. Sundrops.

Upper Mississippi river, *Garrison*. Rare. South.

Æ. pumila, L. (Including *Æ. chrysantha*, Michx.) Small Evening-Primrose.

Throughout the state, but infrequent. Lake of the Woods *Dawson*, *Burgess*; upper Mississippi river, *Garrison*; Goodhue county, *Sandberg*; Lake city, *Mrs. Ray*; Hesper, Iowa, *Mrs. Carter*; Pipestone county, *Mrs. Bennett*.

Æ. serrulata, Nutt. Evening-Primrose.

Common in all the prairie portion of the state; abundant in the Red river valley; extending northeast to the upper Mississippi, *Houghton*.

Æ. albicaulis, Nutt.* White, shrubby Evening-Primrose.

Brown's Valley (petals white, 1 inch long), *Upham*; near Muskoda, Clay county, *Leiberg*; Pembina, *Havard*. West.

LUDWIGIA, L. FALSE LOOSESTRIFE.**L. polycarpa**, Short & Peter. False Loosestrife.

Lake Pepin, *Miss Manning*; White Bear lake, Ramsey county, *Simmons*. Rare. Southeast.

L. palustris, Ell. Water Purslane.

St. Croix river, *Parry*; Blue Earth county, *Leiberg*. [Saskatchewan river, *Richardson*.] Infrequent.

LYTHRACEÆ. LOOSESTRIFE FAMILY.

DIDIPLIS, Raf. Didiplis.**D. linearis**, Raf. (*Ammannia Nuttallii*, Gray.) Didiplis.

Minnesota, *T. J. Hale*, in *Gray's Manual*. Southeast.

LYTHRUM, L. LOOSESTRIFE.**L. alatum**, Pursh. Loosestrife.

Common, or frequent, through the southern third of the state; extending north to Stearns county, *Mrs. Blaisdell*, and the upper Mississippi river, *Garrison*.

[*Nesaea verticillata*, HBK, which occurs on the upper St. Croix river in Wisconsin, should be looked for in the adjoining part of Minnesota.]

**ÆNOTHERA ALBICAULIS*, Nutt. Perennial, puberulent or hirsute; stems usually 1 to 3 feet high, erect or ascending, with a white, membranous, shining bark; leaves very variable, linear or lanceolate, attenuate at the base, entire or more or less dentate; petals round-ovate, more or less unguiculate, entire, exceeding the stamens and equaling the pistil, often nearly white; capsule thickened at base, sessile, linear, divaricate, often flexuous or deflexed; seeds rather small, linear-lanceolate, smooth. *Porter and Coulter's Flora of Colorado*.

CACTACEÆ. CACTUS FAMILY.

OPUNTIA, Tourn. PRICKLY PEAR. INDIAN FIG. "CACTUS."

O. Rafinesquii, Engelm. Prickly Pear.

On rocks : at Taylor's Falls, *Miss Field*, *Miss Cathcart*; in section 17, Haven, Sherburne county, *Upham*; Redstone, near New Ulm, *Juni*. Rare. South. (The "prickly pear" which Keating and Sir John Richardson mention as abundant on the islands of the lake of the Woods is probably *Echinocystis lobata*. *Macoun*.)

O. Missouriensis, DC. Prickly Pear,

Section 17, Omro, Yellow Medicine county, *Upham*; Pipestone county (plentiful at the pipestone quarry), *Mrs. Bennett*, determined by *Dr. Engelmann*. Rare. South.

O. fragilis, Haw.* Prickly Pear.

Plentiful at the pipestone quarry, Pipestone county ("joints small, terete, with a terminal habit of growth, making them somewhat like a string of beads"), *Mrs. Bennett*, determined by *Dr. Engelmann*; Redwood Falls, *Miss Butler*. Rare. Southwest. (The range of this species is principally westward, on the upper Missouri and Yellowstone and thence south; but it occurs very rarely and locally farther east, being reported by *Swezey*, at Baraboo, Wisconsin.)

CUCURBITACEÆ. GOURD FAMILY.

SICYOS, L. ONE-SEEDED STAR-CUCUMBER.

S. angulatus, L. One-seeded Star-Cucumber.

Frequent through the south part of the state; extending north to St. Croix Falls, *Miss Field*, and Stearns county, *Garrison*.

ECHINOCYSTIS, Torr. & Gray. WILD BALSAM-APPLE.

E. lobata, Torr. & Gray. Wild Balsam-apple.

Common, or frequent, through the south half of the state, and in the Red river valley; extending northeast to Mille Lacs, *Upham*, the upper Mississippi river, *Garrison*, the lake of the Woods, *Dawson*, and Fort Francis, Rainy river, *Macoun*.

UMBELLIFERÆ. PARSLEY FAMILY.

HYDROCOTYLE, Tourn. WATER PENNYWORT.

H. Americana, L. Water Pennywort.

Lapham. Falls of the St. Croix, *Parry*. East.

H. umbellata, L. Water Pennywort.

North shore of lake Superior, *Juni*. Rare. East. [This species also occurs in Michigan.]

***OPUNTIA FRAGILIS**, HAW. The joints are small, ovate, compressed or turned, or even terete; 4 larger spines on the upper fully developed pulvilli cruciate, the upper one suberect, stouter and longer than the others, mostly yellowish-brown; on the lower margin 4-6 small white radiating spines; bristles few. Fruit apparently somewhat fleshy, getting dry much later with 20 to 28 pulvilli, almost naked, only the upper ones with a few short spines; seeds few, large, regular. *Engelmann and Bigelow*, in *Pacific Railroad Report*.

SANICULA, Tourn. SANICLE. BLACK SNAKEROOT.**S. Canadensis**, L. Sanicle. Black Snakeroot.

Common, or frequent, through the south part of the state; extending north at least to Pine and Sherburne counties (common,) *Upham*, and Stearns county, *Campbell*.

S. Marylandica, L. Sanicle. Black Snakeroot.

Common, or frequent, throughout the state.

ERYNGIUM, Tourn. Eryngo.**E. yuccæfolium**, Michx. Rattlesnake-Master. Button Snakeroot.

Common southeastward; extending north to Rice and Nicollet counties, and west to Martin county and the southeast part of Brown county, *Upham*.

DAUCUS, Tourn. CARROT.**D. Carota**, L. Common Carrot.

Occasionally spontaneous: Nicollet county, *Aiton*; Lake City, *Miss Manning*.

CARUM, L. Caraway.**C. Carui**, L.* Common Caraway.

"Self-seeding" northeastward, *Clark*; not infrequently adventive, Todd, Isanti and Steele counties, *Upham*.

POLYTÆNIA, DC. POLYTÆNIA.**P. Nuttallii**, DC. Polytenia.

Lapham. Rare. South.

HERACLEUM, L. COW-PARSNIP.**H. lanatum**, Michx. Cow-Parasnip.

Frequent throughout the state; abundant north of lake Superior.

PEUCEDANUM, L. PEUCEDANUM. HOG'S-FENNEL.**P. nudicaule**, Nutt.† Peucedanum. Hog's-Fennel.

Rock county, *Leiberg*; extending northeast to Saint Cloud, Stearns county (bluff of Mississippi river, near the Normal School) *Mrs. Blaisdell*, determined by *Prof. Asa Gray*. "Abundant on gravelly drift knolls in southwestern Minnesota and northwestern Iowa; remarkable for being the earliest flowering plant of that region, blooming almost as soon as the snow has disappeared." *Leiberg*. Southwest.

**Carum Carui*, L. Finely pinnately compound leaves; stem-leaves with slender but short thread-shaped divisions; white flowers; oblong, highly aromatic fruit. *Gray's Field, Forest, and Garden Botany*.

†**PEUCEDANUM NUDICAULE**, Nutt. Caulescent or sometimes scarcely so, minutely pubescent, 3 to 15 inches high; leafy only at base; leaves bipinnate or ternate-bipinnate, the segments incisely lobed with usually rather broad and subacute divisions; umbel somewhat capitate in flower, with 8 to 12 rays; involucre none; involucels unilateral, of 6 to 10 membranously margined, more or less united bracts; petals white, with attenuated apex and quasi-obcordate; calyx-teeth short; fruit pubescent, broadly oval, 3 to 4 lines long and 3 lines broad, the thickish wing more than half as wide as the seed; vittæ 3 in the intervals, 6 upon the commissure, conspicuous; seed flattened. As observed by Dr. Gray, the plant does not accord with Nuttall's description, nor in all respects with the characters of the genus; the lateral wings, however, are contiguous until the full maturity of the seed. *Watson's Rep. in King's Expl. of the Fortieth Parallel*.

PASTINACA, Tourn. **PARSNIP.**

P. sativa, L. (*Peucedanum sativum*, Benth. & Hook.) *Common Parsnip.*
Occasionally adventive throughout the state. [Common in Manitoba, *Macoun.*]

ARCHEMORA, DC. **COWBANE.**

A. rigida, DC. Cowbane. Water Dropwort.

Upper Mississippi river, *Garrison*; Wabasha, *Gilson*; Hesper, Iowa, *Mrs. Carter.*
(The var. *ambigua*, Torr. & Gray, probably also occurs in Minnesota. *Arthur.*) Infrequent. South.

CYMOPTERUS, Raf. **Cymopterus.**

C. glomeratus, Raf.* *Cymopterus.*

"Bend of Red river" [at Breckenridge], *Lapham* (according to his ticket of specimens in the herbarium of Harvard college, *Watson.*) West.

ARCHANGELICA, Hoffm. **ARCHANGELICA.**

A. hirsuta, Torr. & Gray. *Archangelica.*

Anoka county, *Juni*; lake Pepin, *Miss Manning.* Rare. South.

A. atropurpurea, Hoffm. *Great Angelica.*

Common, or frequent, through the north half of the state, excepting perhaps far northwestward; found in Clay county in the Red river valley, *Gedge*; extending south to lake Pepin, *Miss Manning*, Cannon River Falls, *Blake*, *Sanäberg*, and New Ulm, *Juni.*

SELINUM, L. **HEMLOCK-PARSLEY.**

S. Canadense, Michx. (*Conioselinum Canadense*, Torr. & Gray.) *Hemlock-Parsley.*

Upper Mississippi river, *Garrison.* Rare.

ÆTHUSA, L. **FOOL'S PARSLEY.**

Æ. Cynapium, L. *Fool's Parsley.*

Near Lake City, *Miss Manning*; Nicollet county, *Aiton.* Rare. South.

***CYMOPTERUS**, Raf. Calyx-teeth rather prominent and setaceous or lanceolate, minute or obsolete. Petals ovate, oblong or oblanceolate, inflexed, quasi-emarginate. Disk flattened around the styles, undulate-margined. Fruit ovate or elliptical, obtuse or retuse, subterete or slightly compressed dorsally; carpels semi-terete; ribs thick and elevated, all or only the lateral ones or those opposite to the calyx-teeth expanded into wings; vittæ numerous, narrow. Carpophore 2-parted, free or attached to the carpels. Seeds much compressed dorsally and more or less concave on the face.—Perennial and subcæspitose, with a thickened caudex; leaves pinnately decomposed, with narrow, small or incisely pinnatifid segments; umbels compound, usually few-rayed; involucrel bracts 1 to 2 or none; of the involucrels several, very narrow or broad and membranous; flowers white or yellow. *Benth. & Hook.*

CYMOPTERUS GLOMERATUS, Raf. Root thick and fusiform; plant 3 to 8 inches high; caudex about 1 inch high, sometimes divided, bearing the leaves and peduncles at the summit; leaves on long petioles ternately divided and bipinnatifid, segments oblong-linear; rays of the umbel 4 to 6, very short; peduncles much shorter than leaves, 6 to 12 lines long; flowers white, those of the center abortive, pedicellate; leaflets of the palmately 5- to 7- parted involucrel coherent at base and partly adnate to the rays of the umbellets; calyx-teeth subulate; fruit elliptical, 4 lines long, wings thickened and somewhat spongy, more or less obsolete; vittæ in each interval 3 or 4, in the commissure about 8. *Porter and Coulter's Flora of Colorado.*

THASPIUM, Nutt. MEADOW-PARSNIP.**T. barbinode**, Nutt. Meadow-Parsnip.

Blue Earth river, *Parry*; Minneapolis, *Roberts*, *Upham*; extending north to the upper Mississippi river, *Garrison*. South.

T. aureum, Nutt. Meadow-Parsnip.

Common through the south half of the state; extending north to the upper Mississippi river, *Garrison*, and Sand Hill river, *Upham*; Pembina, *Chickering*, *Howard*.

T. aureum, Nutt., var. **apterum**, Gray. Meadow-Parsnip.

Minnesota river, *Parry*; abundant in Martin county, and in Emmet county, Iowa, *Cratty*. Perhaps the more common form of the species. South.

T. trifoliatum, Gray. Meadow-Parsnip.

Common through the south half of the state and northwestward; extending north-east to the upper Mississippi river, *Garrison*.

T. trifoliatum, Gray, var. **apterum**, Gray. Meadow-Parsnip.

Common throughout the Red river valley (the prevailing representative of this genus north of Sand Hill river), *Upham*; and common in Emmet county, Iowa, *Cratty*. Probably the most frequent form of the species in this state. (The var. *atropurpureum*, Gray, doubtless also occurs here, but must be rare.)

PIMPINELLA, L. BURNET SAXIFRAGE. GOLDEN ALEXANDERS.**P. integerrima**, Benth. & Hook. (*Zizia integerrima*, DC.) Golden Alexanders.

Winona county, *Holzinger*; lake Pepin, *Miss Manning*; Faribault, *Miss Beane*; Martin county (plentiful), *Cratty*; Red river valley near Moorhead, *Leiberg*. Local.

CICUTA, L. WATER-HEMLOCK.**C. maculata**, L. Spotted Cowbane. Musquash Root. Beaver-Poison.

Common, or frequent, throughout the state; abundant in the Red river valley. The roots of this and the following species are deadly poison.

C. virosa, L.* Water-Hemlock. Musquash-Poison.

Pembina, Red river valley ("this species exhibits forms running toward *C. maculata*," *Chickering*; frequent from the Red river westward, on wet spots on the prairie, *Macoun*. Northwest.

C. bulbifera, L. Bulb-bearing Water-Hemlock.

Throughout the state; common northward, infrequent southward.

***CICUTA VIROSA**, L. Root-fibres slender. Rootstock short, hollow, with transverse partitions. Radical leaves bininate; ultimate leaflets or segments strapshaped-elliptical, entire or cleft, coarsely and unequally serrate. Stem erect, branched, hollow, 1 to 4 feet high. Lower leaves very large, triangular or lanceolate in outline, on thick, hollow petioles, with the pinnae again pinnate; the secondary pinnae undivided or 2- or 3-cleft or partite or pinnatifid, 1 to 3 inches long, varying in breadth from $\frac{1}{8}$ to $\frac{3}{8}$ inch; stem-leaves much smaller and less compound. Umbels flat-topped, lax, stalked, terminal or (from the growth of an axillary branch) opposite the leaves; rays of the umbels 1 to 2 inches long; pedicels $\frac{1}{4}$ to $\frac{3}{8}$ inch long. Involucre none; involucrel of numerous linear tapering leaves, shorter than the flowers. Flowers $\frac{1}{2}$ inch across, white. Calyx-teeth ovate, much shorter than the petals, persistent. Petals roundish-obovate, spreading, slightly notched, with a small inflexed lobe. Cremocarp with the breadth greater than the length, which is one-tenth inch, reddish-brown, with the vittae apparent when dry; ridges broad, little elevated; styles long, reflexed. *Sowerby's English Botany*, vol. iv.

SIUM, L. WATER-PARSNIP.

- S. cicutæfolium**, Gmelin. (*S. lineare*, Michx.) Water-Parsnip.
Common, or frequent, throughout the state.

BERULA, Koch. WATER-PARSNIP.

- B. angustifolia**, Koch. (*Sium angustifolium*, L.) Water-Parsnip.
Cold springs, Mankato and Kasota, *Leiberg*. Infrequent. South.

CRYPTOTÆNIA, DC. HONEWORT.

- C. Canadensis**, DC. Honewort.

Common through the south part of the state, extending north to the upper Mississippi river; Fond du Lac, at west end of lake Superior, *Mrs. Herrick*.

OSMORRHIZA, Raf. Sweet Cicely.

- O. longistylis**, DC. Smoother Sweet Cicely.
Common throughout the state.

- O. brevistylis**, DC. Hairy Sweet Cicely.
Frequent throughout the state.

CONIUM, L. POISON HEMLOCK.

- C. maculatum**, L. *Poison Hemlock*.
Red river valley near Saint Vincent, *Scott*. Infrequent.

ARALIACEÆ. GINSENG FAMILY.

ARALIA, Tourn. GINSENG. WILD SARSAPARILLA.

- A. racemosa**, L. Spikenard.

Frequent throughout most of the state; common in Todd, Stearns and Brown counties; rare far northward.

- A. hispida**, Vent. Bristly Sarsaparilla. Wild Elder.

Common along the north shore of lake Superior, *Roberts, Juni*; extending south to the Falls of the St. Croix, *Parry*, and to Dakota county (frequent), *Upham*. Northeast.

- A. nudicaulis**, L. Wild Sarsaparilla.

Common throughout the state.

- A. quinquefolia**, Decaisne & Planch. Ginseng.

Throughout the state, excepting perhaps northwestward; local, wanting in some districts, rare far northward; frequent, occasionally abundant, in the region of the upper Mississippi, and in Mille Lacs, Pine, Anoka, Hennepin and Brown counties. Large quantities of the aromatic, medicinal root of this plant, mostly dug by the Chipewewa Indians, are bought every year in the north part of the state, the price being about a dollar per pound. It is mostly exported to China; and the annual exportation of this article from the United States, mainly from Pennsylvania, West Virginia, Ohio, Michigan, Wisconsin and Minnesota, amounts to about \$700,000. *U. S. Agricultural Report for 1877*, p. 545.

- A. trifolia**, Decaisne & Planch. Dwarf Ginseng. Ground-nut.

East part of the state, extending north to Pine county, *Clark*; lake Pepin, *Miss Manning*; Nicollet county, *Leiberg*.

CORNACEÆ. DOGWOOD FAMILY.

CORNUS, Tourn. CORNEL. DOGWOOD.

C. Canadensis, L. Dwarf Cornel. Bunch-berry.

Abundant through the north part of the state; extending south to Fergus Falls, Leonard, Wadena county, Upham, Minneapolis, Winchell, Roberts, and Saint Paul (rare). Miss Cathcart; rare and local farther southeast, as in Wabasha county, Holzinger, Miss Manning.

C. circinata, L'Her. Round-leaved Dogwood.

Frequent, occasionally common, throughout the state.

C. sericea, L. Silky Cornel. Kinnikinnick.

Frequent throughout the state, excepting far northward. The inner bark of this and the next following species, the leaves of the bearberry (*Arctostaphylos Uva-ursi*), and leaves of sumach, gathered when they turn red, are each used by the Indians, under the name *Kinnikinnick*, to mix with their tobacco for smoking. Parry states that the bark of this species, wherever it is found, is preferred for this purpose; and that the bark of the next is commonly substituted for it by the Indians about lake Superior.

C. stolonifera, Michx. Red-osier Dogwood. Kinnikinnick.

Abundant through the north half of the state, and common southward to Winona and Mower counties, Winchell, and Blue Earth county, Upham; but scarcely reaching into Iowa (in Emmet county, rare, Cratty). The name of the Redwood river, which is a translation of its original Indian name, is said by Prof. A. W. Williamson to be probably derived from this or the preceding species of Kinnikinnick.

C. asperifolia, Michx. Rough-leaved Dogwood.

Blue Earth river, Parry, Leiber; Cannon River Falls, Blake, Sandberg; Hesper, Iowa (common), Mrs. Carter. South.

C. paniculata, L'Her. Panicked Cornel.

Common through the south half of the state, and in the Red river valley; the most plentiful species of cornel in the Big Woods; extending north to Todd and Wadena counties (common), Upham, but not reported in the region of the upper Mississippi river and northeastward.

C. alternifolia, L. Alternate-leaved Cornel.

Frequent, occasionally common, throughout the state, excepting far northward, where it is rare (at Poplar river, north of lake Superior, Juni).

CAPRIFOLIACEÆ.* HONEYSUCKLE FAMILY.

LINNÆA, Gronov. LINNÆA. TWIN-FLOWER.

L. borealis, Gronov. Linnæa. Twin-flower.

Abundant north of lake Superior and thence to the sources of the Mississippi and northward; St. Louis river (usually having five perfect stamens), Mrs. Herrick; extending southwest to Wadena and Todd counties, Upham, and south to Minneapolis (at lake Calhoun), Roberts. In the northeast part of the state, "this pretty little plant, the

* Advance sheets of a new part of Professor Gray's *Synoptical Flora of North America* (Vol. I, Part II; Caprifoliaceæ to Compositæ, inclusive), kindly sent by him while this catalogue was in process of being printed, have supplied very important corrections, especially in synonymy, as well as numerous additions, and valuable aid in the statements of geographic range.

Dwarf Cornel and the *Clintonia* are the most common small flowering plants found in the moss-carpeted forest." *Roberts*.

SYMPHORICARPOS, Dill. SNOWBERRY.

S. occidentalis, Hook. Wolf berry.

Common, often abundant, through the south half of the state; and northwesterly from Wadena county to the Red river valley, *Upham*, and the lake of the Woods, *Dawson*; infrequent northeastward. [North of lake Superior, *Agassiz*.]

S. racemosus, Michx. Snowberry.

Lake Pepin, *Miss Manning*; sources of the Mississippi, *Houghton*, *Garrison*; Red river valley, *Scott*. North.

S. racemosus, Michx., var. **pauciflorus**, Robbins. Snowberry.

Lake Pepin, *Miss Manning*; Minneapolis, *Winchell*; Stillwater, *Miss Field*; Redwood Falls, *Pemberton*; Isanti, Crow Wing and Wadena counties, *Upham*. North.

S. vulgaris, Michx. Indian Currant. Coral-berry.

Lake Pepin, *Miss Manning*; Blue Earth county, *Leiberg*; Hennepin county, *Herrick*; upper Mississippi river, *Garrison*. Rare. South.

LONICERA, L. HONEYSUCKLE. WOODBINE.

[*L. grata*, Ait., has been several times reported in this state; but Gray's *Synoptical Flora of N. A.* shows that these references doubtless belong to some other species.]

L. Sullivantii, Gray. (*L. flava*, in part, Gray's *Manual*.) Yellow Honeysuckle.

Winona county, *Holzinger*; Lake City, *Miss Manning*; Cannon River Falls, *Blake*, *Sandberg*; Hennepin county, *Winchell*; Fergus Falls, *Leonard*.

L. glauca, Hill. (*L. parviflora*, Lam., and var. *Douglasii*, Gray, in *Manual*.) Yellow Honeysuckle. Crimson Honeysuckle.

Common, or frequent, throughout the state. This species with "crimson or deep dull purple" flowers has been noted by many observers in all parts of the state as a distinct variety, but Gray's *Synoptical Flora of N. A.* does not separate it from the type with greenish yellow flowers.

L. hirsuta, Eaton. Hairy Honeysuckle.

Lake Superior to the source of the Mississippi, *Houghton*; common north of lake Superior, *Juni*; Carlton county, *Roberts*; Pembina, *Chickering*, *Haward*. North.

L. involucrata, Banks. Involute Honeysuckle.

Isle Royale, lake Superior; doubtless also in northern Minnesota.

L. ciliata, Muhl. Fly-Honeysuckle.

North of lake Superior, *Juni*; Hennepin county, *Winchell*; frequent at Hesper, Iowa, *Mrs. Carter*.

L. cærulea, L. Mountain Fly Honeysuckle.

North shore of lake Superior (swamp near Port Arthur), *Macoun*; doubtless in north-eastern Minnesota.

L. oblongifolia, Hook. Swamp Fly-Honeysuckle.

Kanabec county, *Upham*. North.

DIERVILLA, Tourn. BUSH-HONEYSUCKLE.

D. trifida, Mœnch. Bush-Honeysuckle.

Throughout the state; common, often abundant, northward, and frequent southward.

TRIOSTEUM, L. Fever-wort. Horse-Gentian.

T. perfoliatum, L. Fever-wort. Horse-Gentian.

Frequent through the south part of the state; extending north to Stearns and Todd counties, *Upham*.

ADOXA, L. MOSCHATEL.

A. Moschatellina, L.* Moschatel. Hollow-root. Musk Crowfoot.

Beside Rolling Stone creek, three miles west of Minnesota City, Winona county, *Holzinger*; Vasa, Goodhue county, *Sandberg*. Rare. (Also found at Decorah, Iowa, and on the Rocky mountains in Colorado; common far north in British America.)

SAMBUCUS, Tourn. ELDER.

S. Canadensis, L. Common Elder. Sweet Elder.

Common, or frequent, through the south half of the state, and rare northwesterly to Otter Tail and Becker counties.

S. racemosa, L. (*S. pubens*, Michx.) Red-berried Elder.

Common, or frequent, throughout the state.

VIBURNUM, L. ARROW-WOOD. LAURESTINUS.

V. Lentago, L. Sweet Viburnum. Sheep-berry. Black Haw.

Common through the south half of the state; extending north at least to Cass county (Fish-hook lake) and the White Earth reservation, *Garrison*, and to Pembina, *Chickering*, *Scott*, *Havard*.

V. cassinoides, L. (*V. nudum*, L., var. *cassinoides*, Torr. & Gray.)

Withe-rod.

Upper Mississippi river and White Earth reservation, *Garrison*.

V. dentatum, L. Arrow-wood.

White Earth reservation, *Garrison*; Fergus Falls, *Leonard*; Minnesota river, *Parry*; Pipestone county, *Mrs. Bennett*; New Ulm (common), *Juni*; Minneapolis, *Griswold*, *Kassub*; lake Pepin, *Miss Manning*.

V. pubescens, Pursh. Downy Arrow-wood.

Common, or frequent, throughout the state.

V. acerifolium, L. Maple-leaved Arrow-wood. Dockmackie.

White Earth reservation, *Garrison*; Lake City, *Mrs. Ray*. Infrequent. Southeast.

[*V. pauciflorum*, Pylaie, will doubtless be found in northern Minnesota; and perhaps also *V. lantanoides*, Michx.]

V. Opulus, L. Cranberry-tree. Bush or High Cranberry.

Common through the north half of the state and in the Big Woods; frequent thence southeastward; absent far southwest. Fruit much used for sauce. The name Pembina,

***ADOXA**, L. A genus of but a single species, widely distributed throughout the cooler parts of the globe. Flowers perfect. Tube of the calyx coherent with the lower part of the ovary, the limb slightly 2-3 cleft. Petals 4-5, inserted on the limb of the calyx, united at the base, spreading. Stamens 4-5, each filament 2-parted; the divisions bearing each a single-celled peltate anther. Styles 4-5, subulate. Fruit an herbaceous and juicy berry, 4-5-celled; each cell with a single suspended seed. Seeds compressed, with a membranaceous margin.

A. MOSCHATELLINA, L. A small perennial herb, with the odor of musk; root tuberous; radical leaves twice ternately compound, on long petioles, the cauline solitary, 1-2 ternate or incised; flowers 4-6 (greenish) in a terminal capitulum, the lateral ones mostly pentamerous, the terminal tetramerous. *Torrey and Gray's Flora of N. A.*, as quoted by *Arthur*.

borne first by a river, and thence given to a town and county, is stated by Keating to be from the Chippewa word for this fruit, "*anepeminan*, which name has been shortened and corrupted into Pembina (*Viburnum Oxyococcus*)." *Narrative of Long's Expedition*, vol. ii, p. 38; see also p. 127.

RUBIACEÆ. MADDER FAMILY.

GALIUM, L. BEDSTRAW. CLEAVERS.**G. Aparine**, L. Cleavers. Goose-Grass.

Stearns county, *Mrs. Blaisdell*; Minneapolis, *Roberts*; Faribault, *Miss Beane*; Goodhue county, *Sandberg*; common at Hesper, Iowa, *Mrs. Carter*; frequent in Emmet county, Iowa, *Cratty*.

G. asprellum, Michx. Rough Bedstraw.

Common, or frequent, throughout the state.

G. concinnum, Torr. & Gray. Bedstraw.

Minneapolis, *Roberts*; Blue Earth county, *Leiberg*; Martin county (abundant), *Cratty*; Fergus Falls, *Leonard*. South.

G. trifidum, L. (*G. tinctorium*, L.) Small Bedstraw. Dyer's Cleavers.

Common, or frequent, throughout the state; exhibiting within our limits, the three varieties mentioned by Gray's *Manual*.

G. trifidum, L., var. **pusillum**, Gray. Small Bedstraw. Dyer's Cleavers.

Pembina, *Havard*. North.

G. trifidum, L., var. **latifolium**, Torr. Dyer's Cleavers.

Minneapolis, *Roberts*.

G. triflorum, Michx. Sweet-scented Bedstraw.

Throughout the state; common northward, frequent southward.

G. circæzans, Michx. Wild Licorice.

Lapham. Rare. Southeast.

G. lanceolatum, Torr. Wild Licorice.

Goodhue county, *Sandberg*. Rare. East.

G. boreale, L. Northern Bedstraw.

Abundant, or common, throughout the state.

CEPHALANTHUS, L. BUTTON-BUSH.**C. occidentalis**, L. Button-bush.

Lapham. Taylor's Falls, *Roberts*; shore of lake Pepin in Wisconsin, *Miss Manning*. South.

MITCHELLA, L. PARTRIDGE-BERRY.**M. repens**, L. Partridge-berry.

St. Croix river, *Parry*, *Miss Field*; upper Mississippi river, *Garrison*; northern Kanabec county (common), *Upham*; abundant at Taylor's Falls and Duluth, *Miss Cathcart*.

HOUSTONIA, Gronov. HOUSTONIA.**H. purpurea**, L., var. **longifolia**, Gray. Houstonia.

Frequent throughout most of the state. Gooseberry river, lake Superior, *Juni*; St. Louis river, *Houghton*; lake of the Woods, *Dawson*; and thence south at least to

Chisago county (plentiful), *Upham*, lake Pepin, *Miss Manning*, Blue Earth county, *Leiberg*, and the Upper Minnesota river, *Parry*.

H. purpurea, L., var. **ciliolata**, Gray. Houstonia.
Stearns county, *Campbell*. [Walhalla, northeastern Dakota, *Scott*.]

VALERIANACEÆ. VALERIAN FAMILY.

VALERIANA, Tourn. VALERIAN.

V. edulis, Nutt. Valerian.

Upper Mississippi river, *Parry*; Minneapolis, *Roberts*; lake Pepin, *Miss Manning*; Faribault, *Miss Beane*; Winona county, *Holzinger*; Fillmore county, *Mrs. Carter*; Steele county (frequent), *Upham*.

[*V. sylvatica*, Bauks, probably also occurs northward.]

VALERIANELLA, Tourn. (*FEDIA*, Gærtn.) CORN SALAD.
LAMB LETTUCE.

V. chenopodifolia, DC. (*F. Fagopyrum*, Torr. & Gray.) Corn Salad.
Lamb Lettuce.

Lake Pepin, *Miss Manning*; eastern Rice county (common), *Upham*. Southeast.

V. radiata, Dufresne. (*F. radiata*, Michx.) Corn Salad. Lamb Lettuce.
Lapham. Cannon River Falls, *Blake*, *Sandberg*. Rare. Southeast.

DIPSACEÆ. TEASEL FAMILY.

DIPSACUS, Tourn. Teasel.

D. sylvestris, Mill. Wild Teasel.

Lake Pepin, *Miss Manning*. Infrequent.

COMPOSITÆ. COMPOSITE FAMILY.

VERNONIA, Schreb. IRON-WEED.

V. noveboracensis, Willd. Iron-weed.

Upper Mississippi river, *Houghton*; Hennepin county, *Herrick*; St. Paul, *Kelley*; Blue Earth county, *Leiberg*. Southeast.

V. fasciculata, Michx. Iron-weed.

Common through the south half of the state and in the Red river valley, *Upham*.

LIATRIS, Schreb. BUTTON SNAKEROOT. BLAZING-STAR. GAY
FEATHER.

L. squarrosa, Willd. Blazing-Star.

Common through the south part of the state; extending north to the upper Mississippi river, *Garrison*.

[*L. squarrosa*, Willd., var. *intermedia*, DC. (heads narrow; bracts of the involucre erect or little spreading, less prolonged), probably also occurs in this state, according to Gray's *Synoptical Flora of N. A.*]

L. cylindracea, Michx. Button Snakeroot. † Blazing-Star.

Common, or frequent, through the south half of the state; extending north to the upper Mississippi river, *Houghton*, *Garrison*, and Fergus Falls, *Leonard*.

L. scariosa, Willd. Blazing-Star. Gay Feather.

Common, often abundant, through the south half of the state, being the most plentiful species southwestward; also common in the Red river valley, especially north of Sand Hill river and along the old Pembina trail, *Upham*; extending northeast to the upper Mississippi river, *Houghton*. (A remarkable form of this species, bearing the heads at the end of leafy, ascending branches, 2 to 6 inches long, was found in a bog near Mankato by *Mr. Leiberg*. White-flowered specimens have been collected by *Mr. W. H. Kelley*, at Dellwood, White Bear lake, Ramsey county.)

L. spicata, Willd. Blazing-Star.

Lake Pepin, *Miss Manning*; Minneapolis, *Kassube*; Anoka county, also New Ulm, *Juni*; Blue Earth county, *Leiberg*, *Gedge*; Kandiyohi county, *Upham*; Fergus Falls, *Leonard*. Less frequent than the last and the next. South.

L. pycnostachya, Michx. Blazing-Star.

Common through the south half of the state; very abundant in the Red river valley in Clay and Norman counties, but rare or infrequent north of Sand Hill river, *Upham*. This species is three weeks earlier in flowering than *L. scariosa*, and prefers moister ground.

L. punctata, Hook.* Blazing-Star.

Generally common on the drier portions of the prairie, in the west part of the state, extending east to Martin county, *Cratty*, Saint Peter, *Gedge*, and the St. Croix river, *Swezey*; but infrequent north of the Sand Hill river; seen in Kittson county only at the Ridge, twelve miles east of Saint Vincent, *Upham*, *Dawson*; also found at Pembina, *Havard*.

KUHNIA, L. KUHNIA.**K. eupatorioides**, L. Kuhnia.

Frequent, or common, through the south part of the state; Goodhue county, *Sandberg*; Hennepin county, *Herrick*; Blue Earth county, *Leiberg*; common southwestward (leaves broadly lanceolate, deeply toothed), *Upham*; extending northwest to Devil's lake, Dakota, *Geyer*.

K. eupatorioides, L., var. **corymbulosa**, Torr. & Gray. † Kuhnia.

Prairies and plains, Illinois to Dakota and Nebraska, and south to Alabama and Texas, *Gray's Synoptical Flora of N. A.*; therefore doubtless in southern and western Minnesota.

* **LIATRIS PUNCTATA**, Hook. Stems 8 inches to 3 feet high, from a thick, knotted, fusiform root, glabrate, leafy to the top; leaves linear, rigid, strongly punctate on both sides, glabrous or their margins somewhat ciliate, lower ones 3 to 5 inches long, slightly 3-nerved, 1 to 3 lines wide, pungently acute; heads in a dense spike, 4 to 10 inches long, 4- to 6-flowered; flowers reddish-purple; scales of the cylindrical involucre oblong, strongly punctate, imbricated, appressed, with mucronate, acuminate, rather spreading tips, margins woolly-ciliate; bristles of the pappus about 30, purplish or white, very plumose; achenia hairy. *Porter and Coulter's Flora of Colorado*.

† **KUHNIA EUPATORIODES**, L., var. **CORYMBULOSA**, Torr. & Gray. A foot or two high, stouter, somewhat cinereous-pubescent or tomentulose: leaves rather rigid and sessile, from oblong to lanceolate, coarsely veiny: heads rather crowded. *Gray's Synoptical Flora of N. A.*

EUPATORIUM, Tourn. THOROUGHWORT. BONESET.**E. purpureum**, L. Joe-Pye Weed. Trumpet-weed.

Common throughout the state.

E. purpureum, L., var. **maculatum**, Darl.* Joe-Pye Weed. Trumpet-weed.

Frequent, or common, throughout the state.

E. altissimum, L. Tall Boneset.*Lapham.* Goodhue county, *Sandberg*; Blue Earth county, *Leiberg*, *Gedge*.
Rare. South.**E. perfoliatum**, L. Thoroughwort. Boneset.Common, or frequent, through the south half of the state; upper Mississippi river, *Garrison*; less frequent farther north to the lake of the Woods, *Dawson*. Well known as a bitter tonic.**E. serotinum**, Michx. Thoroughwort. Boneset.*Lapham.* Todd county (frequent), *Upham*; Martin county, and Emmet county, Iowa (common), *Cratty*. South.**E. ageratoides**, L. f. White Snake-root.

Common, or frequent, throughout the state.

PETASITES, Tourn. (NARDOSMIA, Cass.) SWEET COLTSFOOT.**P. sagittata**, Gray.† (N. sagittata, Hook.) Sweet Coltsfoot.Red river valley near Saint Vincent (in a "low damp thicket; in full bloom in the first week of May; seed nearly ripe, June 4; flower with an odor like that of *Cratægus*, white, tinged with purple"), *Dawson*; also on Roseau river, *Scott*. Rare. Northwest.[*P. palmata*, Gray, (N. palmata, Hook.) probably also occurs in Minnesota.]**TUSSILAGO**, Tourn. COLTSFOOT.*T. Farfara*, L. Coltsfoot. "Ginger-root."Northeastward, "much used as a cough medicine," *Clark*; lake Pepin, *Miss Manning*.**ADENOCAULON**, Hook. ADENOCAULON.**A. bicolor**, Hook. Adenocaulon.Stearns county, *Garrison*. Rare. North.**ASTER**, Tourn. STARWORT. ASTER.**A. corymbosus**, Ait. Aster.Hennepin county, *Roberts*. [North of lake Superior, *Agassiz*.] Infrequent.**A. macrophyllus**, L. Large-leaved Aster.Abundant north of lake Superior, *Roberts*; lake of the Woods, *Dawson*; upper* **EUPATORIUM PURPUREUM**, L., var. **MACULATUM**, Darl. Common in open ground, 3 or 4 feet high, often roughish-pubescent: stem commonly purple, striate or sulcate; leaves somewhat rugose, 3-5-nate: inflorescence more compact and depressed. The most widely distributed form. *Gray's Synoptical Flora of N. A.*† **PETASITES SAGITTATA**, Gray. Leaves from deltoid-oblong to reniform-hastate, from acute to rounded-obtuse, repand-dentate, very white-tomentose beneath, when full grown 7 to 10 inches long: heads short-racemose, becoming corymbose: ligules equalling or shorter than the disk. *Gray's Synoptical Flora of N. A.*

Mississippi river, *Garrison*; Todd and Crow Wing counties (common), *Upham*; White Bear, Ramsey county, *Simmons*. North and east.

A. sericeus, Vent. Silky Aster.

Common through the south half of the state, and frequent in the Red river valley, *Upham*; extending northeast to the upper Mississippi river, *Garrison*, and the mouth of Rainy river, *Macoun*.

A. patens, Ait. Aster.

Upper Mississippi river, *Garrison*; Fergus Falls, *Leonard*; Douglas county, *Mrs. Terry*; Anoka county, *Juni*; Blue Earth county, *Gedge*. Infrequent. South.

A. lævis, L. Smooth Aster.

Frequent, or common, in both var. *lævigatus* and var. *cyaneus*, of *Gray's Manual*, through the south half of the state and in the Red river valley; extending northeast to Crow Wing county, *Upham*.

A. azureus, Lindl. Azure Aster.

Prairies of the Blue Earth river, *Geyer*; Goodhue county, *Sandberg*; Minneapolis, *Twining*, *Roberts*; Douglas county, *Mrs. Terry*. South.

A. Shortii, Boott. Short's Aster.

Lapham. Rare. Southeast.

A. undulatus, L. Wavy Aster.

Lapham. Douglas county, *Mrs. Terry*; Blue Earth county, *Gedge*. Infrequent. South.

A. cordifolius, L. Heart-leaved Aster.

Common in woods through the south half of the state, and in the Red river valley; only reported northeastward by *Juni* at Little Marais, lake Superior.

A. sagittifolius, Willd. Arrow-leaved Aster.

North of lake Superior (abundant), *Roberts*, *Juni*; Douglas county, *Mrs. Terry*; falls of the St. Croix, *Parry*; Minneapolis, *Roberts*; lake Pepin, *Miss Manning*; Minnesota river, *Geyer*; Emmet county, Iowa (common), *Cratty*; and westward into Dakota, *Gray's Synoptical Flora of N. A.*

A. Drummondii, Lindl.* Drummond's Aster.

Open grounds and border of woods, Illinois and Minnesota to Texas. Forms pass into *A. sagittifolius*. *Gray's Synoptical Flora of N. A.*

A. ericoides, L., var. *villosus*, Torr. & Gray. Heath-like Aster.

Blue Earth county, *Gedge*. South.

A. multiflorus, Ait. Many-flowered Aster.

Common, often abundant, through the south half of the state and in the Red river valley; extending northeast to Todd and Crow Wing counties (common), *Upham*.

A. dumosus, L. Aster.

Lake Pepin, *Miss Manning*; Blue Earth county, *Gedge*. Infrequent. Southeast.

A. vimineus, Lam. (*A. Tradescanti*, in *Gray's Manual*.) Aster.

Lake Pepin, *Miss Manning*; Douglas county, *Mrs. Terry*; common southward and westward, *Juni*, *Upham*.

*ASTER DRUMMONDII, Lindl. Pale with a fine and mostly soft cinereous pubescence; leaves from cordate to cordate-lanceolate and mostly on margined petioles, or the small uppermost lanceolate and sessile by a narrow base, obtusely or acutely serrate (the large 4 inches, smaller about an inch long), sometimes scabrous above: bracts of the involucre acute or acutish; rays violet-blue or paler, 3 to 5 lines long. *Gray's Synoptical Flora of N. A.*

A. Tradescanti, L.* Tradescant's Aster.

Open grounds, Canada to Virginia, Illinois and Saskatchewan. Nearly allied with the two preceding and the two following species. *Gray's Synoptical Flora of N. A.*

A. diffusus, Ait. (A. miser, in *Manual*.) Aster.

Throughout the state. Common north of lake Superior, and at Minneapolis, *Roberts*; lake of the Woods, *Dawson*; Todd county, *Upham*; St. Croix river, *Parry*; Goodhue county, *Sandberg*; Blue Earth county, *Leiberg*; Emmet county, Iowa, *Cratty*.

A. paniculatus, Lam. (A. simplex, and A. tenuifolius, partly, in *Manual*.) Panicked Aster.

Common, or frequent, throughout the state; especially plentiful westward.

A. polyphyllus, Willd.† (A. tenuifolius, partly, in *Manual*.) Aster.

Notes of A. tenuifolius, as described in *Gray's Manual*, probably belonging in part to A. polyphyllus, are as follows: upper Mississippi river, *Houghton*; Fergus Falls, *Leonard*; Douglas county, *Mrs. Terry*; Wadena and Todd counties, *Upham*; Blue Earth county, *Leiberg*; Emmet county, Iowa (rare), *Cratty*.

A. salicifolius, Ait. (A. carneus, in *Manual*.) Aster.

Douglas county, *Mrs. Terry*; Lac qui Parle, *Upham*; Anoka county, *Juni*. [Also northwest to the Saskatchewan river and eastern Montana, *Gray's Synoptical Flora of N. A.*]

A. junceus, Ait. (A. æstivus, in *Manual*.) Aster.

Throughout the state, but infrequent. Blue Earth county, *Leiberg*; Goodhue county, *Sandberg*; Anoka county, *Juni*; Douglas county, *Mrs. Terry*; Pembina, *Havard*. [North of lake Superior, *Agassiz*.]

A. longifolius, Lam.‡ Long-leaved Aster.

This species (not the one so named in *Gray's Manual*, which is the next; more nearly related with A. junceus) doubtless occurs in northern Minnesota.

A. Novi-Belgii, L. (Including A. longifolius of *Gray's Manual*.) New York Aster.

Spirit lake, Iowa, *Geyer*; Blue Earth county, *Gedge*; southwestward (frequent), *Juni*; Douglas county, *Mrs. Terry*; Fergus Falls, *Leonard*; upper Mississippi river, *Garrison*; Pembina, *Havard*.

* **ASTER TRADESCANTI, L.** Stem slender, 2 to 4 feet high, with numerous erect or ascending branches and branchlets: leaves lanceolate or linear, slightly serrate or entire, thinnish: small heads numerous, corymbosely or somewhat racemously paniculate (the most notable distinction from A. vimineus): only two or three lines high: bracts of the involucre linear, acutish, partly green at tip and down the back: rays white, or sometimes tinged with lilac, only about 2 lines long. *Gray's Synoptical Flora of N. A.*

† **ASTER POLYPHYLLUS, Willd.** Mostly tall (4 or 5 feet high), with virgate branches, glabrous: cauline leaves narrowly lanceolate or linear (4 or 5 inches long, quarter to half inch wide); those of flowering branchlets small and subulate-linear: heads paniculate (4 lines high): involucre nearly hemispherical; involucre bracts lanceolate-subulate, outer successively shorter, rather rigid, with green nearly erect tips; rays numerous, bright white, disposed to turn rose-purplish, 4 lines long: akenes minutely pubescent. *Gray's Synoptical Flora of N. A.*

‡ **ASTER LONGIFOLIUS, Lam.** A foot to a yard high, glabrous or pubescent, leafy: leaves elongated-lanceolate to linear-lanceolate, entire or sparingly serrulate, 3 to 7 inches long, tapering to both ends: involucre 4 to 5 lines high, little or not at all imbricated; its bracts all of nearly equal length, some looser, outermost not rarely quite herbaceous: rays 3 or 4 lines long, violet or purplish, rarely almost white. Low grounds or along streams, Labrador to Montana, Slave Lake, south to Canada and N. New England. *Gray's Synoptical Flora of N. A.*

A. puniceus, L. Aster.

Common throughout the state, excepting northwestward; extending to Fergus Falls, Leonard, and into Dakota, *Gray's Synoptical Flora*; but not observed in the Red river valley, *Upham*.

A. puniceus, L., var. **lucidulus**, Gray. (var. **vimineus**, Torr. & Gray.)

Aster.

Frequent in the south half of the state.

A. prenanthoides, Muhl. Aster.

Lapham. Common in the vicinity of Hesper, Iowa, adjoining Houston and Fillmore counties, *Mrs. Carter*. Southeast.

A. oblongifolius, Nutt. Aster.

Douglas county, *Mrs. Terry*; Fort Snelling, *Roberts*; Minneopa falls, Blue Earth county, *Upham*; Pipestone county, *Mrs. Bennett*. South.

[*A. amethystinus*, Nutt., occurs in Iowa, and probably also in Minnesota, *Arthur*.]

A. Novæ-Angliæ, L. New England Aster.

Minneapolis, *Twining, Roberts*; lake Pepin, *Miss Manning*; common at Hesper, Iowa, *Mrs. Carter*; Blue Earth county, *Gedge*; Rock county, *Leiberg*. [Upper Missouri river, *Geyer*, and Saskatchewan, *Gray's Synoptical Flora of N. A.*] South and west.

A. modestus, Lindl.* Aster.

Moist woods, Oregon to British Columbia on the Pacific, and east to Saskatchewan and Pembina (*Macoun*), *Gray's Synoptical Flora of N. A.* Northwest.

[*A. GRAMINIFOLIUS*, Pursh., is *ERIGERON HYSSOPIFOLIUS*, Michx., in *Gray's Synoptical Flora of N. A.*, and will be found accordingly under that genus.]

[*A. acuminatus*, Michx., should be looked for in northern Minnesota.]

A. ptarmicoides, Torr. and Gray. Aster.

Abundant, or common, throughout the state. [The var. *lutescens*, Gray, with "rays pale yellow, small," which occurs in Manitoba and northern Illinois (*Gray's Synoptical Flora of N. A.*), will probably be found also in Minnesota.]

A. angustus, Torr. and Gray. Aster.

Lapham. Clay county, in the Red river valley, *Gedge*, determined by *Watson*. Northwest.

A. linariifolius, L. (*Diplopappus linariifolius*, Hook.) Double-bristled Aster.

Lapham. Rare. East.

A. umbellatus, Mill. (*Diplopappus umbellatus*, Torr. & Gray.) Double-bristled Aster.

Throughout the state: abundant northward, common or frequent southward.

A. umbellatus, Mill., var. **pubens**, Gray. Double-bristled Aster.

Lower face of the oblong-lanceolate leaves tomentulose-pubescent, also usually of the flowering branchlets.—Saskatchewan to upper Michigan. *Gray's Synoptical Flora of N. A.*

***ASTER MODESTUS**, Lindl. Merely pubescent or glabrate: stem more slender than in the two preceding species, 2 feet high: leaves thinnish, lanceolate or broader (2 to 4 inches long), sparingly and acutely serrate or denticulate, very acute, mostly narrowed to a sessile or partly clasping but not auriculate base: heads fewer and smaller than in the preceding, hemispherical, numerous and usually thyrsoidly or cymosely congested at the summit of the simple very leafy stem: bracts of the involucre less numerous, loose, and more or less herbaceous (or somewhat colored) almost from the base, linear-attenuate, all equalling the disk: rays numerous and narrow, pale blue: style-appendages lanceolate: akenes hirsute. *Gray's Synoptical Flora of N. A.*

ERIGERON, L. FLEABANE.

E. hyssopifolius, Michx. (*Aster graminifolius*, Pursh.) Fleabane.

North shore of lake Superior, *Juni*; between the lake of the Woods and Red river, *Dawson*. North.

E. Canadensis, L. Horse-weed. Butter-weed.

Common throughout the state.

E. divaricatus, Michx. Dwarf Fleabane.

Open grounds and river banks, Indiana to Minnesota, Nebraska and Texas. *Gray's Synoptical Flora of N. A.*

E. acris, L. Fleabane.

North shore of lake Superior, *Macoun*; doubtless in northern Minnesota. [Perhaps the var. *DRÖBACHENSIS*, Blytt, which has a similar range with the typical species. Somewhat glabrous, or even quite so: involucre also green, naked, at most hirsute only at the base, often minutely viscidulous: slender rays somewhat slightly exerted, sometimes minute and filiform and shorter than the pappus. . . . North shore of lake Superior, etc. *Gray's Synoptical Flora of N. A.*]

E. bellidifolius, Muhl. Robin's Plantain.

Frequent southward; extending north at least to Isanti county, *Upham*, and Clay county and Detroit, Becker county, *Gedge*.

E. Philadelphicus, L. Common Fleabane.

Frequent, occasionally common, throughout the state.

E. glabellus, Nutt. Fleabane.

Goodhue county, *Sandberg*; Red river valley near Saint Vincent, *Dawson*, *Scott*. [Devil's lake, *Dakota*, *Geyer*.] West.

E. annuus, Pers. Daisy Fleabane. Sweet Scabious.

St. Croix Falls, *Miss Field*; Minneapolis, *Miss Butler*; lake Pepin, *Miss Manning*; frequent in the vicinity of Hesper, Iowa, adjoining the southern boundary of Houston and Fillmore counties, *Mrs. Carter*. This species reaches its northwest limit in southeastern Minnesota; it was not observed, though carefully looked for, throughout the remainder of the state.

E. strigosus, Muhl. Daisy Fleabane.

Throughout the state; common southward, infrequent northward.

[The species referred to the genus *DIPLOPAPPUS*, Cass., in *Gray's Manual*, are included under *ASTER* in his *Synoptical Flora of N. A.*; and in this catalogue they are placed at the end of that genus.]

BOLTONIA, L'Her. BOLTONIA.

B. asteroides, L'Her. (Including *B. glastifolia*, L'Her.) Boltonia.

Common through the south part of the state; extending north at least to Minneapolis, *Williams*, Alexandria, *Mrs. Terry*, Fergus Falls, *Leonard*, and Devil's lake, *Dakota*, *Geyer*. South and west.

GUTIERREZIA, Lagasca. GUTIERREZIA.

G. Euthamiæ, Torr. & Gray.* Gutierrezia.

Red river valley near Saint Vincent, *Scott*, determined by *Watson*. West.

**GUTIERREZIA*, Lagasca. Heads small or middle-sized, 6- to 90-flowered, the rays pistillate, fertile, the disk-flowers tubular, perfect and fertile. Involucre varying from narrowly obconic to broadly hemispherical, the scales closely imbricated in several series, rigid, and with greenish herbaceous tips. Receptacle naked. Corollas yellow,

SOLIDAGO, L. GOLDEN-ROD.**S. bicolor, L. Golden-rod.**

Lapham. The typical species is rare.

S. bicolor, L., var. concolor, Gray. Golden-rod.

Common on rocks, north shore of lake Superior, *Roberts, Juni*; northwest side of Mille Lacs, *Upham*; falls of the St. Croix, *Parry*.

S. latifolia, L. Golden-rod.

Common, or frequent, throughout the state.

S. cæsia, L. Golden-rod.

Lake Minnetonka, *Roberts, Herrick*; lake Pepin, *Miss Manning*. Infrequent. Southeast.

S. puberula, Nutt. Golden-rod.

Lapham. Le Sueur county, *Gedge*; Pembina, *Havard*. A golden-rod agreeing well, except as to geographical limits, with the description of this species in Gray's *Manual*, is common on dry prairies throughout southern Minnesota, extending northeast to Todd and Crow Wing counties, *Upham*.

S. uliginosa, Nutt. (S. stricta, in Gray's Manual.) Golden-rod.

North of lake Superior (common), *Roberts*; Anoka county, *Juni*; St. Croix river, *Parry*; lake Pepin, *Miss Manning*. North.

S. speciosa, Nutt. Golden-rod.

Minneapolis, *Roberts*; lake Pepin, *Miss Manning*; Blue Earth county, *Leiberg*. South.

S. speciosa, Nutt., var. angustata, Torr. & Gray. Golden-rod.

Stearns county, *Campbell*; Emmet county, Iowa (rare), *Cratty*.

S. speciosa, Nutt., var. rigidiuscula, Torr. & Gray. Golden-rod.

A form of the var. *angustata*, growing in dry open places, with more rigid and rougher-edged small leaves. Minnesota to Nebraska and Texas. *Gray's Synoptical Flora of N. A.*

S. Virgaurea, L., var. alpina, Bigelow. Golden-rod.

Lapham. North.

[*S. humilis*, Pursh (*S. Virgaurea, L., var. humilis, Gray*), and *S. macrophylla*, Pursh (*S. thyrsoidea, E. Meyer*), probably also occur, with the preceding, in northeastern Minnesota.]

of the ray oval, oblong or linear, of the disk funnel-shaped, 5-toothed, the teeth erect or recurved. Branches of the style in the ray-flower, linear, smooth, the stigmatic lines extending to the top; in the disk, with the hairy appendages shorter or several times longer than the stigmatic portion. Achenia oblong or obconic, terete or somewhat compressed. Pappus of the disk composed of several oblong or linear chaffy scales, or reduced to a lacerate coroniform border, of the ray similar to that of the disk, but commonly smaller or sometimes obsolete.—Mostly perennial and suffruticose plants of North and South America, with glabrous and often resinous-dotted or varnished linear and entire or broader and denticulate leaves.

G. ЕУТНАМІѦ, Torr. and Gray. Stems 6 to 15 inches high, numerous from a woody and much-branched base, striated; leaves crowded, narrowly linear, 1 to 2 inches long $\frac{1}{4}$ to 1 line wide, 1-nerved, minutely scabrous, punctate, resinous, and sometimes varnished; heads in little clusters forming compound corymbs; involucre scarcely 2 lines long and 1 line broad, narrowly obovate; flowers of the ray 2 to 5, of the disk 3 to 6; pappus of 9 or 10 obtuse unequal erose-denticulate chaffy scales, a little shorter than the achenium.—Plant growing in dense tufts, when in flower forming a conspicuous yellow round-topped bushy clump. *Eaton in Bot. Rep. of King's Expt. of the Fort-teth Parallel.*

- S. rigida**, L. Golden-rod.
Abundant through the south half of the state, and in the Red river valley, extending northeast to Crow Wing county, *Upham*. Usually from one and a half to two feet high on prairies, where it most abounds; but from three to five feet high in woods and thickets.
- S. Riddellii**, Frank. Riddell's Golden-rod.
Minneapolis, *Williams*; Rapidan Rapids, Blue Earth county, *Upham*; peat bogs, Blue Earth county, *Leiberg*; common in Emmet county, Iowa, *Cratty*. South.
- S. neglecta**, Torr. & Gray. Golden-rod.
Lapham. Infrequent. Southeast.
- S. patula**, Muhl. Golden-rod.
Lapham. Infrequent. Southeast.
- S. juncea**, Ait. (*S. arguta*, var. *juncea*, Gray, in *Manual*.) Golden-rod.
Common, or frequent, throughout the state, excepting perhaps near its south side; flowering early.
- S. juncea**, Ait., var. **scabrella**, Gray. (*S. arguta*, var. *scabrella*, Torr. & Gray, in *Manual*.) Golden-rod.
Rice county, *Upham*. Probably infrequent. Southeast.
- S. arguta**, Ait. (*S. Muhlenbergii*, Torr. & Gray.) Golden-rod.
North of lake Superior, *Juni*. Rare. East.
- S. rugosa**, Mill. (*S. altissima*, in *Manual*.) Golden-rod.
Blue Earth county, *Gedge*. Infrequent.
- S. ulmifolia**, Muhl. Golden-rod.
Lapham. Falls of the St. Croix, *Parry*. Infrequent. Southeast.
- S. nemoralis**, Ait. Golden-rod.
Common, often abundant, throughout the state.
- S. nemoralis**, Ait., var. **incana**, Gray.* Golden-rod.
Plains of Minnesota and Dakota (*Nicollet*, etc.) to the Rocky Mountains of Montana and Colorado. *Gray's Synoptical Flora of N. A.*
- S. radula**, Nutt. Golden-rod.
Blue Earth county, *Leiberg*; Stearns county, *Campbell*; Yellow Medicine county (frequent), *Upham*. South.
- S. Missouriensis**, Nutt. Golden-rod.
Saint Paul, *Kelley*; Minneapolis, *Twining*, *Roberts*, *Simmons*; Martin county, and Emmet county, Iowa (abundant), *Cratty*; high prairies towards the sources of the Minnesota river, *Geyer*; Red river valley, *Scott*. South and west.
- S. Canadensis**, L. Golden-rod.
Common throughout the state. [The var. *procera*, Torr. & Gray, probably also occurs in Minnesota, especially northwestward.]
- S. serotina**, Ait., var. **gigantea**, Gray. (*S. serotina*, in *Manual*.) Golden-rod.
Common, or frequent, throughout the state.

***SOLIDAGO NEMORALIS**, Ait., var. **INCANA**, Gray. Dwarf, a span to a foot high: leaves oval or oblong, rigid, more or less canescent, sometimes rather strongly serrate, sometimes mostly entire: racemiform clusters erect or the lower somewhat spreading, collected in a dense oblong or conical thyrsum. *Gray's Synoptical Flora of N. A.*

S. serotina, Ait. (*S. gigantea*, in *Manual*.) Golden-rod.

Common, or frequent, throughout the state, especially north of lake Superior, *Roberts*, and in the Red river valley, *Upham*.

S. lanceolata, L. Golden-rod.

Common throughout the state; abundant in the Red river valley.

S. occidentalis, Nutt.* Golden-rod.

Sandy soil, Saint Peter, Nicollet county, *Leiberg*; determined by *Watson* as "probably" this species. Infrequent. Southwest.

APLOPAPPUS, Cass. APLOPAPPUS.**A. spinulosus**, DC.† Aplopappus.

Upper Minnesota river, *Geyer*; Yellow Medicine county, *Upham*. Southwest.

GRINDELIA, Willd. GRINDELIA.**G. squarrosa**, Dunal‡ Grindelia.

Common, or frequent, in the west edge of the state, from Rock county, *Leiberg*, and Pipestone City to Saint Vincent, *Upham*; also plentiful on the quartzite ridge in northern Cottonwood county, *Upham*. West.

***SOLIDAGO OCCIDENTALIS**, Nutt. Smooth; stems 2 to 3 feet high, paniculately corymbose at the summit, leafy; leaves linear-lanceolate, obscurely 3- to 5-nerved, minutely scabrous on the edges, the larger ones 4 inches long, 3 lines broad; heads rather large, pedicellate in many small corymbs, broadly obconic; involucre scales loosely imbricated in about 3 series, oblong-linear, the straight tips greenish, ciliate, rather acute; rays 15 to 25, very small; disk-flowers 10 to 15; achenia pubescent. *Eaton* in *Bot. Rep. of King's Expl. of the Fortieth Parallel*.

†**APLOPAPPUS**, Cass. Heads solitary, terminating the branches, or sometimes corymbosely or spicately clustered, many-flowered, rarely several-flowered, heterogamous and with fertile rays, or very rarely homogamous, the rays being wanting. Involucre imbricated, the scales with or sometimes without herbaceous or foliaceous tips. Receptacle flat or flattish, foveolate or alveolate-dentate. Appendages of the style-branches triangular-lanceolate, or in the N. American species more commonly elongated subulate. Akenes varying from turbinate to linear, terete, angled, or more or less compressed. Pappus simple, of copious and unequal rigid capillary (scabrous or almost barbellate) bristles.—Herbs or low under-shrubby plants, of various aspect and foliage; with yellow flowers, and pappus varying from tawny to reddish, very rarely bright white. Leaves alternate, rigid. *Gray* in *Botany of California*, from *Proc. Am. Acad.*, vol viii.

A. SPINULOSUS, DC. Herbaceous, canescent with a soft, minute, woolly pubescence; stems many, 1 to 2 feet high, corymbosely branched above; leaves small, 9 to 12 lines long, rigid, pinnately or somewhat bi-pinnately parted, segments short, linear-subulate, mucronate with a short bristle; heads small, subglobose, terminating the numerous branchlets; involucre shorter than the disk, scales subulate-lanceolate, mucronulate, imbricated in 3 or 4 series, appressed, canescent; rays 20 to 30; corolla of the disk with very short teeth; pappus pale or tawny, short, very unequal; achenia turbinate, villos. *Porter and Coulter's Flora of Colorado*.

‡**GRINDELIA**, Willd. Heads many-flowered; the ray-flowers generally present, pistillate, the ligule elongated; disk-flowers perfect, the corolla tubular-funnel-shaped, 5-toothed. Involucre subglobose or hemispherical, the scales imbricated in many rows, often with squarrose tips. Receptacle naked, flat, foveolate. Style with lanceolate hispid appendages as long as the stigmatic portion. Achenium smooth, oblong or ovate somewhat angled. Pappus of 2 to 8 smooth rigid deciduous awns, shorter than the disk-corollas.—Biennial (?), perennial or suffruticose, often resiniferous, Mexican and North American plants. Leaves entire or serrate, often punctate, the cauline ones sessile. Heads corymbed at the ends of the branches, or solitary, mostly rather large.

G. SQUARROSA, Dunal. Glabrous and viscidly resinous; stems herbaceous from a

CHRYSOPSIS, Nutt. GOLDEN ASTER.**C. villosa**, Nutt. Golden Aster.

Common throughout most of the state; but probably wanting or infrequent near its south side, and also northeastward. Fort Snelling, *Parry*; Minneapolis (common), *Roberts*; upper Mississippi river, *Houghton*, *Garrison*; common in Stearns and Todd counties and in the Red river valley, *Upham*.

INULA, L. ELECOMPANE.**I. Helenium**, L. *Elecampane*.

Nicollet county, *Aiton*; Minneapolis, *Roberts*. Infrequent.

POLYMNIA, L. LEAF-CUP.**P. Canadensis**, L. Leaf-cup.

Lapham. Rare. South.

SILPHIUM, L. ROSIN-PLANT.**S. laciniatum**, L. Rosin-weed. Compass-Plant.

Common, often abundant, in the south edge of the state; extending north to Goodhue county, *Sandberg*, southeastern Rice county (plentiful), Nicollet county, *Aiton*, southeastern Watonwan county (frequent), and New Ulm (very scarce), *Juni*; and west to Luverne, *Upham*; and into Dakota, Gray's *Synoptical Flora of N. A.* A gum which is frequently chewed like that of the spruce, exudes from stems of this plant, when their tops are broken off. The peculiar deflection of the leaves to a north and south direction, at the same time presenting one edge upward and the other toward the ground, is very noticeable. (See *American Naturalist*, vol. xvi, pp. 625-635, and vol. xvii, pp. 542 and 656.)

S. terebinthinaceum, Jacq. Prairie Dock. Rosin-Plant.

Lapham. Blue Earth county, *Leiberg*. South.

S. integrifolium, Michx. Rosin-Plant

Lapham. South.

S. perfoliatum, L. Cup-Plant.

Common southward; extending north to Minneapolis, *Roberts*, the Minnesota river (common), Fergus Falls, *Leonard*, and the Sisseton Agency in Dakota, *Upham*.

PARTHENIUM, L. PARTHENIUM.**P. integrifolium**, L. Parthenium.

Lapham. South.

IVA, L. MARSH ELDER. IVA.**I. xanthiifolia**, Nutt. (*Cyclachæna xanthiifolia*, Fres.) Iva.

Frequent southeastward; abundant southwestward; extending north to Todd

perennial caudex, 12 to 20 inches high, corymbosely branched above; leaves somewhat rigid, glaucous and punctate-reticulated; the radical ones spatulate-lanceolate, narrowed into a petiole, dentate or incised; the cauline mostly oblong, sessile and partly clasping, finely toothed or spinulose-serrate; heads [yellow] numerous; involuclers sub-globose, 6 lines broad; the scales very rigid, closely appressed, but with very long reflexed or squarrose subulate points; rays numerous, rather narrow; pappus of 2 to 4 very rigid deciduous bristles or awns. August. *Eaton* in *Bot. Rep. of King's Expl. of the Fortieth Parallel*.

county (common), and in the Red river valley to Grand Forks, *Upham*, and Saint Vincent, *Scott*, *Havard*. "A new weed that is steadily gaining ground, traveling eastward and possibly southward. It is a candidate for the same situations the large ragweed prefers—the edges of fields, and along roadsides and streets, but especially about barns. If circumstances are unfavorable, it can blossom when only a few inches high, while under more fortunate conditions it reaches much above one's head. It closely resembles cocklebur when young, but as it grows larger has more the appearance of the common sunflower, with flowers, however, after the pattern of the ragweed." *Arthur*.

AMBROSIA, Tourn. RAGWEED.

A. trifida, L. Great Ragweed.

Abundance and range nearly like the last; a similarly vile weed.

A. trifida, L., var. **integrifolia**, Torr. & Gray. Smaller Ragweed.

Hennepin county, *Herrick*; Blue Earth county, *Leiberg*.

A. artemisiæfolia, L. Roman Wormwood. Hog-weed. Bitter-weed.

Common or frequent, through the south half of the state; extending northwesterly to Pembina in the Red river valley, *Havard*, and to the Saskatchewan river.

A. psilostachya, DC. Western Ragweed.

Frequent through the south half of the state; common in the Red river valley; also found at the lake of the Woods, *Dawson*.

XANTHIUM, Tourn. COCKLEBUR. CLOTBUR.

X. Canadense, Mill. (*X. strumarium*, in *Manual*.) Common Cocklebur.

Frequent, or common, through the south half of the state; extending north to the northwest side of Mille Lacs (common), and the Red river valley; found at the lake of the Woods, *Dawson*. (A variety of this species, having no pubescence between the prickles of the fruit, is common, occurring in company with the ordinary type, in Blue Earth county and along the Minnesota river. *Leiberg*.)

X. Canadense, Mill., var. **echinatum**, Gray. Cocklebur.

Banks of Spirit lake, and head-waters of Little Sioux river, *Geyer*; banks of the Red river (abundant), *Dawson*, *Scott*; and on the shore of lake Superior.

HELIOPSIS, Pers. OX-EYE. FALSE SUNFLOWER.

H. lævis, Pers. Ox-eye. False Sunflower.

North of lake Superior (common), *Juni*, *Roberts*; upper Mississippi river, *Garrison*; Pembina, *Chickering*. Perhaps these references should be placed instead under the following species, which certainly is the prevailing representative of the genus in this state.

H. scabra, Dunal.* (*H. lævis*, Pers., var. *scabra*, Torr. & Gray.) Ox-eye. False Sunflower.

Red river prairie, *Dawson*, *Scott*, *Havard*; Todd county, also Minneapolis and Steele county (common), *Upham*; Stearns county, *Garrison*; Anoka county and New Uim, *Juni*; Martin county and Emmet county, Iowa (abundant), *Cratty*; Blue Earth county, *Gedge*.

* **HELIOPSIS SCABRA**, Dunal. Hispidulous-scabrous, especially the leaves, 2 to 4 feet high: leaves from broadly ovate and subcordate to ovate-lanceolate, the upper occasionally entire: rays oblong, nearly or quite an inch in length: akenes smooth, but the angles above pubescent when young, the summit usually bearing an obscure or evident and irregular coroniform chaffy pappus, or sometimes 2 or 3 conspicuous and rigid teeth! Otherwise as the foregoing, into which it may pass. *Gray's Synoptical Flora of N. A.*

ECHINACEA, Mœnch. PURPLE CONE-FLOWER.**E. angustifolia**, DC. Narrow-leaved Purple Cone-flower.

Abundant south and southwest; extending north to Anoka county, *Juni*, Stearns county, *Campbell*, Grant county, *Roberts*, and Clay county (common), *Upham*. (The club-shaped stems, six to nine inches high, remain standing through the winter.)

RUDBECKIA, L. CONE-FLOWER.**R. laciniata**, L. Cone-flower.

Common, or frequent, through the south half of the state and in the Red river valley; on Roseau river, *Dawson*.

R. subtomentosa, Pursh. Cone-flower.

Lapham. Stearns county, *Garrison*. Southeast.

R. hirta, L. Cone-flower.

Common, occasionally abundant, throughout the state, excepting perhaps north-eastward.

LEPACHYS, Raf. LEPACHYS.**L. pinnata**, Torr. & Gray. Lepachys.

Frequent, in some places abundant, southward; extending north to Minneapolis (common) *Roberts*, Stearns county, *Campbell*, and in the Red river valley to Clay county (common), *Upham*, and Pembina, *Havard*.

L. columnaris, Torr. & Gray.* Lepachys.

Upper Minnesota river, *Geyer*; near Moorhead, *Leiberg*, and Glyndon, Clay county, *Gedge*; Pembina, *Scott*. West.

HELIANTHUS, L. SUNFLOWER.**H. petiolaris**, Nutt.† Sunflower.

Dunes at Sand Hill river, Garfield, Polk county (lanceolate leaves, opposite on lower half of the stem; rays about 12, one to one and a half inches long; disk dark-purple), *Upham*. West.

H. annuus, L.‡ (*H. lenticularis*, Dougl.) Sunflower.

Frequent in the Red river valley; Saint Vincent, Grand Forks, and Norman county, *Upham*. West. (Indigenous throughout the western half of the United States; referred to *H. annuus*, L., the cultivated sunflower, as its original and typical form, by Gray in the *Botany of California and American Journal of Science*, series 3, xxv, 245. "Gigantesque forms everywhere commonly cultivated," and occasionally adventive.)

*LEPACHYS COLUMNARIS, Torr. & Gray. Strigose-scabrous, branched from the base, 1 to 2 feet high; radical leaves usually undivided, spatulate-lanceolate, cauline ones pinnately parted, the upper sessile, segments linear-lanceolate or oblong, rigid, mucronulate, entire, rarely somewhat lobed; disk columnar, longer than the 5 to 8 oblong or obovate-oval, recurved, yellow rays; chaff with woolly tips. Disk 1 inch or more long. *Porter and Coulter's Flora of Colorado*.

†HELIANTHUS PETIOLARIS, Nutt. Stem erect, 1 to 3 feet high, strigose or hispid, branching; leaves scabrous, alternate, the lower sometimes opposite, ovate-lanceolate or ovate, entire or somewhat repand-toothed, 3-nerved, on very long, slender, scabrous petioles; peduncles terminal, naked, bearing solitary (usually large) heads; scales of the involucre lanceolate, acute or acuminate; disk-flowers pubescent at base; achenia villous; pappus of two chaffy awns. Heads very variable in size. *Porter and Coulter's Flora of Colorado*.

‡See description of *HELIANTHUS ANNUUS*, L., on next page.

H. rigidus, Desf. Sunflower.

Common through the south half of the state and in the Red river valley ; one to three feet high on the natural prairie ; persisting as a troublesome weed in wheat-fields during the first two or three years of cultivation, there growing from three to five feet in height.

H. lætiflorus, Pers. Sunflower.

Martin county, *Gedge*; Blue Earth county, *Leiberg*; Redwood, Todd (common), Wadena and Polk counties, *Upham*; Pembina, *Haward*. South and west.

H. occidentalis, Riddell. Sunflower.

St. Croix river, *Parry*; plentiful near lake Johanna, Ramsey county, *Roberts*, *Herrick*; lake Pepin, *Miss Manning*. Infrequent. Southeast.

H. Maximiliani, Schrader.* Sunflower.

Common in the south half of the state ; reaching eastward at least to Minneapolis, where it is plentiful ; also abundant in the Red river valley ; extending northwest to the Saskatchewan river (Gray's *Synoptical Flora of N. A.*). Usually from nine to eighteen inches high, or sometimes three to five feet, on the natural prairie ; but continuing as the most troublesome weed in wheat-fields, where it commonly grows four to six feet in height and sometimes eight feet or more ; foliage dull, grayish green ; flowers showy, occasionally double (with all the corollas ligulate), blooming from July to September. The most noteworthy member of this genus in Minnesota. West and south.

Determined by *Prof. Asa Gray*; previously supposed, by the local botanists of the state, to be *H. giganteus*, L. ; in Dr. Lapham's catalogue, it appears to be called *H. tomentosus*, Michx. ; to *R. I. Cratty* and *J. C. Arthur* belongs the credit of obtaining its correct identification. (See Arthur's *Contributions to the Flora of Iowa*, No. V, and his note respecting this species in the *Botanical Gazette*, viii, p. 339. Dr. George Engelmann wrote me, Dec. 27, 1883 : "The notice in the *Botanical Gazette* about *Helianthus Maximiliani*, wondering that it was found so far north, in Minnesota, is founded on error. The species comes originally from the upper Missouri, latitude of Minnesota, and has often been collected in Minnesota also by me ; but extends, like many prairie plants, through many degrees of latitude, to Texas.")

H. giganteus, L. Sunflower.

St. Croix river, *Parry*; lake Pepin, *Miss Manning*; Minneapolis, *Twining*; north of lake Superior, *Roberts*; and northwest to the Saskatchewan river, Gray's *Synoptical Flora of N. A.* Infrequent. East and north.

H. grosse-serratus, Martens. Sunflower.

Moist prairies, Minnesota river, *Geyer*; abundant in Martin county and in Emmet county, Iowa, *Cratty*; lake Pepin, *Miss Manning*; moist land, Minneapolis, and Red-

HELIANTHUS ANNUUS, L. (*H. lenticularis*, Dougl.) Annual, scabrous and even hispid ; stems purple-spotted, stout, 3 to 8 feet high, branching ; leaves alternate, ovate, acuminate, coarsely serrate, 3 to 6 inches long, 2 to 4 inches broad, 3-nerved at the base and suddenly narrowed into a petiole nearly as long as the leaf ; uppermost leaves more lanceolate ; heads mostly paniced, peduncled, 2½ to 4 inches broad ; involucre spreading ; the numerous ovate ciliate abruptly acuminate scales imbricated in about 3 rows, outer ones shortest ; rays 20 to 24 [to 40], large ; chaff of the flat receptacle nearly as long as the purplish disk-flowers, concave, carinate, tricuspidate, the middle point much the strongest and dark-colored ; achenia finely appressed-pubescent ; pappus of two lanceolate chaffy awns. *Eaton* in *Bot. Rep. of King's Expl. of the Fortieth Parallel*.

***HELIANTHUS MAXIMILIANI**, Schrad. Stem strigose-scabrous, branched ; leaves alternate (those of the branches sometimes opposite), lanceolate, entire or nearly so, tapering to each end, acuminate, very scabrous and often canescent-strigose on both sides, the lower petioled ; scales of the involucre lanceolate-subulate, much attenuate, strigose-canescens ; pappus of two lanceolate slightly fringed chaffy scales. *Arthur's Contributions to the Flora of Iowa*, No. V, from *Torrey and Gray's Flora of N. A.*

wood, Stearns and Pope counties (common), *Upham*; less frequent, or wanting, in the Red river valley; four to eight feet high; leaves dark green, coarsely toothed, with intervals varying from a quarter to two-thirds of an inch between the teeth. South.

H. strumosus, L. Sunflower.

Through the south half of the state, infrequent. Douglas county, *Mrs. Terry*; New Ulm, *Juni*; Blue Earth county, *Leiberg*; Minneapolis, *Twining*, *Kassube*; lake Pepin, *Miss Manning*. [The var. *mollis*, Torr. & Gray, probably also occurs in this state.]

H. divaricatus, L. Sunflower.

Minneapolis, etc. (common), *Roberts*; Saskatchewan river, Gray's *Synoptical Flora of N. A.* South and west.

H. hirsutus, Raf. Sunflower.

Minneapolis, *Twining*, *Upham*; Worthington, Nobles county (common), *Foote*. South.

H. trachelifolius, Willd. Sunflower.

Frequent, or common, throughout the state, excepting northeastward. Minneapolis, *Roberts*; lake Pepin, *Miss Manning*; upper Mississippi river, *Garrison*; Pembina, *Havard*; Rice (common), Morrison and Polk counties (often showing forms intermediate between this and the next, partaking of the characters of both), *Upham*.

H. decapetalus, L. Sunflower.

Lapham. Anoka county, also New Ulm (common), *Juni*; Stearns county, etc., *Upham*. [The form called var. *frondosus*, in Gray's *Manual*, has been observed in Stearns county by *Garrison*.]

H. tuberosus, L. (*H. daronicoides*, in *Manual*.) Sunflower. (Original of Jerusalem Artichoke.)

Throughout the state. Minnesota and St. Croix rivers, *Parry*; Redwood Falls, *Miss Butler*; New Ulm (common), *Juni*; upper Mississippi river, *Garrison*; common in the valley of the St. Louis river and northeasterly, *Clark*; extending north west to the Saskatchewan river, Gray's *Synoptical Flora of N. A.*

H. tuberosus, L., var. *subcanescens*, Gray. Sunflower.

Mostly dwarf (about two feet high), comparatively small-leaved, rough-hispidulous or scabrous, but the lower face of the leaves whitish with soft and fine pubescence.—Plains of Minnesota, Dakota, etc., *Kennicott*, *Coues*, *Ward*, sometimes with well-developed tubers. Gray's *Synoptical Flora of N. A.*

COREOPSIS, L. TICKSEED.

C. lanceolata, L. Tickseed.

Lapham. Rare. Southeast.

C. tinctoria, Nutt.* Tickseed.

Low ground, Saskatchewan and Minnesota to Louisiana, Texas and Arizona. Gray's *Synoptical Flora of N. A.*

C. palmata, Nutt. Tickseed.

Common through the south half of the state; extending north to the upper Mississippi river, *Houghton*, *Garrison*, and northwest to Winnipeg, Gray's *Synoptical Flora of N. A.*

***COREOPSIS TINCTORIA**, Nutt. Annual: glabrous, 2 or 3 feet high; leaves opposite; radical and some lower cauline leaves 2-pinnately divided into lanceolate or linear divisions; upper with 3 to 7 linear divisions; outer involucre short and close: rays from half to three-fourths inch long, sometimes base only, sometimes nearly all crimson-brown: akenes oblong, thinish, moderately incurved, wingless; pappus none or an obscure border. Gray's *Synoptical Flora of N. A.*

- C. aristosa**, Michx. Tickseed.
Anoka county, *Juni*; peat bogs, Blue Earth county, *Leiberg*. Infrequent. South.
- C. trichosperma**, Michx. Tickseed Sunflower.
Lapham. Saint Paul, *Kelley*. Southeast.

BIDENS, Tourn. BUR-MARIGOLD.

- B. frondosa**, L. Common Beggar-ticks. Stick-tight.
Common, or frequent, throughout the state.
- B. connata**, Muhl. Swamp Beggar-ticks.
Lapham. Blue Earth county, *Leiberg*; Minneapolis, *Roberts*. South.
- B. cernua**, L. Smaller Bur-Marigold.
Common north of lake Superior, *Roberts*, and at Glenwood, Pope county, *Upham*; Stearns county, *Campbell*; Anoka county, also New Ulm, *Juni*; Ramsey county, *Kelley*; lake Pepin, *Miss Manning*; Nobles county, *Leiberg*; not common southward, nor in the Red river valley.
- B. chrysanthemoides**, Michx. Larger Bur-Marigold.
Common throughout the state.
- B. Beckii**, Torr. Water Marigold.
St. Croix river to the sources of the Mississippi, *Houghton*; lake of the Woods, *Dawson*; Minneapolis (common), *Roberts*. Probably frequent throughout the state.

DYSODIA, Cav. FETID MARIGOLD.

- D. chrysanthemoides**, Lag. Fetid Marigold.
Nobles county, *Leiberg*. Infrequent. South.

GAILLARDIA, Fougereux. GAILLARDIA.

- G. aristata**, Pursh.* Gaillardia.
Lapham. Red river valley, in Clay county, *Gedge*, Marshall county, *Winchell*, and near Saint Vincent, *Scott*. West.

***GAILLARDIA**, Fougereux. Heads many-flowered, radiate; rays neutral, deciduous, many-nerved, the apex trifid; disk-flowers perfect, the tube short, the 5-cleft limb hispid with articulate usually colored hairs. Receptacle convex, usually fimbriate. Involucral scales in two or three series, from a rigid base, running into a leafy appendage longer than the disk. Branches of the style terminated by a long awl-shaped hispid appendage. Achenia oblong or inversely pyramidal, villous. Pappus of 6 to 10 membranous or hyaline scales, the midnerve produced into a slender awn.—North American herbs more or less pubescent or glandular. Leaves alternate, the lower ones petioled and often lobed, the upper sessile and entire. Heads on long naked peduncles. Rays yellow, often saffron-colored or brownish-purple at the base. Disk-flowers yellow or violet. *Bot. Rep. of King's Expl. of the Fortieth Parallel.*

G. ARISTATA, Pursh. Perennial, villous-pubescent or almost tomentose with jointed hairs; stem simple or branched, 1 to 2 feet high; leaves minutely punctate; radical and lower ones lanceolate, tapering into slender petioles, sinuate pinnatifid or coarsely toothed, minutely serrate or nearly entire; the uppermost linear or oblong-lanceolate, sessile, usually dilated at the base and partly clasping; heads large, $1\frac{1}{2}$ to $2\frac{1}{2}$ inches in diameter, including the rays; involucre hirsute; corollas of the disk with short, broadly subulate teeth, of a rich brownish-purple or maroon color; rays 10 to 18, crowded, elongated-cuneiform, deep yellow; chaff of the pappus 6 to 8, broadly lanceolate; fimbriæ of the receptacle few, aristæform, slender, distinct, not dilated at the base, 2 to 3 times the length of the nearly smooth achenia. *Porter and Coulter's Flora of Colorado.*

G. pinnatifida, Torr.* Gaillardia.
Red river prairie, *Dawson*, West (mostly southwest). [Perhaps more correctly referable to the preceding species.]

HELENIUM, L. SNEEZE-WEED.

H. autumnale, L. Sneeze-weed.
Common through the south half of the state and in the Red river valley; extending northeastward at least to the upper Mississippi river, *Garrison*.

ANTHEMIS, L. CHAMOMILE.

A. Cotula, L. (*Marua Cotula*, DC.) *May-weed. Dog Fennel*.
A common, often abundant, weed in the southern two-thirds of the state; less frequent in clearings of the forest farther north; also less common westward, and scarce from Ada northward in the Red river valley.
A. nobilis, L. *Garden Chamomile*.
Adventive, Beaver Bay, *Juni*.

ACHILLEA, Vaill. YARROW.

A. Millefolium, L. Common Yarrow or Milfoil.
Common throughout the state. The following notes describe this species on the north shore of lake Superior: "Abundant all along the shore, forming a fringe of white just on the line between the forest trees and the waves; was not found in other situations." *Juni*.—"The rose-colored variety occurs sparingly, showing all shades of color from white to a quite deep pink." *Roberts*.

CHRYSANTHEMUM, Tourn. CHRYSANTHEMUM.

C. Leucanthemum, L. (*Leucanthemum vulgare*, Lam.) *Ox-eye Daisy. White-weed*.
Lake City, *Miss Manning*; Stillwater, *Miss Field*; Mankato, *Prof. Bechdolt*; Minneapolis (frequent), *Roberts*; Saint Cloud, *Campbell*; upper Mississippi river, *Garrison*. Rare or local; inclined to spread; an abundant and pernicious weed in states farther east.

TANACETUM, Tourn. TANSY.

T. vulgare, L. *Common Tansy*.
Adventive: lake Pepin; Goodhue county; Minneapolis; Blue Earth county; Emmet county, Iowa.
T. Huronense, Nutt. *Lake Huron Tansy*.
Upper Mississippi river, *Garrison*. Infrequent. North.

ARTEMISIA, Tourn. WORMWOGD.

A. glauca, Pall.† Wormwood.
Saskatchewan and Minnesota, *Drummond*, *Nicollet*, *Keenicott*. (*Gray's Synoptical Flora of N. A.*)

*GAILLARDIA PINNATIFIDA, Torr. Perennial, canescent; stems 8 to 12 inches high, branching; leaves sessile, pinnatifid, the rachis and remote lobes linear; heads rather small; involucre in about two series, nearly equal to the disk; rays deeply 3-cleft; chaff of the pappus lanceolate; fimbriæ of the receptacle aristæform, slender, sparse, longer than the achenia. *Porter and Coulter's Flora of Colorado*.—A showy flower; heads 1 to 2 inches broad; rays yellow, or purple toward the base; disk-flowers purplish; leaves 1 to 3 inches long. *Bot. Rep. of King's Expl. of the Fortieth Parallel*.

† See description of ARTEMISIA GLAUCA, Pall., on next page.

A. dracunculoides, Pursh. Wormwood.

Common through the south half of the state, and probably occurring also, but less frequently, in the Red river valley; extending northeast to Crow Wing and Todd counties, *Upham*.

A. borealis, Pallas. Wormwood.

Upper Mississippi river, *Garrison*. North. [Probably the var. **WORMSKIOLDII**, Bess., which is taller, 10 to 16 inches high, with more numerous heads in looser or compound narrower thyrus. *Gray's Synoptical Flora of N. A.*]

A. Canadensis, Michx. Wormwood.

Lake Superior to sources of the Mississippi, *Houghton, Garrison*; lake of the Woods, *Dawson*; Red river valley, *Scott*; White Bear, Ramsey county, *Kelley*. North.

A. caudata, Michx. Wormwood.

Common through the south half of the state; abundant (frequently having galls) in the Red river valley, *Upham*.

A. serrata, Nutt.* Wormwood.

· Prairies and low grounds, Illinois to Dakota; first collected by *Nuttall*. (*Gray's Synoptical Flora of N. A.*)

A. longifolia, Nutt.† Wormwood.

Rocky banks, Minnesota and Nebraska to Saskatchewan and Montana; first collected by *Nuttall*, or by *Lewis and Clarke*. (*Gray's Synoptical Flora of N. A.*)

A. Ludoviciana, Nutt. Western Mugwort. "Sage."

The form with incised or subpinnatifid leaves is occasionally found through the south half of the state and in the Red river valley, *Upham*. This is not regarded by *Gray's Synoptical Flora* as distinct from the form with undivided leaves (var. *gnaphalodes*, in *Manual*), which has been noted as follows: Minneapolis, *Roberts*; Blue Earth county, *Leiberg*; abundant in Martin county, and in Emmet county, Iowa, *Cratty*; Red river valley (common), *Upham, Scott*. (*Mr. Arthur* states that the first of these forms is infrequent or rare in Iowa; but that the second is common there. Specimens of this species sent by *Prof. Gedge* from Marshall, Lyon county, in rich soil near the Redwood river, have the broadly lanceolate leaves all entire or only sparingly toothed, with their upper surface nearly glabrate and green; as is said by *Gray's Synoptical Flora* to be sometimes their condition.)

A. biennis, Willd. Biennial Wormwood.

Frequent, often common, throughout the state.

A. Absinthium, L. Common Garden Wormwood.

Lapham. Blue Earth county, *Leiberg*. Rarely adventive.

ARTEMISIA GLAUCA, Pall. Minutely silky pubescent or canescent, sometimes glabrate and glaucous: stems strict, a foot or two high, somewhat woody at base: leaves rather short, from linear- to oblong-lanceolate, mostly entire, occasionally some 3-cleft, or the lowest even more divided: heads nearly of the next, into which it probably passes. *Gray's Synoptical Flora of N. A.*

***ARTEMISIA SERRATA**, Nutt. Stems 6 to 9 feet high, very leafy; leaves green and glabrous above, white-tomentose beneath, lanceolate or uppermost linear, 3 to 7 inches long, all serrate with sharp narrow teeth, pinnately veined, the earliest sometimes pinnately incised: heads amply paniculate, rather few-flowered, less than two lines long, greenish, hardly pubescent. *Gray's Synoptical Flora of N. A.*

†**ARTEMISIA LONGIFOLIA**, Nutt. Stem 2 to 5 feet high: leaves entire, at first tomentulose, but usually glabrate above, white tomentose beneath, linear or linear-lanceolate (3 to 7 inches long, 1 to 5 lines wide); veins obsolete: heads amply paniculate, usually canescent, 2 to 3 lines long. *Gray's Synoptical Flora of N. A.*

A. frigida, Willd. Wormwood. "Sage."

Lake Superior; "rising ground, east of the Red river prairie," *Dawson, Scott*; and southward to Minneapolis (plentiful on the river bluffs below the falls of St. Anthony) and Fort Snelling, lake Pepin, *Miss Manning*, and Pipestone county, *Leiberg, Mrs. Bennett*. Local.

GNAPHALIUM, L. CUDWEED. EVERLASTING.**G. decurrens**, Ives. Everlasting.

North shore of lake Superior (Deronda bay and Grand Portage island), *Juni*; Nicollet county, *Gedge*. Infrequent. Northeast.

G. polycephalum, Michx. Common Everlasting.

Throughout the state, but infrequent. Lake Superior, *Whitney*; lake of the Woods, *Dawson*; St. Croix Falls, *Miss Field*; lake Pepin, *Miss Manning*; Blue Earth county, *Leiberg*.

G. uliginosum, L. Low Cudweed.

Lapham. Pipestone county, *Mrs. Bennett*. Infrequent.

ANAPHALIS, DC. EVERLASTING.**A. margaritacea**, Benth. & Hook. (*Antennaria margaritacea*, R. Br.) Pearly Everlasting.

Common at Beaver Bay (north shore of lake Superior), and at Minneapolis, *Roberts*; Wadena county, etc., *Upham*; Blue Earth county, *Leiberg*. Throughout. Local.

ANTENNARIA, Gaertn. EVERLASTING.**A. plantaginifolia**, Hook. Plantain-leaved Everlasting.

Common, or abundant, throughout the state.

ERECHTITES, Raf. FIREWEED.**E. hieracifolia**, Raf. Fireweed.

Stearns county, *Garrison*; Douglas county, *Mrs. Terry*; falls of the St. Croix, *Parry*; Minneapolis, *Kassube*; lake Pepin, *Miss Manning*; Anoka county, also New Ulm, *Juni*; Blue Earth county (common), *Leiberg*. South.

CACALIA, L. INDIAN PLANTAIN.**C. reniformis**, Muhl. Great Indian Plantain.

Fillmore county, *Winchell*; lake Pepin, *Miss Manning*; Hennepin county, *Herrick*. Infrequent. South.

C. atriplicifolia, L. Pale Indian Plantain.

Goodhue county, *Sandberg*. Southeast.

C. tuberosa, Nutt. Tuberous Indian Plantain.

Dakota county (frequent), *Upham*; Steele county, *Miss Bizby*; Blue Earth county, *Leiberg*; New Ulm, *Juni*; common in Martin county and in Emmet county, Iowa, *Cratty*. South.

SENECIO, Tourn. GROUNDSSEL.**S. vulgaris**, L. Common Groundsel.

Mankato (frequent), *Leiberg*; Saint Paul, *Kelley*.

S. palustris, Hook. Groundsel.

Common, or frequent, through the northern and central portions of the state:

extending eastward at least to the St. Louis river, *Mrs. Herrick*, Morrison county and Minneapolis, *Upham*, Goodhue county, *Sandberg*, and lake Pepin, *Miss Manning*; abundant about lakes in Grant county, *Roberts*, and in swamps near New Ulm, *Juni*; very rare in Emmet county, Iowa, *Cratty*.

S. integerrimus, Nutt.* Groundsel.

Lapham, West.

S. aureus, L. Golden Ragwort. Squaw-weed. Life-root.

Common, or frequent, throughout the state, in some portions abundant.

S. aureus, L., var. **obovatus**, Torr. & Gray. Golden Ragwort. Squaw-weed.

Minneapolis, *Kassube*; Pipestone county, *Mrs. Bennett*; and perhaps throughout the state.

S. aureus, L., var. **Balsamitæ**, Torr. & Gray. Golden Ragwort. Squaw-weed.

Throughout the state. North of lake Superior, *Agassiz*; Pembina, *Chickering*; Pokegama Falls, *Houghton*; Minneapolis, *Roberts*.

S. canus, Hook.† Groundsel.

Put in bay, north shore of lake Superior, *Juni*. North.

S. lugens, Richardson.‡ (Including var. *Hookeri*, Eaton.) Groundsel.

Red river valley near Moorhead, *Leiberg*; Pipestone county, *Mrs. Bennett*. [Also Plymouth county, in northwestern Iowa, *Arthur*.] West.

ARNICA, L. ARNICA.

A. Chamissonis, Less. (*A. mollis*, Hook.) Arnica

North shore of lake Superior, *Juni*. North.

CENTAUREA, L. STAR THISTLE.

C. Cyanus, L. *Blue-bottle*. *Bachelor's-Button*.

Escaped from gardens, Blue Earth county, *Leiberg*.

***SENECIO INTEGERRIMUS**, Nutt. Glabrous throughout; stem simple, striate, 12 to 18 inches high; leaves entire; radical ones 3 to 5 inches long and 1 to 2 inches wide, rather obtuse, tapering into a petiole, somewhat fleshy, upper small, lanceolate, acute, partly clasping; corymb simple or nearly so; heads rather large, 8 to 20; involucre hemispherical, bracteolate, scales 15 to 20, narrowly linear, acute; rays about 8, small; disk-flowers 40 to 50; achenia striate, nearly glabrous. *Porter and Coulter's Flora of Colorado*.

†**SENECIO CANUS**, Hook. Whitish tomentose throughout; stems tufted, 2 to 12 inches high; radical leaves obovate, obtuse, narrowed into short petioles; the cauline sessile, lanceolate, pinnately cleft, or with a few teeth near the base, rarely entire; heads rather large, few in a simple corymb; involucre nearly ecalyculate; rays 8 to 12, not twice as long as the involucre; achenia glabrous. *Eaton in Bot. Rep. of King's Expl. of the Fortieth Parallel*.

‡**SENECIO LUGENS**, Richardson. Lightly floccose-woolly when young, in the typical form early glabrate and bright green; stem 6 inches to 2 feet high, few- and small-leaved and naked above, terminated by a cyme of several or rather numerous heads (these about five lines high); radical and lower cauline leaves spatulate, varying to oval or oblong, either gradually or abruptly contracted at base into a winged or margined short petiole, usually repand- or callous-denticulate; upper cauline lanceolate or reduced and bract-like; bracts of the campanulate involucre lanceolate, with obtuse or acutish commonly blackish-sphacelate tips; heads many-flowered; rays 10 or 12, conspicuous. *Gray's Synoptical Flora of N. A.*

CNICUS, Tourn. (Included in *CIRSIUM* by *Manual*.) THISTLE.

C. lanceolatus, Hoffm. Common Thistle.

Frequent, but seldom plentiful, throughout the state. North of lake Superior, *Juni*; Pembina, *Haward*; Minneapolis, *Griswold*, *Kassube*; lake Pepin, *Miss Manning*; Wabasha, *Gibson*; Nicollet county, *Aiton*; Blue Earth county and southward (common), *Leiberg*.

C. Pitcheri, Torr. Pitcher's Thistle.

North shore of lake Superior, *Macoun*; doubtless in Minnesota.

C. undulatus, Gray. Thistle.

North of lake Superior (in a grass field at Grand Marais, said to have made its first appearance in 1878), *Roberts*. [Near Fort Pierre, Dakota, *Geyer*.] Plains, &c., from lake Huron and Minnesota to Saskatchewan, west to Oregon, south to Kansas and New Mexico. *Gray's Synoptical Flora of N. A.*

C. undulatus, Gray, var. **canescens**, Gray. Thistle.

Merely a form with smaller heads, sometimes not over an inch long, the leaves varying from ciliate spinulose-dentate to deeply pinnatifid.—Minnesota to New Mexico and southern Utah. *Gray's Synoptical Flora of N. A.*

C. undulatus, Gray, var. **megacephalus**, Gray. Thistle.

Stouter form, usually broader-leaved, with broad heads 2 inches or more long.—Minnesota and Texas to Idaho. *Gray's Synoptical Flora of N. A.*

C. altissimus, Willd. Tall Thistle.

Lake Pepin, *Miss Manning*; Minneapolis, *Simmons*; Faribault, *Miss Beane*; Blue Earth county, *Leiberg*; abundant in Martin county, and in Emmet county, Iowa. *Cratty*; common northward and in the Red river valley, *Upham*, *Scott*. South and west.

C. altissimus, Willd., var. **discolor**, Gray. (*C. discolor*, Muhl.) Thistle.

Minneapolis, *Kassube*, *Roberts*, *Simmons*; Hesper, Iowa (common), *Mrs. Carter*; Worthington (common), *Foote*; Redwood Falls, *Pemberton*; Anoka county, *Juni*; Stearns county, *Garrison*; Clay county, *Upham*; Pembina, *Haward*. South and west.

C. muticus, Pursh. Swamp Thistle.

Common, or frequent, throughout the state.

C. pumilus, Torr. Pasture Thistle.

Goodhue county, *Sandberg*; Dakota county (frequent), *Upham*; Anoka county, *Juni*; Stearns county, *Garrison*; Alexandria, Douglas county, *Mrs. Terry*. South.

C. arvensis, Hoffm. Canada Thistle.

Newburgh, Fillmore county, *Mrs. Carter*; covering about an acre close west of Rochester, Olmsted county; a few miles east of Faribault; Stillwater, *Miss Field*; on Western avenue, at the west border of Minneapolis, spreading, *Roberts*. Rare, but likely to become common; in many districts farther east, "a most troublesome weed, extremely difficult to eradicate."

ONOPORDON, Vaill. COTTON THISTLE. SCOTCH THISTLE.

O. acanthium, L. Cotton Thistle. Scotch Thistle.

Lake City, *Mrs. Ray*. Rare.

ARCTIUM, L. (*LAPPA*, Tourn.) BURDOCK.

A. Lappa, L. (*L. officinalis*, Allioni, var. *major*, Gray.) Common Burdock.

Common through the south half of the state, and probably northeastward; less frequent in the Red river valley.

CICHORIUM, Tourn. SUCCORY. CHICORY.*C. Intybus*, L. Succory. Chicory.Minneapolis, *Herrick*; near Excelsior, Hennepin county, *Mrs. Terry*. Rare.**KRIGIA**, Schreber. (Including **CYNTHIA**, Don.) KRIGIA.**K. Virginica**, Willd. Dwarf Dandelion.Upper Mississippi river, *Garrison*. Rare.**K. amplexicaulis**, Nutt. (*Cynthia Virginica*, Don.) *Cynthia*.Common, or frequent, through the south half of the state; extending north at least to Morrison county (common), *Upham*, and the upper Mississippi river *Garrison*.**TROXIMON**, Nutt. TROXIMON.**T. cuspidatum**, Pursh. Troximon.Common, or frequent, through the south and west portions of the state; extending northeast to lake Pepin, *Miss Manning*, Minneapolis, *Twining*, *Roberts*, Stearns county, *Campbell*, and Pembina, *Chickering*.**T. glaucum**, Nutt.* Troximon.Red river prairie, *Dawson*, *Haward*; near Glyndon, *Leiberg*, *Gedge*; Kittson, Stevens and Lincoln counties, *Upham*. West. [T. aurantiacum, Hook., has been reported, but probably erroneously, at Pembina.]**TRAGOPOGON**, L. GOAT'S-BEARD. VEGETABLE OYSTER.*T. pratensis*, L.† *Yellow Goat's-Beard*.Naturalized in meadow of Spring creek near Red Wing, *Sandberg*.**HIERACIUM**, Tourn. HAWKWEED.**H. umbellatum**, L.‡ Hawkweed.North shore of lake Superior to the Rocky mountains and northward, *Gray's Synoptical Flora of N. A.*; probably in northern Minnesota.

* **TROXIMON GLAUCUM**, Nutt. Usually a foot or two high, rather stout, pale or glaucous, either glabrous or with loose pubescence: leaves linear to lanceolate, from entire to sparingly dentate or sometimes lacinate, 4 to 12 inches long: involucre commonly an inch high and many-flowered; its bracts lanceolate or broader; outer series shorter, often pubescent, or even villous: akenes with apex tapering gradually into a rather stout and nerved beak which is shorter than the body; akenes with the beak 5 or 6 lines long, longer than the pappus, the copious and rather rigid bristles of which are (as in most species) only denticulate-scabrous. *Gray's Synoptical Flora of N. A.*

† **TRAGOPOGON**, L. Involucre simple, of many leaves; receptacle naked; pappus plumose, achenia longitudinally striate, contracted into a long, filiform beak. Biennial European herbs, with long, linear, grass-like leaves. *Wood's Class-Book*.

T. pratensis, L. Leaves linear, those of the stem dilated at the base and abruptly acuminate into a slender point towards the apex, glabrous. Peduncles scarcely thickened beneath the anthodes [heads]. Florets yellow. Achenes with the beak about as long as the achene, ribbed; those of the outer florets usually mucronated on the ribs. Pappus of all the florets of plumose hairs. *Sowerby's English Botany*, vol. v.

‡ **HIERACIUM UMBELLATUM**, L. Stem a foot or two high, strict, leafy to the top, bearing a few somewhat umbellately disposed heads: leaves narrowly or sometimes broadly lanceolate, nearly entire, sparsely denticulate, occasionally lacinate-dentate, all narrow at base; the cauline leaves all closely sessile: involucre half inch high, or sometimes smaller, usually livid, glabrous or nearly so: outermost bracts loose or spreading. *Gray's Synoptical Flora of N. A.*

H. Canadense, Michx. Canada Hawkweed.

Common, or frequent, throughout the state; abundant north of lake Superior, *Roberts*.

H. scabrum, Michx. Rough Hawkweed.

St. Croix river, *Parry*; Saint Cloud, *Campbell*; Beaver Bay, *Roberts*; Pembina, *Chickering*. (A hawkweed agreeing with Gray's description of this species in bearing 40- to 50-flowered heads, but in other characters like *H. paniculatum*, grows in the Red river valley on moist prairie, *Upham*.)

H. longipilum, Torr. Long-bearded Hawkweed.

St. Croix river, *Parry*; Blue Earth county, *Leiberg*. Rare. South.

H. venosum, L. Rattlesnake-weed.

Red river prairie, *Dawson, Scott*. Infrequent.

PRENANTHES, Vaill. (Including **NABALUS**, Cass.) RATTLE-SNAKE-ROOT.

P. alba, L. White Lettuce. Rattlesnake-root.

Common throughout the state.

P. serpentaria, Pursh.* (*N. albus*, Hook., var. *serpentaria*, Gray.) Rattlesnake-root.

Hennepin county, *Herrick*; Stearns county, *Campbell*. [Devil's lake, Dakota, *Geyer*.]

P. altissima, L. Tall White Lettuce.

Between lake Superior and the lake of the Woods, *Macoun*.

P. racemosa, Michx. Rattlesnake-root.

Frequent, or common, throughout the state.

P. aspera, Michx. Rattlesnake-root.

Frequent through the south half of the state; extending north to Stearns county, *Campbell*, and Douglas county, *Mrs. Terry*.

P. crepidinea, Michx. Rattlesnake-root.

Lake Benton, Lincoln county, *Upham*. Infrequent. South.

LYGODESMIA, Don. LYGODESMIA.**L. juncea**, Don. Lygodesmia.

Common southwestward, on sandy land; extending north and east to Muskoda, Clay county, and Sand Hill river, *Upham*, Pembina, *Haward*, Meeker county, *Campbell*, Minneapolis, *Roberts*, St. Croix river, *Swezey*, and Blue Earth county, *Leiberg*.

[*Crepis runcinata*, Torr. & Gray, whose eastern limit extends from the Saskatchewan region to Nebraska and Iowa (*Arthur*), and the nearly related *C. glauca*, Torr. & Gray, of similar range, seem likely to be found in western Minnesota.]

* **PRENANTHES SERPENTARIA**, Pursh. Commonly 2 feet high, glabrous or a little hirsute-pubescent: stem sometimes purple-spotted, rather stout: leaves diversely variable, assuming all the forms of the preceding species: inflorescence corymbosely thyrsoid-paniculate; the heads mostly glomerate at summit of ascending or spreading flowering-branches or peduncles: involucre green, rarely purplish-tinged, 8- to 12-flowered; flowers purplish, greenish white or ochroleucous: pappus sordid straw-color or whitish. . . . Open grounds, commonly in sandy or sterile soil. *Gray's Synoptical Flora of N. A.*

TARAXACUM, Haller. DANDELION.**T. officinale**, Weber. (*T. Dens-leonis*, Desf.) Common Dandelion.

Common, often abundant, throughout most of the state; but less frequent near its west side. It seems to be quite absent from some districts westward, as Cottonwood county, *Holzinger*; and occurs rarely in the Red river valley near Saint Vincent, *Dawson*, *Havard*.

LACTUCA, Tourn. (Including **MULGEDIUM**, Cass.) LETTUCE.**L. Canadensis**, L. Wild Lettuce.

Frequent throughout the state.

L. hirsuta, Muhl. (*L. Canadensis*, L., var. *sanguinea*, Torr. & Gray.) Wild Lettuce.

Minneapolis, *Roberts*, *Upham*; frequent in Martin county and in Emmet county, Iowa, *Cratty*. South.

L. pulchella, DC. (*Mulgedium pulchellum*, Nutt.) False or Blue Lettuce.

Red river valley at Pembina, *Havard*, and near Moorhead, *Leiberg*; lake Carlos, Douglas county, *Mrs. Terry*; Minneapolis, *A. W. Jones*; Lake Benton and Polk county, *Upham*. North and west.

L. Florida, Gærtn. (*M. Floridanum*, DC.) False or Blue Lettuce.

Lapham. Winona county, *Holzinger*; Minneapolis, *A. W. Jones*. South.

L. leucophæa, Gray. (*M. leucophæum*, DC.) False or Blue Lettuce.

North of lake Superior, *Roberts*; lake of the Woods, *Dawson*; Pembina, *Havard*; Blue Earth county, *Leiberg*.

SONCHUS, Tourn. SOW-THISTLE.**S. oleraceus**, L. Common Sow-Thistle.

Saint Paul, *Kelley*; Minneapolis, *Miss Butler*; Nicollet county, *Aiton*; New Ulm, *Juni*. Infrequent.

S. asper, Vill. Spiny-leaved Sow-Thistle.

More frequent than the preceding; observed at Grand Marais and Beaver Bay, on the north shore of lake Superior; at Minneapolis; and in Goodhue, Winona, Rice and Blue Earth counties.

S. arvensis, L. Field Sow-Thistle.

Anoka county, *Juni*. Infrequent.

LOBELIACEÆ. LOBELIA FAMILY.

LOBELIA, L. LOBELIA.**L. cardinalis**, L. Cardinal Flower.

Along the Mississippi river at Wabasha, *Gibson*, lake Pepin, *Miss Manning*, and Saint Paul, *Mrs. Terry*; and the St. Croix river at Marine Mills, Washington county, *Miss Cathcart*, and at St. Croix Falls, *Miss Field*.

L. syphilitica, L. Great Lobelia.

Common, or frequent, through the south half of the state; extending north to the upper Mississippi river, *Garrison*, and the Red river valley, *Gedge*.

L. inflata, L. Indian Tobacco.

Lake St. Croix, *Parry*; St. Croix Falls, *Miss Field*; Blue Earth county, *Leiberg*. Infrequent.

L. spicata, Lam. Lobelia.

Common through the south half of the state and in the Red river valley ; extending northeast to the upper Mississippi, *Houghton*.

L. Kalmii, L. Kalm's Lobelia.

Common through the north half of the state and south to Minneapolis, *Roberts*, *Upham*; rare southward, as in peat bogs in the Minnesota valley between Kasota and Mankato, *Leiberg*.

L. Dortmanna, L. Water Lobelia.

Isle Royale, *Dr. A. B. Lyons*; doubtless in Minnesota north of lake Superior.

CAMPANULACEÆ. CAMPANULA FAMILY.

CAMPANULA, Tourn. BELLFLOWER.**C. rotundifolia**, L. Harebell. Bluebell.

Common throughout the state. A very pretty flower, plentiful in all our prairie region and along the shore of lake Superior ; in the latter situation varying through intermediate forms to the var. *linifolia* of Gray's *Manual*, *Roberts*.

C. aparinoides, Pursh. Marsh Bellflower.

Common throughout the state. (In the vicinity of Mankato, a bellflower is reported by *Leiberg* as common in bogs, agreeing well with the description of this species, except in the large size of the flowers, which have the corolla $\frac{2}{3}$ to $\frac{3}{4}$ of an inch long, five times as long as the small calyx-lobes. The ordinary smaller-flowered form of this species has not been observed there. The large-flowered form has also been collected at Minneapolis.)

C. Americana, L. Tall Bellflower.

Frequent through the south part of the state; extending north to Douglas county, *Mrs. Terry*.

SPECULARIA, Heister. VENUS'S LOOKING-GLASS.**S. perfoliata**, A. DC. Venus's Looking-Glass.

Lapham. Minneapolis, *Kassube*; near Saint Paul, *Mrs. Terry*. Infrequent. South.

ERICACEÆ. HEATH FAMILY.

GAYLUSSACIA, HBK. HUCKLEBERRY. WHORTLEBERRY.**G. resinosa**, Torr. & Gray. Common Black Huckleberry.

Frequent, often common, northeastward ; extending west to Cass lake, *Schoolcraft*, and south to the falls of Kettle river, in section 15, T. 42, R. 20, *Upham*.

VACCINIUM, L. CRANBERRY. BLUEBERRY. BILBERRY.**V. Oxycoccus**, L. Small Cranberry.

Common northward ; extending west to the upper Mississippi river, *Garrison*, Becker county, *Gedge*, and Fergus Falls, *Leonard*; and south to Anoka county (plentiful), *Roberts*, and White Bear lake, Ramsey county, *Kelley*.

V. macrocarpon, Ait. Large American Cranberry.

Common through the north half of the state, excepting the Red river valley and near the shore of lake Superior ; extending south to Fergus Falls, *Leonard*, and Minneapolis, *Roberts*. Much gathered for the market, especially by the Chippewa Indians.

V. Vitis-Idea, L. Cowberry.

North shore of lake Superior (swamps at Port Arthur), *Macoun*; doubtless in Minnesota.

V. stamineum, L. Deerberry. Squaw Huckleberry.

Near Saint Paul, *Mrs. Terry*. Rare.

V. uliginosum, L. Bog Bilberry.

North of lake Superior, *Juni*. North.

V. caespitosum, Michx., var. **cuneifolium**, Nutt. Bilberry.

Margins of a lake near Stillwater, *Parry*. Rare. North.

[*V. ovalifolium*, Smith, and *V. myrtilloides*, Hook., will doubtless be found in Minnesota north of lake Superior.]

V. Pennsylvanicum, Lam. Dwarf or Low Blueberry.

Common in the north half of the state; extending south to Minneapolis, *Roberts*, and lake Pepin, *Miss Manning*, the Mississippi river being its southwestern limit from Minneapolis to Morrison county, *Upham*.

V. Canadense, Kalm. Canada Blueberry.

Falls of the St. Croix river, *Parry*; Stearns county, *Garrison*; and northward.

V. corymbosum, L. Swamp or High Blueberry.

Lapham. Ramsey county (var. *amœnum*, Gray), *Winchell*; White Earth reservation, *Garrison*. Rare.

CHIOGENES, Salisb. CREEPING SNOWBERRY.**C. hispida**, Torr. & Gray. Creeping Snowberry.

Frequent northeastward; extending south to Anoka county (plentiful in tamarack swamps), *Roberts*; Hennepin county, *Simmons*.

ARCTOSTAPHYLOS, Adans. BEARBERRY.**A. Uva-ursi**, Spreng. Bearberry. Kinnikinnick.

Common, often abundant, on sandy land through the north half of the state; extending south to Isanti and Sherburne counties (common), *Upham*; rare and local farther south, as in Goodhue county, *Sandberg*, at lake Pepin, *Miss Manning*, and on sandy knolls in section 12, Saratoga, Winona county, *Winchell*.

EPIGÆA, L. MAYFLOWER. TRAILING ARBUTUS. GROUND LAUREL.**E. repens**, L. Mayflower. Trailing Arbutus. Ground Laurel.

Minnesota Point and elsewhere near Duluth, *Juni*, *Miss Cathcart*; falls of Kettle river, *Upham*. Infrequent. Northeast.

GAULTHERIA, Kalm. AROMATIC WINTERGREEN.**G. procumbens**, L. Aromatic Wintergreen. Checkerberry.

Common northeastward; extending west and south to Rainy Lake river, *Keating*, the lake of the Woods, *Dawson*, Wadena county, *Upham*, and Anoka county, *Roberts*, rare farther southeast, as at lake Pepin, *Miss Manning*, and Mound Prairie, Houston county, *Winchell*.

CASSANDRA, Don. LEATHER-LEAF.**C. calyculata**, Don. Leather-Leaf.

North of lake Superior (common), *Roberts*; lake of the Woods, *Dawson*; St. Croix river, *Parry*; extending south to Wadena (frequent) and Chisago counties, *Upham*, Minneapolis, *Kassube*, and Stillwater, *Miss Field*.

CASSIOPE, Don. CASSIOPE.

- C. hypnoides**, Don. Cassiope.
Minnesota Point, lake Superior, *Miss Cathcart*. Rare. North.

ANDROMEDA, L. ANDROMEDA.

- A. polifolia**, L. Wild Rosemary.

Plentiful near Grand Marais, and in swamps near lake Johanna, Ramsey county, *Roberts*; Minnesota Point, *Miss Cathcart*; lake of the Woods, and thence toward Red river, *Dawson*; St. Croix river, *Parry*; Chisago county, etc., *Upham*; near Minneapolis, *Kassube*. North.

KALMIA, L. AMERICAN LAUREL.

- K. glauca**, Ait. Pale Laurel.
Certainly to be found in northern Minnesota, *Macoun*.

MENZIESIA, Smith. MENZIESIA.

- M. glabella**, Gray.* Menziesia.

Minnesota Point, lake Superior, *Miss Cathcart*. (The *Botany of California* states that this [called *M. ferruginea*] extends east "nearly to the upper Great lakes.") Rare. Northwest.

LEDUM, L. LABRADOR TEA.

- L. latifolium**, Ait. Labrador Tea.

Common, often abundant, through the north half of the state; extending south to Sherburne and Anoka counties (common), *Roberts*, and near Saint Paul, *Mrs. Terry*. Used as tea by the Chippewa Indians.

PYROLA, Tourn. WINTERGREEN. SHIN-LEAF. PYROLA.

- P. rotundifolia**, L. Wintergreen. Shin-leaf.

Common through the north half of the state; extending south to Minneapolis (common), *Roberts*, and rare farther south, as at Cannon River Falls, *Blake*, *Sandberg*, and Chatfield, Fillmore county, *Winchell*.

- P. rotundifolia**, L., var. *incarnata*, DC. Wintergreen.
Detroit, Becker county, *Gedge*. North.

- P. rotundifolia**, L., var. *asarifolia*, Hook. Wintergreen.
St. Croix Falls, *Miss Field*; Saint Cloud, *Garrison*. [Lake Superior, *Whitney*.] North.

- P. rotundifolia**, L., var. *uliginosa*, Gray. Wintergreen.
Minneapolis (frequent), *Roberts*, *Winchell*; Morrison county (on dryish land in woods), *Upham*.

- P. elliptica**, Nutt. Wintergreen. Shin-leaf.
Common, or frequent, throughout the state.

* **MENZIESIA GLABELLA**, Gray. Strigose-chaffy scales wanting, or very few on young petioles and midrib beneath; leaves obovate, mostly obtuse, barely mucronate-tipped, glaucescent and glabrous or nearly so beneath (an inch or two long), sprinkled with some small appressed hairs above, the obscurely serrulate margins minutely ciliate: pedicels naked or somewhat glandular: corolla ovoid-campanulate. *Gray's Synoptical Flora of N. A.*

P. chlorantha, Swartz. Wintergreen. Shin-leaf.

Common, or frequent, through the north half of the state; extending south to Isant county, *Upham*.

P. secunda, L. Wintergreen. Shin-leaf.

Common northward; extending south to the St. Croix river, *Parry*, Goodhue county, *Sandberg*, lake Pepin, *Miss Manning*, Blue Earth county, *Leiberg*, and Redwood Falls, *Pemberton*.

P. secunda, L., var. **pumila**, Paine. Wintergreen. Shin-leaf.

North of lake Superior, *Juni*; in tamarack swamps near Minneapolis, *Roberts*. Rare. North.

P. minor, L. Wintergreen. Shin-leaf.

North of lake Superior (in woods at Kakabeka falls), *Macoun*; doubtless in northern Minnesota.

MONESSES, Salisb. **MONESSES. ONE-FLOWERED PYROLA.****M. uniflora**, Gray. One-flowered Pyrola.

North of lake Superior (frequent), *Juni*, *Roberts*; Becker county, *Gedge*; Stearns county, *Campbell*. North.

CHIMAPHILA, Pursh. **PIPSISSEWA. WINTERGREEN.****C. umbellata**, Nutt. Prince's Pine. Pipsissewa. Wintergreen.

Frequent northward; extending south to Wadena county, *Upham*, Saint Cloud, *Campbell*, and Anoka county (at Deer lake), *Roberts*; near Minneapolis, *W. H. Hatch*; rare and local farther southeast, as in Goodhue county, *Sandberg*, at lake Pepin, *Miss Manning*, and Hesper, Iowa, *Mrs. Carter*.

C. maculata, Pursh. Spotted Wintergreen.

Clearwater, Wright county, *Mrs. Terry*; Saint Paul, *Miss Cathcart*. Rare.

[*Pterospora andromedea*, Nutt., will probably be found in northern Minnesota.]

MONOTROPA, L. **INDIAN PIPE. PINE-SAP.****M. uniflora**, L. Indian Pipe. Corpse-Plant.

Throughout the state: common, occasionally abundant, northward; infrequent or rare southward.

M. Hypopitys, L. Pine-sap. False Beech-drops.

Caribou Point and Carlton's Peak, north of lake Superior, also at Taylor's Falls, *Roberts*. Rare. North.

ILICINEÆ. (AQUIFOLIACEÆ.) HOLLY FAMILY.**ILEX**, L. **HOLLY.****I. verticillata**, Gray. Black Alder. Winterberry.

St. Croix river, *Parry*; lake Pepin, *Miss Manning*; Saint Paul, *Kelley*; Minneapolis, *Winchell*; Stearns county, *Upham*; St. Louis river, *Mrs. Herrick*. North.

NEMOPANTHES, Raf. **MOUNTAIN HOLLY.****N. Canadensis**, DC. Mountain Holly.

Lapham. St. Croix river, *Parry*; lake Pepin, *Miss Manning*. Infrequent. North.

PLANTAGINACEÆ. PLANTAIN FAMILY.

PLANTAGO, Tourn. PLANTAIN. RIBWORT.

P. major, L. Common Plantain. Wayside Plantain.

Common, often abundant, throughout the state. Evidently indigenous in Rock county, *Leiberg*, and in the Red river valley (where a form occurs, very probably the var. *Asiatica*, Decaisne, coarser than ordinary, with scape and spike from 1½ to 2 feet high, the spike being 6 to 12 inches long), *Upham*. [Sheyenne river, Dakota, *Geyer*.]

P. Rugelii, Decaisne.* (*P. Kamtschatica*, Hook.) Plantain.

Blue Earth county (common), *Leiberg*; Martin county, *Cratty*. Perhaps frequent throughout the state, but overlooked on account of its resemblance to the preceding. (Indigenous; found only in America.)

[*P. cordata*, Lam., should be looked for in the east part of the state; and *P. lanceolata*, L., may be expected as a weed southeastward.]

P. eriopoda, Torr.† Plantain.

Red river valley, *Watson*, *Scott*. Northwest.

P. Patagonica, Jacq., var. **gnaphalioides**, Gray. Plantain.

Upper Minnesota river, *Parry*; New Ulm, *Juni*; Nicollet county, *Aiton*; Blue Earth county, *Leiberg*; common in Watab, Benton county, and frequent, often common, thence southwestward, *Upham*; plentiful at the Pipestone quarry (showing gradations in size to small matted plants with almost filiform scapes, none of which exceed two or three inches in height, bearing few-flowered capitate spikes ½ to ¾ inch long), *Mrs. Bennett*, [Devil's lake, Dakota, *Geyer*.] South and west.

PRIMULACEÆ. PRIMROSE FAMILY.

PRIMULA, L. PRIMROSE. COWSLIP.

P. farinosa, L. Bird's-eye Primrose.

North shore of lake Superior, *Whitney*, *Macoun*; St. Croix lake, Stillwater, *Miss Field*. North.

P. Mistassinica, Michx. Primrose.

Lapham. Abundant on the north shore of lake Superior, *Juni*, *Roberts*. North.

ANDROSACE, Tourn. ANDROSACE.

A. occidentalis, Pursh. Androsace.

Blue Earth county (common), also a dwarfed form, about an inch high, with solitary

* **PLANTAGO RUGELII**, Decaisne. Leaves paler [than in *P. major*], commonly thinner: spikes long and thin, attenuate at the apex: sepals oblong, all as well as the similar bract acutely carinate: capsules erect in the spike, cylindraceous-oblong (somewhat over 2 lines long, one-sixteenth inch in diameter), about twice the length of the calyx, circumscissile much below the middle: ovules 6 to 10; seeds 4 to 9, oval-oblong (about a line long), opaque and dull brown, not reticulated. *Gray's Synoptical Flora of N. A.*

† **PLANTAGO ERIOPODA**, Torr. Perennial; leaves fleshy, broadly lanceolate, 4 to 6 inches long, 1 to 2 inches wide, attenuate at each end, long-petioled, glabrous, entire, 5-nerved; base of the leaves and scape clothed with long dense brown wool; scape 1 foot high, terete, glabrous or pubescent, with a cylindrical spike (3 to 6 inches long) of rather remote perfect flowers; bracts scarious-margined, ciliate; stamens and styles very long; bracts broadly ovate, mostly obtuse; capsules 4- to 5-seeded; seeds not hollowed. *Watson's Rep. in King's Expl. of the Fortieth Parallel*.

flowers, found near South Bend, in this county, *Leiberg*; Pipestone county, *Mrs. Bennett*; Sauk Rapids, *Mrs. Blatsaell*; Wahalla, northeastern Dakota, *Scott*. South and west.

DODECATHEON, L. AMERICAN COWSLIP.

D. Meadia, L. American Cowslip. Shooting Star. Pride of Ohio.

Lapham. Winona, *Holzinger*, *Mrs. Terry*; Lake City, *Miss Manning*. Rare. South and west.

TRIENTALIS, L. STAR-FLOWER. CHICKWEED-WINTERGREEN.

T. Americana, Pursh. Star-flower. Chickweed-Wintergreen.

Common through the north half of the state, and south to Minneapolis, *Roberts*, and Saint Paul, *Miss Cathcart*; less frequent farther southeastward, as at lake Pepin, *Miss Manning*, Faribault, *Miss Beane*, and in Blue Earth county, *Leiberg*; absent south-westward.

LYSIMACHIA, Tourn. LOOSESTRIFE.

L. thyrsoiflora, L. Tufted Loosestrife.

Frequent throughout the state.

L. stricta, Ait. Loosestrife.

Throughout the state; common northward, and south to Minneapolis; infrequent farther southward.

L. quadrifolia, L. Loosestrife.

Lapham. Dry, sandy ridges, St. Croix river, *Parry*; Lake City, *Mrs. Ray*. Rare. East.

STEIRONEMA, Raf. LOOSESTRIFE.

S. ciliatum, Raf. (*Lysimachia ciliata*, L.) Loosestrife.

Common, or frequent, throughout the state.

S. lanceolatum, Gray, var. **hybridum**, Gray. (*L. lanceolata*, Walt., var. *hybrida*, Gray.) Loosestrife.

Common southward; extending north to Fergus Falls, *Leonard*, and the upper Mississippi river, *Garrison*.

S. longifolium, Gray. (*L. longifolia*, Pursh.) Loosestrife.

Frequent, often common, in the south half of the state and the Red river valley; extending northeast to the upper Mississippi river, *Garrison*.

GLAUX, Tourn. SEA-MILKWORT.

G. maritima, L. Sea-Milkwort.

Red river prairie (damp places in marshes), *Dawson*. [Between Sheyenne river and Devil's lake, Dakota, *Geyer*.] Northwest.

ANAGALLIS, Tourn. PIMPERNEL.

A. arvensis, L. *Pimpernel*. "Poor Man's Weather-glass."

Martin county, *Gedge*. Rare.

CENTUNCULUS, Dill. CHAFFWEED.

C. minimus, L. Chaffweed.

Pipestone quarry, *Mrs. Bennett*. Rare. Southwest.

[*Samolus Valerandi*, L., var. *Americanus*, Gray, will probably be found in Minnesota.]

LENTIBULACEÆ. BLADDERWORT FAMILY.

UTRICULARIA, L. BLADDERWORT.

U. vulgaris, L. Greater Bladderwort.

Frequent throughout the state. (It is sometimes nearly or quite destitute of air-bladders in Hennepin and Blue Earth counties.)

U. minor, L. Smaller Bladderwort.

Also frequent throughout the state.

U. intermedia, Hayne. Bladderwort.

Throughout the state, but infrequent. Traverse des Sioux, Minnesota river, *Parry*; Blue Earth county, *Leiberg*; Minneapolis, *Roberts*. [Emmet county, Iowa (rare), *Cratty*; lake Superior, *Whitney*.]

U. cornuta, Michx. Bladderwort.

Isanti and Morrison counties, *Upham*; Minneapolis, *Simmons*.

PINGUICULA, Tourn. BUTTERWORT.

P. vulgaris, L. Butterwort.

Common north of lake Superior, *Roberts*; Duluth, *Miss Cathcart*. North.

OROBANCHACEÆ. BROOM-RAPE FAMILY.

APHYLLON, Mitchell. NAKED BROOM-RAPE. CANCER-ROOT.

A. Ludovicianum, Gray. (Phelipæa Ludoviciana, Don.) Broom-rape.

Traverse des Sioux, Nicollet county; "found in a singular isolated locality, rooting on an Indian grave." *Parry*. Rare.

A. uniflorum, Gray. (one-flowered Cancer-root.

Minneapolis, *Kassub*; Minnehaha falls, *Roberts*; lake Pepin, *Miss Manning*. [Emmet county, Iowa, *Cratty*; lake Superior, *Whitney*.] Rare.

A. fasciculatum, Gray. Naked Broom-rape. Cancer-root.

Bare granite rocks, upper Minnesota river, *Parry*; Lake City, *Miss Manning*; Hesper, Iowa, *Mrs. Carter*. Rare.

SCROPHULARIACEÆ. FIGWORT FAMILY.

VERBASCUM, L. MULLEIN.

V. Thapsus, L. Common Mullein.

Common, or frequent, through the east half of the state; infrequent westward.

V. Blattaria, L. Moth Mullein.

Lapham. Lake Pepin, *Miss Manning*. Rare.

LINARIA, Tourn. TOAD-FLAX.

L. Canadensis, Dumont. Wild Toad-Flax.

Plentiful on the prairie about Sandy lake, close north of Minneapolis, *Roberts*; Alexandria, *Mrs. Terry*; upper Mississippi river, *Garrison*. Infrequent.

L. vulgaris, Mill. *Toad-Flax. Butter-and-eggs. Ramsted.*

Becoming a frequent weed, occasionally abundant: upper Mississippi river; Minneapolis; Goodhue, Wabasha, Nicollet and Blue Earth counties.

SCROPHULARIA, Tourn. FIGWORT.

S. nodosa, L. var. **Marilandica**, Gray. Figwort.

Common through the south half of the state; extending north to the upper Mississippi river. *

[*Collinsia parviflora*, Dougl., will probably be found in northern Minnesota.]

CHELONE, L. TURTLE-HEAD. SNAKE-HEAD.

C. glabra, L. Turtle-head. Snake-head. Shell-flower. Balmony.

Common, or frequent, throughout the state, excepting perhaps south westward.

PENTSTEMON, Mitchell. BEARD TONGUE. PENTSTEMON.

P. pubescens, Solander. Beard-tongue. Pentstemon.

Common, or frequent, through the southeast and central portions of the state and in the Red river valley, extending northeast to the upper Mississippi river, and to the lake of the Woods (rare), *Dawson*; apparently wanting in Blue Earth county and westward, *Leiberg*; but found in Pipestone county, *Mrs. Bennett*.

P. grandiflorus, Nutt. Large-flowered Pentstemon.

Common from lake Pepin, Saint Paul and Minneapolis, to the upper Mississippi river; and thence frequent westerly to Rock county, *Leiberg*, Pipestone county, *Mrs. Bennett*, and the Red river valley near Glyndon, *Gedge*.

P. acuminatus, Dougl.* Beard-tongue. Pentstemon.

Red river, *Watson* in *Bot. Rep. of King's Expl. of the Fortieth Parallel.* West.

MIMULUS, L. MONKEY-FLOWER.

M. ringens, L. Monkey-flower.

Common, or frequent, throughout the state. (In Blue Earth and Martin counties usually having the angles of the stem very decidedly winged, *Gedge*; so, too, at White Bear, Ramsey county, *Mrs. Field*.)

M. Jamesii, Torr. & Gray. Monkey-flower.

Throughout the state. Minneapolis (plentiful), Fort Snelling, Stillwater, and lake Pepin; Saint Cloud, and the upper Mississippi river; Beaver creek, Rock county, *Leiberg*.

GRATIOLA, L. HEDGE-HYSSOP.

G. Virginiana, L. Hedge-Hyssop.

Frequent, occasionally common, throughout the state. The most northern localities

* **PENTSTEMON ACUMINATUS**, Dougl. Glauous, 6 to 20 inches high, generally stout and rigid, leafy: leaves coriaceous, somewhat cartilaginous-margined; radical and lowest cauline obovate or oblong; upper cauline from lanceolate to broadly ovate, or the upper cordate-clasping, these mostly acute or acuminate: thyrsus strict, interrupted, leafy below, naked above; the clusters several-flowered, and peduncles and pedicels mostly very short: sepals ovate and acute or lanceolate: corolla lilac or changing to violet; the limb half or two-thirds inch in diameter: sterile filament mostly bearded at the dilated tip: capsule firm-coriaceous and acuminate. *Gray's Synoptical Flora of N. A.*

reported are the St. Louis river, *Mrs. Herrick*, and the Red river (in an open swamp), *Dawson*, who mentions also a variety of this species near Saint Vincent.

[A form which seems to be a distinct variety, or perhaps a species hitherto undescribed, differing much from the ordinary type of *G. Virginiana*, is reported by *Mr. Leiberg*, with the following description: "Sterile filaments conspicuously tipped with a head; plant rather robust, 8 to 12 inches high, very smooth when dried, but in the growing state covered with a clammy exudation; lower leaves lanceolate, entire, short (half an inch long); upper leaves somewhat clasping, conspicuously 3- to 5-nerved, ovate or broadly lanceolate, acute, mostly sharply toothed, from an inch to one and a half inches long; pedicels mostly longer than the leaves; bractlets under the calyx two, lanceolate, entire or slightly toothed, 5 to 6 lines long, 1 to 1½ lines wide, twice as long and about three times as wide as the sepals; corolla yellowish white, a half inch in length.—Abundant in peaty bogs, Nicollet county. June."]

ILYSANTHES, Raf. FALSE PIMPERNEL.

I. gratioloides, Benth. False Pimpernel.

Fort Snelling, *Roberts*; Blue Earth county (common), *Leiberg*; Emmet county, Iowa (rare), *Cratty*. South.

SYNTHYRIS, Benth. SYNTHYRIS.

S. Houghtoniana, Benth. Synthyris.

Stillwater, *Parry*; Cannon River Falls, *Blake*, *Sandberg*; near Saint Paul, *Roberts*; Chisago and Morrison counties (in the latter common north of Little Falls), *Upham*.

VERONICA, L. SPEEDWELL.

V. Virginica, L. Culver's Physic.

Common through the south half of the state and in the Red river valley; extending northeast to the upper Mississippi river.

V. Anagallis, L. Water Speedwell.

Frequent through the south half of the state and in the Red river valley.

V. Americana, Schwein. American Brooklime.

Frequent throughout the state.

V. scutellata, L. Marsh Speedwell.

Throughout the state, but infrequent. Bogs, upper Mississippi river, *Parry*; St. Louis river, *Mrs. Herrick*; Minneapolis, *Juni*, *Kassube*. [Devil's lake, Dakota, *Geyer*.]

[*V. serpyllifolia*, L., doubtless occurs in this state, but has been overlooked.]

V. peregrina, L. Neckweed. Purslane Speedwell.

Frequent, or common, throughout the state.

V. arvensis, L. Corn Speedwell.

Duluth, *Juni*; Hesper, Iowa, *Mrs. Carter*. Infrequent.

BUCHNERA, L. BLUE-HEARTS.

B. Americana, L. Blue-Hearts.

Wabasha, *Gibson*. Rare. Southeast.

GERARDIA, L. GERARDIA.

G. purpurea, L. Purple Gerardia.

Common through the south half of the state; less frequent northward, as at the lake of the Woods, *Dawson*, and in the Red river valley, *Scott*, *Havard*.

G. purpurea, L., var. **paupercula**, Gray.* Purple Gerardia.

Lower Canada to Saskatchewan, and southward from coast of New England to Penn., N. Illinois and Wisconsin. *Gray's Synoptical Flora of N. A.*; apparently the prevailing form of this species in Minnesota.

G. aspera, Dougl. Purple Gerardia.

Common through the west half of the state, abundant in the Red river valley; extending east to lake Pepin, *Miss Manning*.

G. tenuifolia, Vahl. Slender Gerardia.

Common, or frequent, through the south half of the state; also found in the Red river valley, *Scott*, and at Devil's lake, Dakota, *Geyer*; extending northeast to the upper Mississippi river, *Garrison*.

G. tenuifolia, Vahl., var. **asperula**, Gray.† Slender Gerardia.

Collected by *T. J. Hale*, near the St. Croix river, and in Fillmore county.

G. Skinneriana, Wood. (*G. setacea*, Gray's *Manual*.) Gerardia.

Lapham. Upper Mississippi river, *Garrison*. Rare. South.

G. quercifolia, Pursh. Smooth False Foxglove.

Lapham. Rare. South.

G. grandiflora, Benth. False Foxglove.

Nicollet county, *Aiton*; Saint Paul, *Miss Cathcart*. South.

G. pedicularia, L. Lousewort Foxglove.

Lapham. Minneapolis, *Roberts*; White Bear lake, Ramsey county, *Kelley*; lake Pepin, *Miss Manning*. Southeast.

G. auriculata, Michx. Gerardia.

Blue Earth county, *Leiberg*; Nicollet county, *Aiton*; New Ulm, *Juni*; frequent in Martha county, and in Emmet county, Iowa, *Cratty*. South.

CASTILLEIA, Mutis. PAINTED-CUP.**C. coccinea**, Spreng. Scarlet Painted-Cup. Indian Pink. "Bloody Warrior."

Common, often abundant, throughout the wooded portion of the state; less so in the prairie region; rare from Blue Earth county westward, *Leiberg*. Nearly all yellow, at least in some years, upon districts ten to twenty miles in extent, as was observed in Washington and Ramsey counties; elsewhere scarlet, with occasional yellow specimens intermixed.

C. pallida, Kunth, var. **septentrionalis**, Gray. Pale Painted-Cup.

Lapham. Fergus Falls, *Leonard*; Red river valley, *Scott*. [North of lake Superior, *Agassiz*.] Rare. North.

C. sessiflora, Pursh. Pale Painted-Cup.

Frequent throughout the prairie portion of the state; extending northeast to the upper Mississippi river.

***GERARDIA PURPUREA**, L., var. **PAUPERCULA**, Gray. A span to a foot high, smoother: stem more simple or with stricter branches: pedicels mainly opposite: flowers decidedly smaller: corolla usually only half inch long, lighter rose-purple; calyx-teeth deltoid-subulate from a broad base, leaving comparatively narrower sinuses, sometimes over half the length of the tube. *Gray's Synoptical Flora of N. A.*

†**GERARDIA TENUIFOLIA**, Vahl., var. **ASPERULA**, Gray. Distinguished by Professor Gray, from the typical *G. tenuifolia*, as follows: Leaves all nearly filiform, the upper side hispidulo-scabrous or asperulous (in the manner of *G. aspera*): inflorescence more paniculate and with the pedicels all ascending: corolla small, the expanded limb only half an inch in diameter.—Dry and bare hills and bluffs, Missouri to Minnesota, Wisconsin and Michigan. *Botanical Gazette*, vol. iv, p. 153: May, 1879.

ORTHOCARPUS, Nutt. **ORTHOCARPUS**.**O. luteus**, Nutt.* Orthocarpus.

Lapham. North part of the Red river valley (Kittson county), *Upham*; Roseau prairie, *Scott*; Pembina, *Haward*. Northwest.

EUPHRASIA, Tourn. **EYEBRIGHT**.**E. officinalis**, L. Eyebright.

North shore of lake Superior; "abundant everywhere about the edges of mossy thickets, especially on the rocky 'peninsula' at Grand Marais; in bloom the last of July and during August; small and little branched in exposed situations, larger and much branched among other vegetation." *Roberts*. North.

RHINANTHUS, L. **YELLOW RATTLE**.**R. Crista-galli**, L. Yellow Rattle.

Lake Superior, *Gray's Manual*; doubtless in northeastern Minnesota (but probably not in the vicinity of Minneapolis, where it has been reported). North.

PEDICULARIS, Tourn. **LOUSEWORT**.**P. Canadensis**, L. Common Lousewort. Wood Betony.

Common, in many places abundant, throughout the state, excepting perhaps northeastward. Flowers all greenish yellow, with no tinge of purple, upon extensive districts.

P. lanceolata, Michx. Lousewort.

Frequent southeastward; common westward and in the Red river valley.

MELAMPYRUM, Tourn. **COW-WHEAT**.**M. Americanum**, Michx. Cow-Wheat.

Throughout the state; common or frequent northward, rare southward. Pine barrens, St. Croix river, *Parry*; Ramsey county, *Mrs. Terry*; north of lake Superior (common), *Juni*, *Roberts*; lake of the Woods, *Dawson*.

ACANTHACEÆ. **ACANTHUS FAMILY**.**RUELLIA**, L. **RUELLIA**.**R. ciliosa**, Pursh. Ruelha.

Lake Pepin, *Miss Manning*. Rare. Southeast.

***ORTHOCARPUS**, Nutt. Calyx tubular-campanulate, 4-cleft, or cleft anteriorly and posteriorly and the divisions 2-cleft or parted. Corolla mostly with slender tube; upper lip (galea) little longer and usually much narrower than the inflated 1- to 3-saccate lower one. Stamens 4; the smaller anther-cell sometimes wanting — Low herbs, almost all annual (W. North American and one Chilian); with mainly alternate entire or 3- to 5-parted and lacinate leaves; the upper passing into bracts of the dense spike and not rarely colored, as also the calyx-lobes; the corolla yellow, or white with purple or rose-color, often much surpassing the calyx. Seeds numerous or rather few. Fl. spring and summer. §2. **TRUE ORTHOCARPUS**, Benth. Corolla with simply saccate lip inconspicuously or obsoletely 3-toothed, and moderately smaller ovate-triangular galea; its small tip or mucro usually somewhat inflexed or uncinat; stigma small, entire; anthers all 2-celled; seed-coat very loose, costate-reticulated; root annual.

O. LUTEUS, Nutt. Pubescent and hirsute, sometimes viscid; stem strict, a span to a foot high; leaves from linear to lanceolate, occasionally 3-cleft; bracts of the dense spike broader or with more dilated base, completely herbaceous, mostly 3-cleft, about equalling the flowers; corolla golden yellow, less than half inch long, twice or thrice the length of the calyx; tip of galea obtuse and straight. *Gray's Synoptical Flora of N.A.*

VERBENACEÆ. VERVAIN FAMILY.

VERBENA, Tourn. VERVAIN.**V. angustifolia**, Michx. Narrow-leaved Vervain.

Stearns county, *Mrs. Blaisdell*; Goodhue county, *Sandberg*; lake Pepin, *Miss Manning*. Rare. Southeast.

V. hastata, L. Blue Vervain.

Common throughout the state, excepting far northward, where it is infrequent or rare, both in the Red river valley and about lake Superior; found at the lake of the Woods, *Dawson*.

V. urticæfolia, L. White Vervain. Nettle-leaved Vervain.

Frequency and range like the last.

V. stricta, Vent. Hoary Vervain.

Common, or frequent, on sandy land southward; extending north to the upper Mississippi river, *Houghton*.

V. officinalis, L. *European Vervain*.

Minneapolis, *Herrick*. Rare.

V. bracteosa, Michx. Prostrate Vervain.

Common through the south half of the state; extending north to the upper Mississippi river, *Houghton*, *Garrison*. (A probable hybrid between this species and *V. stricta* was found at Minneapolis in 1882. It was procumbent and much branched, much larger and coarser than *V. bracteosa*, covering a space about three feet in diameter; hirsute; leaves often 3- to 5-cleft; spikes clustered, loosely flowered; bracts inconspicuous, shorter than the calyx; flowers small, blue. *Upham*.)

LIPPIA, L. LIPPIA.**L. lanceolata**, Michx. Fog-fruit.

Lake Pepin, *Miss Manning*. Rare. Southeast.

PHRYMA, L. LOPSEED.**P. Leptostachya**, L. Lopseed.

Common, or frequent, through the south half of the state; extending north to Todd county, *Upham*, the upper Mississippi river, *Garrison*, and Fergus Falls, *Leonard*.

LABIATÆ. MINT FAMILY.

TEUCRIUM, L. GERMANDER.**T. Canadense**, L. American Germander. Wood Sage.

Frequent, occasionally common, through the south half of the state and in the Red river valley to Pembina, *Havard*.

ISANTHUS, Michx.**I. cæruleus**, Michx. False Pennyroyal.

Lake City, *Mrs. Ray*; Blue Earth county, *Leiberg*; Minneapolis, *Winchell*, *Roberts*. South.

MENTHA, Tourn. MINT.*M. viridis*, L. *Spearmint*.

Often cultivated, and occasionally spontaneous, escaping from gardens.

M. piperita, L. *Peppermint*.
Occurring like the last.

M. Canadensis, L. Wild Mint.
Common throughout the state.

LYCOPUS, Tourn. WATER HOREHOUND.

L. Virginicus, L. Bugle-weed.
Frequent, especially northward; common north of lake Superior, *Juni, Roberts*.

L. rubellus, Mœnch. (L. *Europæus*, L., var. *integrifolius*, Gray.) Water Horehound.
Minneapolis, *Twining, Herrick*; upper Mississippi river, *Garrison*; Baptism river, *Juni*.

L. lucidus, Turcz., var. **Americanus**, Gray.* Water Horehound.
Blue Earth county, *Leiberg*; Bear lakes, Murray county, *Upham*. West.

L. sinuatus, Ell. (L. *Europæus*, L., var. *sinuatus*, Gray.) Water Horehound.
Frequent, or common, throughout the state.

PYCNANTHEMUM, Michx. MOUNTAIN MINT. BASIL.

P. lanceolatum, Pursh. Mountain Mint. Basil. "Pennyroyal."
Common, in many districts abundant, on moist land throughout the prairie portion of the state.

P. linifolium, Pursh. Mountain Mint. Basil.
Blue Earth county, *Leiberg*. South.

CALAMINTHA, Tourn., Mœnch. CALAMINT.

C. Nuttallii, Benth. (C. *glabella*, Benth., var. *Nuttallii*, Gray.) Calamint.
Falls of St. Anthony, *Wood's Class-Book*. Infrequent. East.

C. Clinopodium, Benth. Basil.
Stearns county, *Garrison*. Infrequent.

HEDEOMA, Pers. MOCK PENNYROYAL.

H. pulegioides, Pers. American Pennyroyal.
Upper Mississippi river, *Garrison*; lake Pepin, *Miss Manning*. Rare. South.

H. hispida, Pursh. Mock Pennyroyal.
Common, or frequent, through the south half of the state; extending north to the upper Mississippi river, *Garrison*.

MONARDA, L. HORSE-MINT.

M. fistulosa, L. Wild Bergamot.
Throughout the state: frequent northeastward; common, often abundant, southward and in the Red river valley.

* **LYCOPUS LUCIDUS**, Turcz. Stem stout (2 to 3 feet high), erect, acute-angled at top; leaves lanceolate or oblong-lanceolate (2 to 4 inches long), acute or acuminate, with large and very sharp serrations, the base obtuse, or occasionally acute, sessile; calyx-teeth alternate, subulate.—Var. **AMERICANUS**, Gray. Leaves barely shining on both sides, often hairy-pubescent; stem generally hairy; calyx-teeth small and rigid. *Gray's Revision of Lycopus, Proc. Amer. Acad.*, 1870.

M. punctata, L. Horse-Mint.

Upper Mississippi river, *Houghton*; Stearns county, *Mrs. Blaisdell*; Nicollet county, *Aiton*; lake Pepin, *Miss Manning*. Rare. Southeast.

BLEPHILIA, Raf. BLEPHILIA.**B. ciliata**, Raf. Blephilia.

Lapham. Rare. Southeast.

B. hirsuta, Benth. Blephilia.

Lapham. Infrequent. Southeast.

LOPHANTHUS, Benth. GIANT HYSSOP.**L. nepetoides**, Benth. Giant Hyssop.

Falls of the St. Croix, *Parry*; Lac qui Parle county, *Upham*. South.

L. scrophulariæfolius, Benth. Giant Hyssop.

Frequent southward; extending north to the upper Mississippi river, *Houghton*.

L. anisatus, Benth. Anise Hyssop.

Common, or frequent through the south half of the state; abundant in the Red river valley; extending northeast to the upper Mississippi, *Houghton*, and Rainy Lake river, *Keating*. "All three of the above species are found side by side at the Falls of the St. Croix." *Parry*.

NEPETA, L. CAT-MINT.**N. Cataria**, L. Catnip.

Frequent throughout the state.

N. Glechoma, Benth. Ground Ivy. Gill.

Occasionally adventive: Todd county, *Upham*; Minneapolis (frequent), *Roberts*; Mankato, *Leiberg*; Lake City, *Miss Manning*; Emmet county, Iowa (rare), *Cratty*.

DRACOCEPHALUM, Tourn. DRAGON-HEAD.**D. parviflorum**, Nutt. Dragon-head.

Throughout the state: frequent northward; rare southward.

PHYSOSTEGIA, Benth. FALSE DRAGON-HEAD. LION'S-HEART.**P. Virginiana**, Benth. False Dragon-head. Lion's-heart.

Frequent through the south half of the state and in the Red river valley; extending northeast to the upper Mississippi river, *Parry*.

BRUNELLA, Tourn. SELF-HEAL. HEAL-ALL.**B. vulgaris**, L. Self-heal. Heal-all.

Throughout the state: common northward; frequent southward.

SCUTELLARIA, L. SKULLCAP.**S. versicolor**, Nutt. Skullcap.

Lapham. Shore of lake Pepin, in Wisconsin, *Miss Manning*. South.

S. parvula, Michx. Skullcap.

Frequent through the south half of the state and north to the upper Mississippi river.

S. galericulata, L. Skullcap.
Common, or frequent, throughout the state.

S. lateriflora, L. Mad-dog Skullcap.
Commonness and range like the last.

MARRUBIUM, Tourn. HOREHOUND.

M. vulgare, L. *Horehound*.
Lake Pepin, *Miss Manning*. Infrequent.

GALEOPSIS, L. HEMP-NETTLE.

G. Tetrahit, L. *Common Hemp-Nettle*.

Abundant north of lake Superior; infrequent southward. *Mr. Roberts* describes it on the north shore of lake Superior as "very common, growing on the shingle especially; corolla almost universally white, marked with yellow in the throat; rarely purple."

STACHYS, Tourn. HEDGE-NETTLE. WOUNDWORT.

S. palustris, L. Hedge-Nettle. Woundwort.

Abundant on moist ground and margins of sloughs throughout the state; in many districts southwestward persisting as a weed in wheat-fields. (The tube of the corolla is abruptly constricted on the front side near its base, and within at that point bears short white hair. Floral leaves small, but much exceeding the sessile calyx.)

S. aspera, Michx. (*S. palustris*, L., var. *aspera*, Gray.) Hedge-Nettle.
Woundwort.

Common north of lake Superior at Little Marais and Palisades, *Roberts*; Pembina, *Chickering*, *Scott*; Stearns county, *Garrison*; Minneapolis, *Twining*, *Kassube*; Blue Earth county, *Leiberg*.

LEONURUS, L. MOTHERWORT.

L. Cardiaca, L. *Common Motherwort*.

Becoming frequent southward: Minneapolis; Saint Paul; Stillwater; lake Pepin; Fillmore, Blue Earth and Martin counties.

LAMIUM, Tourn. DEAD-NETTLE.

L. amplexicaule, L. *Dead-Nettle*.

Excelsior, near Minneapolis, *Mrs. Herrick*; probably also at Duluth. This is likely to become a frequent weed.

BORRAGINACEÆ. BORAGE FAMILY.

SYMPHYTUM, Tourn. COMFREY.

S. officinale, L. *Comfrey*.

Escaped from cultivation: Minneapolis, *W. H. Hatch*; Goodhue county, *Sandberg*. Infrequent.

ONOSMODIUM, Michx. FALSE GROMWELL.

O. Carolinianum, DC. False Gromwell.

Frequent, occasionally common, through the south half of the state.

O. Carolinianum, DC, var. **molle**, Gray. (*O. molle*, Michx.) False Gromwell.

Winona county, *Holzinger*; Spring Valley, Fillmore county, *Dr. W. E. Leonard*; Scott county, *Winchell*; Nicollet county, *Aiton*; Blue Earth county, *Leiberg*; Fergus Falls, *Dr. H. C. Leonard*; Worthington (rare), *Foot*. South and west.

LITHOSPERMUM, Tourn. GROMWELL. PUCCOON.

[*L. arvense*, L., may be expected. It is reported in Michigan as a bad weed in wheat-fields.]

L. angustifolium, Michx. Narrow-leaved Gromwell.

Frequent southward and in the Red river valley; extending northeast to the upper Mississippi river. (The early-flowering state of this species, with the tube of the corolla much elongated, is described in Gray's *Manual* under the name *L. longiflorum*, Spreng.)

L. officinale, L. Common Gromwell.

Minneapolis, *Roberts, Herrick*; Brockway, Stearns county, *Miss Campbell*. Rare.*

L. latifolium, Michx. Broad-leaved Gromwell.

Isanti county, *Upham*; Saint Paul, *Miss Catheart*; near Meeker's island, Minneapolis, *Kassube*; Chaska, Carver county, *Juni*; Blue Earth county, *Leiberg*; Martin county (rare), *Cratty*. South.

L. hirtum, Lehm. Hairy Puccoon.

Common, often abundant, on sandy land in the south half of the state; extending north at least to Fergus Falls, *Leonard*.

L. canescens, Lehm. Hairy Puccoon or Alkanet. "Indian Paint."

Abundant, or common, through the south half of the state, and in the Red river valley; extending northeast to the upper Mississippi river. The red juice of the root is used by the Indians to paint their faces and for other purposes in dyeing.

[For *L. longiflorum*, Spreng, see *L. angustifolium*, Michx., above.]

MERTENSIA, Roth. SMOOTH LUNGWORT.

M. Virginica, DC. Virginian Cowslip or Lungwort. "Blue Bells."

Lapham. Rochester, Olmsted county, *Miss Bean*; Le Roy, Mower county, *Miss Birby*. Southeast.

M. paniculata, Don. Smooth Lungwort.

Common on the north shore of Lake Superior, *Juni, Roberts*; St. Louis river, *Mrs. Herrick*. "The flower-buds pink, turning blue as they open, thus giving the flowering plant a showy, variegated appearance. Still blooming in August." *Roberts*.

MYOSOTIS, L. SCORPION-GRASS. FORGET-ME-NOT.

M. arvensis, Hoffm. Forget-me-not.

Minneapolis (quite surely this species), *Herrick*. Rare.

M. verna, Nutt. Forget-me-not.

Pipestone county, *Mrs. Bennett*. Rare.

ECHINOSPERMUM, Swartz. STICKSEED. BUR-SEED.

E. floribundum, Lehm.* Stickseed. Bur-seed.

Red river near Saint Vincent, *Dawson*. West.

***ECHINOSPERMUM FLORIBUNDUM**, Lehm. Rather strict, two feet or more high, or sometimes smaller: leaves from oblong- to linear-lanceolate; the lowest tapering into

E. deflexum, Lehm.* Stickseed. Bur-seed.
Red river valley at Pembina, *Havard*. Northwest.

E. Lappula, Lehm. Stickseed. Bur-seed. "Stick-tight."

Common, often abundant, through the south half of the state; less frequent in the Red river valley and the region of lake Superior (reported at Duluth, *Juni*, and in the vicinity of Saint Vincent, abundant, *Dawson*).

E. Redowskii, Lehm., var. **occidentale**, Watson. Stickseed. Bur-seed. "Stick-tight."

Frequency and range nearly like the last; but probably absent northeastward. (Procumbent and ascending, six to twelve inches high.)—The American plant is less strict, at length diffuse, and the tubercles or scabrosities of the nutlet are sharp instead of blunt or roundish, as in the Asiatic plant. *Gray's Synoptical Flora of N. A.*

E. Virginicum, Lehm. (Cynoglossum Morrisoni, DC.) Beggar's Lice.
Stickseed. Bur-seed. "Stick-tight."

Common, or frequent, through the south half of the state; rare or less frequent northward.

CYNOGLOSSUM, Tourn. HOUND'S-TONGUE.

C. officinale, L. *Hound's-Tongue*.

Becoming a frequent weed: lake Pepin, *Miss Manning*; Hastings, *Leonard*, and Mendota, Dakota county, *Kassube*; Nicollet county, *Aiton*; Jordan, Scott county, *Juni*; Stearns county, *Garrison*, *Campbell*.

C. Virginicum, L. Wild Comfrey.

Goodhue county, *Sandberg*; Stearns county, *Upham*; St. Louis river, *Mrs. Herrick*, East and north.

ASPERUGO, Tourn. GERMAN MUDWORT.

A. procumbens, L.† *German Mudwort*.

Adventive, but scarcely established, at Pipestone City, *Mrs. Bennett*. Rare.

margined petioles: racemes numerous, commonly geminate and in fruit rather strict: nutlets with elongated triangular back naked (2 lines long), merely scabrous; and the margin armed with a close row of flat subulate prickles, their bases often confluent: scar smaller and narrowly ovate. Limb of corolla varying from 2 to 5 lines in diameter. *Gray's Synoptical Flora of N. A.*

***ECHINOSPERMUM DEFLEXUM**, Lehm. Diffusely branched, a foot or so high: leaves from oblong to lanceolate: racemes lax, loosely paniculate: flowers soon sparse, smaller than in the preceding: nutlets smaller, and the mostly naked back (a line long) broader. Habit intermediate between the preceding and *E. Virginicum*, Lehm.; the American specimens having occasionally some few prickles developed from the rough-granulate dorsal face of the nutlets. Fruit as well as flowers about half the size of that of *E. floribundum*. *Gray's Synoptical Flora of N. A.*

†**ASPERUGO**, Tourn. Calyx when in flower nearly regular, deeply 5-cleft, in fruit 2-lobed, with the lobes valvate, closed, flattish, palmately lacinate, the one 6- and the other 7-toothed. Corolla funnelshaped-salvershaped; the throat closed by 5 obtuse scales; limb concave, 5-lobed. Stamens included. Nucules laterally compressed, nearly smooth with raised dots, attached by their narrow inner edge to the conical receptacle. A rough herb with fragile juicy stems, and small axillary purplish-blue flowers. Calyx much enlarged and veined in fruit, somewhat like the perianth of the female flowers of the genus *Atriplex*.

A. procumbens, L. The only known species. Annual; stem 1 to 3 feet long, procumbent or trailing, succulent, brittle, angular, thinly studded with reflexed prickles,

HYDROPHYLLACEÆ. WATERLEAF FAMILY.

HYDROPHYLLUM, Tourn. WATERLEAF.

H. Virginicum, L. Waterleaf.

Common, occasionally abundant, through the south half of the state; extending north at least to Morrison county (plentiful), *Upham*, and Clay county in the Red river valley, *Gedde*.

H. appendiculatum, Michx. Waterleaf.

Lake Pepin, *Miss Manning*; Blue Earth county, *Leiberg*. South.

ELLISIA, L. ELLISIA.

E. Nyctelea, L. (Including the slender form, *E. ambigua*, Nutt., which prevails here.) Ellisia.

Frequent through the south half of the state and in the Red river valley.

PHACELIA, Juss. PHACELIA.

P. Purshii, Buckley. Phacelia.

Gray's *Synoptical Flora of N. A.*; Goodhue county, *Sandberg*. Rare. Southeast.

P. Franklinii, Gray. Phacelia.

Shores of lake Superior, especially on Isle Royale, Gray's *Manual*; abundant at Port Arthur, *Macoun*; surely also in northern Minnesota.

POLEMONIACEÆ. POLEMONIUM FAMILY.

POLEMONIUM, Tourn. GREEK VALERIAN.

P. reptans, L. Greek Valerian.

Hesper, Iowa, adjoining Fillmore county (common), *Mrs. Carter*; Winona, *Holtinger*; lake Pepin, *Miss Manning*; Cannon River Falls, *Blake*, *Sandberg*; extending northwest to New Ulm, *Leiberg*, and Alexandria, *Mrs. Terry*. Infrequent. Southeast.

PHLOX, L. PHLOX.

P. maculata, L. Wild Sweet William.

Northfield, Rice county, *Chaney*; Dakota county, *Winchell*, *Upham*; Minneapolis, *Herrick*. South.

P. glaberrima, L. Phlox.

St. Croix Falls, *Miss Field*; New Ulm, *Juni*; upper Mississippi river, *Garrison*. Infrequent. South.

by which they readily adhere to the clothes of passers-by and to the coats of animals. Leaves oblanceolate, subobtuse, the lower ones narrowed into winged petioles and slightly decurrent, those on the upper part of the stem scarcely stalked, nearly opposite, or 3 or 4 in a whorl, more or less clothed with hairs, many of which are hooked-pointed. Peduncles very short, at first erect, afterwards recurved, 1-flowered. Corolla $\frac{1}{6}$ inch across, dull purplish blue. Calyx in fruit $\frac{1}{2}$ inch long, dorsally compressed, of 2 palmately lacinate valves, adpressed to each other, with a prominent network of veins, sparingly ciliated and clothed with bristly hairs. Nucules yellowish-gray, one-fifth inch long, thickly studded with smooth white scale-like patches, *Sowerby's English Botany*, vol. vii.

P. pilosa, L. Hairy Phlox.

Common throughout the prairie portion of the state; extending northeast to the upper Mississippi river, *Houghton, Garrison*.

P. divaricata, L. Phlox.

Frequent, or common, southward; extending north to Minneapolis (common), *Roberts*, and Redwood Falls, *Pemberton*. [The var. *Laphamii*, Wood, occurs at Minnehaha falls (plentiful), *Roberts*, and is also common at Hesper, Iowa, *Mrs. Carter*.]

COLLOMIA, Nutt. COLLOMIA.**C. linearis**, Nutt.* Collomia.

Pipestone county, *Mrs. Bennett*. [Upper Missouri river, *Geyer*.] West.

CONVOLVULACEÆ. CONVOLVULUS FAMILY.

CONVOLVULUS, L. BINDWEED.**C. sepium**, L. (*Ca. ystegia sepium*, R. Br.) Hedge Bindweed. Bracted Bindweed.

Common through the south half of the state and in the Red river valley; extending northeast to the upper Mississippi river; also, St. Louis river, *Mrs. Herrick*, and probably throughout Minnesota.

C. sepium, L, var. **repens**, Gray,† (var. *pubescens*, Gray, in *Manual*.)

Clay county, in the Red river valley, *Gedge*.

C. spithamæus, L. (*Calystegia spithamæa*, Pursh.) Bracted Bindweed.

Throughout the state, but infrequent. Winona county, *Holzinger*; lake Pepin, *Miss Manning*; Dellwood, White Bear lake, Ramsey county, *Kelley*; near Minneapolis (rare), *Kassube*; Stearns county, *Mrs. Blaisdell*; St. Louis river, *Mrs. Herrick*; Red river prairie (rare), *Dawson*; Pembina (in woods), *Chickering*.

CUSCUTA, Tourn. DODDER.**C. tenuiflora**, Engelm. Dodder.

Lapham. Blue Earth county, *Leiberg*, determined by *Watson*. South.

C. chlorocarpa, Engelm. Dodder.

Minneapolis, *Kassube*; Blue Earth county, *Leiberg*. South.

*COLLOMIA, Nutt. Corolla tubular-funneliform or salverform with a more or less dilated throat. Filaments slender, unequally inserted, usually protruded. Ovules solitary, few or many in each cell. Seed-coat developing mucilage and projecting numerous spiral threads (spiracles) when wetted (except in *C. gracilis*). Annuals or some biennials, with alternate leaves (or only the lower ones opposite), which are usually pinnately incised or divided, and with clustered or sometimes scattered flowers.

C. LINEARIS, Nutt. Annual, more or less viscid-pubescent, becoming glabrate below, glandular above; stems erect, simple or branching, 6 to 18 inches high; leaves sessile, lanceolate, very entire; heads crowded; lobes of the calyx triangular-lanceolate, acute; corolla light blue or nearly white, 6 lines long, slender, but little enlarged at the throat, the limb small; ovules solitary; seeds with very numerous spiracles. *Porter and Coulter's Flora of Colorado*, and *Botany of King's Report*, following Gray's *Revision of N. A. Polemoniaceæ, Proc. Amer. Acad.*, 1870, vol. viii.

†CONVOLVULUS SEPIUM, L., var. **REPENS**, Gray. Corolla from almost white to rose-color: bracts from very obtuse to acute: herbage from minutely to tomentose-pubescent: sterile and sometimes flowering stems extensively prostrate: leaves more narrowly sagittate or cordate, the basal lobes commonly obtuse or rounded and entire. *Gray's Synoptical Flora of N. A.*

C. Gronovii, Willd. Dodder.

Common, or frequent, through the south half of the state and in the Red river valley.

C. Gronovii, Willd., var. *latiflora*, Engelm. Dodder.

Doubtless in this state; as it occurs at Hesper, in the north edge of Iowa (on *Impatiens fulva*), *Mrs. Carter, Arthur*. [A form with flowers of more delicate texture, and shorter tube and longer lobes to the corolla. *Gray's Synoptical Flora of N. A.*]

C. glomerata, Choisy. Dodder.

Frequent, or common, through the south part of the state; extending north to Stearns county, *Campbell*, and Redwood Falls, *Miss Butler*.

SOLANACEÆ. NIGHTSHADE FAMILY.

SOLANUM, Tourn. NIGHTSHADE.

S. Dulcamara, L. *Bittersweet*.

Stillwater, *Miss Field*; Lake City, *Mrs. Ray*. Infrequent.

S. nigrum, L. Common Nightshade. Black Nightshade.

Common through the south half of the state, especially southwestward, where the berries are often used for pies and sauce. Indigenous; also cosmopolitan.

PHYSALIS, L. GROUND CHERRY.

P. grandiflora, Hook. Ground Cherry.

Upper Mississippi river, *Garrison*; Stearns county, *Mrs. Blatsdell*; St. Louis river, *Mrs. Herrick*. North.

P. Philadelphica, Lam. Ground Cherry.

Lake Pepin, *Miss Manning*; Blue Earth county, *Leiberg*; Redwood Falls, *Pemberton*. South.

P. angulata, L. Ground Cherry.

Lapham. Minneapolis, *Twining, Simmons*. Rare. South.

P. pubescens, L. Ground Cherry.

Frequent, or common, in the south part of the state; extending west at least to Worthington, Nobles county (common), *Foote*, and north to New Ulm and Anoka county, *Junt*, and Stearns county, *Campbell*.

P. Virginiana, Mill. (*P. viscosa*, in *Gray's Manual*.) Ground Cherry.

Frequent southward; extending north to the upper Mississippi river. *Garrison*. [North of lake Superior, *Agassiz*; Pembina mountain, *Havard*.]

P. Virginiana, Mill., var. *ambigua*, Gray. Ground Cherry.

A coarse and very villous form with anthers violet!—Wisconsin (*Lapham*) to Saskatchewan, *Bourgeau, Drummond, &c.*, *Gray's Synoptical Flora of N. A.*; therefore doubtless in Minnesota.

P. lanceolata, Michx. (*P. Pennsylvanica*, in *Manual*.) Ground Cherry.

Common, or frequent, through the south half of the state and in the Red river valley; extending northeast to Itasca lake, *Houghton*.

NICANDRA, Adans. APPLE OF PERU.

N. physaloides, Gærtm. *Apple of Peru*.

Adventive, Minneapolis, *Williams, Roberts*. Infrequent.

LYCIUM, L. MATRIMONY-VINE.

- L. vulgare*, Dunal. *Matrimony-Vine.*
Adventive, Minneapolis, *Juni, Roberts.* Infrequent.

DATURA, L. JAMESTOWN-WEED. THORN-APPLE.

- D. Stramonium*, L. *Common Stramonium or Thorn-Apple.*
Stearns county, *Campbell*, Minneapolis, *Roberts*; Goodhue county, *Sandberg*; Blue Earth county, *Leiberg.* Infrequent. South.
- D. Tatula*, L. *Purple Thorn-Apple.*
Saint Paul, *Miss Cathcart*; Goodhue county, *Sandberg*; lake Pepin, *Miss Manning.* Rare. South.

NICOTIANA, Tourn. TOBACCO.

- N. rustica*, L. *Wild Tobacco.*
Near Clotho, Todd county, *Upham*; "a relic of cultivation by the Indians." Rare.

GENTIANACEÆ. GENTIAN FAMILY.**HALENIA, Borkh. SPURRED GENTIAN.**

- H. deflexa**, Griseb. Spurred Gentian.
Common north of lake Superior, *Juni, Roberts*; lake of the Woods, *Dawson.* North.

GENTIANA, Tourn. GENTIAN.

- G. Amarella**, L., var. **acuta**, Hook. f.* Gentian.
Red river valley near Saint Vincent, *Scott*; determined by *Watson.* Northwest.
- G. quinqueflora**, Lam., var. **occidentalis**, Gray. Five-flowered Gentian.
Frequent, or occasional, through the south part of the state; extending north to Saint Paul and White Bear lake, *Mrs. Terry*, Stillwater, *Miss Field*, and the upper Mississippi river, *Garrison*. [Common at Hesper, *Mrs. Carter*, and in Emmet county, Iowa, *Cratty*.]
- G. crinita**, Frœl. Fringed Gentian.
Common, or frequent, throughout the state.
- G. serrata**, Gunner. (*G. detonsa*, in *Manual*.) Smaller Fringed Gentian.
Also common throughout the state. This and the preceding grow together, and in many places are very abundant locally.
- G. alba**, Muhl. Whitish Gentian.
Throughout the state, but infrequent. Hesper, *Mrs. Carter*; Winona, *Holzinger*; Cannon River Falls, *Blake, Sandberg*; Faribault, *Miss Beane*; Saint Paul, *Miss Cathcart*;

***GENTIANA AMARELLA, L.** From 2 to 20 inches high: leaves from lanceolate to narrowly oblong, or the lowest obovate-spatulate: inflorescence disposed to be racemiform: calyx 5-cleft (or rarely 4-cleft) below the middle; the lobes lanceolate or linear, equal or one or two of them longer, all shorter than the mostly blue corolla: the latter (funnel-form, with entire lobes) half inch or more long; its lobes oblong, obtuse or becoming acute (with setaceous-fimbriate crown on their base): capsule sessile.—Var. **ACUTA**, Hook. f. Calyx almost 5-parted; crown usually of fewer and sometimes very few setæ. *Gray's Synoptical Flora of N. A.*

Minneapolis, *Roberts*; St. Croix Falls, *Miss Field*; New Ulm, *Juni*; Stearns county, *Campbell*; Roseau river, *Scott*.

G. Andrewsii, Griseb. Closed Gentian.

Frequent through the south half of the state and in the Red river valley; extending northeast to the upper Mississippi river, *Geyer*, *Garrison*.

G. Saponaria, L. Soapwort Gentian.

Lapham. Cannon river, *Geyer*; Anoka county, *Juni*; Pembina, *Havard*. Infrequent. South and west.

G. linearis, Frœl., var. **lanceolata**, Gray.* Gentian.

Minnesota and along lake Superior, Gray's *Synoptical Flora of N. A.*; frequent on prairies, Blue Earth county, *Leiberg*.

G. puberula, Michx. Gentian.

Common, or frequent, through the south half of the state and in the Red river valley (common northward to Ada, Norman county, *Upham*, and infrequent to the vicinity of Saint Vincent, *Scott*).

G. affinis, Griseb.† Gentian.

Lapham. Red river, *Watson* in *King's Report*; near Saint Vincent, *Scott*, determined by *Watson*. West.

MENYANTHES, Tourn. BUCKBEAN.

M. trifoliata, L. Buckbean.

Common throughout the state.

LIMNANTHEMUM, Gmelin. FLOATING HEART.

L. lacunosum, Griseb. Floating Heart.

In a lake near Alexandria, Douglas county, *Mrs. Terry*. Rare.

APOCYNACEÆ. DOGBANE FAMILY.

APOCYNUM, Tourn. DOGBANE. INDIAN HEMP.

A. androsæmifolium, L. Spreading Dogbane.

Common throughout the state.

***GENTIANA LINEARIS**, Frœl. (*G. Saponaria*, L., var. *linearis*, Griseb.) Smooth throughout: stem slender and strict, a foot or two high: leaves linear or narrowly lanceolate, $1\frac{1}{2}$ to 3 inches long, 2 to 5 lines wide, and with somewhat narrowed base: flowers 1 to 5 in the terminal involucrate cluster, and often solitary in one or two axils below: calyx-lobes linear or lanceolate, shorter than the tube: corolla blue, an inch or more long, narrow-funnel-form; the erect lobes roundish-ovate and obtuse, 2 lines long, a little longer than the triangular acute and entire or slightly 1- to 2-toothed appendages.—Var. **LANCEOLATA**. Leaves lanceolate, or the upper and involucrate ones almost ovate-lanceolate (1 or 2 inches long and even half inch wide): appendages of the sinuses of the corolla sometimes very short and broad. . . . Approaches narrow-leaved forms of *G. alba*. *Gray's Synoptical Flora of N. A.*

†**GENTIANA AFFINIS**, Griseb. Stems clustered, a span to a foot high, mostly ascending: leaves from oblong to lanceolate or linear: flowers from numerous and thyrsoid-racemose to few or rarely almost solitary: bracts lanceolate or linear: calyx-lobes linear or subulate, unequal and variable, the longest rarely equalling the tube, the shorter sometimes minute: corolla an inch or less long, rather narrowly funnel-form; its lobes ovate, acutish or mucronulate-pointed, spreading. *Gray's Synoptical Flora of N. A.*

A. cannabinum, L. Indian Hemp.

Also common throughout the state. (Polymorphous; the var. *glaberrimum*, DC., has been noted in Faribault county, *Upham*; and var. *hypericifolium*, Gray, at lake Minnetonka, *Roberts*, St. Louis river, *Mrs. Herrick*, and Pembina, *Haward*; var. *pubescens*, DC., probably also occurs here; but intermediate forms are found, "rendering useless any sub-specific names."

ASCLEPIADACEÆ. MILKWEED FAMILY.

ASCLEPIAS, L. MILKWEED. SILKWEED.

A. speciosa, Torr.* Milkweed. Silkweed.

Red river valley, in Clay county (frequent on portions of the prairie which are intermediate between wet and dry), *Upham*; Big Stone county, *Campbell*, determined by *Prof. Asa Gray*; extending east to the central part of Minnesota, *Rev. E. L. Greene*, and Martin county, *Gedge, Leiberg*. [Frequent in Emmet county, Iowa (sometimes troublesome in grain-fields, like *A. Cornuti* elsewhere), *Cratty*.] West.

A. Cornuti, Decaisne. Common Milkweed or Silkweed.

Common throughout the state, excepting perhaps northeastward.

A. Sullivantii, Engelm. Sullivant's Milkweed.

□ Common, or frequent, across the south part of the state; extending north to Blue Earth county, *Gedge*, Brown county, *Juni*, wet prairies of central Minnesota, *Rev. E. L. Greene*, and in the Red river valley at least to Clay county (frequent), *Gedge*.

A. phytolaccoides, Pursh. Poke-Milkweed.

St. Croix river, *Parry*; lake Pepin, *Miss Manning*; Minneapolis, *Herrick, Hatch*; Stearns county, *Upham*; Detroit, Becker county, *Gedge*. Infrequent. South.

A. purpurascens, L. Purple Milkweed.

Lake Pepin, *Miss Manning*; Stillwater, *Miss Field*; Hennepin county, *Herrick, Hatch*; upper Mississippi river, *Garrison*. Infrequent. South.

A. ovalifolia, Decaisne. Milkweed.

Frequent throughout the prairie region of the state: common in Benton, Stearns and Todd counties (in oak openings and prairies), *Upham*; the most common species of this genus in the Red river valley, *Gedge*.

A. quadrifolia, L. Four-leaved Milkweed.

Shores of lake Pepin, both in Minnesota and Wisconsin, *Miss Manning*. Rare. South.

A. incarnata, L. Swamp Milkweed.

Common throughout the state.

A. incarnata, L., var. *pulchra*, Pers. Swamp Milkweed.

Minneapolis, *Kassube*.

*ASCLEPIAS SPECIOSA, Torr. Finely canescent-tomentose, rarely glabrate with age: leaves from subcordate-oval to oblong, thickish: peduncles shorter than the leaves: pedicels of the many-flowered dense umbel and the calyx densely tomentose: flowers purplish, large: corolla-lobes ovate-oblong, 4 or 5 lines long: hoods 5 or 6 lines long, spreading, the dilated body and its short inflexed horn not surpassing the anthers, but the center of its truncate summit abruptly produced into a lanceolate-ligulate three longer termination: column hardly any: wings of the anthers notched and obscurely corniculate at base.—Follicles echinate with soft spinous processes and densely tomentose, large (3 to 5 inches long) and ventricose, ovate and acuminate, arrect on deflexed pedicels: leaves large and broad, short-petioled, transversely veined: stems stout and simple, 2 to 5 feet high. *Gray's Synoptical Flora of N. A.*

A. obtusifolia, Michx. Milkweed.*Lapham*. South.**A. tuberosa**, L. Butterfly-weed. Pleurisy-root.Common, or frequent, through the south half of the state; extending north to the upper Mississippi river, *Garrison*, and Fergus Falls, *Leonard*; not observed in Clay county, *Gedge*.**A. verticillata**, L. Whorled Milkweed.Frequent southeastward; extending north to Otter Tail county, *Upham*, Clay county (common), *Gedge*, and Pembina, *Chickering*.**ACERATES**, Ell. GREEN MILKWEED.**A. viridiflora**, Ell. Green Milkweed.

Occasional through the south half of the state and in the Red river valley.

A. viridiflora, Ell., var. **lanceolata**, Gray. Green Milkweed.Blue Earth county (frequent), *Leiberg*; Clay county, Red river valley, *Gedge*. [With lanceolate leaves $2\frac{1}{2}$ to 4 inches long. *Gray's Synoptical Flora of N. A.*]**A. viridiflora**, Ell., var. **linearis**, Gray. Green Milkweed.Clay county, *Gedge*. West. [With elongated linear leaves and low stems: umbels often solitary.—Winnipeg Valley to New Mexico. *Gray's Synoptical Flora of N. A.*]**A. lanuginosa**, Decaisne. Green Milkweed.Winona county, *Holzinger*; Blue Earth county, *Leiberg*; Minneapolis, *Juni, Roberts*; Redwood Falls, *Pemberton*; Clay county, Red river valley, *Gedge*. (Specimens with some of the leaves having two equally prominent midribs and the end bifid were collected in Clay county by *Prof. Gedge*.) South and west.**A. longifolia**, Ell. Green Milkweed.Freeborn county, *Upham*; Cannon River Falls, *Blake, Sandberg*; frequent in Martin county, and in Emmet county, Iowa, *Cratty*; Stearns county, *Mrs. Blaisdell*; upper Mississippi river, *Garrison*. South.**OLEACEÆ. OLIVE FAMILY.****FRAXINUS**, Tourn. ASH.**F. Americana**, L. White Ash.

Frequent, often common, throughout the state, excepting far northward. The white and black ash are well known as valuable timber trees.

F. pubescens, Lam. Red Ash.Frequent from lake Pepin, *Miss Manning*, to Stearns and Todd counties and Sand Hill river, *Upham*; the White Earth reservation, *Garrison*; reaching its northern limit on Rainy river, *Richardson*.**F. viridis**, Michx. f. Green Ash.Common, or frequent, throughout the state; extending north at least to Rainy river and the lake of the Woods, and common along the Red river in Manitoba, *Bell*; the most common species of ash in Iowa, *Arthur*.**F. sambucifolia**, Lam. Black Ash.Frequent, occasionally plentiful, throughout the state, excepting perhaps south-westward. [Its northwestern limit reaches the southern part of lake Winnipeg, and thence extends southward along the east side of Red river, *Bell*.]**F. quadrangulata**, Michx. Blue Ash.Upper Mississippi river, *Garrison*; near the Rainy lake valley, *Clark*. Rare.

ARISTOLOCHIACEÆ. BIRTHWORT FAMILY.

ASARUM, Tourn. ASARABACCA. WILD GINGER.

A. Canadense, L. Asarabacca. Wild Ginger.
Common, or frequent, throughout the state.

ARISTOLOCHIA, Tourn. BIRTHWORT.

A. Sipho, L'Her. Pipe-Vine. Dutchman's Pipe.

Fillmore, Houston and Ramsey counties, *Winchell*; Rice county, *Sperry*; lake Pepin, *Miss Manning*. Southeast.

NYCTAGINACEÆ. FOUR-O'CLOCK FAMILY.

OXYBAPHUS, Vahl. OXYBAPHUS.

O. nyctagineus, Sweet. Oxybaphus.

Common, or frequent, through the south half of the state; extending north to the upper Mississippi river, *Parry*, *Garrison*, and Sand Hill river, *Upham*; also found at the lake of the Woods (sandy ridges of southern shore), *Dawson*.

O. hirsutus, Sweet. Oxybaphus.

Frequent southward; extending north to Minneapolis and Big Stone lake, *Upham*, and to Pembina, *Havard*. South and west. [One foot high, hirsute throughout; leaves lanceolate, thick, the lower short-petioled; fruit of *O. nyctagineus*. *Botany of King's Expl. of the Fortieth Parallel*.]

O. angustifolius, Sweet. Oxybaphus.

Frequent through the south half of the state. Southwest. [One to six feet high, glabrous, except the peduncles and involucre; leaves linear. *Botany of King's Expl. of the Fortieth Parallel*. In all these species the fruit is pubescent, and the involucre always 3- to 5-flowered.]

PHYTOLACCACEÆ. POKEWEEED FAMILY.

PHYTOLACCA, Tourn. POKEWEEED.

P. decandra, L. Garget. Poke. Scape. Pigeon-Berry.

Throughout the south half of the state, but infrequent or rare. Blue Earth county, *Leiberg*; Minneapolis, *A. W. Jones*; upper Mississippi river, *Garrison*.

CHENOPODIACEÆ. GOOSEFOOT FAMILY.

CYCLOLOMA, Moquin. WINGED FIGWEEED.

C. platyphyllum, Moquin. Winged Pigweed.

Beach at northwest side of Mille Lacs (plentiful), and north end of Long lake, Crow Wing county, *Upham*.

CHENOPODIUM, Tourn. (Including *BLITUM*, Tourn.) GOOSE-FOOT. FIGWEEED.

C. album, L. *Lamb's-Quarters*. *Pigweed*.

A common weed in waste and cultivated ground throughout the state.

C. Boscianum, Moquin.* (*C. album*, L., var. *Boscianum*, Gray, in *Manual*.)
Goosefoot.

Stony Point, lake Madison, Blue Earth county, *Gedge*. South.

C. urbicum, L. Goosefoot.

Red river valley at Pembina, *Haward*. Infrequent.

C. urbicum, L., var. *rhombofolium*, Moquin. Goosefoot.

Stillwater, *Miss Field*. Infrequent.

C. hybridum, L. Maple-leaved Goosefoot.

Frequent, often common, throughout the state.

C. Botrys, L. Jerusalem Oak. Feather Geranium.

Northeastward, *Clark*; Minneapolis, *Herrick*; Stillwater (plentiful), *Miss Butler*, *Miss Field*. Infrequent.

[*C. ambrosioides*, L., will probably extend to Minnesota.]

C. rubrum, L., var. **humile**, Watson. (*Blitum maritimum*, Nutt.)

Coast Blite.

Lapham. Northwest. [Var. HUMILE, Watson. Smaller, prostrate or ascending: leaves ovate to lanceolate, often hastate, an inch long or less, rarely toothed: flowers in axillary or somewhat spicate clusters. *Watson, Botany of California*.]

C. capitatum, Watson. (*Blitum capitatum*, L.) Strawberry Blite.

Stillwater, *Miss Field*; Stearns county, *Mrs. Blaisdell*; north of lake Superior, *Agassiz*; Carlton county, and Minnesota Point, lake Superior (juice of the fruit used by the Chippewa Indians for staining), *Roberts*. North.

C. Bonus-Henricus, L. (*Blitum Bonus-Henricus*, Reich.) Good-King-Henry.

Lake of the Woods, *Dawson*. Rare.

[*Atriplex patula*, L., var. *hastata*, Gray, and var. *littoralis*, Gray, will probably be found on the shore of lake Superior in Minnesota.]

CORISPERMUM, Ant. Jussieu. BUG-SEED.

C. hyssopifolium, L. Bug-seed.

Minnesota Point (plentiful), also near Minneapolis, *Roberts*; northwest beach of Mille Lacs (abundant), *Upham*; Red river, *Hooker, Watson*. Local.

SALICORNIA, Tourn. GLASSWORT. SAMPHIRE.

S. herbacea, L. Glasswort. Samphire.

In the vicinity of a salt spring on the bank of the Red river near Saint Vincent, *Say, Nuttall*. Rare.

SUÆDA, Forskal. SEA BLITE.

S. depressa, Watson.† Sea Blite.

Lapham. Red river valley near Saint Vincent (common), *Upham*; Pembina, dry plains, *Chickering*. Northwest.

***CHENOPODIUM BOSCIANUM**, Moquin. Erect, slender, 2 feet high, loosely branched, nearly glabrous; leaves thin, oblong to linear-lanceolate, 1 to 2 inches long, acute, attenuate into a long, slender petiole, the lower sinuate-dentate, or often all entire; flowers very small, solitary, or in small clusters upon the slender branchlets; calyx green, not strongly carinate, partly covering the at length naked seed, which is $\frac{1}{2}$ line broad. *Watson's Revision of Chenopodium, Proc. Am. Acad.*, vol. ix.

†**SUÆDA DEPRESSA**, Watson. Annual: low and mostly decumbent, branching from the base, with usually short ascending leafy branchlets: leaves linear, broadest at

AMARANTACEÆ. AMARANTH FAMILY.

AMARANTUS, Tourn. AMARANTH.

A. retroflexus, L. Pigweed. Red-root.

A common weed throughout the state.

A. albus, L. Tumble-weed.

Frequent southeastward and in the Red river valley; abundant southwestward, on both the longest cultivated and the newly broken land. (North of lake Superior, *Agassiz*; "sandy shore of the upper Missouri" [probably there indigenous, and perhaps so in western Minnesota], *Geyer*.) The popular name alludes to the behavior of this plant in autumn and winter, as described by *Arthur*: "It grows in a globular form, often three or four feet in diameter. When killed by frost, the branches remain rigid, the plant soon loosens from the soil, and the wind drives it bounding over the fields and prairies, until brought up in some fence corner. When the corner is full, those that follow are enabled to scale the fence. With a change of wind, all the lodged plants are set flying in another direction. This is an effective method of scattering the seeds."—Prairie fires are sometimes carried by these rolling dead weeds across broad fire-breaks of plowed land.

A. blitoides, Watson.* Amaranth.

Mankato (a common weed by roadsides and in waste places), *Leiberg*; Martin county, and in Emmet county, Iowa, (rare), *Cratty*. South. "It grows flat upon the ground like purslane, and has a dark green, glossy leaf, not much larger than that of purslane, but thinner. It is a native of the western plains, but is traveling eastward as a weed. It is abundant in Iowa at Clear Lake and southward." *Arthur*.

ACNIDA, L. WATER-HEMP.

A. tuberculata, Moquin. (Montelia tamariscina, Gray, in part, and its var. concatenata, Gray.) Water-Hemp.

St. Croix river, *Parry*; common on gravelly shores of the Le Sueur and Minnesota rivers in Blue Earth county, *Leiberg*; also common in Martin county, and in Emmet county, Iowa, *Cratty*. "Sometimes erect, and from one to four feet high; sometimes spreading or prostrate." South.

FRÆLICHIA, Moench. FRÆLICHIA.

F. floridana, Moquin. Frælichia.

Lapham. Minneapolis, *Roberts*. Rare. South.

POLYGONACEÆ. BUCKWHEAT FAMILY.

POLYGONUM, L. KNOTWEED. POLYGONUM.

P. viviparum, L. Alpine Bistort.

Grand Marais, lake Superior, *Roberts*. North.

base, semiterete, $\frac{1}{4}$ to 1 inch long, the floral ones oblong- to ovate-lanceolate or ovate, acute, rather crowded: calyx cleft to the middle somewhat unequally, one or more of the acute lobes strongly carinate or crested: seed vertical or horizontal, half a line broad, very lightly reticulated. *Watson, Botany of California*.

*AMARANTUS BLITOIDES, Watson. Prostrate or decumbent, the slender stems becoming a foot or two long, glabrous or nearly so; leaves broadly spatulate to narrowly oblanceolate, attenuate to a slender petiole, an inch long or usually less; flowers in small contracted axillary spikelets; bracts nearly a line broad. *Proc. Amer. Acad.*, vol. xii.

- P. orientale*, L. *Prince's Feather*.
Lake Pepin, *Miss Manning*. Infrequent.
- P. Pennsylvanicum**, L. *Knotweed*. Polygonum.
Frequent, or common, through the south half of the state and in the Red river valley.
- P. incarnatum**, Ell. Polygonum.
Frequent, or common, through the south half of the state.
- P. lapathifolium**, Ait., var. **incanum**, Koch. Polygonum.
Minneapolis, *Roberts*; lake Pepin, *Miss Manning*. Rare. North.
- P. Persicaria*, L. *Lady's Thumb*. *Heartweed*.
Common throughout the state, excepting near its west side, where this and the two following species seem to be less frequent or rare.
- P. Hydropiper**, L. Common Smartweed or Water-pepper.
Common, often abundant, with range like the last.
- P. acre**, HBK. Water Smartweed.
Common, with same range.
- P. hydropiperoides**, Michx. Mild Water-pepper.
Frequent, or common, southward; also found at the lake of the Woods, *Dawson*, and in the Red river valley, *Scott*.
- P. amphibium**, L., var. **aquaticum**, Willd. Polygonum.
Frequent, often common, throughout the state.
- P. Muhlenbergii**, Watson.* (*P. amphibium*, var. *terrestre*, in *Manual*.)
Polygonum.
Common, or abundant, throughout the state.
- P. Hartwrightii**, Gray.† Polygonum.
Minneapolis (common), *Arthur*; Blue Earth county, *Leiberg*; Emmet county, Iowa (common), *Cratty*. Probably common, or frequent, throughout Minnesota.
- P. Virginianum**, L. Polygonum.
Lapham. St. Croix river, *Parry*; Blue Earth county, *Leiberg*. South.
- P. articulatum**, L. Jointweed.
Sandy barrens, St. Croix river, *Parry*; New Ulm, *Juni*; Minnesota Point, near Duluth (plentiful), *Roberts*. [Upper Missouri river, *Geyer*.]
- P. aviculare**, L. Knotgrass. Goose-grass. Door-weed.
Common throughout the state.

*POLYGONUM MUHLENBERGII, Watson. Perennial, in muddy or dry places, often 2 or 3 feet high, scabrous with short appressed or glandular hairs, especially upon the leaves and upper stems; leaves thin, rather broadly lanceolate, long-acuminate, usually rounded or cordate at base, 4 to 7 inches long, on short stout petioles ($\frac{1}{2}$ to 1 inch long) from near the base of the naked sheath; flowers and fruit nearly as in *P. amphibium*, but spikes more elongated (1 to 3 inches long), often in pairs. *Proc. Amer. Acad.*, xiv.

†POLYGONUM HARTWRIGHTII, Gray. Strigose-hirsute or glabrous; stem erect, striate, bearing at the top thickish leaves which are broadly lanceolate, acute or somewhat obtuse; petioles short; sheaths long with a flat foliaceous limb, which is setose-ciliate; peduncle erect, eglandulose, bearing a solitary dense cylindrical spike of rose-colored flowers; stamens 5; style deeply cleft; perigonium eglandulose. *Proc. Amer. Acad.*, viii.

P. erectum, L. (*P. aviculare*, L., var. *erectum*, Roth.) Erect Knotgrass.

Also common, or frequent: Winona, Blue Earth, Hennepin and Stearns counties, etc.; Worthington (common). *Foote*; Crookston, Grand Forks, and elsewhere in the Red river valley (common), *Winchell*; Pembina, *Havard*.

P. ramosissimum, Michx. Polygonum.

Brown county, *Juni*; Martin county, and Emmet county, Iowa (common), *Cratty*; common from Jackson county westward and in the Red river valley, *Upham*. South and west.

P. tenue, Michx. Slender Knotgrass.

Lapham. Lake Pepin, *Miss Manning*; rocky hills, Mound, Rock county. *Leiberg*; lake of the Woods, *Dawson*. Rare. South and west.

P. arifolium, L. Halberd-leaved Tear-thumb.

Blue Earth county, *Gedge*. Infrequent.

P. sagittatum, L. Arrow-leaved Tear-thumb.

Common near Stewart river (north shore of lake Superior), and at Minneapolis. *Roberts*; Todd county, etc. (common), *Upham*; Stearns county, *Campbell*; Anoka county, also New Ulm, *Juni*.

P. Convolvulus, L. *Black Bindweed*.

Common, or frequent, throughout the state: troublesome in fields of grain by causing it, when beaten down by wind and rain, to remain so.

P. cilinode, Michx. Polygonum.

Abundant north of lake Superior and in Carlton county, *Juni*, *Roberts*; upper Mississippi river, *Garrison*; Stearns county, *Mrs. Blaisdell*. North.

P. dumetorum, L., var. *scandens*, Gray. Climbing False Buckwheat.

Common, or frequent, throughout the state.

FAGOPYRUM, Tourn. BUCKWHEAT**F. esculentum**, Moench. *Buckwheat*.

Occasionally adventive: Minneapolis, and Dakota, Nicollet and Blue Earth counties.

RUMEX, L. DOCK. SORREL.**R. longifolius**, DC. Dock.

Hennepin county, *Herrick*. Infrequent. Northwest.

R. Britannica, L. (*R. orbiculatus*, Gray.) Great Water-Dock.

North of lake Superior (common near Stewart river), *Roberts*; St. Croix river, *Parry*; Isanti county, *Upham*; Stearns county, *Mrs. Blaisdell*; Anoka county, also New Ulm, *Juni*; White Bear lake, Ramsey county, *Kelley*; lake Pepin, *Miss Manning*; Blue Earth county, *Leiberg*.

R. altissimus, Wood. (*R. Britannica*, L., in *Manual*.) Pale Dock. Peach-leaved Dock.

Upper Mississippi river, *Garrison*; Minneapolis, *Kassube*; Cannon River Falls, *Blake*, *Sandberg*; lake Pepin, *Miss Manning*; Winona county, *Holzinger*; Blue Earth county, *Leiberg*; Emmet county, Iowa (common), *Cratty*. South.

R. salicifolius, Weinman. White Dock.

Hennepin county, *Herrick*; Kittson county, *Upham*; Pembina, *Chickering*, *Havard*. [James river, Dakota, *Geyer*.]

R. verticillatus, L. Swamp Dock.

Upper Mississippi river *Garrison*; Isanti county, etc., *Upham*; West Saint Paul, *Miss Butler*; Blue Earth county, *Leiberg*; New Ulm, *Juni*.

R. crispus, L. *Curled Dock. Yellow Dock.*

Common, or frequent, throughout the state.

[*R. obtusifolius*, L., will doubtless extend to Minnesota.]

R. sanguineus, L. *Bloody-veined Dock.*

Chaska, Carver county, *Juni.* Rare.

R. maritimus, L. *Golden Dock.*

Minneapolis, *Roberts, Upham*; Chaska, Carver county, *Juni*; Blue Earth county, *Leiberg*; Emmet county, Iowa, (rare), *Cratty*; Murray county, and the Red river valley, *Upham*; Pembina, *Havard.* South and west.

R. acetosella, L. *Field or Sheep Sorrel. "Horse Sorrel."*

Common throughout the state; plentiful all along the north shore of lake Superior, *Roberts, Juni.*

THYMELEACEÆ. MEZEREUM FAMILY.

DIRCA, L. LEATHERWOOD. MOOSE-WOOD.

D. palustris, L. Leatherwood. Moose-wood.

Common northeastward, extending thus west to the lake of the Woods, *Richardson*, White Earth reservation, *Garrison*, and Detroit, *H. B. Ayres*, and south to the Kettle river, *Shumard*, southeastern Pine county, *Upham*, and St. Croix Falls, *Miss Field*; frequent, but local, farther south, as near Minneapolis, *Simmons*, Saint Paul, *Miss Cathcart*, Hastings, *Mrs. Ray*, Faribault, *Miss Beane*, Blue Earth county (common), *Leiberg*, New Ulm, *Juni*, and near the Great spring, Beaver creek, Caledonia, Houston county, *Winchell*.

ELÆAGNACEÆ. OLEASTER FAMILY.

SHEPHERDIA, Nutt. SHEPHERDIA.

S. Canadensis, Nutt. Canadian Shepherdia.

From lake Winnipeg to lake Superior, *Say, Schweinitz*; north shore of lake Superior, *Juni*; Minneapolis (rare), *Miss Butler.* North.

S. argentea, Nutt. Buffalo-Berry.

Rainy lake, *Say, Schweinitz*; upper Minnesota river, *Geyer*; near Walhalla, in northeastern Dakota, *Scott.* Northwest.

ELÆAGNUS, L. OLEASTER.

E. argentea, Pursh.* Silver-Berry.

Common from Ada northward in the Red river valley (forming patches ten to twenty rods long on the prairie, growing only about two feet high, fruiting plentifully; in thickets becoming five to eight feet high), and local in section 5, Eldorado, Stevens county, *Upham.* Northwest.

**ELÆAGNUS*, L. Flowers perfect. Calyx-tube including the free ovary, the limb cylindrical-campanulate or tubular below, parted above into 4 valvate deciduous lobes, colored within. Disk glandulose. Stamens 4, adnate to the calyx and alternate with its lobes, the free portion of the filaments very short; anthers oblong. Style simple, straight; stigma 1-sided. Fruit drupe-like, covered with the thickened dry or fleshy closed calyx-tube; the stone oblong, 8-striate.—Trees or shrubs, with alternate entire petioled leaves and axillary pedicelled flowers.

E. ARGENTEA, Pursh. A stoloniferous unarmed shrub, 6 to 12 feet high, the younger branches covered with ferruginous scales; leaves 1½ to 4 inches long and ¾ to 2½ inches

SANTALACEÆ. SANDALWOOD FAMILY.

COMANDRA, Nutt. BASTARD TOAD-FLAX.

C. pallida, A. DC.* Bastard Toad-flax.

Red river valley, *Scott*, determined by *Mr. Sereno Watson*. West.

C. umbellata, Nutt. Bastard Toad-flax.

Common throughout the state.

C. livida, Richardson. Bastard Toad-flax.

North shore of lake Superior, *Juni*; Stearns county, *Mrs. Blaisdell*. [Isle Royale (common), *Whitney*.] North.

SAURURACEÆ. LIZARD'S-TAIL FAMILY.

SAURURUS, L. LIZARD'S-TAIL.

S. cernuus, L. Lizard's-tail.

Upper Mississippi river, *Houghton*. Infrequent.

CERATOPHYLLACEÆ. HORNWORT FAMILY.

CERATOPHYLLUM, L. HORNWORT.

C. demersum, L. Hornwort.

White Bear lake, Ramsey county, *Kelley*; lake Calhoun, Minneapolis, *Upham*; small lakes at the Pipestone quarry (var. commune, Gray, with fruit about 3 lines long, tipped with the stout straight style also about 3 lines long, and with a similar short spine, 2 lines long, at the base on each side), *Mrs Bennett*. Probably common throughout the state.

CALLITRICHACEÆ. WATER-STARWORT FAMILY.

CALLITRICHE, L. WATER-STARWORT.

C. verna, L. Water-Starwort.

Throughout the state. North of lake Superior (common), *Roberts*; Pembina, *Harvard*; Cottonwood county, *Upham*.

[*C. autumnalis*, L., probably occurs also in northern Minnesota.]

wide, broadly or narrowly elliptic, rather acute at each end, or lanceolate and undulate, silvery-scurfy and more or less ferruginous; flowers numerous, deflexed, silvery without, pale yellow within, fragrant, 3 to 5 lines long, the tube broadly oval, the limb funnel-form; fruit [silvery in color, like the foliage] globose-ovoid, dry and mealy, edible, 4 or 5 lines in length. *Watson's Rep. in King's Expl. of the Fortieth Parallel.*

*COMANDRA PALLIDA, A. DC. Stems several from a branched woody caudex, herbaceous, striate, erect, 6 to 10 inches high, branching above; leaves alternate, bluish, somewhat punctate on the margins, the lower elliptic oblong, mucronate-acute, 8 to 12 lines long and 2 to 3 lines wide, the uppermost usually linear-lanceolate, 5 to 10 lines long and about 1 line wide, sometimes so continued down the stem (forming var. *angustifolia*); cymes terminal, few-flowered; bracts linear-lanceolate, 2 lines long; flowers perfect; calyx-lobes erect-spreading; fruit 3 lines in diameter, with subfleshy epicarp.—Flowers precisely as in *C. umbellata*; distinguished especially by its narrowed upper leaves and much larger fruit. *Watson's Rep. in King's Expl. of the Fortieth Parallel.*

PODOSTEMACEÆ. RIVER-WEED FAMILY.

PODOSTEMON, Michx. RIVER-WEED.

- P. ceratophyllus**, Michx. River-weed.
Lake Pepin, *Miss Manning*. Rare.

EUPHORBIACEÆ. SPURGE FAMILY.

EUPHORBIA, L. SPURGE.

- E. polygonifolia**, L. Shore Spurge.
Lapham. Shore of lake Superior; lake Pepin, *Miss Manning*.
- E. Geyeri**, Engelm. Geyer's Spurge.
Lapham, T. J. Hale. Common at Minneapolis, *Upham, Simmons*.
- E. serpyllifolia**, Pers. Thyme-leaved Spurge.
Minneapolis, *Herrick*; Blue Earth county, *Leiberg*; Martin county, *Gedge*; New Ulm, *Juni*; Murray county, *Upham*; Stearns county, *Mrs. Blaisdell*; Pembina, *Havard*.
- E. glyptosperma**, Engelm. Spurge.
Minneapolis, *Herrick*; Saint Cloud, *Campbell*; Red river valley, *Scott*.
- E. maculata**, L. Spotted Spurge.
Common through the south half of the state and perhaps northward.
- E. humistrata**, Engelm. Spurge.
Minneapolis, *Roberts*; Winona county, *Holzinger*; Martin county, *Gedge*. South.
- E. hypericifolia**, L. Spurge.
Waste, dry places. St. Croix river, *Parry*; Minneapolis, *Roberts*; lake Pepin, *Miss Manning*; Winona county, *Holzinger*; Blue Earth county, *Leiberg*. South.
- E. marginata**, Pursh. White-margined Spurge. "Mountain Snow."
Frequent, often common, southwestward; extending northeast to Redwood Falls (found to be poisonous to the touch, even in mounting dried specimens), *Miss Butler*; in Lyon county becoming a common weed in cultivated fields, *Upham*.
- E. corollata**, L. Flowering Spurge.
Frequent, often common, through the south half of the state.
- E. heterophylla**, L. Spurge.
Spirit lake, Minnesota river, etc., *Geyer*; Blue Earth county, *Leiberg, Gedge*; Minneapolis, *Twining, A. W. Jones*; Goodhue county, *Sandberg*; lake Pepin, *Miss Manning*. South.
- E. dictyosperma**, Fischer & Meyer. Spurge.
Rock county, *Leiberg*. Southwest.
- E. Cyparissias**, L. Garden Spurge.
Adventive: Mankato, *Leiberg*; Goodhue county, *Sandberg*; lake Pepin, *Miss Manning*.
- [*E. commutata*, Engelm., should be looked for in this state.]

ACALYPHA, L. THREE-SEEDED MERCURY.

- A. Virginica**, L. Three-seeded Mercury.
Minneapolis, *Roberts*; Blue Earth county, *Leiberg*; lake Pepin, *Miss Manning*.

EMPETRACEÆ. CROWBERRY FAMILY.

EMPETRUM, Tourn. CROWBERRY.

- E. nigrum**, L. Black Crowberry.
North shore of lake Superior, *Macoun*; doubtless in northern Minnesota.

URTICACEÆ. NETTLE FAMILY.

ULMUS, L. ELM.

- U. fulva**, Michx. Slippery or Red Elm.
Frequent, often common, throughout the state, excepting far northward. Well known for its mucilaginous, medicinal inner bark; the reddish wood, used for ox-yokes, posts, etc., is strong, light and durable.
- U. Americana**, L. White Elm. American Elm. Water Elm.
Common throughout the state; but not found close to the shore of lake Superior. Wood tough, often used for axe-helves, whip-stocks, etc.; our most desirable tree for transplanting for ornament and shade. This and basswood are the most abundant trees in the Big Woods.
- U. racemosa**, Thomas. Corky White Elm. Rock Elm.
Frequent, often common, eastward; extending west to Blue Earth county, *Leiberg*, Nicollet county, *Aiton*, New Uim (common), *Juni*, and the upper Mississippi river, *Garrison*. Wood drier than the last and more valuable; much used by wheelwrights.

CELTIS, Tourn. NETTLE-TREE. HACKBERRY.

- C. occidentalis**, L. Sugarberry. Hackberry.
Frequent through the south half of the state; rare and local northward, as at the east side of Mille Lacs and at lake Alexander, *Upham*; near lake Lida, Otter Tail county, *Frazee*; on the Red river in Clay county; at Red Lake Falls; on the upper Mississippi; and on the Big Fork of Rainy Lake river, in T. 149, R. 26, *Hinchelwood*. [Also at Eagle lake, north of Rainy lake, *Bell*, *Macoun*; and in northeastern Dakota, *Scott*.]

MORUS, Tourn. MULBERRY.

- M. rubra**, L. Red Mulberry.
Big Woods, *Winchell*; Houston county, *J. S. Harris*. [West to Dakota, *Sargent*, and eastern Nebraska, *Aughey*.] Infrequent. South.

URTICA, Tourn. NETTLE.

- U. gracilis**, Ait. Tall Wild Nettle.
Common throughout the state.
- U. dioica**, L. Great Stinging Nettle.
Upper Mississippi river, *Garrison*; lake Pepin, *Miss Manning*. Rare.

LAPORTEA, Gaud. WOOD-NETTLE.

- L. Canadensis**, Gaud. Wood-Nettle.
Common through the south half of the state and in the Red river valley; extending northeast to the upper Mississippi river and Roseau river. "It is of this plant the Indians usually make their fishing lines, the rotted remains of the previous year's growth furnishing an abundant supply." *Perry*.

PILEA, Lindl. RICHWEED. CLEARWEED.**P. pumila**, Gray. Richweed. Clearweed.

St. Croix river, *Parry*; Minneapolis, *Simmons*; lake Minnetonka (common), *Roberts*; Blue Earth county, *Leiberg*; Fergus Falls, *Leonard*. South.

BOEHMERIA, Jacq. FALSE NETTLE.**B. cylindrica**, Willd. False Nettle.

Lapham. Fergus Falls, *Leonard*. Infrequent.

PARIETARIA, Tourn. PELLITORY.**P. Pennsylvanica**, Muhl. Pellitory.

Minneapolis (presenting, besides the type, a larger and much branched form), *Herrick*, *Simmons*; Blue Earth county, *Leiberg*; and northwest to the upper Missouri and Saskatchewan rivers. Infrequent. South and west.

CANNABIS, Tourn. HEMP.**C. sativa**, L. *Hemp*.

A common or frequent weed.

HUMULUS, L. HOP.**H. Lupulus**, L. Common Hop.

Common, especially northward; "native on all the tributaries of the upper Mississippi," *Parry*.

PLATANACEÆ. PLANE-TREE FAMILY.

PLATANUS, Tourn. PLANE-TREE. BUTTONWOOD.**P. occidentalis**, L. American Plane-tree. Buttonwood. Sycamore.

Lapham. Southeast, rare. The northwest limit of this species scarcely enters Minnesota.

JUGLANDACEÆ. WALNUT FAMILY.

JUGLANS, L. WALNUT.**J. cinerea**, L. Butternut. Oil-nut. White Walnut.

Common southward, but absent far southwest; extending north to the Snake river in Pine and Kanabec counties, *Norwood*, *Opham*, and on the Mississippi river to the north line of Aitkin county, *Garrison*. Wood valuable for cabinet work and in house-building for inside finishing.

J. nigra, L. Black Walnut.

Frequent in the south part of the state; extending north to Nininger, Dakota county, southern Scott and Carver counties, and to Walnut Grove in the south edge of Redwood county. Because of the great value of its lumber, nearly all the black walnut of large size in this state has been cut; but much of young growth remains.

CARYA, Nutt. HICKORY.**C. alba**, Nutt. Shell-bark or Shag-bark Hickory. "Walnut."

Common, or frequent, in Houston county; extending north into Winona county at

least to Winona and Stockton, and west (rare) into Fillmore, Mower and Freeborn counties, to Moscow, *Winchell*; near Weaver and Kellogg, Wabasha county, and near Chatfield, on the south line of Olmsted county, *W. D. Hurlbut*. Southeast. "Timber very valuable, used wherever great durability, strength and elasticity are required."

C. porcina, Nutt. Pig-nut or Broom Hickory.

Lapham. Southeastward, extending north to Snake river, *Clark*; near lake Pepin on the Wisconsin side, *Mrs. Ray*.

C. amara, Nutt. Bitter-nut or Swamp Hickory.

Common, or frequent, southward; extending through the Big Woods, and north to Mille Laes, and sparingly to the upper Mississippi river, and to Whiteface river, tributary to the St. Louis river. This species furnishes nearly all the hoop-poles for four-barrels cut in the southern and central portions of the state.

CUPULIFERÆ. OAK FAMILY.

QUERCUS, L. OAK.

Q. alba, L. White-Oak.

Frequent, or common, in the southeast and central parts of the state; extending north to Fond du Lac, *Clark*. Savannah river, and Squagemaw lake, *Winchell*, and to Pokegama falls, Pemidji lake (plentiful in many places on the upper Mississippi river), and the White Earth reservation, *Garrison*. "Strong, durable, and beautiful timber."

Q. stellata, Wang. (*Q. obtusiloba*, Michx.) Post-Oak. Rough or Box White-Oak.

Upper Mississippi river, *Houghton*. Infrequent.

Q. macrocarpa, Michx. Bur-Oak. Over-cup or Mossy-cup White-Oak.

Common, or abundant, throughout the state, excepting far northeastward. Its northeastern limit north of lake Superior, according to *Bell*, is near the international boundary; but he states that it attains a good size on the Rainy river and thence westward. ("In going west, this species is first met with at the east end of Eagle lake" [north of Rainy lake], *Macoun*.) Timber valuable, similar to that of white oak.

Q. bicolor, Willd. Swamp White-Oak.

Frequent in Benton, Mille Laes and Morrison counties, and thence north to lake Winnibigoshish and the White Earth reservation, *Garrison*.

Q. Muhlenbergii, Engelm. (*Q. Prinus*, L., var. *acuminata*, Michx.) Yellow Chestnut-Oak.

Lapham. Southeast.

Q. tinctoria, Bartram. (*Q. coccinea*, Wang., var. *tinctoria*, Gray.) Black Oak. Quercitron or Yellow-barked Oak.

Common, or abundant, southward; extending north to Pine county, *Upham*, and to Pokegama falls and the White Earth reservation, *Garrison*; the most abundant species of oak in the southeast part of the state. This species and the bur oak vary from 20 to 50 or 60 feet in height, according to their situation and soil; besides which, each occurs frequently dwarfed, growing as scrubby brush from 3 to 10 feet high.

Q. coccinea, Wang. Scarlet Oak.

Upper Mississippi river, *Garrison*; "in Minnesota (*Engelmann*)," *Sargent*.

Q. coccinea, Wang., var. *ambigua*, Gray. Gray Oak.

Prairie river, attaining a height of 50 feet and diameter of 10 inches, *Clark*; White Earth reservation, *Garrison*. North.

Q. rubra, L. Red Oak.

Occasional southward, and north to the upper Mississippi river, *Geyer, Garrison*; continuing on the north side of lake Superior to the Kaministiquia river, *Bell, Macoun*.

In autumn the leaves of the black and red oaks change to red and crimson colors; while the foliage of the white and bur oaks changes only to dull green, gray and brown. At the same time the leaves of the sumachs and red maple become red or scarlet; of the sugar maple, yellow; and of bass, box-elder, ash trees, elms, poplars, and cottonwood, various shades of brown and yellow.

Q. palustris, Du Roi. Swamp Spanish Oak. Pin Oak.

Lapham. Upper Mississippi river, *Garrison*.

[*Sargent and Bell* have mentioned Minnesota as a western limit of the American beech (*Fagus ferruginea, Ait.*), but it probably does not extend into this state.]

CORYLUS, Tourn. HAZEL-NUT. FILBERT.**C. Americana, Walt.** Common Wild Hazel-nut.

Common, in many districts abundant, throughout the state.

C. rostrata, Ait. Beaked Hazel-nut.

Common northward; extending south to Benton county and Spruce Hill, Douglas county, *Upham*; rare and local farther south, as on rocky bluffs in southeastern Winona county, *Winchell*. *Juni* says of this species north of lake Superior: "In some places the bushes reach a height of fifteen feet, with stems from one to one and a half inches in diameter. The tops bend over from the weight of the fruit."

OSTRYA, Michx. HOP-HORNBEAM. IRON-WOOD.**O. Virginica, Willd.** American Hop-Hornbeam. Iron-wood. Lever-wood.

Common, often abundant, throughout the state; but not close to the shore of lake Superior.

CARPINUS, L. HORNBEAM. IRONWOOD.**C. Caroliniana, Walt.** (*C. Americana, Michx.*) American Hornbeam.

Blue or Water Beech.

Common through the south half of the state; extending north to Pine county and Sandy lake, *Clark*, the Savannah portage, *Winchell*, and White Earth reservation, *Garrison*. "Wood of this and the preceding tough and durable; used for wedges, levers, &c."

MYRICACEÆ. SWEET-GALE FAMILY.**MYRICA, L.** BAYBERRY. WAX-MYRTLE.**M. Gale, L.** Sweet Gale.

Common on lake-shores, along the international boundary, between lake Superior and Rainy lake, *Winchell*. North.

COMPTONIA, Solander. SWEET-FERN.**C. asplenifolia, Ait.** Sweet-Fern.

Frequent northeastward; extending south to Snake river in southeastern Pine county, *Upham*, and southwest to Cass lake, *Schoolcraft*; it also occurs at Jacob Streitz's quarry in section 28, Saint Cloud, *Upham*, and near Excelsior, Hennepin county, *Mrs. Terry*.

BETULACEÆ. BIRCH FAMILY.

BETULA, Tourn. BIRCH.

[*B. lenta*, L. (cherry birch, sweet or black birch) possibly extends west to northern Minnesota. *Dr. Bell* mentions this state as its northwestern limit. Some of the more northern references under *B. nigra* may belong instead to this species.]

B. lutea, Michx. f. Yellow or Gray Birch.

Common through the north half of the state and south to Sherburne county, reaching a height of 75 feet and diameter of 3 or 4 feet; rare in the Big Woods, and southeast to Houston county, *Winchell*. "The 49th parallel forms the average northern limit of this species from Newfoundland to the Red river valley, in which it curves round and runs southward." *Bell*.

B. papyracea, Ait. Paper or Canoe Birch. Silver Birch.

Common, often abundant, through the north half of the state, attaining an equal size with the preceding; also common, but much smaller, southeastward near the Mississippi river; thence extending west, less frequent, to the Big Woods, and to Birch Cooley (plentiful), Renville county; absent southwestward; "found along the Assiniboine valley as far west as the Qu'Appelle lakes," *Bell*. "The bark of this tree, together with that of the *Arbor-vitæ*, is made use of in innumerable ways by the Indians." *Roberts*.

B. nigra, L. River or Red Birch.

Savannah portage, *Douglass*; White Earth reservation, *Garrison*; Kettle river, *Shumard*; Blue Earth county, *Nicollet*; Winona county, *Holzinger*; abundant along the Mississippi bottoms at least as far north as Minneiska, Wabasha county, *Winchell*. Southeast.

B. pumila, L. Low Birch. "Tag Alder."

Common through the north half of the state, and south to Minneapolis and Saint Paul; less frequent or rare farther south, to lake Pepin, *Miss Manning*, and Olmsted county, *Harrington*.

B. glandulosa, Michx. Dwarf Birch.

Savannah river, *Houghton*; north shore of lake Superior, *Juni*, *Winchell*; ridge east of the Red river, *Scott*. North.

ALNUS, Tourn. ALDER.**A. viridis**, DC. Green or Mountain Alder.

North of lake Superior (common), *Juni*, *Roberts*. North.

A. incana, Willd., var. **glauca**, Regel. Speckled or Hoary Alder. Black Alder.

Common, or frequent, through the north half of the state, and southeastward to Minneapolis; less frequent thence southeast; rare southwestward.

A. serrulata, Ait. Smooth Alder.

Lapham, *Winchell*. Rare. Southeast.

SALICACEÆ. WILLOW FAMILY.

SALIX, Tourn. WILLOW. OSIER.**S. candida**, Willd. Hoary Willow.

Throughout the state, excepting far southward. Bogs, St. Croix river, *Parry*; Min-

neapolis, *Kassabe*; Blue Earth county, *Leiberg*; New Ulm, *Juni*; north of lake Superior, *Agassiz*; upper Mississippi river, *Garrison*; Red river valley, *Macoun*.

S. tristis, Ait. Dwarf Gray Willow.

Lapham. Minneapolis, *Winchell*; Blue Earth county, *Leiberg*; Lake City, *Mrs. Ray*.

S. humilis, Marshall. Prairie Willow.

Blue Earth county, *Leiberg*, *Upham*; frequent in Emmet county, Iowa, *Cratty*; abundant near the Mississippi river, on dry, sandy land, especially in openings of woods, from lake Pepin, *Miss Manning*, *Mrs. Ray*, and Ramsey county, north at least to Brainerd (usually only about one foot high, agreeing best, excepting in habitat, with Gray's description of *S. tristis*), *Upham*; north of lake Superior, *Agassiz*. Probably throughout the state.

S. discolor, Muhl. Glaucoous Willow. Pussy Willow.

Common, or frequent, throughout the state.

[*S. sericea*, Marshall, probably occurs, but infrequently, in Minnesota.]

S. petiolaris, Smith.* Petioled Willow.

Freeborn county (frequent), *Upham*. Probably our prevailing form of this species is var. *GRACILIS*, Anders. (*M. S. Bebb*.)

S. purpurea, L. Purple Willow.

Minneapolis, *Stimmons*. Infrequent.

S. cordata, Muhl. Heart-leaved Willow.

Common, or frequent, throughout the state.

S. cordata, Muhl., var. **angustata**, Gray.

Stearns county, *Garrison*. [North of lake Superior, *Agassiz*; Nebraska (common), *Aughey*.]

S. balsamifera, Barratt.† (*S. pyrifolia*, Anders.; see notes by *M. S. Bebb* in *Botanical Gazette*, vol. iv, p. 190.) Balsam-bearing Willow.

Red river valley near Saint Vincent, *Burgess*, *Macoun*. North.

**SALIX PETIOLARIS*, Smith, var. *GRACILIS*, Anders. Female aments gracefully subpendulous, at length somewhat leafy-peduncled, very loosely flowered; scales linguulate, apex brownish; capsules long acute-rostrate from an ovate base, thinly silky, or somewhat glabrous, very long-pedicelcd; pedicel nearly eight times the length of the nectary; style very short; stigmas 2-parted, fuscous, spreading; leaves narrowly lanceolate-linear, serrulate, about 2 inches long and 2 to 4 lines wide, pale and subglaucoous beneath, both sides at length glabrous. Varies: 1st, sericocarpa; capsules narrowly conical, 2½ lines long, thinly silky. 2d, leiocarpa; capsules thick at base, greenish red. *Andersson* in *DC. Prod.*, 16, 2, 235; translated by *M. S. Bebb*.

†*SALIX BALSAMIFERA*, Barratt. A glabrous, much branched shrub, 4 to 8 feet high; twigs crimson where exposed to the sun; leaves ovate, abruptly pointed, 1 inch wide by 1½ inches long, on sterile shoots oblong-lanceolate, 1½ inches wide by 3 to 4 inches long, all rounded or subcordate at base, very thin and slightly hairy beneath when young, rigid, glabrous, and prominently reticulate-veined when mature, bright green above, paler or glaucoous beneath, margin finely glandular-serrate; petioles slender, ½ inch long; stipules minute, caducous; aments with a few leaf-like bracts at base, the male densely flowered, very silky, female less so and becoming very lax in fruit, bracts often more leafy; scales pale or rosy; capsules elongate-conical or rostrate from a thick base, 2 or 3 lines long, glabrous, the long pedicels six to eight times the length of the nectary; style rather short, bifid; lobes of the stigma thick, spreading, emarginate. "No. 53, *Herb. H., B. and T.*" (v. s. in h. Torr.) *S. cordata*, Muhl., var. *balsamifera*, Hook., *Fl. Bor.-Am.*, 2, 149. *S. pyrifolia*, Anders., *DC. Prod.*, 16, 2, 264.—White mountains of N. H., *Pringle*; New Brunswick, *Fowler*; and Labrador, *Allen*; westward to the Saskatchewan. Readily distinguished from *S. cordata* by the very loosely flowered fertile aments, often two inches or more long in fruit, thicker and more yellowish staminate aments, and the proportionately broader and shorter Amelanchier-like leaves. *M. S. Bebb*, *MSS*.

S. rostrata, Richardson. (*S. livida*, Wahl., var. *occidentalis*, Gray.)
Beaked Willow. Livid Willow.
Common throughout the state.

S. lucida, Muhl. Shining Willow.
Common, or frequent, throughout the state.

S. nigra, Marshall. Black Willow.
Throughout the state: frequent northward, common southward. This and the next are our only native species of willow that become trees, the others being shrubs.

S. amygdaloides, Anders.* Almond-leaved Willow.
Red river and eastward, *Bebb*; probably frequent throughout the state.

S. fragilis, L. *X alba*, L. *White Willow*.

Occasionally spontaneous; much cultivated, especially on the prairies, for shade and protection from the wind. Timber culture, of this tree, red and sugar maple, box-elder, cottonwood, Lombardy poplar, and other species, is being begun extensively in the prairie region, chiefly for the rewards provided by laws of the state and United States governments. The white willow is well adapted to yield fuel, as it grows rapidly, and, when cut down, shoots up vigorously anew from the stump. In good soil, with good care, probably ten acres of this willow would supply an average household with fire-wood continually.

M. S. Bebb regards this "white willow," commonly planted (by cuttings) for screens, as a hybrid of *S. fragilis* and *S. alba*, being apparently the form named *S. fragilis*, L., var. *Russelliana*, Carey, in Gray's *Manual*. Mr. *Bebb* writes: "Among the varieties cultivated throughout the Northwest, I have seen no genuine *S. alba*. In one form, *S. fragilis* \times *alba*, var. (c.) *vestita*, Wimmer (*S. palustris*, Host.), the leaves approach very near to *S. alba*, var. *cœrulea*, but the flowers are different. Much the more commonly planted form is *S. fragilis* \times *alba*, var. (b.) *glabra*, Wimmer (exactly *S. excelsior*, Host.; *S. viridis*, Fries, when the under surface of the leaf is pale green)."

S. longifolia, Muhl. Long-leaved Willow. Sand-bar Willow.
Common throughout the state.

S. myrtilloides, L. Myrtle Willow.

Frequent northward, rare southward. Swamps, St. Croix river, *Parry*; north of lake Superior, *Agassiz*; Kanabec and Benton counties, *Upham*; Dellwood, White Bear lake, Ramsey county, *Kelley*; Minneapolis, *Kassube*; near Eagle lake, Blue Earth county, *Leiberg*; Emmet county, Iowa (rare), *Cratty*.

POPULUS, Tourn. POPLAR. ASPEN.

P. tremuloides, Michx. American Poplar or Aspen.

Common, or abundant, throughout the state, especially northward. Wood of this and the next is valuable for paper-making.

P. grandidentata, Michx. Large-toothed Poplar or Aspen.

Common, or frequent, throughout most of the state; excepting the southeastern

**SALIX AMYGDALOIDES*, Anders. Leaves broadly lanceolate, 3 to 6 inches long, $\frac{1}{2}$ to $1\frac{1}{2}$ inches wide, with a long tapering point, glaucous beneath, closely serrate, petioles long and slender, stipules minute and very early deciduous: aments leafy-peduncled, elongated-cylindrical, pendulous; the fertile when in fruit lax, 3 to 4 inches long, $\frac{1}{2}$ inch thick; scales in the male ament ovate, villous with crisp hairs, in the female narrower, somewhat smooth, fugacious: capsules globose-conical, glabrous, long-pedicelled; style very short or obsolete, stigmas notched. . . . In aspect very unlike *S. nigra* [like which, this species attains a tree-like size], and in fact more frequently mistaken for *S. lucida*. The broad leaves, being supported by long and slender petioles, are moved by the slightest breeze, displaying in rapid, fluttering succession their conspicuous white under surfaces, thus producing an effect in striking contrast with the changeless, soft light reflected from masses of the foliage of *S. nigra* when swayed gently by the wind. *Bebb* in *Wheeler's Report of Surveys west of the One Hundredth Meridian*.

counties and far northward, where it occurs sparingly, and southwestward, where it is absent.

P. monilifera, Ait. (Including *P. angulata*, Ait.) Cottonwood. Neck-lace Poplar.

Common, or frequent, through the south half of the state; rare farther north; reaching its northern limit in southeastern Pine county, the region of the upper Mississippi, *Houghton*, White Earth reservation, *Garrison*, and Red Lake Falls and the Red river valley, *Upham*. "Large trees occur along the Assiniboine river," *Bell*. "Extensively planted for shelter and fuel. The cotton from the seeds proves a source of much annoyance to the tidy housewife. If only male trees, those with reddish tassels, were planted, no cotton would be produced. Both kinds of tassels, the green and the red, appear in spring before the leaves come out." *Arthur*.

P. balsamifera, L. Balsam Poplar. Tacamahac.

Common, or frequent, through the north half of the state; extending southwest to Cannon river (rare), *Sandberg*, Osakis lake, *Upham*, and Fergus Falls, *Leonard*.

P. balsamifera, L., var. **candicans**, Gray. Balm of Gilead.

Frequent northeastward; extending southwest to southeastern Pine county, Little Falls, and White Earth reservation.

P. dilatata, Ait. *Lombardy Poplar*.

Spontaneous, Mankato, *Leiberg*. [Stiff spiry tree, with closely appressed branches, and small broadly triangular pointed leaves; formerly much planted. *Gray's Field, Forest, and Garden Botany.*]

P. alba, L. *White Poplar. Silver-leaf Poplar. Abele. Abel-tree.*

Cultivated, and thence sometimes spreading spontaneously, in Martin county, *Cratty*. [Tree planted from Europe, with spreading branches, roundish, slightly heart-shaped wavy-toothed or lobed leaves soon green above, very white cottony beneath; buds not glutinous; spreads inveterately by the root. *Gray's Field, Forest, and Garden Botany.*]

CONIFERÆ. PINE FAMILY.

PINUS, Tourn., Link. PINE.

P. Banksiana, Lambert. "Jack Pine." Gray or Northern Scrub Pine.
Banks' or Banksian Pine. Black Pine.

Common northeastward; abundant on sandy land in the region of the upper Mississippi and Crow Wing rivers, from Brainerd and Wadena northward; having its southwest limit at the St. Croix and Snake rivers, Princeton, Brockway (Stearns county), Stowe and Oak Valley (ten miles south of Wadena), in the White Earth reservation, and at the lake of the Woods and on Roseau river. This species, almost alone, but with red pines here and there sparingly intermixed, forms thick woods at many places in Cass, Wadena and Crow Wing counties, as, for example, at Brainerd, growing very straight and slender, 40 to 60 feet in height, but seldom exceeding a foot in diameter. Its coarse, resinous wood is excellent fuel, but it is not adapted to building purposes. Many railroad ties are made from this and the next species of pine, but are inferior in value and durability to those of bur oak, which are more used in this way. Often five ties, each eight feet long, are obtained from a single Jack pine. Rarely this tree attains a height of eighty feet, one of this size being found by *Professor Winchell* on Brule mountain, north of lake Superior. [This tree grows sixty to seventy feet high in northern Michigan (*Wheeler and Smith's Catalogue*, and *Bulletin of the Torrey Botanical Club*, x, 82); and *Dr. Bell* records it as about seventy feet in height and two feet in diameter, in large groves, on the southern branches of the Albany river.]

P. resinosa, Ait. "Norway Pine." Red Pine.

Common or frequent northward, growing in groves, or scattered, on somewhat sandy land; not extending, in general, quite so far southwest as the preceding. Usually

called "Norway pine"; but wrongly, for this species is not found in Norway, nor in Europe. It is mostly from 50 to 75 feet high, but seldom more than about a foot in diameter. *Clark* reports that it attains a height of 90 feet and diameter of 20 inches, north of lake Superior. It is considerably sawn for lumber, and is also much used for piles, as for wharves and foundations of bridge piers. In the region of the upper Mississippi this species is reported by *Garrison* as occurring in two varieties, which are distinguished by lumbermen under the names Hard Norway pine and Red-barked Norway pine.

P. Strobis, L. White Pine.

Common through the north half of the state, excepting west of Red lake and the lake of the Woods; preferring somewhat clayey land, occasionally making a majestic forest without intermixture of other large trees, but oftener associated with maple, elm, bass, oak, ash, and other deciduous species; frequent along the north side of lake Superior, but forming no extensive pine forest on the immediate shore. This is the largest, as well as the most useful, of our trees, growing from 80 to 125, rarely 150, feet in height, and from three to six feet in diameter.

The southwestern limit of the pineries extends from the north edge of Chisago county westerly through Kanabec and Mille Lacs counties, the northeast corner of Benton county, Morrison county, and northeastern Todd county, to Pine lakes, Frazee City, and the White Earth reservation; but only a comparatively small part of the region northeast of this line is covered with pine woods. Southeastward, beyond this limit, white pine occurs rarely and locally in the vicinity of the Mississippi, St. Croix, Cannon, Zumbro and Root rivers, in most instances on bluffs of these or their tributary streams; as at Saint Cloud, Dayton, Minnehaha falls, Pine Bend, Taylor's Falls, Franconia (where it was first cut in Minnesota, to any considerable extent, for lumber), near Cannon River Falls, near Mantorville, near Rochester, in section 29, Saint Charles, Winona county, and at various points in Fillmore and Houston counties.

Mr. Platt B. Walker, of Minneapolis, editor of the *Lumberman and Manufacturer*, states that approximately 400,000,000 feet (board-measure) of pine are annually cut in the north central part of this state, on the Mississippi river and its tributaries, about three-quarters of which are sawed at Minneapolis; and that some 200,000,000 feet are annually cut on the St. Croix river and its branches, about half of which is cut in Minnesota, chiefly on the Snake river, the amount sawed at Stillwater being some 100,000,000 feet yearly. Throughout these districts about three-quarters of the timber cut are white pine, and the remainder red or Norway pine. Much white pine is also cut on the St. Louis river, the Otter Tail river, Clearwater river (a tributary of Red Lake river), and recently on the Rainy Lake river; and red pine is cut on Pine creek, tributary to Roseau lake and river, west of the lake of the Woods.

The amount of merchantable pine standing in Minnesota in 1880 was estimated by *C. S. Sargent*, special agent of the United States census, at 6,100,000,000 feet; and the amount cut in the state during the preceding year is reported to be 540,997,000 feet.

PICEA, Link. SPRUCE.

P. nigra, Link. (*Abies nigra, Poir.*) Black Spruce. Double Spruce.

Common northeastward; extending south to Chisago and Isanti counties, and west to Spruce Hill, Douglas county, the White Earth reservation, Red lake, and the lake of the Woods and Roseau river. It attains, in favorable situations, a height of 70 feet and diameter of 18 inches, *Clark*; but usually it is small, and none of it is cut for lumber in this state.

P. alba, Link. (*A. alba, Michx.*) White Spruce. Single Spruce.

Common far northward; extending south to Moose Lake, Carlton county, *Upham*, and to the upper Mississippi river and White Earth reservation, *Garrison*, and west to the lake of the Woods and Roseau river; 20 feet high, 8 inches in diameter, *Clark*.

TSUGA, Carrière. HEMLOCK-SPRUCE.

T. Canadensis, Carrière. (*Abies Canadensis, Michx.*) Hemlock-Spruce. Hemlock.

Mentioned by *Nicollet* as observed in the region of the upper Mississippi, and by

Norwood in the valley of the St. Louis river; included in *Dr. Lapham's* catalogue; also reported as occurring, locally, near Pokegama lake, Cass county, and at the north side of Sand lake, in the southwest part of T. 46, R. 19, Carlton county, and in other parts of this county, as on Black Hoof creek; all of which need verification. Though plentiful not far eastward in Wisconsin, it extends very scantily, if at all, into Minnesota. ["On the south shore of lake Superior it does not reach the western extremity, turning southward in the neighborhood of Ashland. I am informed, however, that there is an outlying grove of hemlock at Thomson, about twenty-five miles west of Duluth. This tree maintains a good size to the verge of its range, and always appears to terminate abruptly." *Bell.*]

ABIES, Link. FIR.

A. balsamea, Marshall. Balsam Fir.

Common northeastward, attaining a height of 50 feet, *Clark*; extending south and west to nearly the same limits as the black spruce; also farther south, rare and local, as near Mantorville, Dodge county, *Harrington*, and in the heavy timber in the northeast part of Spring Valley, Fillmore county, *Winchell*.

LARIX, Tourn. LARCH.

L. Americana Michx. American or Black Larch. Tamarack. Hackmatack.

Abundant through the north half of the state, and common southeast to Wright, Hennepin and Ramsey counties; rare farther southeast, as on Pine creek in Houston county, *Winchell*; absent southwestward. This tree occurs in swamps, which are generally frequent, varying in extent from a few rods to several miles. *Mr. Nathan Butler* states that such swamps, bearing tamarack but scarcely any other trees, occupy nearly the entire country between Red lake and the lake of the Woods; and *Mr. G. M. Dawson* and others give a similar description of the area crossed by the international boundary between the lake of the Woods and the Red river valley. Tamarack also often grows on drier, hard ground; sometimes, north of lake Superior, attaining a height of 90 or 100 feet (but very slender, having a diameter of only about one foot; valuable for railroad ties), *Clark*. Its usual height is from 20 to 40 feet.

Watab river and township bear the name which the Chippewas give to the long threads obtained by splitting tamarack roots, used by them in sowing their birch canoes. *Keating's Narrative of Long's Expedition*, vol. ii, p. 73.

THUYA (Thuja), Tourn. ARBOR VITÆ.

T. occidentalis, L. American Arbor Vitæ. "White Cedar."

Common northeastward, forming almost impenetrable "cedar swamps," often attaining a large size, from 40 to 70 feet in height, and from one to two or even three feet in diameter, *Clark, Roberts*; extending west to the south end of lake Winnipeg, *Bell*, the lake of the Woods and Roseau river, Red and Pemidji lakes, and to the head of Straight river in northeastern Becker county, and south to the south shore of Mille Lacs and the mouth of Snake river. It also occurs very rarely farther southeast, as on Gwinn's bluff in southeastern Winona county, *Winchell*. On the north shore of lake Superior, "not so common as inland, but maintains its hold upon life in the most unfavorable positions. Often the only representative of the vegetable kingdom on a bare rock in the lake, where its stem and branches plainly indicate the direction of the prevailing winds and waves." *Juni*. This tree is the principal species upon a large area adjoining the Mississippi river in northern Aitkin county. Its wood is light and very durable, being especially sought for fence and telegraph posts. It is often spiral-grained.

JUNIPERUS, L. JUNIPER.

J. communis, L. Common Juniper.

Throughout the state, but infrequent. Minnesota Point, near Duluth (plentiful), also near Minneapolis, *Roberts*; Wadena and Benton counties (rare), *Upham*; Sherburne

and Ramsey counties, *Kelley*; Hennepin county, *Simmons*; Goodhue county, *Sandberg*; southeastern Winona county, *Winchell*; Dodge county, *Harrington*; Blue Earth county, *Leiberg*; bluffs of the Cottonwood river, *Juni*.

J. communis, L., var. **alpina**, Gaud. Juniper.

North shore of lake Superior, *Juni*; Taylor's Falls, *Miss Cathcart*. North.

J. Virginiana, L. Red Cedar. Red Savin.

Rainy Lake river, *Dawson*; upper Mississippi (rare), *Nicollet*, *Garrison*; lake Pepin, *Miss Manning*; bluffs of the Cottonwood river, *Juni*; at Redwood Falls, perhaps furnishing the name of the Redwood river. (Also see *Cornus stolonifera*.) Found scantily in exposed situations, as on the bluffs or shores of rivers and lakes, growing to be 10 to 25 feet high, in the greater part of the state; most frequent in its southeast quarter; absent, or rare, near its west side and north of lake Superior.

J. Sabina, L., var. **procumbens**, Pursh. Savin. Juniper.

Lake of the Woods, *Dawson*; plentiful on dunes at Sand Hill river, Garfield, Polk county, *Upham*; near Itasca lake, *Garrison*; Rice county, *Sperry*; bluffs of Le Sueur river, *Leiberg*; Olmsted county (rare), *Harrington*; the Big Woods, and Fillmore, Winona and Houston counties (rare), *Winchell*. North.

TAXACEÆ. YEW FAMILY.

TAXUS, Tourn. YEW.

T. Canadensis, Willd. (*T. baccata*, L., var. *Canadensis*, Gray.) American Yew. Ground Hemlock.

Abundant north of lake Superior, *Juni*, *Roberts*; common, or frequent, thence west and south to nearly the same limits as the pines, black spruce and balsam fir; near Lake City, *Mrs. Ray*.

ARACEÆ. ARUM FAMILY.

ARISÆMA, Martius. INDIAN TURNIP. DRAGON-ARUM.

A. triphyllum, Torr. (*A. atrorubens*, Blume. *Bot. Gazette*, ix, 114.) Indian Turnip. Jack-in-the-Pulpit.

Common, or frequent, throughout the state.

A. Dracontium, Schott. Green Dragon. Dragon-root.

Lake Pepin, *Miss Manning*. Rare. Southeast.

CALLA, L. WATER ARUM. CALLA.

C. palustris, L. Water Arum. Wild Calla.

Common in the north half of the state, and southeast to Minneapolis and Saint Paul; rare farther southeast, as near lake Pepin, *Miss Manning*; absent southward.

SYMPLOCARPUS, Salisb. SKUNK CABBAGE.

S. foetidus, Salisb. Skunk Cabbage.

Chisago county, etc. (common), *Upham*; Stillwater, *Miss Field*; Saint Paul, *Kelley*; near Minnehaha falls, *Roberts*; lake Pepin, *Miss Manning*; Winona county, *Holzinger*; New Ulm, *Juni*. [Hesper, Iowa, *Mrs. Carter*; lake Superior, *Whitney*.]

ACORUS, L. SWEET FLAG. CALAMUS.**A. Calamus, L.** Sweet Flag. Calamus.

Common, or frequent, throughout the state; excepting perhaps southwestward, in which direction it extends at least to Redwood Falls, *Miss Butler*, and Emmet county, Iowa (rare), *Cratty*.

LEMNACEÆ. DUCKWEED FAMILY.

LEMNA, L. DUCKWEED. DUCK'S-MEAT.**L. trisulca, L.** Duckweed. Duck's-meat.

Throughout the state. Minnesota river, *Parry*; Blue Earth county (flowering plentifully in 1882), *Leiberg*; frequent in Martin county, and in Emmet county, Iowa, *Cratty*; Minneapolis, *Arthur*, *Roberts*; Taylor's Falls, *Mrs. Ray*; Pembina, *Chickering*; Red river prairie and lake of the Woods, *Dawson*.

L. minor, L. Duckweed. Duck's-meat.

Throughout the state. Blue Earth county, *Leiberg*; Minneapolis, *Arthur*, *Simmons*; Duluth harbor (plentiful), *Roberts*; also, Red river prairie and lake of the Woods (common), *Dawson*.

SPEIRODELA, Schleid. DUCKWEED. DUCK'S-MEAT.**S. polyrrhiza, Schleid.** (*Lemna polyrrhiza, L.*) Duckweed. Duck's-meat.

Throughout the state. Blue Earth county, *Leiberg*; frequent in Martin county, and in Emmet county, Iowa, *Cratty*; Minneapolis (abundant), *Arthur*, *Upham*; Saint Paul, *Kelley*; and northwest to the Saskatchewan river.

WOLFFIA, Horkel, Schleid. WOLFFIA.**W. Columbiana, Karsten.** Wolfia.

Found by *Mr. Leiberg* in a pond at the southwest edge of the village of South Bend, Blue Earth county; plentiful, covering the surface to a depth of one or two inches in the summer; often blown upon the shore in small ridges by storms; slightly spreading to adjacent ponds; determined by *Dr. Engelmann*, who thinks that it is not a native of these northern latitudes, but has been probably brought by water-fowls. It appears to have become thoroughly acclimated in this locality.

TYPHACEÆ. CAT-TAIL FAMILY.

TYPHA, Tourn. CAT-TAIL FLAG.**T. latifolia, L.** Common Cat-tail. Reed-mace.

Common throughout the state.

SPARGANIUM, Tourn. BUR-REED.**S. eurycarpum, Engelm.** Bur-reed.

Throughout the state. Lake of the Woods, *Dawson*; Minneapolis (common), *Roberts*; West Saint Paul, *Miss Butler*; Wabasha, *Gibson*; Blue Earth county, *Leiberg*; Redwood Falls, *Pemberton*; Emmet county, Iowa (rare), *Cratty*.

S. simplex, Hudson. Bur-reed.

Red river valley, at Pembina, *Chickering*; Agate bay, lake Superior, *Juni*; West Saint Paul, *Miss Butler*; lake Pepin, *Miss Manning*.

- S. simplex**, Hudson, var. **Nuttallii**, Gray. Bur-reed.
St. Croix river, *Parry*.
- S. simplex**, Hudson, var. **androcladum**, Gray. Bur-reed.
Freeborn county, *Upham*.
- S. simplex**, Hudson, var. **angustifolium**, Gray. Bur-reed.
Lapham. North. [Isle Royale, *Whitney*.]
- S. minimum**, Bauhin. Bur-reed.
Brooks, St. Croix river, *Parry*; lake of the Woods, *Dawson*. [North of lake Superior, *Agassiz*; Isle Royale, *Whitney*.] North.

NAIADACEÆ. PONDWEED FAMILY.

NAIAS, L. NAIAD.

- N. flexilis**, Rostk. & Schmidt. Naiad.
Throughout the state. Blue Earth county, *Leiberg*; plentiful in Martin county and in Emmet county, Iowa, *Cratty*; Minneapolis (abundant), *Miss Butler*. [Manitoba, *Macoun*.]

ZANNICHELLIA, Michx. HORNED PONDWEED.

- Z. palustris**, L. Horned Pondweed.
Peat-bogs between Kasota and Mankato, *Leiberg*. Rare.

POTAMOGETON, Tourn. PONDWEED. POTAMOGETON.

- P. natans**, L. Pondweed.
Common, or frequent, throughout the state.
- P. Claytonii**, Tuckerman. Pondweed.
Plentiful near Stewart river, north of lake Superior, *Roberts*.
[*P. rufescens*, Schrader, will probably be found in northeastern Minnesota.]
- P. lonchites**, Tuckerm. Pondweed.
Le Sueur river, Blue Earth county, *Leiberg*; Emmet county, Iowa (frequent), *Cratty*. South.
- P. amplifolius**, Tuckerman. Pondweed.
Plentiful in Devil's Track lake, north of lake Superior, *Roberts*; lake Pepin, *Miss Manning*; Emmet county, Iowa (rare), *Cratty*.
- P. gramineus**, L., var. **heterophyllus**, Fries. Pondweed.
Throughout the state. Abundant in Devil's Track lake, *Roberts*; frequent in Emmet county, Iowa, *Cratty*.
- P. lucens**, L. Pondweed.
Throughout the state, but infrequent. Lake Minnetonka, *Roberts*; White Bear lake, Ramsey county, *Simmons*; Stearns county, *Campbell*. [North of lake Superior, *Agassiz*; Manitoba, *Macoun*.]
- P. lucens**, L., var. **minor**, Nolte. Pondweed.
Lake Minnetonka, *Herrick*, *Roberts*.
[*P. prælongus*, Wulfen., will doubtless be found in Minnesota.]

P. Illinoensis, Morong.* Pondweed.

Emmet county, Iowa, *Cratty, Arthur*; doubtless also to be found in southern Minnesota.

P. perfoliatus, L. Pondweed.

Throughout the state. Blue Earth county, *Leiberg*; lake Calhoun, Minneapolis, *Upham*; Stearns county, *Campbell*; lake of the Woods, *Dawson*.

P. perfoliatus, L., var. lanceolatus, Robbins. Pondweed.

Also throughout the state. Lake Minnetonka, *Arthur*; frequent in Martin county, and in Emmet county, Iowa, *Cratty*.

P. zosteræfolius, Schum. (P. compressus, Fries, not L.) Pondweed.

Minneapolis, *Simmons*; Blue Earth county, *Leiberg*, and Martin county (frequent), *Cratty*, both determined by *Rev. T. Morong*.

P. pauciflorus, Pursh. Pondweed.

Minneapolis (common), *Miss Butler*; lake Pepin, *Miss Manning*; Blue Earth county, *Leiberg*, determined by *Rev. T. Morong*; Emmet county, Iowa (frequent), *Cratty*. [North of lake Superior, *Agassiz*.]

P. pusillus, L. Pondweed.

Throughout the state. Lake of the Woods, *Dawson*; White Bear lake, Ramsey county, *Simmons*; Emmet county, Iowa, *Cratty*, determined by *Rev. T. Morong*.

P. pusillus, L., var. major, Fries. Pondweed.

Martin county (frequent), *Cratty*, determined by *Rev. T. Morong*.

P. pusillus, L., var. vulgaris, Fries. Pondweed.

Lake Minnetonka (plentiful), *Herrick, Roberts*; Wiuona lake, *Holzinger*.

P. pectinatus, L. Pondweed.

Throughout the state. Mississippi river near Saint Cloud, *Campbell*; Blue Earth county, *Leiberg*; Martin county (abundant), *Cratty*, determined by *Rev. T. Morong*. [North of lake Superior, *Agassiz*; James river, Dakota, *Geyer*.]

ALISMACEÆ. WATER-PLANTAIN FAMILY.

TRIGLOCHIN, L. ARROW-GRASS. (This genus and *Scheuchzeria* are included in the preceding order, *Naiadaceæ*, by *Watson* in the *Botany of California*.)

**POTAMOGETON ILLINOENSIS, Morong.* Stem stout, branching towards the summit; floating leaves opposite, thick, coriaceous, oval or ovate, 2 to 3 inches long by 1½ broad, 19- to 23-nerved, rounded or sub-cordate at base, and with a short blunt point at the apex, on short petioles; submersed leaves comparatively few, dark green, oblong-elliptical, acute at each end, usually ample (the largest nearly 8 inches long and 1½ wide), entire, rarely mucronate, nearly or quite sessile, the uppermost opposite; stipules coarse, free, obtuse, strongly bicarinate, about 2 inches in length; peduncles often clustered at the summit of the stem, 2 to 4 inches long, usually somewhat thickening upwards; spikes about 2 inches long, densely flowered; fruit roundish obovate, 1¾ to 2 lines long and 1 to 1½ lines wide, 3-keeled on the back, the middle keel prominent and sometimes shouldered at the top, flattened and slightly impressed on the sides, obtuse or occasionally pointed at the base, the style short and nearly facial, the apex of the embryo pointing transversely inwards. Allied to *P. lucens, L.*, in habit, but with larger fruit, and in foliage quite distinct. *Morong* in *Botanical Gazette*, vol. v, p. 50 (May, 1880).

T. palustre, L. Arrow-grass.

Throughout the state. Peat-bogs between Kasota and Mankato (plentiful), *Leiberg*; Red river valley, *Scott*.

T. maritimum, L. Arrow-grass.

Lapham. Stearns county, *Campbell*. [Sheyenne river and Devil's lake, Dakota, *Geyer*.] North.

T. maritimum, L., var. **elatum**, Gray. Arrow-grass.

Duluth (common), and Minneapolis (frequent), *Roberts*; Chisago county, *Upham*; upper Minnesota river, *Parry*; also, peat-bogs between Kasota and Mankato (plentiful), *Leiberg*; Emmet county, Iowa (rare), *Cratty*.

SCHEUCHZERIA, L. SCHEUCHZERIA.**S. palustris**, L. Scheuchzeria.

St. Croix river, *Parry*; near Clearwater, Wright county, *Mrs. Terry*; Minneapolis, *Kassube*, (take Calhoun) *Miss Butler*; Emmet county, Iowa (rare), *Cratty*.

ALISMA, L. WATER-PLANTAIN.**A. Plantago**, L. Water-Plantain.

Common throughout the state. "Very variable as respects foliage, the forms being determined chiefly by the place of growth and not deserving to rank as varieties." *Watson, Botany of California*.

ECHINODORUS, Richard, Engelmann. ECHINODORUS.**E. parvulus**, Engelm. Echinodorus.

Muddy margins of ponds, St. Croix, *Parry*. [North of lake Superior, *Agassiz*.]

SAGITTARIA, L. ARROW-HEAD.**S. variabilis**, Engelm. Common Arrow-head.

Common (especially the var. *hastata*, Gray) throughout the state; var. *angustifolia*, Gray, Minneapolis, *Miss Butler*. "This plant, so variable in foliage, and so abundant in distribution, furnishes an important article of native food in the tubers which beset its fibrous roots. These tubers (from the fact of their affording nourishment to the larger aquatic fowls which congregate in such abundance about the northwestern lakes) are called by the Chippewas, Wab-es-l-pln-ig, or swan potatoes, a name which has been naturally appropriated to several streams of this region, Wabesipinicon; meaning, the abode of the swan potato. These tubers frequently attain the size of a small hen's-egg, and are then eaten by the Indians, with whom they are a great favorite. In their raw state they contain a bitter, milky juice, but in boiling become sweet and palatable." *Parry*.

S. heterophylla, Pursh. Arrow-head.

Upper Mississippi river, *Houghton*; Hennepin county, *Roberts, Griswold*; probably extending through the south half of the state.

S. graminea, Michx. Arrow-head.

Minneapolis, *Kassubc*. South.

S. cristata, Engelm.* Arrow-head.

Emmet county, Iowa, on the south boundary of Minnesota, *Cratty*; doubtless also in this state.

*SAGITTARIA CRISTATA, Engelm. Flowers only of the lowest whorl fertile; fruit-heads much larger than in *S. graminea*; achenia broad, with a conspicuous horizontal

HYDROCHARIDACEÆ. FROG'S-BIT FAMILY.

ANACHARIS, Richard. WATER-WEED.**A. Canadensis**, Planchon. Water-weed.

Common throughout the state. Duluth harbor (plentiful), and Minneapolis, *Roberts*; lake Minnetonka, *Miss Butler*; Winona lake, *Holzinger*; Blue Earth county, *Leiberg*; plentiful in Martin county, and in Emmet county, Iowa, *Cratty*. This aquatic plant, common, but nowhere troublesome, in this its native country, having become naturalized in Europe, grows there more rankly, so as to become in many places a serious obstruction to river-navigation. Since 1836, when it first appeared in England and Ireland, it has spread eastward upon the continent along the rivers of Belgium, Holland and Germany, and is now complained of at Riga in western Russia. *Popular Science Monthly*, vol. xix, p. 430 (July, 1881).

VALLISNERIA, Micheli. TAPE-GRASS. EEL-GRASS.**V. spiralis**, L. Tape-grass. Eel-grass.

With the preceding, in Duluth harbor (plentiful), and Minneapolis, *Roberts*, (lake Calhoun) *Miss Butler*; Blue Earth county, *Gedge*, (Eagle lake) *Leiberg*; Redwood Falls, *Miss Butler*.

ORCHIDACEÆ. ORCHIS FAMILY.

ORCHIS, L. ORCHIS.**O. spectabilis**, L. Showy Orchis.

Duluth (frequent), and Saint Paul (rare), *Miss Cathcart*; Stearns county, *Campbell*; Fergus Falls, *Leonard*; Minneapolis (frequent), *Roberts*; Northfield, *Chaney*; Faribault, *Miss Beane*; Blue Earth county, *Leiberg*; frequent at Hesper, Iowa, *Mrs. Carter*.

O. rotundifolia, Pursh. (*Habenaria rotundifolia*, Richardson.) Orchis.

Detroit, Becker county, *Gedge*. Rare. North.

HABENARIA, Willd. REIN-ORCHIS.**H. tridentata**, Hook. Rein-Orchis.

Lapham. Goodhue county, *Sandberg*. [North of lake Superior, *Agassiz*.] Infrequent.

H. virescens, Spreng. Greenish Orchis.

Lake City, *Miss Manning*; Goodhue county, *Sandberg*; Minneapolis, *Roberts*; Stearns county, *Campbell*; Detroit, Becker county, *Gedge*. Infrequent.

H. viridis, R. Br., var. **bracteata**, Reich. Bracted Green Orchis.

Throughout the state. Carlton's Peak, north of lake Superior, and also near Minneapolis, *Roberts*; eastern border of Red river prairie, *Dawson*; Stearns county, *Campbell*; lake Elmo, Washington county, *Leonard*; Blue Earth county, *Leiberg*; Faribault, *Miss Beane*; Winona county, *Holzinger*. [Hesper, *Mrs. Carter*, and south to Council Bluffs, Iowa, *Geyer*.]

style, and crested back and sides. . . . Near *S. graminæa*, Michx., and perhaps only a variety of it, although the only other *Sagittaria* with such crests to the achenia is *S. natans*, Michx. Further observations are needed to eventually place it correctly. Letter of Dr. Engelmann, dated March 15th, 1882, in *Arthur's Contributions to the Flora of Iowa*. No. V.

H. hyperborea, R. Br. Northern Green Orchis.

Throughout the state. Lake Superior, *Whitney*; lake of the Woods, *Dawson*; Detroit, Becker county, *Gedge*; Stearns county, *Campbell*; Minneapolis (common), *Roberts*; Hesper, Iowa (rare), *Mrs. Carter*.

H. dilatata, Gray. Rein-Orchis. Northern White Orchis.

Lake Superior, *Whitney*; Detroit, *Gedge*; Minneapolis (common), *Roberts*; St. Croix river, *Parry*. North.

[*H. rotundifolia*, Richardson, is found to belong to the preceding genus, Orchis.]

H. obtusata, Richardson. Rein-Orchis.

Abundant north of lake Superior, *Juni*, *Roberts*. North.

H. Hookeri, Torr. Small Two-leaved Orchis.

Throughout the state. St. Croix river, *Parry*; Elk River, Sherburne county, *Campbell*; Saint Paul, *Miss Cathcart*; Winona county, *Holzinger*; Hesper, Iowa, *Mrs. Carter*. [Lake Superior, *Whitney*; Manitoba, *Macoun*.]

H. orbiculata, Torr. Large Round-leaved Orchis.

North of lake Superior, *Juni*, *Roberts*; St. Louis river, *Mrs. Herrick*. Northeast.

H. blephariglottis, Hook., var. **holopetala**, Gray. White Fringed-Orchis.

Minnesota Point, near Duluth, *Miss Cathcart*. Rare.

H. leucophæa, Gray. Western Greenish Fringed-Orchis.

Frequent in the south half of the state, extending north at least to Alexandria, *Mrs. Terry*, and Clay county, in the Red river valley, *Upham*. Sometimes almost pure white. It has spread widely in Martin county during the past six or seven years, being now very common in some parts of the county, *Gedge*.

H. lacera, R. Br. Ragged Fringed-Orchis.

Minneapolis, *Roberts*; Goodhue county, *Sandberg*. South.

H. psycodes, Gray. Purple Fringed-Orchis.

Frequent throughout the state.

GOODYERA, R. Br. RATTLESNAKE-PLANTAIN.**G. repens**, R. Br. Rattlesnake-Plantain.

North of lake Superior (common), also at Minneapolis, *Roberts*; St. Croix Falls, *Miss Field*. North.

G. pubescens, R. Br. Rattlesnake-Plantain.

North of lake Superior, *Juni*; Taylor's Falls, *Miss Cathcart*, *Roberts*; Clearwater, Wright county, *Mrs. Terry*; Cannon River Falls, *Blake*, *Sandberg*.

G. Menziesii, Lindl. Rattlesnake-Plantain.

Isle Royale, *Dr. A. B. Lyons*; doubtless also in Minnesota north of lake Superior.

SPIRANTHES, Richard. LADIES' TRESSES.**S. latifolia**, Torr. Ladies' Tresses.

Lapham. Hills of Zumbro river, *Geyer*. Rare. Southeast.

S. Romanzoffiana, Chamisso. Ladies' Tresses.

North shore of lake Superior, *Juni*; Polk county, *Upham*; Clay county, *Gedge*; Stearns county, *Campbell*; Minneapolis, *Roberts*; Cottonwood county, *Holzinger*; peat-bog between Kasota and Mankato (very scarce), *Leiberg*. North.

S. cernua, Richard. Ladies' Tresses.

Common, or frequent, through the south half of the state, and perhaps northward ;

lake Superior, *Whitney*, and lake of the Woods, *Dawson*; var. *latifolia*, Torr., hills of Zumbro river, *Geyer*.

S. gracilis, Bigelow. Ladies' Tresses.

Throughout the state, but infrequent. Pine barrens, St. Croix river, *Parry*; Stearns county, *Campbell*; Minneapolis, *R. S. Williams*, *Roberts*; lake Pepin, *Miss Manning*. [Decorah, Iowa, *Arthur*; Nebraska, *Aughey*; Manitoba, *Macoun*.]

LISTERA, R. Br. TWAYBLADE.

L. cordata, R. Br. Twayblade.

Between lake Superior and the lake of the Woods, *Macoun*; Isle Royale, *Dr. A. B. Lyons*. North.

L. convallarioides, Nutt. Twayblade.

Also, between lake Superior and the lake of the Woods, *Macoun*; Isle Royale, *Dr. A. B. Lyons*. North.

ARETHUSA, Gronov. ARETHUSA.

A. bulbosa, L. Arethusa.

Chisago county, *Upham*; Ramsey county (near lake Johanna), *Roberts*; Red Wing, *Sandberg*. Rare. North.

POGONIA, Juss. POGONIA.

P. ophioglossoides, Nutt. Pogonia.

St. Croix river, *Parry*; Isanti county, *Upham*; Stearns county, *Campbell*; Saint Paul, *Mrs. Terry*, *Kelley*; Minneapolis (frequent), *Roberts*, *Miss Butler*.

[*P. pendula*, Lindl., and *P. verticillata*, Nutt., should be looked for in this state.]

CALOPOGON, R. Br. CALOPOGON. GRASS PINK.

C. pulchellus, R. Br. Calopogon. Grass Pink.

Common, or frequent, throughout the state.

CALYPSO, Salisb. CALYPSO.

C. borealis, Salisb. Calypso.

Black Point, north shore of lake Superior, *Roberts*; Duluth, *Miss Cathcart*. Rare. North.

MICROSTYLIS, Nutt. ADDER'S-MOUTH.

M. monophyllos, Lindl. Adder's-Mouth.

Lapham. St. Croix river, *Parry*; Taylor's Falls, *Roberts*. Rare. North.

M. ophioglossoides, Nutt. Adder's-Mouth.

Itasca lake, *Houghton*; Mille Lacs, *Campbell*; St. Croix river, *Parry*; at head of lake Pepin, *Sandberg*; Hesper, Iowa (rare), *Mrs. Carter*. [Manitoba, *Macoun*.]

LIPARIS, Richard. TWAYBLADE.

L. liliifolia, Richard. Twayblade.

Minneapolis (one mile west of city), *Roberts*; near Saint Paul, *Mrs. Terry*; Goodhue county, *Sandberg*; Winona county, *Holzinger*; Hesper, Iowa, *Mrs. Carter*. Rare.

L. Loeselii, Richard. Twayblade.

In tamarack swamps near Minneapolis, *Roberts*; Stearns county, *Campbell*. Rare.

CORALLORHIZA, Haller. CORAL-ROOT.**C. innata, R. Br. Coral-root.**

Stearns county, *Campbell*; along the northern boundary of Minnesota, *Macoun*. Throughout the state: rare southward, frequent northward.

C. multiflora, Nutt. Coral-root.

Hesper, Towa, *Mrs. Carter*; Taylor's Falls, *Roberts*; Stearns county, *Campbell*; Pembina, *Havard*; lake Superior, *Whitney*. Throughout the state, but infrequent.

C. Macraei, Gray. Coral-root.

Lapham. [Mackinaw (abundant), *Whitney*.] Rare in Minnesota.

APLECTRUM, Torrey. PUTTY-ROOT. ADAM-AND-EVE.**A. hiemale, Torr. Putty-root. Adam and Eve.**

St. Croix Falls, *Miss Field*; Saint Paul, *Miss Cathcart*; Hastings, *Mrs. Ray*; Faribault, *Miss Beane*; in woods at the head of Van Bruntslough, Mankato, *Leiberg*. [Mantoba, *Macoun*.] Rare.

CYPRIPEDIUM, L. LADY'S-SLIPPER. MOCCASIN-FLOWER.**C. arietinum, R. Br. Ram's-head Lady's-Slipper.**

Clearwater lake, in the northwest part of Wright county, *Mrs. Terry*; Stearns county, *Campbell*; Detroit, Becker county, *Gedge*. Rare. North.

C. candidum, Muhl. Small White Lady's-Slipper.

Through the south half of the state, mostly infrequent and local. Winona county, *Holzinger*; lake Pepin, *Miss Manning*; Cannon River Falls, *Blake, Sandberg*; Minneapolis, *Roberts*, (lake Harriet) *Mrs. Terry*; Anoka county, also New Ulm, *Juni*; Faribault, *Miss Beane*; Nicollet county, *Leiberg*; Emmet county, Iowa (plentiful), *Cratty*; extending north at least to Morrison county, *Miss Babbitt*, the upper Mississippi river, *Garrison*, and Fergus Falls, *Leonard*.

C. parviflorum, Salisb. Smaller Yellow Lady's-Slipper.

Frequent throughout the state, excepting far southward.

C. pubescens, Willd. Larger Yellow Lady's-Slipper.

Common, or frequent, throughout the state.

C. spectabile, Swartz. Showy Lady's-Slipper.

Common, or frequent, often growing on dryish hard land, throughout the state; excepting perhaps far northeastward, in which direction it extends at least to the St. Louis river, *Mrs. Herrick*, the upper Mississippi river, *Garrison*, Detroit, Becker county (abundant), *Gedge*, and Pembina, *Havard*.

C. acaule, Ait. Stemless Lady's-Slipper.

Frequent through the north half of the state; extending south to Saint Paul, *Miss Cathcart*, Minneapolis (in tamarack swamps), *Roberts*, and Martin county, *Gedge*.

AMARYLLIDACEÆ. AMARYLLIS FAMILY.**HYPOXYS, L. STAR-GRASS.****H. erecta, L. Star-grass.**

Common through the south half of the state and in the Red river valley; extending northeast to the upper Mississippi river.

HÆMODORACEÆ. BLOODWORT FAMILY.

ALETRIS, L. COLIC-ROOT. STAR-GRASS.

- A. farinosa**, L. Colic-root. Star-grass.
Lopham. Rare. Southeast.

IRIDACEÆ. IRIS FAMILY.

IRIS, Tourn. FLOWER-DE-LUCE. IRIS.

- I. versicolor**, L. Larger Blue Flag.
Common, or frequent, throughout the state.

SISYRINCHIUM, L. BLUE-EYED GRASS.

- S. angustifolium**, Miller. (S. Bermudiana, L., in part; see *American Naturalist*, vol. xviii, pp. 623-5; June, 1884.) Blue-eyed Grass.

This variable species (in the varieties *anceps* and *mucronatum*, with intermediate forms) is found throughout the state, being usually abundant in all the prairie region. The var. *albidum* occurs infrequently at Marine, Washington county, *Miss Field*, Minneapolis, *Roberts*, *Kassube*, and southwestward.

DIOSCOREACEÆ. YAM FAMILY.

DIOSCOREA, Plumier. YAM.

- D. villosa**, L. Wild Yam-root.

Common, or frequent, through the south part of the state; extending north to Saint Paul, *Roberts*, Minneapolis, *Kassube*, (lake Calhoun) *W. H. Hatch*, Anoka county, *Juni*, and the north side of Snake river east of Chengwatana, Pine county, *Upham*.

SMILACEÆ. SMILAX FAMILY.

SMILAX, Tourn. GREENBRIER. CATBRIER.

- S. rotundifolia**, L. Common Greenbrier.

Lake Superior to the Mississippi, *Houghton*; Stearns county, *Mrs. Blaisdell*; Anoka county, *Juni*; Minneapolis (common), *Roberts*, *Upham*; Minnesota river, *Parry*; Faribault, *Miss Beane*; Goodhue county, *Sandberg*; lake Pepin, *Miss Manning*; Houston county, *Winchell*.

- S. hispida**, Muhl. Greenbrier. Catbrier.

Minnesota river, *Parry*; Blue Earth county, *Leiberg*; frequent in Martin county, and in Emmet county, Iowa, *Cratty*; Kanabec county, *Upham*.

- S. herbacea**, L. Carrion-Flower.

Common, or frequent, throughout the state.

- S. herbacea**, L., var. **pulverulenta**, Gray. Carrion-Flower.

Vicinity of Hesper, Iowa, on the southern border of Houston and Fillmore counties, *Mrs. Carter*; Lake City, *Mrs. Ray*; Faribault, *Miss Beane*.

LILIACEÆ. LILY FAMILY.

TRILLIUM, L. TRILLIUM. THREE-LEAVED NIGHTSHADE. WAKE-ROBIN.

T. sessile, L. Trillium. Threc-leaved Nightshade. Wake-Robin.
Saint Paul, *Miss Cathcart*. Southeast.

T. recurvatum, Beck. Trillium. Thre-leaved Nigh tshade.
Lake Pepin, *Miss Manning*. Southeast.

T. grandiflorum, Salisb. Large White Trillium or Wake-Robin.
Frequent northward ; extending southeast to lake Pepin, *Miss Manning*, North-
field, Rice county, *Chaney*, and Blue Earth county, *Gedge*.

T. erectum, L. Purple Trillium or Birthroot. Bath Flower.
Lapham. Blue Earth county, *Leiberg*; Saint Paul, *Miss Cathcart*; Minneapolis,
Simmons. Rare. (Watson's *Revision of the North American Liliaceæ* makes this
name include also the two following, which, however, are retained here as in Gray's
Manual.)

T. erectum, L., var. **album**, Pursh. Trillium. Birthroot.
Winona, *Holzinger*; Marine, Washington county, *Miss Field*; Stearns county, *Gar-
rison*. Rare.

T. erectum, L., var. **declinatum**, Gray. Trillium. Birthroot.
Frequent, in some localities plentiful, throughout the state.

T. cernuum, L. Nodding Trillium or Wake-Robin.
Common, or frequent, throughout most of the state ; extending north at least to
Grand Marais, *Roberts*, and the upper Mississippi river, *Garrison*; and west to Fergus
Falls, *Leonard*, and Redwood Falls, *Pemberton*.

T. nivale, Riddell. Dwarf White Trillium. Snowy Trillium.
Winona, *Holzinger*; lake Pepin, *Miss Manning*; near South Beud, Blue Earth county,
Leiberg; Emmet county, Iowa, *Cratty*. Rare. South.

MEDEOLA, Gronov. INDIAN CUCUMBER-ROOT.

M. Virginiana, L. Indian Cucumber-root.
Lapham. Near Saint Paul, *Mrs. Terry*; Lake City, *Mrs. Ray*. Infrequent.
Southeast.

MELANTHIUM, L. MELANTHIUM.

M. Virginicum, L. Bunch-flower.
Minneapolis (near lake Calhoun), *Mrs. Terry*. Rare. Southeast.

ZYGADENUS, Michx. ZYGADENE.

Z. elegans, Pursh. (*Z. glaucus*, Nutt.) Zygadene. "Alkali-Grass."
Common, often abundant, throughout the west part of the state ; frequent eastward
to the upper Mississippi river, Sauk Center, and Nicollet and Steele counties; rare
farther east in Benton county, at Minneapolis, Castle Rock, Dakota county, Cannon
River Falls, Goodhue county, and lake Pepin.

VERATRUM, Tourn. FALSE HELLEBORE.

V. viride, Ait. American White Hellebore. Indian Poke.
Stearns county, *Garrison*. Infrequent. North.

TOFIELDIA, Hudson. FALSE ASPHODEL.**T. palustris**, Hudson. False Asphodel.

Isle Royale and Thunder bay; doubtless also on the north shore of lake Superior in Minnesota.

T. glutinosa, Willd. False Asphodel.

Stillwater, *Parry*; Minneapolis, *Roberts*, *Miss Butler*; Fergus Falls, *Leonard*; common in the Red river valley, *Upham*.

UVULARIA, L. BELLWORT.**U. grandiflora**, Smith. Large-flowered Bellwort.

Common, or frequent, through the south half of the state and in the Red river valley,

U. perfoliata, L. Mealy Bellwort.

Frequent in the south half of the state; extending north at least to St. Croix Falls, *Miss Field*, Stearns county, *Campbell*, and the Sisseton Agency, Dakota, *Upham*.

OAKESIA, Watson. BELLWORT. OAKESIA.**O. sessilifolia**, Watson. (*Uvularia sessilifolia*, L.) Sessile-leaved Bellwort.

Throughout the state. Morrison county, *Miss Babbitt*; Stearns county, *Campbell*; Fergus Falls, *Leonard*; Anoka county, etc., *Upham*; Minneapolis, *Twining*, *Roberts*; Saint Paul, *Miss Cathcart*; Northfield, Rice county, *Chaney*. [Manitoba, *Macoun*; Nebraska, *Aughey*.]

STREPTOPUS, Michx. TWISTED-STALK.**S. amplexifolius**, DC. Twisted-Stalk.

North of lake Superior, *Juni*; Taylor's Falls, *Miss Cathcart*; bluffs near (south of) Saint Paul, *Mrs. Terry*. Rare. North.

S. roseus, Michx. Twisted-Stalk.

Common north of lake Superior, *Roberts*; Benton county, *Upham*; bluffs south of Saint Paul, *Mrs. Terry*. North.

CLINTONIA, Raf. CLINTONIA.**C. borealis**, Raf. Northern Clintonia.

Abundant northeastward; extending west to the Winnipeg valley, *Watson*, the sources of the Mississippi, *Houghton*, and Wadena county. *Upham*; and south to Kanabec county (common), Stearns county, *Campbell*, Minneapolis (rare), *Roberts*, Saint Paul, *Miss Cathcart*, and the Wisconsin side of lake Pepin, *Mrs. Ray*.

SMILACINA, Desf. FALSE SOLOMON'S SEAL.**S. racemosa**, Desf. False Spikenard. False Solomon's Seal.

Common, or frequent, throughout the state.

S. stellata, Desf. False Solomon's Seal.

Also common, or frequent, throughout the state.

S. trifolia, Desf. Three-leaved False Solomon's Seal.

Frequent through the north half of the state; extending south at least to Minneapolis, *Roberts*, and Fergus Falls, *Leonard*.

MAIANTHEMUM, Weber. FALSE SOLOMON'S SEAL.**M. Canadense**, Desf. (*Smilacina bifolia*, Ker., var. *Canadensis*, Gray.) Two-leaved False Solomon's Seal.

Common throughout the state.

POLYGONATUM, Tourn. SOLOMON'S SEAL.**P. biflorum, Ell. Smaller Solomon's Seal.**

Frequent, occasionally common, throughout most of the state; extending north to lake Superior, *Whitney*, and Pembina, *Havard*.

P. giganteum, Dietrich. Great Solomon's Seal.

Frequent, or common, throughout the state. (*Mr. Lewis Foote* remarks that these species are not separable in their varying forms, but seem to constitute a single polymorphous species.)

ASPARAGUS, L. ASPARAGUS.**A. officinalis, L. Garden Asparagus.**

Adventive: Minneapolis; Cannon River Falls; lake Pepin; Blue Earth county; New Ulm.

LILIUM, L. LILY.**L. Philadelphicum, L. Wild Orange-red Lily.**

Generally common, or frequent, throughout the state; especially in Sherburne and Todd counties, in the Red river valley, and thence south to Iowa.

L. Canadense, L. Nodding Wild Yellow Lily.

Common throughout the east half of the state; less frequent in the Red river valley; rare southwestward.

L. superbum, L. Turk's-cap Lily. "Wild Tiger-Lily."

Upper Mississippi river, *Garrison*; Minneapolis, *Twining*, *Simmons*; Excelsior, Hennepin county, *Mrs. Terry*; Nicollet county, *Aiton*; Martin county, *Gedge*; Cannon River Falls, *Blake*, *Sandberg*; lake Pepin, *Miss Manning*; Hesper, Iowa, *Mrs. Carter*. Infrequent. South.

ERYTHRONIUM, L. ADDER'S-TONGUE. DOG'S-TOOTH VIOLET.**E. Americanum, Smith. Yellow Adder's-tongue or Dog's-tooth Violet.**

Saint Paul, *Miss Cathcart*; Lake City, *Mrs. Ray*; Winona, *Holzinger*; plentiful locally near Hesper, Iowa, *Mrs. Carter*; Blue Earth county, *Leiberg*. [Lake Superior, *Whitney*; Nebraska, *Aughey*.] Infrequent. East and south.

E. albidum, Nutt. White Adder's-tongue or Dog's-tooth Violet.

Common, often abundant, southeastward; less frequent, or rare, southwestward; extending north to St. Croix Falls, *Miss Field*, Stearns county, *Campbell*, and Brown county, *Juni*.

E. propullans, Gray.* Adder's-tongue. Dog's-tooth Violet.

Fariabault (abundant), *Miss Beane*; described and figured by *Professor Gray* in the *American Naturalist*, vol. v, pp. 298-300, July, 1871, from specimens "collected at Fariabault, Minnesota, by *Mrs. Mary B. Hedges*, the teacher of botany in St. Mary's Hall."

*ERYTHRONIUM PROPULLANS, Gray. The flower is much smaller than that of any other known species, being barely half an inch long; and its color, a bright pink or rose, like that of the European *E. Dens-Canis*, reflects the meaning of the generic name (viz., red), which is lost to us in our two familiar Adder-tongues, one with yellow, the other with white, blossoms. The most singular peculiarity of the new species is found in the way in which the bulb propagates. In *E. Dens-Canis* new bulbs are produced directly from the side of the old one, on which they are sessile, so that the plant as it multiplies forms close clumps. In our *E. Americanum* long and slender offshoots, or subterranean runners, proceed from the base of the parent bulb and develop the new bulb at their distant apex. Our western *E. albidum* does not differ in this respect. In the new species an offshoot springs from the ascending slender stem, or sub-

CAMASSIA, Lindl. QUAMASH.

C. Fraseri, Torr. (*Scilla Fraseri*, Gray.) Eastern Quamash. Wild Hyacinth.

Blue Earth county, *Leiberg*; Martin county, *Cratty*. South.

ALLIUM, L. ONION. GARLIC.

A. tricoccum, Ait. Wild Leek.

Throughout the state, excepting perhaps far northward; but mostly infrequent or rare. Minnesota and St. Croix rivers, *Parry*; upper Mississippi river, *Garrison*; Fergus Falls, *Leonard*; Minneapolis, *W. H. Hatch, Roberts*; Goodhue county, *Sandberg*; Blue Earth county, *Leiberg*; New Ulm, *Juni*; Martin and Nobles counties, *Gedge*. [Emmet county, Iowa (very rare), *Cratty*; lake Superior, *Whitney*.]

A. cernuum, Roth. Wild Onion.

Common throughout the prairie portion of the state; also found at the lake of the Woods, *Dawson*. (The umbel is reflexed until flowering, but then usually becomes erect.)

A. stellatum, Fras. Wild Onion.

Upper Minnesota river, *Geyer*; Tracy, Lyon county, *Gedge*; Minneapolis, *Griswold*; lake Pepin, *Miss Manning*; Stearns county, *Garrison*; Alexandria, *Mrs. Terry*. Rare.

A. reticulatum, Fras.* Wild Onion.

Red river valley, *Scott*, determined by *Mr. Sereno Watson*. West.

A. Schoenoprasum, L. Chives.

Northeastward, *Clark*; Stearns county, *Mrs. Blaisdell*; upper Mississippi river, *Garrison*. [Manitoba, *Macoun*.] North.

A. Canadense, Kalm. Wild Garlic.

Common or frequent, through the south part of the state; extending west to Worthington, *Foote*, and Pipestone county, *Mrs. Bennett*, and north to Minneapolis and Big Stone lake, *Upham*.

JUNCACEÆ. RUSH FAMILY.

LUZULA, DC. WOOD-RUSH.

L. pilosa, Willd. Wood-Rush.

Lake Pepin, *Miss Manning*. [Manitoba, *Macoun*.] Probably common northward.

terranean sheathed portion of the scape (which is commonly five or six inches long), remote from the parent bulb, usually about mid-way between it and the bases or apparent insertion of the pair of leaves: this lateral offshoot grows downward, sometimes lengthening as in the foregoing species, sometimes remaining short, and its apex dilates into the new bulb. . . . Scape bulbiferous from its sheathed portion below the developed leaves; these oblong-lanceolate, acuminate, slightly mottled; perianth rose-purple or pink (half an inch long); the segments acute, all with a yellow spot but plane at the base, the inner like the outer destitute of either groove or tooth-like appendages, but a little more narrowed at base; anthers merely oblong; style hardly at all narrowed downward, entire, the small stigma even barely three-lobed; ovules few (4 to 6) in each cell. *Gray* in *American Naturalist*, vol. v.

***ALLIUM RETICULATUM**, Fras. Coats densely fibrous; scape 3 to 8 inches high, subterete; leaves very narrowly linear, elongated; spathe usually 2-valved; umbel many-flowered, spreading; pedicels usually short (2 to 6 lines long); stamens and style shorter than the usually acute (3 to 4 lines long) white or slightly pinkish sepals; crest mostly short. *Watson's Revision of Allium* in *King's Expl. of the Fortieth Parallel*, and his *Revision of the North American Liliaceae*, *Proc. Amer. Acad.*, xiv.

L. spadicea, DC., var. **melanocarpa**, Meyer. (*L. parviflora*, Desv., var. *melanocarpa*, Gray.) Wood-Rush.

Frequent along the northern boundary of Minnesota, *Macoun*.

L. campestris, DC. Wood-Rush.

Throughout the state. Upper Mississippi river, *Garrison*; Anoka county, etc. *Upham*; lake Pepin, *Miss Manning*; Emmet county, Iowa (very rare), *Cratty*.

JUNCUS, L. RUSH. BOG-RUSH.

J. effusus, L. Common or Soft Rush.

Throughout the state, *Lapham*. Lake Pepin, *Miss Manning*. [North of lake Superior, *Agassiz*; Manitoba, *Macoun*.]

J. filiformis, L. Bog-Rush.

Lapham. Lake Pepin, *Miss Manning*. [Manitoba, *Macoun*; Nebraska, *Aughey*.] Throughout the state, chiefly northward.

J. Balticus, Dethard. Bog-Rush.

Lapham. Pembina, *Chickering*; Red river country generally, *Dawson*. [North of lake Superior, *Agassiz*; Emmet county, Iowa (rare), *Cratty*.] Throughout the state, chiefly northward.

J. Balticus, Dethard, var. **montanus**, Engelm.* Bog-Rush.

Lake of the Woods, *Dawson*, *Macoun*. West.

J. bufonius, L. Bog-Rush.

Lake Pepin, *Miss Manning*; lake of the Woods, *Macoun*. [James river, Dakota, *Geyer*.] Infrequent.

[*J. stygius*, L., and *J. Gerardi*, Loisel, should be looked for in Minnesota north of lake Superior.]

J. tenuis, Willd. Bog-Rush.

Common, or abundant, throughout the state.

J. tenuis, Willd., var. **congestus**, Engelm. Bog-Rush.

Blue Earth county, *Leiberg*, determined by *Watson*. Southwest. [Branches contracted into a head, and flowers darker-colored. *Engelmann*, *Trans. Acad. Sci., Saint Louis*, vol. ii.]

J. Vaseyi, Engelm. Vasey's Bog-Rush.

Steele county, *Upham*; lake Superior and Manitoba, *Macoun*; probably occurring throughout Minnesota.

J. pelocarpus, E. Meyer. Bog-Rush.

Lapham. St. Croix river, *Parry*; lake Pepin, *Miss Manning*.

J. alpinus, Villars, var. **insignis**, Fries. Bog-Rush.

North shore of lake Superior, *Juni*; lake of the Woods, *Dawson*, *Macoun*. North.

J. acuminatus, Michx., var. **legitimus**, Engelm. Bog-Rush.

Lapham. [North of lake Superior, *Agassiz*; Manitoba, *Macoun*; Devil's lake, Dakota, *Geyer*.] Throughout the state.

* **JUNCUS BALTICUS**, Dethard, var. **MONTANUS**, Engelm. Sepals nearly of the same length, the minor ones sometimes more obtuse; anthers four times longer than the filament; capsule ovate-pyramidal, angled, beaked; seeds smaller, narrower and longer pointed than in the eastern form. *Watson's Rep. in King's Expl. of the Fortieth Parallel*.

J. nodosus, L. Bog-Rush.

Common throughout the state.

J. nodosus, L., var. **megacephalus**, Torr. Bog-Rush.Common in Martin county, and in Emmet county, Iowa, *Cratty*; Manitoba, *Macoun*; probably throughout the state.**J. Canadensis**, J. Gay, var. **longicaudatus**, Engelm. Bog-Rush.Minneapolis. *Simmons*; Blue Earth county, *Leiberg*. Through the south part of the state.**J. Canadensis**, J. Gay, var. **coarctatus**, Engelm. Bog-Rush.North of lake Superior, *Juni*. [Manitoba, *Macoun*.] North.

PONTEDERIACEÆ. PICKEREL-WEED FAMILY.

PONTEDERIA, L. PICKEREL-WEED.**P. cordata**, L. Pickerel-Weed.Lake Pepin, *Miss Manning*; White Bear lake, Ramsey county, *Simmons*, *Kelley*; lake Minnetonka, also in Douglas county, *Mrs. Terry*; pond in section 23, Burns, Anoka county, *Roberts*; Stearns county, *Campbell*. Infrequent.**SCHOLLERA**, Schreber. WATER STAR-GRASS.**S. graminifolia**, Willd. Water Star-grass.White Bear lake, Ramsey county, *Simmons*; lake Minnetonka, *Roberts*, *Miss Butler*; Blue Earth county, *Leiberg*. South.

COMMELYNACEÆ. SPIDERWORT FAMILY.

TRADESCANTIA, L. SPIDERWORT.**T. Virginica**, L. Common Spiderwort.Common, often abundant, through the south half of the state; extending northeast to the upper Mississippi river, and north to lake Winuipeg, *Watson*. Southwestward the flowers are often seen varying from the ordinary blue to purple and pink.

XYRIDACEÆ. YELLOW-EYED-GRASS FAMILY.

XYRIS, L. YELLOW-EYED GRASS.**X. flexuosa**, Muhl. Yellow-eyed Grass.Sandy lake, about three miles north of East Minneapolis, *Roberts*; also collected near Minneapolis by *Mr. Kassube*; White Bear, Ramsey county, *Miss Field*. Rare.

ERIOCAULONACEÆ. PIPEWORT FAMILY.

ERIOCAULON, L. PIPEWORT.**E. septangulare**, With. Pipewort.Lake Agnes, Alexandria, Douglas county, *Mrs. Terry*. Rare.

CYPERACEÆ. SEDGE FAMILY.

CYPERUS, L. GALINGALE.

C. diandrus, Torr., var. **castaneus**, Torr. (*C. rivularis*, Kunth.) Galingale.

Common through the south half of the state; extending north at least to the upper Mississippi river, *Garrison*.

C. erythrorrhizos, Muhl. Galingale.

Lapham. [In Michigan, Wisconsin and Nebraska.] Infrequent. South.

C. aristatus, Rottb. (*C. inflexus*, Muhl.) Galingale.

St. Croix river, *Parry*; Minneapolis, *Kassube*, *Simmons*; Blue Earth county, *Leiberg*. [Manitoba, *Macoun*, (lake Winnipeg) *Watson*; Emmet county, Iowa (rare), *Cratty*.] Throughout the state.

C. esculentus, L. (*C. phymatodes*, Muhl.) Galingale. Nut-Grass.

Lapham. Blue Earth county, *Leiberg*; Cannon River Falls, *Blake*, *Sandberg*; Minneapolis, *Simmons*. South.

C. strigosus, L. Galingale.

Common throughout the state, excepting perhaps northeastward. (Specimens apparently referable to this species, collected by *Mr. Simmons* near lake Calhoun, in Minneapolis, have only 8- to 12-flowered spikes, scarcely a half inch long, arranged in densely crowded spike clusters, the lower portions of which are sometimes compound.)

C. Michauxianus, Schultes. Galignale.

Lapham. Blue Earth county, *Leiberg*. Probably frequent, or common, through the south part of the state.

C. Schweinitzii, Torr. Galingale.

Throughout the south half of the state and in the Red river valley. Sandy ridges, St. Croix river, *Parry*; Minneapolis (common), *Kassube*, *Upham*; Blue Earth county, *Leiberg*. [Emmet county, Iowa (very rare) *Cratty*; Devil's lake, Dakota, *Geyer*.]

C. filiculmis, Vahl. Galingale.

Common, or frequent, throughout the state, excepting perhaps northeastward. Upper Mississippi river, *Houghton*; Minnesota river, *Parry*; Minneapolis, *Kassube*, *Simmons*, *Upham*; Blue Earth county, *Leiberg*. [Manitoba, *Macoun*.]

DULICHIMUM, Richard. DULICHIMUM.

D. spathaceum, Pers. Dulichium.

Common, or frequent, throughout the state.

HEMICARPHA, Nees. HEMICARPHA.

H. subsquarrosa, Nees. Hemicarpha.

Lapham. Blue Earth county, *Leiberg*; Minneapolis, plentiful beside railroad near the University, *Arthur*, and near lake Calhoun, *Simmons*; probably frequent through the south half of the state.

ELEOCHARIS, R. Br. SPIKE-RUSH.

E. obtusa, Schultes. Spike-Rush.

Common through the south half of the state and in the Red river valley.

E. palustris, R. Br. Spike-Rush.

Common throughout the state.

- E. palustris**, R. Br., var. **glaucescens**, Gray. Spike-Rush.
Minneapolis, *Kassabe*.
- E. compressa**, Sullivant. Spike-Rush.
Blue Earth county, *Leiberg*. [Emmet county, Iowa (rare), *Cratty*.] South.
- E. intermedia**, Schultes. Spike-Rush.
Lapham. Blue Earth county, *Leiberg*. Probably throughout the state.
- E. tenuis**, Schultes. Spike-rush.
Lapham. Blue Earth county (frequent in peat-bogs), *Leiberg*. [Devil's lake, Dakota, *Geyer*.]
- E. acicularis**, R. Br. Spike-Rush.
Common throughout the state.
- E. Wolfii**,* Gray. Wolf's Spike-Rush.
Collected by *Mr. R. I. Cratty* on wet prairies in Emmet county, Iowa, adjoining the south line of Martin and Jackson counties in Minnesota, where it may also be confidently looked for; determined by *Mr. William Booth*.
- E. pauciflora**, Watson. (*Scirpus pauciflorus*, Lightfoot.) Spike-Rush.
Lake Superior and lake of the Woods, *Macoun*. North.

SCIRPUS, L. BULRUSH or CLUB-RUSH.

- S. cæspitosus**, L. Bulrush or Club-Rush.
North and northwest of lake Superior, *Macoun*; doubtless in northern Minnesota.
- S. pungens**, Vahl. Bulrush.
Common throughout the state, excepting perhaps northeastward.
- S. Torreyi**, Olney. Torrey's Bulrush.
Lapham. Infrequent.
- S. lacustris**, L. (*S. validus*, Vahl.) Great Bulrush. "Black Rush."
["Tule" in California (*S. lacustris*, L., var. *occidentalis*, Watson).]
Abundant throughout the state. "In common use among the Indians for making mats." *Parry*.
- S. debilis**, Pursh. Bulrush.
Lapham. [Also in the Wisconsin catalogue, probably on *Dr. Lapham's* authority; and in Nebraska, *Aughey*.]
[*S. maritimus*, L., was collected by *Geyer* at Devil's lake and on the Sheyenne and James rivers, in Dakota. It will probably be found in the Red river valley in Minnesota.]
- S. fluviatilis**, Gray. River Club-Rush.
Through the south half of the state, and in the Red river valley. Minneapolis, *Roberts*; Blue Earth county, *Leiberg*; Emmet county, Iowa (common), *Cratty*; Pembina, *Chickering*.

***ELEOCHARIS WOLFII**, Gray. Rhizomes very small, creeping, perennial, forming small scattered tufts; culm a foot high, slender, pale-glaucous, striate, two-edged, one side flat, the other convex; sheath obliquely truncate, hyaline above; spike ovate-oblong, acute; scales oblong-ovate, obtuse, scarious, pale purple; style 3-parted; achenium pyriform, shining, having about 9 nearly equidistant obtuse ribs, with transverse wrinkles between; tubercle small, depressed, truncate, more or less apiculate; bristles of the perigynium [always?] none.—[First known from Illinois.] The spike, as to form and imbrication of the scales, is much as in *E. tenuis* and *E. acicularis*, etc.; but the achenium, with its several longitudinal ribs and delicate transverse lineation, is upon the plan of *E. acicularis*. This renders the species a very peculiar and distinct one. *Gray, Proc. Amer. Acad.*, vol. x, p. 77, as translated by *Arthur, Contributions to the Flora of Iowa, No. VI.*

S. sylvaticus, L., var. **digynus**, Boeck. (S. microcarpus, Presl.) Bulrush.
Lapham. Pine county, etc., *Upham.*

S. atrovirens, Muhl. Bulrush.

Common throughout the state. (*Mr. Leiberg* reports in Blue Earth county, besides the type, a variety with the heads less deusely clustered than usual, forming a compound panicle.)

S. polyphyllus, Vahl. Bulrush.
Isanti county, Upham. South.

S. lineatus, Michx. Bulrush.
Blue Earth county, *Leiberg*; Minneapolis, *Simmons.* South.

S. Eriophorum, Michx. Wool-Grass.

Frequent throughout the state, excepting perhaps southwestward. Blue Earth county, *Leiberg*; Minneapolis, *Simmons, Kassube*; Todd county, etc., *Upham*; lake of the Woods, *Dawson, Macoun.* [North of lake Superior, *Agassiz.*]

ERIOPHORUM, L. COTTON-GRASS.

E. alpinum, L. Alpine Cotton-Grass.
North of lake Superior, *Juni.*

E. vaginatum, L. Sheathed Cotton-Grass.

Throughout the state, excepting far southward. Blue Earth county, *Leiberg*; Minneapolis, *Kassube*; Anoka county, *Juni*; Chisago county (frequent), *Upham.* [Manitoba, *Macoun.*]

[*E. Virginicum*, L., doubtless will be found in this state, but has not yet been reported. It occurs in Wisconsin, Nebraska and Manitoba.]

E. polystachyum, L. Many-stemmed Cotton-Grass.

Common, or frequent, through the south half of the state, and perhaps farther north. Anoka county, *Juni*; Minneapolis, *Herrick, Simmons*; Blue Earth county, *Leiberg*; Emmet county, Iowa (common), *Cratty.* It has been noted in its var. **ANGUSTIFOLIUM**, Gray, at Minneapolis, *Kassube*, and in Steele county, *Upham.*

E. polystachyum, L., var. **latifolium**, Gray. Cotton-Grass.

Minneapolis, *Upham*; and probably extending, with the var. **angustifolium**, through the south half of the state.

E. gracile, Koch, var. **paucinervium**, Engelm. Graceful Cotton-Grass.

Throughout the state. Chisago county (frequent), and Sherburne county, *Upham*; Minneapolis, *Simmons*; Blue Earth county, *Leiberg.* [Manitoba, *Macoun*; Emmet county, Iowa (rare), *Cratty.*]

FIMBRISTYLIS, Vahl. FIMBRISTYLIS.

F. capillaris, Gray. Fimbristylis.
Lapham. Infrequent. South.

RHYNCHOSPORA, Vahl. BEAK-RUSH.

R. alba, Vahl. Beak-Rush.
Lapham. Infrequent. South.

R. capillacea, Torr. Beak-Rush.
Blue Earth county, *Leiberg.* Infrequent. South.

[*Cladium mariscoides*, Torr., should be looked for in southern Minnesota.]

SCLERIA, L. NUT-RUSH.

- S. triglomerata**, Michx. Nut-Rush.
Lapham. Infrequent. South.
- S. verticillata**, Muhl. Nut-Rush.
Blue Earth county, *Leiberg.* Rare. South.

CAREX, L. SEDGE.

- C. scirpoidea**, Michx. Sedge.
Port Arthur, and "northwest angle" of the lake of the Woods, *Macoun.* North.
- C. polytrichoides**, Muhl. Sedge.
Little Marais, lake Superior, *Juni.* Probably common throughout the state.
- C. Backii**, Boott. Back's Sedge.
Minneapolis, *Juni.* North.
- C. siccata**, Dew. Sedge.
Throughout the state, but infrequent. *Lapham.* Minneapolis, *Kassube;* Emmet county, Iowa (very rare), *Cratty.*
- C. disticha**, Huds. Sedge.
Throughout the state. Minneapolis, *Juni, Kassube;* Emmet county, Iowa (common) *Cratty.*
- C. teretiuscula**, Good. Sedge.
Throughout the state. Minneapolis, *Juni;* Blue Earth county, *Leiberg.*
- C. teretiuscula**, Good., var. **ramosa**, Boott.* Sedge.
Emmet county, Iowa (frequent), *Cratty;* doubtless also in Minnesota.
- C. vulpinoidea**, Michx. Sedge.
Common throughout the state. Minneapolis, *Juni;* Blue Earth county, *Leiberg;* common in Martin county, and in Emmet county, Iowa, *Cratty.*
- C. crus-corvi**, Shuttleworth. Sedge.
Blue Earth county, *Leiberg.* South.
- C. stipata**, Muhl. Sedge.
Common throughout the state. Moose Lake, Carlton county, *Juni;* Blue Earth county, *Leiberg.*
- C. conjuncta**, Boott. Sedge.
Minneapolis, *Juni, Kassube.* Southeast.
- C. Douglasii**, Boott.† Douglas's Sedge.
Red river (open prairie); "this is the first Carex to appear in flower, and occurs very abundantly all over the prairie of the Red river," *Dawson, Macoun,* West.

***CAREX TERETIUSCULA**, Good., var. **RAMOSA**, Boott. (C. prairiea, Dew.) Spike below branched; spikelets ovate, sessile, 5 to 7 on a branch; perigynium ovate-lanceolate, convex both sides, scabrous on the margin, slightly bifid, smaller than the ovate-lanceolate glume; stem 2 to 3 feet high, leafy towards the base. *Wood's Class-Book.*

†**CAREX DOUGLASII**, Boott. Spike dioecious, with about twelve, sometimes more, ovate spikelets, the upper closely aggregated, the lower occasionally remote and compound; bracts sometimes setaceous, broad at base, sometimes scale-like and mucronate; style exserted; stigmas 2, very long; perigynium elliptic-lanceolate or ovate, tapering to a long serrated bifid beak, shorter than the lanceolate acute scale; achene-nium orbicular. Root creeping; culm 6 to 12 inches high. *Olney in Bot. Rep. of King's Expl. of the Fortieth Parallel.*

C. marcida, Boott.* Sedge.

Red river (open prairie swamp), *Dawson, Macoun.* West.

C. cephaloidea, Boott. Sedge.

Throughout the state, excepting perhaps northeastward. Frequent in Martin county, and in Emmet county, Iowa, *Cratty*; swamps, "northwest angle" of lake of the Woods, *Macoun*.

C. cephalophora, Muhl. Sedge.

Common, or frequent, through the south part of the state. Blue Earth county, *Leiberg*.

C. Muhlenbergii, Schk. Sedge.

Lapham. Chaska, Carver county, *Juni.* Rare. South.

C. rosea, Schk. Sedge.

Common, or frequent, throughout the state. Red river (swamp), *Dawson, Macoun*; Minneapolis, *Juni, Kassube*; Blue Earth county, *Leiberg*; Hesper, Iowa (frequent), *Mrs. Carter*; Martin county, and Emmet county, Iowa (common), *Cratty*.

C. chordorhiza, Ehrh. Sedge.

Throughout the state, but infrequent. [North of lake Superior (at Fort William), *Macoun*; Emmet county, Iowa, *Arthur*.]

C. tenella, Schk. Sedge.

Throughout the state, excepting far southward. Minneapolis, *Juni, Kassube*.

C. trisperma, Dew. Sedge.

Range like the last. Put in bay, lake Superior, *Juni*.

C. tenuiflora, Wahl. Sedge.

Range like the two preceding. Minneapolis, *Juni, Herrick*.

C. canescens, L. Sedge.

Throughout the state: common northward, less frequent southward. Blue Earth county, *Leiberg*.

C. canescens, L., var. **alpicola**, Wahl. (var. *vitis*, Carey.) Sedge.

Agate bay, lake Superior, *Juni.* North.

C. arcta, Boott.† Sedge.

Lake Superior, Rainy lake, and lake of the Woods, *Richardson, Boott.* North.

***CAREX MARCIDA**, Boott. Spike oblong, pale, composed of numerous small ovate aggregated androgynous spikelets, staminate at top, the lower spikelets compound; stigmas 2; perigynium tawny, suborbicular, or ovate tapering to a bifid beak, plane-convex, nerved, winged, the upper margins serrated, short-stipitate, nearly equal to the acute ovate scale, which is of a pale straw-color, with a white membranous margin; achenium tawny, lenticular, contracted at base. Culm 1 to 2 feet high, rigid; leaves broad, linear, erect. *Olney* in *Bot. Rep. of King's Expl. of the Fortieth Parallel*.

†**CAREX ARCTA**, Boott. Spike oblong, capitate, pale, of 8 to 14 spikelets, which are oblong and obtuse, androgynous, at the base sparingly staminate, many-flowered, closely crowded, the lower bracteate; bracts bristle-shaped, dilated at the base, longer than the spikelets; stigmas 2; perigynia ovate, acuminate-beaked, with the minute orifice emarginate and deeply cleft on the outer side, serrate above on the sharp margins, on the outer side slightly nerved, on the inner more sparingly or obsoletely nerved, spreading, pale-green, at length becoming rusty above, membranaceous, at the base thickly spongy; longer than (and as broad as) the scale, which is ovate, acute and mucronulate, whitish or rusty-colored, with a greenish margin and a green mid-nerve. . . . Culm somewhat less than a foot high, sharply triangular, rather stout, upwardly roughish, leaved at the base. Leaves 1 to 1½ lines wide, flat, with a prolonged-tapering tip, longer (often much) than the culm. Bracts at their base broadly dilated, bristle-

- C. Deweyana**, Schw. Sedge.
Throughout the state. Agate bay, lake Superior, *Juni*; Spirit Lake, Iowa, *Arthur*.
- C. echinata**, Murr. (*C. stellulata*, Good.) Sedge.
Throughout the state. North of lake Superior, *Agassiz*; Manitoba, *Macoun*; Emmet county, Iowa, *Cratty*, *Arthur*.
- C. echinata**, Murr., var. **microcarpa**, Boeck. (*C. stellulata*, Good., var. *scirpoides*, Carey.) Sedge.
Minneapolis, *Juni*, *Kassube*; Emmet county, Iowa (frequent), *Cratty*.
- C. arida**, Schw. & Torr. Sedge.
Throughout the state, but infrequent. [Near Winnipeg, Manitoba, *Macoun*; upper Missouri river, *Geyer*.]
- C. scoparia**, Schk. Sedge.
Common throughout the state. Minneapolis, *Juni*; Blue Earth county, *Leiberg*.
- C. lagopodioides**, Schk. Sedge.
Common, or frequent, throughout the state. *Lapham*. Savannah river, *Houghton*; Agate bay, lake Superior, *Juni*.
- C. cristata**, Schw. Sedge.
Throughout the state, excepting perhaps northeastward. Blue Earth county, *Leiberg*; Emmet county, Iowa (rare), *Cratty*.
- C. adusta**, Boott. Sedge.
Throughout the state, but rare. Red river valley, at Pembina, *Dawson*; Minneapolis, *Kassube*.
- C. straminea**, Schk. (Including vars. *typica*, *tenera*, *aperta* and *festuacea*, Boott.) Sedge.
Throughout the state. St. Louis river, *Houghton*; Pembina, *Dawson*; Minneapolis, *Kassube*; Blue Earth County, *Leiberg*.
- C. straminea**, Schk., var. **Crawei**, Boott. (vars. *hyalina* and *Meadii*, Boott.) Sedge.
Common in Emmet county, Iowa (on the southern boundary of Minnesota), *Cratty*.
- C. vulgaris**, Fries. Sedge.
Throughout the state, excepting perhaps far southward. Minneapolis, *Juni*; Blue Earth county, *Leiberg*.
- C. aquatilis**, Wahl. Sedge.
Range like the last. *Lapham*. Minneapolis, also New Ulm, *Juni*.
- C. stricta**, Lam. (See *Botanical Gazette* for Sept., 1884.) Sedge.
Common throughout the state. Agate bay, lake Superior, *Juni*; Red river, *Dawson*, *Macoun*; Minneapolis, *Kassube*; Blue Earth county, *Leiberg*; plentiful in Emmet county, Iowa, *Cratty*.
- C. lenticularis**, Michx. Sedge.
Agate bay, lake Superior, *Juni*. North.

shaped, the lower 5 or 6 elongated, the lowest hardly equaling the spike. Spike 10 to 16 lines long, 3 to 6 lines broad. Spikelets 5 lines long, 2 to 2½ lines broad, dense flowered, at the base sparingly staminate but never narrowed below, all crowded. Scales similar. Perigynium 1.3 to 1.4 lines long, 0.6 line broad. Achenium 0.7 line long, 0.5 line broad, suborbicular, prolonged at the base, plano-convex, pale; the base of the style enlarged.—It differs from *C. canescens* and *C. vitilis* in its more numerous spikelets, in their being capitate and the lower ones bracted, and in its longer leaves. In general appearance it more nearly resembles *C. elongata*, yet in the form and nervation of the perigynium it is far different. *Boott's Illustrations of Carex*.

- C. crinita**, Lam. Sedge.
Throughout the state, excepting perhaps far southward. North of lake Superior, *Juni*.
- C. crinita**, Lam., var. **gynandra**, Schw. & Torr. (*C. gynandra*, Schw.)
Sedge.
Agate bay, lake Superior, *Juni*. Rare.
- C. limosa**, L. Sedge.
Throughout the state, but infrequent. [North of lake Superior (at Fort William), *Macoun*; Emmet county, Iowa, *Cratty*, *Arthur*.]
- C. Magellanica**, Lam. (*C. irrigua*, Smith.) Sedge.
Throughout the state, excepting far southward, but rare. Put in bay, lake Superior, *Juni*.
- C. Buxbaumii**, Wahl. Sedge.
Throughout the state. Blue Earth county, *Leiberg*; Emmet county, Iowa (frequent), *Cratty*.
- C. atrata**, L. Sedge.
Kakabeka falls, north of lake Superior, *Macoun*; probably also in northern Minnesota.
- C. alpina**, Swartz. Sedge.
Temperance river, lake Superior, *Juni*. North.
- C. aurea**, Nutt. Sedge.
Throughout the state, excepting perhaps far southward. Lake of the Woods (thicket), *Dawson*, *Macoun*; Minneapolis, *Juni*, *Kassube*.
[*C. aurea*, Nutt., var. *androgyna*, Olney,* collected by *Macoun* at Thunder bay, lake Superior, should be looked for in northern Minnesota.]
- C. livida**, Willd. Sedge.
Greenwood river, lake Superior, *Juni*. Rare. North.
- C. vaginata**, Tausch. Sedge.
Certainly in swamps in northern Minnesota, *Macoun*. North.
- C. Meadii**, Dew. Mead's Sedge.
Minneapolis, *Kassube*. [Manitoba, *Macoun*; Iowa, *Arthur*.]
- C. Meadii**, Dew., var. **Bebbii**, Arthur. † Sedge.
Emmet county, Iowa, *Cratty*, *Arthur*; doubtless also in Minnesota.

**CAREX AUREA*, Nutt., var. *ANDROGYNA*, Olney. Culms short, more rigid; leaves erect, broader; upper spikes more closely aggregated and denser flowered, the upper spike generally androgynous, having more or less fertile flowers at the top. *Olney* in *Bot. Rep. of King's Expl. of the Fortieth Parallel*.

†*CAREX MEADII*, Dew., var. *BEBBI* (Olney). This was published in Olney's *Carex* *Bor.-Amer.*, Fasc. 1, No. 22, without comments, as a variety of *C. panicea*, L., and has never, I believe, been described. The following description will enable collectors to identify the plant:—Sterile spike with stalk two to four times its length; fertile spikes usually 2, erect, remote, slender-peduncled, rather loosely flowered; sheaths of the foliaceous bracts long and slightly inflated; perigynia and scales as in *C. Meadii*, except paler, and the former less distinctly nerved; culms slender, somewhat roughish. — Resembles *C. tetanica*, for which it is sometimes mistaken, in habit and in the loosely flowered fertile spikes, only with longer peduncles, but *C. Meadii* in the perigynia and scales; it may be merely an attenuated form of the latter. Moist prairies, Illinois, Wisconsin, and northwestwardly. *Arthur* in *Contributions to the Flora of Iowa*, No. VI.

- C. Crawei**, Dew. Sedge.
Blue Earth county, *Leiberg*; Emmet county, Iowa, *Cratty*, determined by *Mr. William Boott*. [Manitoba, *Macoun*.] Rare.
- C. granularis**, Muhl. Sedge.
Common throughout the state. Minneapolis, *Juni*, *Kassube*; Blue Earth county, *Leiberg*.
- C. Torreyi**, Tuckerman. Sedge.
Minneapolis, *Juni*, *Kassube*; Red river valley, *Macoun*. North.
- C. grisea**, Wahl. Sedge.
Blue Earth county, *Leiberg*; Martin county, *Cratty*.
- C. Davisii**, Schw. & Torr. Sedge.
Through the south part of the state. Minneapolis, *Simmons*.
- C. gracillima**, Schw. Sedge.
Throughout the state, excepting perhaps far southward. Minneapolis, *Juni*, *Kassube*; Blue Earth county, *Leiberg*.
- C. digitalis**, Willd. Sedge.
Minneapolis, *Juni*; north of lake Superior, *Agassiz*. Infrequent.
- C. laxiflora**, Lam. Sedge.
Common, or frequent, throughout the state. Blue Earth county, *Leiberg*.
- C. laxiflora**, Lam., var. **blanda**, Boott. Sedge.
Jordan, Scott county, *Juni*; Emmet county, Iowa, *Cratty*. Doubtless other varieties of this species also occur here.
- C. eburnea**, Boott. Sedge.
Throughout the state, excepting perhaps southwestward. Blue Earth county, *Leiberg*; Emmet county, Iowa (rare), *Cratty*.
- C. pedunculata**, Muhl. Sedge.
Throughout the state. Rainy lake, *Richardson*, *Boott*; Blue Earth county, *Leiberg*.
- C. Emmonsii**, Dew. Emmons' Sedge.
Blue Earth county, *Leiberg*. [Manitoba, *Macoun*.]
- C. Pennsylvanica**, Lam. Sedge.
Common throughout the state, excepting perhaps northeastward. Minneapolis, *Juni*, *Kassube*; Blue Earth county, *Leiberg*; Emmet county, Iowa (common), *Cratty*.
- C. varia**, Muhl. Sedge.
Lapham. Infrequent.
- C. Richardsonii**, R. Br. Richardson's Sedge.
Throughout the state. Minneapolis, *Juni*. (frequent) *Kassube*; Blue Earth county, *Leiberg*.
- C. pubescens**, Muhl. Sedge.
Through the south part of the state. Minneapolis, *Juni*, *Kassube*; Blue Earth county, *Leiberg*.
- C. miliacea**, Muhl. Sedge.
Range like the last. Minneapolis, *Juni*, *Kassube*.
- C. arctata**, Boott. Sedge.
Agate bay, lake Superior, *Juni*. Infrequent.
- C. capillaris**, L. Sedge.
Port Arthur, lake Superior, *Macoun*; Saskatchewan river, *Bourgeau*; probably also in northern Minnesota.

- C. flexilis**, Rudge. Sedge.
Knife river, lake Superior, *Juni*. Rare. North.
- C. Cederi**, Ehrh. Sedge.
Throughout the state, excepting perhaps far southward. *Lapham*. Leech lake, *Houghton*; Rainy river and lake, *Richardson*, *Boott*.
- C. filiformis**, L. Sedge.
Throughout the state. Put in bay, lake Superior, *Juni*; Emmet county, Iowa (frequent), *Cratty*.
- C. filiformis**, L., var. **latifolia**, Boeck. (*C. lanuginosa*, Michx.) Sedge.
Throughout the state. North shore of lake Superior (frequent), and Minneapolis, *Juni*; Red river valley near Saint Vincent, *Dawson*, *Macoun*; Emmet county, Iowa (plentiful), *Cratty*.
- C. Houghtonii**, Torr. Houghton's Sedge.
Itasca lake (Lac la Biche), *Houghton*; Blue Earth county, *Leiberg*. [Manitoba, *Macoun*; Council Bluffs, Iowa, *Geyer*.]
- C. riparia**, Curtis. Sedge.
Common, or frequent, throughout the state. North of lake Superior (common), *Juni*; lake of the Woods (sandy swamp), *Dawson*, *Macoun*; Blue Earth county, *Leiberg*.
- C. aristata**, R. Br. Sedge.
Throughout the state, but infrequent. Pembina, *Chickering*; New Ulm, *Juni*; Blue Earth county, *Leiberg*.
- C. Pseudo-Cyperus**, L., var. **comosa**, W. Boott. (*C. comosa*, Boott.) Sedge.
Common, or frequent, through the south part of the state. Blue Earth county, *Leiberg*; Emmet and Dickinson counties, Iowa (frequent), *Cratty*, *Arthur*.
- C. Pseudo-Cyperus**, L. Sedge.
Throughout the state. Lake of the Woods (marsh), *Dawson*, *Macoun*; Chaska, Carver county, *Juni*; Spirit Lake, Iowa, *Arthur*.
- C. hystricina**, Willd. Sedge.
Common throughout the state, excepting perhaps far northwestward. *Lapham*. Minneapolis, *Juni*, *Kassube*; north of lake Superior, *Agassiz*.
- C. tentaculata**, Muhl. Sedge.
Range like the last, but less frequent. *Lapham*. Minneapolis, *Simmons*; north of lake Superior, *Agassiz*.
- C. intumescens**, Rudge. Sedge.
Common throughout the state. Lake of the Woods and Rainy lake, *Richardson*, *Boott*; north of lake Superior (common), also New Ulm, *Juni*.
- C. lupulina**, Muhl. Sedge.
Blue Earth county, *Leiberg*; Minneapolis, *Simmons*. [Manitoba, *Macoun*.]
- C. squarrosa**, L. Sedge.
Wabasha, *Gibson*, determined by *Arthur*. South.
- C. retrorsa**, Schw. Sedge.
Throughout the state. Lake of the Woods, *Richardson*, *Boott*; Moose Lake, Carlton county, *Juni*; Blue Earth county, *Leiberg*; Emmet county, Iowa, *Cratty*.
- C. utriculata**, Boott. Sedge.
Throughout the state, excepting far southward. Red river prairie, *Dawson*, *Macoun*.
- C. monile**, Tuckerman. Sedge.
North of lake Superior, *Juni*; Emmet county, Iowa (frequent), *Cratty*.

C. oligosperma, Michx. Sedge.

Agate bay, lake Superior *Juni*. Infrequent. North.

C. saxatilis, L. var. **miliaris**, Bailey. (*C. miliaris*, Michx. *C. rotundata*, Wahl.?, in *Manual*.) Sedge.

Collected in Minnesota by *Dr. J. Leidy*; determined by *S. T. Olney*. *Bot. Rep. of King's Expt. of the Fortieth Parallel*.

C. longirostris, Torr. Sedge.

Throughout the state. Minneapolis, *Juni*, *Kassabe*; Mankato (common), *Leiberg*; also common in Martin county, and in Emmet county, Iowa, *Cratty*.

[A considerable number of species of *Carex* not here recorded will doubtless be added by future observers in this state, who should look for all such as approach, or are especially northern, in their geographic range, given in *Gray's Manual*.]

GRAMINEÆ. GRASS FAMILY.

LEERSIA, Swartz. WHITE GRASS. FALSE RICE.**L. Virginica**, Willd. White Grass.

Ramsey and Goodhue counties, *Ostlund*; Minneapolis, *Simmons*; Blue Earth county, *Leiberg*; Emmet county, Iowa (rare), *Cratty*. South.

L. oryzoides, Swartz. Rice Cut-grass.

Common in sloughs through the south half of the state and in the Red river valley, *Juni*, *Upham*; Ramsey and Goodhue counties, *Ostlund*; Blue Earth county, *Leiberg*.

L. lenticularis, Michx. Fly-catch Grass.

Lapham. South.

ZIZANIA, L. WATER OR INDIAN RICE.**Z. aquatica**, L. Wild Rice. Indian Rice. Water Oats. Folie Avoine (of the French voyageurs).

Common, or frequent, in favorable situations, throughout the state; sometimes attaining, in Brown county, a height of 13 feet, with leaves 4 feet long, *Juni*.

"Wild rice; *Pshu* of the Sioux; *Manomin* of the Chippewas. This aquatic grass, not uncommon in the Northern United States, acquires in the Northwest an economical importance second to no other spontaneous production. It is the only instance in this region of a native grain, occurring in sufficient quantity to supply the wants of ordinary consumption. It is particularly abundant on the lake-like expansions of rivers, towards their sources, which give such a marked feature to the distribution of these northern streams, and is so grandly illustrated in their main type, the Mississippi. It seems to select, by preference, the lower terminations of these expansions, which generally debouch by a narrowed outlet and considerable fall, constituting rapids. It is in these situations best exposed to the proper degree of inundation, and finds a suitable bed of the slimy sand, in which it grows most readily. It is rarely met with on inland lakes which have no outlet. As an article of food it is highly palatable and nutritious, being generally preferred to the commercial rice. The grain is long, slender, of a brown color. In boiling, it puffs out to a pulaceous mass, and increases its bulk several times. It flowers in August, and is ready for gathering in September, which is conveniently done in canoes, the standing stalks being bent over the sides, and the grain beaten in. Its productive fields, at this season, harbour a great number of wild fowls, which obliges those who wish to secure a full crop, to anticipate the gathering season, by tying up the standing grain into bundles, which gives at the same time a claim to the crop. When gathered it is subjected to a process of parching and thrashing, which, with the imperfect means at the command of the Indians, is the most tedious part of the business." *Parry*.

ALOPECURUS, L. FOXTAIL GRASS.

- A. geniculatus, L., var. aristulatus, Munro.** (*A. aristulatus, Michx.*)
Wild Foxtail.
Common, or frequent, throughout the state.

PHLEUM, L. CAT'S-TAIL GRASS.

- P. pratense, L. Timothy. Herd's-Grass* (of New England).
Commonly cultivated, often spontaneous, throughout the state.

SPOROBOLUS, R. Br. (Including *VILFA, Beauv.*) DROP-SEED GRASS. RUSH-GRASS.

- S. asper, Kunth.** (*Vilfa aspera, Beauv.*) Rush-Grass.
Lapham. New Ulm, *Juni.* South.
- S. vaginæflorus, Torr.** (*V. vaginæflora, Torr.*) Rush-Grass.
Lapham. Minneapolis (sandy bottomland of the Mississippi river), *Oestlund;* Emmet county, Iowa (frequent), *Cratty.* South.
- S. cuspidatus, Torr.** (*V. cuspidata, Torr.*) Rush-Grass.
Lapham. Hennepin and Goodhue counties, *Oestlund;* Emmet county, Iowa (rare), *Cratty.* [Devil's lake, and southern Dakota, *Geyer;* Manitoba, *Macoun.*]
- S. depauperatus, Torr.*** (*V. depauperata, Torr.*) Rush-Grass.
Red river valley, at Pembina, *Havard.* West.
- S. junceus, Kunth.** Drop-seed Grass.
Lapham. New Ulm, *Juni.* Rare. South.
- S. heterolepis, Gray.** Drop-seed Grass.
Throughout the state, excepting perhaps northeastward. Ramsey county, *Oestlund;* Blue Earth county, *Leiberg;* common in Emmet county, Iowa, *Cratty.* [Eastern Nebraska (abundant), *Aughey;* Manitoba, *Macoun.*]
- S. cryptandrus, Gray.** Drop-seed Grass.
Through the south part of the state. Ramsey county, *Oestlund;* Minneapolis, *Simmons, Upham, Dr. Vasey;* Emmet county, Iowa (rare), *Cratty;* Spirit lake and Little Sioux river, *Geyer.*

AGROSTIS, L. BENT-GRASS.

- A. perennans, Tuckerman.** Thin-Grass.
Throughout the state, excepting perhaps northeastward. *Lapham.* Minneapolis, *Upham;* Pembina, *Havard.*
- A. scabra, Willd.** Hair-Grass.
Common, or frequent, throughout the state.

***SPOROBOLUS DEPAUPERATUS, Torr.** Root perennial, creeping; culms ascending, appressed-branched, slender, often geniculate, glabrous, striate, rather rigid, $\frac{1}{2}$ to 2 feet long; leaves 1 to 3 inches long, narrow and usually convolute, spreading or recurved; panicle very slender and contracted, 1 to 3 inches long; compound or often nearly simple; spikelets small; glumes unequal, ovate, obtuse or acutish, membranous, two-thirds the length of the acute lower palea, which is more less obscurely 3-nerved.—Resembling *V. cuspidata*, and scarcely differing except in the shorter obtuse glumes of the rather smaller flowers. Lower palea a little more than 1 line long, glabrous or slightly scabrous on the midnerve, the upper one obtuse or erose at the summit. *Watson's Rep. in King's Expl. of the Fortieth Parallel.*

A. canina, L. Brown Bent-Grass.Pipestone county, *Leiberg*. Rare.**A. vulgaris**, With. Red-top. Herd's-Grass (of Pennsylvania, &c.)Probably native northward; also much cultivated, and thence often spontaneous, throughout the state. (According to *Dr. George Thurber*, in the *Botany of California*, this should be called a variety of *A. alba*, L.)**A. vulgaris**, With., var. **alba**, Vasey. (*A. alba*, L.) Fiorin. White Bent-Grass.Ramsey county, *Oestlund*; Red Wing, *Sandberg*; Blue Earth county, *Leiberg*; New Ulm, *Juni*. [Lake Superior, *Whitney*.]**CINNA**, L. WOOD REED-GRASS.**C. arundinacea**, L. Wood Reed-Grass.Throughout the state. *Lapham*. Upper Mississippi river, *Houghton*; Blue Earth county, *Leiberg*.**C. pendula**, Trin. (*C. arundinacea*, L., var. *pendula*, Gray.) Wood Reed-Grass.Lake Superior and northward, *Gray's Manual*; doubtless in northern Minnesota.**MUHLENBERGIA**, Schreber. DROP-SEED GRASS.**M. sobolifera**, Trin. Drop-seed Grass.*Lapham*. South.**M. glomerata**, Trin. Drop-seed Grass.Common, or frequent, throughout the state; not confined to wet places, but often growing on dry and even sandy ground; abundant southwestward, frequently persisting as a plentiful weed in wheat-fields and other cultivated land, *Upham*.**M. glomerata**, Trin., var. **ramosa**, Vasey, ined. Drop-seed Grass.Minneapolis (bluff of Mississippi river near the University), *Upham*; probably the prevailing form of the species in this state. [Much branched from the base upward, the lateral branches slender, naked above, very leafy; outer glumes only slightly longer to one-third longer than the flower; flowering glume sparingly villous. Minnesota, Dakota and Utah. *Letter of Dr. Vasey*, Sept. 30, 1884.]**M. Mexicana**, Trin. Drop-seed Grass.Ramsey county, *Oestlund*; Blue Earth county, and southwestward (common), *Leiberg*; Pembina, *Havard*.**M. sylvatica**, Torr. & Gray. Drop-seed Grass.*Lapham*. North of lake Superior, *Agassiz*. Probably throughout the state.**M. Willdenovii**, Trin. Drop-seed Grass.Through the south part of the state. *Lapham*. Blue Earth county, *Leiberg*.**M. ambigua**, Torr.* Drop-seed Grass.Stony banks of Okaman lake (lake Elysian), Waseca county, *Geyer*.

***MUHLENBERGIA AMBIGUA**, Torr. Panicle dense, obovate; glumes rather unequal (the inferior one shorter), linear-lanceolate, very acute, 1- or 2-flowered, very hairy at the base; superior valve [palea] with a bristle at the tip equalling it in length, a little shorter than the glumes (exclusive of the awns); superior floret either perfect, and then resembling the inferior, or rudimentary and aristiform. . . . Culms caespitose, about 1½ feet high, glabrous; leaves broadly linear; stipules very short, truncate

BRACHYELYTRUM, Beauv. BRACHYELYTRUM.**B. aristatum**, Beauv. Brachyelytrum.

Lapham. Blue Earth county, *Leiberg*.

DEYEUXIA, Clarion. (Included in CALAMAGROSTIS, Gray's *Manual*.)

REED BENT-GRASS.

D. Canadensis, Beauv. Blue-Joint.

Common throughout the state. The principal grass of the natural meadows bordering streams in the wooded region northward, supplying an abundance of excellent hay for the logging teams of the pineries.

D. stricta, Trin. Reed Bent-Grass.

Throughout the state. Collected in Minnesota by *Nicollet* (*Watson*); Ramsey and Hennepin counties, *Oestlund*; Minneapolis, *Simmons*; Blue Earth County, *Leiberg*; Emmet county, Iowa (common), *Cratty*; Pembina, *Havard*.

D. Laponica, Kunth. (Calamagrostis Laponica, Trin., in Addenda of Gray's *Manual*.) Reed Bent-Grass.

Isle Royale, lake Superior, *Prof. T. C. Porter*; doubtless also in northern Minnesota.

D. confinis, Nutt. Reed Bent-Grass.

Lapham. Common in Grant county and the Red River valley, *Upham*.

D. Nuttalliana, Steud. Reed Bent-Grass.

Lapham. Lake Winnibigoshish, *Houghton*; Minneapolis, *Kassube*.

AMMOPHILA, Host. (§§ 2 and 3, CALAMAGROSTIS, Gray's *Manual*.)

REED BENT-GRASS.

A. longifolia, Benth. (*C. longifolia*, Hook.) Reed Bent-Grass.

Throughout the state. Ramsey county, *Oestlund*; Saint Paul, *Kelley*; Minneapolis, also northwestward (common on the beaches of lake Agassiz), *Upham*; Blue Earth county, *Leiberg*.

A. arundinacea, Host. (*C. arenaria*, Roth.) Sea Sand-Reed.

Common on southern beaches of lake Superior, *Whitney*; doubtless also on the shore of this lake in Minnesota.

ORYZOPSIS, Michx. MOUNTAIN RICE.**O. melanocarpa**, Muhl. Mountain Rice.

Lapham. Ramsey county, *Oestlund*; Minneapolis, *Simmons*; Blue Earth county, *Leiberg*.

O. asperifolia, Michx. Mountain Rice.

Throughout the state, excepting perhaps far southward. *Lapham.* Stearns county, *Garrison*; Minneapolis, *Simmons*.

O. Canadensis, Torr. Mountain Rice.

Lapham. Infrequent. Range like the last.

and lacerate; panicle 4 to 6 inches long, purplish; glumes tapering to a very acute cuspidate point, with a strong green midrib; perianth clothed at the base with whitish hairs, which are nearly half as long as the valves; valves nearly equal; awn a little tortuous, sometimes longer than the valve; superior floret often perfect, and maturing its fruit; when rudimentary, consisting of a mere awn, without any valve. A remarkable species, with the habit of *M. glomerata* and *M. Mexicana*. *Torrey* in *Nicollet's Report*.

STIPA, L. FEATHER-GRASS. WEATHER-GRASS.**S. Richardsonii, Link. Richardson's Feather-Grass.**

North shore of lake Superior, and in Manitoba, *Macoun*; doubtless reaching into Minnesota. North.

S. spartea, Trin. Porcupine Grass.

Abundant southwestward, being the principal grass of the prairie in some districts, and extending undiminished into Dakota; common north to Clay county and east to New Ulm; frequent northeast to the sources of the Mississippi, *Houghton*, and to Sherburne and Anoka counties, and in the southeast part of the state, *Upham*. (See *American Naturalist*, vol. xviii, pp. 929-931.) The grain is prolonged below in a stout callus or base, needle-like in sharpness, and above in a long twisted awn; both of which are minutely barbed, so that, when inserted in the wool of sheep or in men's clothing, the seed works forward readily but not backward. Thus this very appropriately named grass is a serious annoyance at the time of maturity and falling of the seed, which is in July. Within a few weeks later, these seeds are found to have bored into the hard, dry, clayey soil of the prairie to a depth of two or three inches, having been pushed or impelled in some way by means of the awn. Perhaps this is effected by its lengthening, while braced against the herbage above, after it had been contracted by partially coiling up, these changes being produced by alternations of dryness and moisture, as in days of sunshine and dewy nights; or, as seems more probable, it may be that the wind, blowing upon the awn, first fastens the sharp-pointed grain in the ground, and afterward slowly drills it downward. This was first brought to the notice of the writer by *Mr. T. M. Young*, at the Sisseton Agency, in Dakota, where, late in August, scarcely any seeds of this grass remained on the surface; but they were found very plentifully thus buried in the ground, often only from a half inch to one inch apart. All had penetrated to nearly the same depth, which was about two and a half inches from the surface to the point of the seed, two thirds of this depth being occupied by the lower part of the awn.

ARISTIDA, L. TRIPLE-AWNED GRASS.**A. basiramea, Engelm. * Triple-awned Grass.**

Minneapolis (plentiful in the vicinity of the University, in the sward on dry sandy land with species of *Bouteloua*, *Poa* and *Andropogon*, from which it is noticeably distinguished by its darker purplish color), *Upham*; Saint Cloud (plentiful), *Campbell*; Pipestone City and Luyerne, in southwestern Minnesota, and near Rock Rapids, Lyon county, in the northwest corner of Iowa, *Leiberg*.

It has also been collected in Nebraska by *Rev. J. H. Wibbe*, and in Kansas by *Mr. E. Hall*; and *Mr. F. L. Scribner* and *Prof. J. M. Coulter* report it from Iowa and Illinois. *Rev. J. Scott* writes that it occurs at Brandon, Manitoba. [Nebraska specimens show a much greater size (20 inches high) and a more branching habit, the culms becoming geniculate. *Vasey*.]

***ARISTIDA BASIRAMEA**, Engelm. in a letter to W. Upham.—Annual: culms erect, 6 to 15 inches high, slender, much branched at the base (some of the branches very short but floriferous), and with short floriferous branches enclosed in the upper leaf-sheaths: leaves comparatively long (3 to 6 inches), narrowly linear, flat, becoming involute toward the apex, sparsely hairy on the margins below, the upper ones nearly equaling the panicle; sheaths striate, loose; ligule very short, truncate: panicle $1\frac{1}{2}$ to 3 inches long, erect, rather lax, its base sheathed by the upper leaf; branches of the panicle short, mostly single, the lower in twos or threes; glumes linear, unequal, 1-nerved, lower one 4 lines, upper one 6 lines long including the short bristle-like point: flowering glume nearly terete, spotted with black, about 5 lines long including the short, acute and hairy callus; middle awn about 6 lines long, the lateral ones about 4 lines long, spirally twisted below (when mature). The sheathed flowers are somewhat smaller.

This species was discovered last season by *Mr. Warren Upham*, at Minneapolis, Minn. The late *Dr. Engelm.* suggested the name, in a letter, as indicative of its habit, and would have published it if he had lived. It is closely related to *A. DICHO-*

A. purpurea, Nutt.* Triple-awned Grass.

Blue Earth county, and common westward to Pipestone county, *Leiberg*. South-west.

A. purpurascens, Poir. Triple-awned Grass.

Lapham. St. Croix county, Wisconsin, *Swezey*. Infrequent. South.

A. tuberculosa, Nutt. Triple-awned Grass.

Lapham. Pine barrens, St. Croix river, *Parry*. South.

SPARTINA, Schreber. CORD OR MARSH GRASS.**S. cynosuroides**, Willd. Fresh-water Cord-Grass.

Abundant through the south half of the state and in the Red river valley; north of lake Superior, *Agassiz*; making up the greater part of the hay cut in sloughs, worth for fodder fully half as much as the hay of the uplands. Its height is usually from two to four feet, but occasionally it is eight or nine feet. In the five or six counties next to the southwest corner of the state, because of the scarcity of wood and the high cost of that or coal for fuel, a large proportion of the people burn only hay during the whole year. For this purpose the coarse hay of this species is the only kind used. It is mostly burned in ordinary stoves, having been twisted, then doubled and again twisted, forming wisps about one and a half feet long. The quantity of this fuel required for a year's supply in an ordinary farm-house is from eight to twelve tons.

BOUPELOUA, Lagasca. MUSKIT-GRASS. GRAMA-GRASS.**B. oligostachya**, Torr. Muskit-Grass. Grama.

Common, or frequent, southwestward and in the Red river valley; less frequent east to Stillwater and the edge of Wisconsin.

B. hirsuta, Lagasca. Muskit-Grass. Grama.

Common through the south part of the state, extending north to Minneapolis and the St. Croix river, *Parry*; abundant at New Ulm and in Rock and Pipestone counties.

This and the preceding are sometimes called Buffalo Grass in this state, a name which more properly belongs to *Buchloe*. See pages 14 and 32 of *Rothrock's Report on the Botany of Wheeler's Surveys west of the One Hundredth Meridian* for chemical analyses of *Festuca ovina* and the two foregoing species of *Bouteloua*, which with others of this genus are commonly called Grama in the southwestern United States.

B. racemosa, Lagasca. (*B. curtipendula*, Gray.) Muskit Grass. Grama.

Common through the south part of the state, especially southwestward; likewise in the Red river valley.

TOMA, from which it differs in its shorter, erect (not dichotomous) culms, and in its much larger flowers, and especially in the much longer, spreading, lateral awns. From **A. GRACILIS** it differs in the shorter panicle, the longer upper leaves with sheathed flowers, and in the flowers being twice as large. From **A. RAMOSISSIMA** it differs in wanting the larger size, the diffusely branched habit, the much larger flowers with 3-10 5-nerved glumes, and the strong recurved middle awn of that species. *Dr. George Vasey* in the *Botanical Gazette*, vol. ix, p. 76 (May, 1884).

***ARISTIDA PURPUREA**, Nutt. Perennial; culms 6 to 15 inches high, simple, erect, slender, mostly glabrous; sheaths narrow, scabrous, exceeding the internodes, pilose at the throat; leaves very narrow, convolute, $\frac{1}{2}$ to 10 inches long; panicle slender, erect or flaccid, 3 to 6 inches long, loosely few-flowered; glumes purplish, the upper 6 to 9 lines long, about twice exceeding the lower, and longer than the flower, bifid and shortly awned; flower densely short-pilose at the pointed base, scabrous above, 6 lines long, the awns equal or nearly so, separate to the base, not jointed, 1 to 2 inches long, scabrous. *Watson's Rep. in King's Expl. of the Fortieth Parallel*.

BUCHLOE, Engelm. BUFFALO GRASS.

B. dactyloides, Engelm.* Buffalo Grass.

Abundant in the vicinity of the pipestone quarry, at Pipestone City, commencing a few rods north of the railroad depot, and extending the whole length of the outcropping ledge of rock northward, in company with a dense growth of prickly pear (*Opuntia Missouriensis* and *O. fragilis*); also occurring, at rare intervals, on stony and gravelly soil, in Rock county, and in Lyon county, Iowa; (not found farther east; perhaps in all these places introduced by the Indians in their journeys from the western plains to the pipestone quarry;) *Leiberg*. [Formerly the most abundant species of grass throughout Nebraska, lately disappearing, according to *Aughey*, who attributes its dying out to increased rain-fall.]

GRAPHEPHORUM, Desv. GRAPHEPHORUM.

G. festucaceum, Gray.† *Grappheporum*.

In Emmet county, Iowa, six miles south of the state line (plentiful upon space of five or six square rods, in edge of lake), *Cratty*; determined by *Prof. Asa Gray*; the first observation of this species in the United States, though it abounds in the Saskatchewan region and extends thence northward, and also is found in northern Europe. Doubtless it occurs in western and northern Minnesota. (*Botanical Gazette*, vol. ix, p. 27; Feb., 1884.)

***BUCHLOE**, Engelmann. Flowers diœcious, heteromorphous.—*Male plant*. Spikes 1-sided, 2-ranked; spikelets 2- or 3 flowered. Glumes 2, 1-nerved, lower much smaller. Palets 2, of equal length, longer than the glumes; lower one 3-nerved, mucronate; upper one 2-nerved. Squamulæ in pairs, truncate, emarginate. Stamens 3; anthers linear. Rudiment of an ovary none.—*Female plant*. Spikes 1 to 3, short, capitate, oblique in the involucre sheaths of the upper leaves; spikelets 1-flowered, crowded, upper floret abortive, withering. Glumes 2; lower glume of the lowest spikelets 1- to 3-nerved, lanceolate-subulate, with an herbaceous tip, or 2- or 3-cleft, lower side adnate to the back of the upper glume; lower glumes of the other spikelets (internal as to the head) free, much smaller, membranaceous, ovate-lanceolate, acute, 1-nerved; upper glumes (external) connate at the base with the thickened rachis, at length like a hard, woody involucre, ovate, nerveless, pale, trifid at the herbaceous, nerved tip. Lower palet (internal as to the head) shorter, 3-nerved, herbaceous, tricuspidate; upper palet shorter, 2-nerved. Squamulæ as in the male flowers. Rudiments of the stamens 3, minute. Ovary lenticular, glabrous, very short-stipitate; stigmas much longer than the 2 erect terminal styles, plumose with simple hairs, exsert from the apex of the flower. Caryopsis free, included in a horny, at length deciduous head, sublenticular, flat on the outside (toward the lower palet), convex on the inner side.

B. DACTYLOIDES, Engelmann. *Trans. Saint Louis Acad.*, vol. i, p. 432, pl. 12 and 14. Densely tufted, spreading by stolons, forming broad mats; culms 3 to 6 inches long; flowering stems of the male plant 4 to 6 inches long, glabrous or slightly hairy; leaves 2 to 4 inches long, $\frac{1}{2}$ to $1\frac{1}{2}$ lines wide, nearly smooth; sheaths striate, glabrous, strongly bearded at the throat; spikes 3 to 6 lines long; spikelets alternate in 2 rows, uppermost abortive, bristle-form, 2 to 3 lines long; lower glume ovate-lanceolate, with a scarios margin; upper glume twice longer, ovate; lower palet convex, 3-nerved, upper one 2-nerved, two minute scales at the margin and inside of the lower palet; stamens 3. Stems of the female plant much shorter than the leaves, $1\frac{1}{2}$ to 2 inches high; heads 3 to $3\frac{1}{2}$ lines long; glumes becoming ligneous; spikes or heads usually 2; at maturity becoming thick, extremely hard, including the loose grain.—The celebrated "buffalo grass," known to hunters and trappers as one of the most nutritious grasses, on which for a part of the year subsist and fatten the immense herds of buffalo and the cattle of the hunter and emigrant. *Porter and Coulter's Flora of Colorado*.

†**GRAPHEPHORUM FESTUCACEUM**, Gray. (*Festuca borealis*, Mert. & Koch. *Arundo festucacea*, Willd.) Culm as thick as a swan's quill, 3 to 4 or more feet high; leaves 8 to 10 inches long, broadly linear-acuminate, rough to the touch. Panicle a foot and more long, almost quite erect, as well as the subverticillate slender branches.

DIARRHENA, Raf. **DIARRHENA**.

- D. Americana**, Beauv. Diarrhena.
Sherburne county, *Upham*. Rare. South.

DACTYLIS, L. **ORCHARD GRASS**.

- D. glomerata*, L. *Orchard Grass*.
Ramsey county, *Oestlund*; Minneapolis, *Simmons*; Mankato, *Leiberg*.

KCELERIA, Pers. **KCELERIA**.

- K. cristata**, Pers. *Kceleria*.

Common, or frequent, throughout the state. [The most plentiful species of grass on the line of the Northern Pacific railroad in western Dakota, *Leiberg*.]

EATONIA, Raf. **EATONIA**.

- E. obtusata**, Gray. *Eatonia*.

Minneapolis, *Upham*; Blue Earth county, *Leiberg*. [Manitoba, *Macoun*.] South and west.

- E. Pennsylvanica**, Gray. *Eatonia*.

Throughout the state, excepting perhaps northwestward. Ramsey county, *Oestlund*; Minneapolis, *Upham*; Blue Earth county, *Leiberg*; New Ulm, *Juni*. [North of lake Superior, *Agassiz*.]

GLYCERIA, R. Br. **MANNA-GRASS**.

- G. Canadensis**, Trin. *Rattlesnake-Grass*.

Frequent throughout the state, excepting far southward. St. Croix river, *Parry*; Ramsey county, *Oestlund*; Minneapolis, *Simmons*, *Kassube*.

- G. elongata**, Trin. *Manna-Grass*.

Minneapolis, *Upham*; Blue Earth county, *Leiberg*. Infrequent.

- G. nervata**, Trin. *Fowl Meadow-Grass*.

Common throughout the state.

[*G. pallida*, Trin., doubtless occurs in this state, but has been overlooked.]

- G. aquatica**, Smith, var. **Americana**, Vasey. *Reed Meadow-Grass*.

Common throughout the state.

Spikelets erect, $\frac{1}{2}$ to $\frac{3}{4}$ of an inch long, scattered or subfascicled, sessile or pedicellate, generally 4-flowered. Glumes unequal, convex, rounded at the back, not keeled, the outer one shorter than the florets, acute, entire at the point, the middle nerve reaching beyond the point, so as to form a short arista; there are besides, on each side, two short lateral nerves; the inner glume as long as the whole spikelet of florets, torn at the point, aristate, the middle nerve reaching beyond the point; there are besides 2 lateral nerves reaching to the apex, and 2 intermediate shorter ones. Florets cylindrical, closely placed, with a tuft of white hairs at the base of each; outer valve [pale] of the perianth jagged at the point, shortly aristate, with 7 nerves reaching to the summit; the inner lanceolate, the margin inflected, with 2 strong, green, ciliated nerves at the flexures, running out so as to form a bifid apex; upper floret smaller than the rest. *Hooker's Flora Borealis Am.*, II, 251. — The Iowa specimens, communicated by Mr. R. I. Cratty, agree fully with this description, except that the spikelets are not so large, scarcely exceeding $\frac{3}{8}$ of an inch in length. Pedicels of the spikelets rough; awns formed by the nerves, especially of the glumes, inconspicuous, and sometimes barely observable. It grows 3 to 5 feet high in water, at the margin of lakes. *Arthur* in *Contributions to the Flora of Iowa*, No. VI.

G. fluitans, R. Br. Manna-Grass.
Common, or frequent, throughout the state.

POA, L. MEADOW-GRASS. SPEAR-GRASS.

P. annua, L. Low Spear-Grass.

Throughout the state, excepting perhaps far southward, but infrequent. Minneapolis, *Kassube*; Blue Earth county, *Leiberg*.

P. compressa, L. Wire-Grass.

Throughout the state, but infrequent. *Parry*, *Lapham*. Ramsey county, *Oestlund*; Blue Earth county, *Leiberg*; Pembina, *Chickering*, *Havard*.

P. alpina, L. Spear-Grass.

Isle Royale, and north shore of lake Superior, *Loring*, *Porter*, *Macoun*; doubtless also in Minnesota. North.

P. cæsia, Smith. Spear-Grass.

Throughout the state. North shore of lake Superior, *Juni*; Blue Earth county, *Leiberg*; Emmet county, Iowa, *Cratty*.

P. cæsia, Smith, var. **strictior**, Gray. Spear-Grass.

Isle Royale, *Whitney*; Red river, *Dawson*, *Macoun*. North.

P. serotina, Ehrh. False Red-top. Fowl Meadow-Grass.

Common throughout the state.

P. pratensis, L. Green or Common Meadow-Grass. Kentucky Blue-Grass. June Grass.

Common throughout the state; taking the place of the original prairie grasses in southwestern Minnesota, *Juni*. [In Nebraska not native, but spreading westward, *Aughey*.]

P. sylvestris, Gray. Spear-Grass.

Lapham. Pembina, *Havard*. Rare. South and west.

[*P. debilis*, Torr., probably occurs in this state.]

P. alsodes, Gray. Spear-Grass.

Saint Paul, *Kelley*; Red river valley, at Pembina, *Chickering*. Infrequent. South and west.

ERAGROSTIS, Beauv. ERAGROSTIS.

E. reptans, Nees. Eragrostis.

Through the south part of the state. *Lapham*. Goodhue county, *Oestlund*; Blue Earth county, *Leiberg*.

E. poæoides, Beauv., var. **megastachya**, Gray. Eragrostis.

Abundant, in door-yards and by road-sides, through the south half of the state; common north at least to Crow Wing, Todd and Grant counties, and in the Red river valley, *Upham*. It was found by *Geyer* in 1839 on sandy plains in the valley of the Shyenne river, Dakota, and is quite probably indigenous* in this region.

E. pilosa, Beauv. *Eragrostis*.

Blue Earth county, *Leiberg*; Minneapolis (distinct from *E. Purshii*), *Upham*. Infrequent. South.

E. Frankii, Meyer. Frank's Eragrostis.

Hastings, Dakota county, *Oestlund*. Southeast

E. Purshii, Schrader. Pursh's Eragrostis.

Becoming abundant by road-sides and in waste places, Ramsey county, Minneapolis,

and Steele county, *Oestlund, Simmons, Upham*; determined by *Scribner, Vasey and Watson*. South.

E. capillaris, Nees. Eragrostis.

Lapham Minneapolis, *Kassube*. Infrequent. South.

E. pectinacea, Gray. Eragrostis.

Lapham. Minneapolis, *Simmons*. South.

E. pectinacea, Gray, var. **spectabilis**, Gray. Eragrostis.

Minneapolis (river bluff near the University), *Oestlund, Upham*. South.

FESTUCA, L. FESCUE-GRASS.

F. tenella, Willd. Slender Fescue-Grass.

Through the south half of the state. *Lapham*. Minneapolis, *Simmons*, (abundant on sandy land east of the University) *Upham*.

F. ovina, L. Sheep's Fescue.

Frequent throughout the state, excepting perhaps far southward.

F. rubra, L. (*F. ovina*, L., var. *rubra*, Gray.) Red Fescue.

Lake Superior, *Dr. Robbins*, and northward, Gray's *Manual*; probably in northern Minnesota.

[*F. duriuscula*, L. (*F. ovina*, L., var. *duriuscula*, Gray), should also be looked for northward.]

F. elatior, L. (Including *F. pratensis*, Hudson.) Taller or Meadow Fescue.

Minneapolis, old state farm close southeast from University, *Oestlund*. Infrequent.

F. nutans, Willd. Nodding Fescue.

Throughout the state, excepting perhaps far northward, but infrequent. Lake Winnebigoishish, *Houghton*; lake Minnetonka, *Oestlund*; Blue Earth county, *Leiberg*; Emmet county, Iowa (rare), *Cratty*.

BROMUS, L. BROME-GRASS.

B. secalinus, L. Cheat or Chess.

Occasional in wheat-fields, mostly southeastward. A very unwelcome immigrant. Plentiful in Houston county, especially in fields of winter wheat, also frequent in mowing land, *J. S. Harris*; frequent, but not so plentiful as to be troublesome, in Steele county and at Minneapolis, *Upham*.

B. racemosus, L. Upright Chess.

Minneapolis, *Kassube*. Infrequent.

B. Kalmii, Gray. Wild Chess.

Common, or frequent, throughout the state, excepting perhaps northeastward.

B. ciliatus, L. Wild Chess.

Common, or frequent, throughout the state.

B. ciliatus, L., var. **purgans**, Gray. Wild Chess.

Minneapolis, *Upham*. Probably common.

PHRAGMITES, Trin. Reed.

P. communis, Trin. Reed.

Common, or frequent, in the edges of ponds and lakes, throughout the prairie portion of the state; also at Roseau lake and the lake of the Woods, *Dawson*.

SCHEDONNARDUS, Steudel.* **SCHEDONNARDUS**.

- S. Texanus**, Steud. (*Lepturus paniculatus*, Nutt.) Schedonnardus.
Rocky hills, Mound township, Rock county, *Leiberg*. [Upper Missouri river, *Geyer*.]
Rare. Southwest.

LOLIUM, L. **DARNEL**. RAY-GRASS.

- L. temulentum*, L. *Bearded Darnel*.
Mankato (plentiful about the elevator of the St. Paul & Sioux City railroad), *Leiberg*.

AGROPYRUM, Beauv. (**TRITICUM**, L., in part.) **WHEAT-GRASS**.

- A. repens**, Beauv. (*T. repens*, L.) Couch-, Quitch-, Quick-, or Witch-Grass.

Frequent, or common, throughout the state, but rarely so plentiful as to be troublesome. (Specimens which must be referred to this species, as decided by *Mr. Sereno Watson*, were found at Minneapolis on the embankment of the railroad about an eighth of a mile northwest from the University and close west of Tuttle's brook, having a very narrow and long spike of many spikelets, awnless, as long or half as long as the joints of the rhachis, 3-flowered, with a rudiment of a fourth flower, often the lowest or the middle flower not ripening its grain, and having in some instances no running rootstocks. The typical *T. repens* occurs near by, and also forms which seem to be intermediate in respect to both the character of the spikes and the presence of rootstocks. *Upham*.)

- A. dasystachyum**, Vasey. (*T. dasystachyum*, Gray.) Wheat-Grass.
North shore of lake Superior, *Agassiz*; doubtless also in northern Minnesota.

- A. violaceum**, Vasey. (*T. violaceum*, Hornemann.) Wheat-Grass.
Throughout the state, but rarer than the next. Pembina, *Havard*; in openings of woods, on sandy modified drift, at the north west side of Mille Lacs, *Upham*; Ramsey county, *Oestlund*; Emmet county, Iowa, *Cratty*.

- A. caninum**, Rœn. & Schultes. (*T. caninum*, L.) Wheat-Grass.
Frequent throughout the state, excepting perhaps far southward. Pembina, *Havard*; Minneapolis, *Twining*, *Upham*; Blue Earth county, *Leiberg*; New Ulm, *Juni*. [Between the James and Red rivers, Dakota, *Geyer*.]

HORDEUM, L. **BARLEY**.

- H. jubatum**, L. Squirrel-tail Grass.
Common, or frequent, throughout the state.
- H. pusillum**, Nutt. (*H. pratense*, Gray's *Manual*.) Barley-Grass.
Blue Earth county, *Leiberg*. Rare. South.

ELYMUS, L. **LYME-GRASS**. WILD RYE.

- E. Virginicus**, L. Wild Rye.
Frequent throughout the state; less common than the next.

- E. Canadensis**, L. Nodding Wild Rye.
Common throughout the state.

***SCHEDONNARDUS**, Steudel. Spikelets one-flowered, solitary at each joint of the slender triangular rhachis of the paniculate spikes, and partly immersed in an excavation; the spikes alternate and distant; outer glumes acuminate, unequal, the longer equalling the flowering glume, which is linear-acuminate, and thickish at the keel; palea shorter and thinner. *Vasey's Grasses of U. S.*

E. Canadensis, L., var. **glaucofolius**, Gray. Nodding Wild Rye.

Throughout the state. Lake of the Woods (sandy shore), *Dawson*; Martin county, and Emmet county, Iowa, *Cratty*.

E. Sibiricus, L. Wild Rye.

Red river valley, at Pembina, *Havard*. North.

E. striatus, Willd. Wild Rye.

Throughout the state. St. Croix river, *Houghton*; Ramsey county, *Oestlund*; Minneapolis, *Simmons*; Blue Earth county, *Leiberg*; New Ulm, *Juni*; Martin county (plentiful), *Cratty*. [Lake Superior, *Whitney*; Manitoba, *Macoun*.]

E. striatus, Willd., var. **villosus**, Gray. Wild Rye.

Also throughout the state. Pembina, *Havard*; lake Minnetonka, *Roberts*; Blue Earth county (frequent), *Leiberg*.

E. mollis, Trin. Wild Rye.

Lake shores [probably lake Superior], Minnesota, *Wood's Class-Book*. [North of lake Superior, *Agassiz*.]

E. Sitanion, Schultes.* Wild Rye.

From northern Minnesota to Texas and west to California, *Watson*; Blue Earth county and westward, *Leiberg*. West.

ASPRELLA, Willd. (GYMNOSTICHUM, Schreb.) BOTTLE-BRUSH GRASS.**A. Hystrix**, Willd. (G. Hystrix, Schreb.) Bottle-brush Grass.

Common, or frequent, throughout the state.

DANTHONIA, DC. WILD OAT-GRASS.**D. spicata**, Beauv. Wild Oat-Grass.

Throughout the state, but mostly infrequent. Lake of the Woods, *Dawson*; Stearns county, etc., *Upham*; Pipestone county, *Mrs. Bennett*.

AVENA, L. Oat.**A. fatua**, L.† *Wild Oats*.

Ramsey county (new state farm and adjoining land, growing in grain-fields and on waste ground, apparently naturalized and spreading), *Oestlund*. Extensively naturalized in California; also found in Texas and Wisconsin, in the latter state becoming very troublesome in oat-fields, *Vasey*; but not yet reported (so far as known to the writer) in other portions of the United States east of the Rocky mountains. Its seeds ripen early and mostly fall before harvest, rendering its extermination more difficult. It is supposed to be the original of the cultivated oat (*A. sativa*, L.).

***ELYMUS SITANION**, Schultes. Culms 4 inches to 2 feet high, tufted, and with the leaves and sheaths glabrous or somewhat pubescent or scabrous; spike erect, 1 to 3 inches long, squarrose with its long recurved awns, jointed and fragile at maturity; spikelets in pairs, 2- to 5-flowered, smooth or puberulent; glumes entire or usually parted to the base and the segments unequally 2-cleft, the divisions long-awned (1 to 3 inches); flowers 3 lines long, the awn of the lower palea equaling that of the glumes, with often a subsidiary awn or tooth on each side at the apex of the palea. A very variable grass. *Watson's Rep. in King's Expl. of the Fortieth Parallel*.

† *Avena fatua*, L. An erect annual, 2 or 3 feet high, smooth except at the hairy nodes, with flat slightly scabrous leaves and loose sheaths: panicle 8 to 10 inches long, the few-flowered rays spreading equally; spikelets about an inch long, the scarious pointed glumes longer than the florets, often purplish at base: lower palea about 6 lines long, firm at base, scabrous and covered with long brown hairs, its lobes tapering to a sharp point; awn about twice the length of palea, bent near the middle and twisted below: grain very hairy. *Thurber in Botany of California*.

A. striata, Michx. Oat-Grass.

Throughout the state, excepting perhaps far southward, Isanti county, etc. (frequent), *Upham*; New Ulm, *Juni*.

A. Smithii, T. C. Porter. Oat-Grass.

Isle Royale, and eastward about lake Superior, Gray's *Manual*; probably also north of this lake in Minnesota.

TRISETUM, Persoon. TRISETUM.**T. subspicatum**, Beauv., var. **molle**, Gray. Trisetum.

North of lake Superior (common), *Macoun*.

DESCHAMPSIA, Beauv. (AIRA, L., in part.) HAIR-GRASS.**D. cæspitosa**, Beauv. (*A. cæspitosa*, L.) Hair-Grass.

Throughout the state, excepting perhaps far southward, but infrequent. Blue Earth county, *Leiberg*.

[*D. flexuosa*, Beauv. (*A. flexuosa*, L.), probably also occurs in this state.]

ARRHENATHERUM, Beauv. OAT-GRASS.*A. avenaceum*, Beauv. Tall Oat-Grass.

New state farm, Ramsey county, *Oestlund*. Infrequent.

HIEROCHLOA, Gmelin. HOLY GRASS.**H. borealis**, Rœm. and Schultes. Vanilla or Seneca Grass.

Common, or frequent, throughout the state.

PHALARIS, L. CANARY-GRASS.*P. Canariensis*, L. Canary-Grass.

Occasionally adventive: Minneapolis, *Simmons*, *Upham*; Waterville, Le Sueur county, *Oestlund*.

P. arundinacea, L. Reed Canary-Grass.

Common, or frequent, throughout the state.

[*Milium effusum*, L., probably occurs in this state, but has been overlooked.]

BECKMANNIA, Host. BECKMANNIA. BECKMANN'S GRASS.**B. eruceiformis**, Host.* Beckmann's Grass.

Lapham. Pipestone quarry (growing in the hollows of the rock, where water occasionally stands), *Leiberg*. [James river, Dakota, *Geyer*; and north to the Saskatchewan river and Bear lake, *Watson*.] Rare. West.

***BECKMANNIA**, Host. Panicle racemose, contracted. Spikelets compressed, 2-flowered, the upper floret an abortive rudiment. Glumes 2, obovate, compressed-boatshaped, subcoriaceous, equal, a little shorter than the flower, pointless. Palets membranous, the lower ovate, concave, acutish, mucronate, 3-nerved, the upper 2-nerved, bifid. Stamens 3. Styles 2, with elongated plumose stigmas. Scales 2, bifid, glabrous. Grain free, glabrous.—A coarse perennial aquatic.

B. ERUCEIFORMIS, Host. Culms stout, 1 to 3½ feet high, erect from an ascending base, with the sheaths glabrous; ligules elongated; leaves linear, 4 to 8 inches long and 2 to 6 lines wide, flat, acute, scabrous; panicle 4 to 12 inches long, erect, strict, secund, the short crowded branchlets densely flowered from the base, glabrous; spikelets sessile, imbricately arranged in two rows, nearly orbicular, 1½ lines in diameter, the upper rudimentary floret minute, stipitate. June to September. *Watson's Rep. in King's Expl. of the Fortieth Parallel*.

PANICUM, L. PANIC-GRASS.*P. glabrum*, Gaudin. *Smooth Finger-Grass.*Minneapolis (plentiful), *Simmons, Upham*; Blue Earth county, *Leiberg*.*P. sanguinale*, L. *Common Crab- or Finger-Grass.*Minneapolis, *Kassube*; Blue Earth county, *Leiberg*.**P. agrostoides**, Spreng. PANIC-GRASS.*Lapham*. Ramsey and Hennepin counties, *Oestlund*. South.**P. capillare**, L. Old-witch Grass.

Common throughout the state. Late in autumn "the spreading panicle is easily broken off and blown about by the wind."

P. autumnale, Bosc. PANIC-GRASS.*Lapham*. New Ulm, *Juni*. Rare. South.**P. virgatum**, L. PANIC-GRASS.Abundant southwestward and in the Red river valley; frequent southeastward. "Nowhere so luxuriant as near the upper Des Moines river and Spirit lake," *Geyer, Torrey*.**P. latifolium**, L. PANIC-GRASS.Through the south half of the state, but infrequent. Minnesota river, *Parry*; Blue Earth county, *Leiberg*; Minneapolis, *Simmons*; Anoka county, etc., *Upham*.[*P. clandestinum*, L., probably also occurs in this state.]**P. xanthophysum**, Gray. PANIC-GRASS.Throughout the state. Minneapolis, *Kassube*; Steele and Isanti counties, *Upham*. [Manitoba, *Macoun*; also in the catalogues of Wisconsin, Iowa and Nebraska.]**P. consanguineum**, Kunth, var. **latifolium**, Vasey, ined.* PANIC-GRASS.New state farm, Ramsey county, *Oestlund*. Probably frequent; resembling *P. xanthophysum*, so that perhaps some of the references under that species belong instead to this.**P. pauciflorum**, Ell. PANIC-GRASS.Throughout the state, excepting perhaps northeastward. Red river (swampy prairie), *Dawson*; Ramsey county, *Oestlund*; Minneapolis, *Upham*; Blue Earth county, *Leiberg*; Emmet county, Iowa (common), *Cratty*.**P. dichotomum**, L. PANIC-GRASS.Common, or frequent, throughout the state. [Specimens collected in early summer by *Mr. Oestlund* on the new state farm, Ramsey county, are regarded by *Dr. Vasey* as representing the typical form of this species. It occurs intermingled with other grasses on lowlands: mainly smooth; culms slender, 1½ feet high; panicle long-peduncled.]**P. dichotomum**, L., var. **pubescens**, Vasey, ined. (*P. pubescens*, Lam.) PANIC-GRASS.Ramsey and Hennepin counties (usually about a foot high, becoming much branched), *Oestlund, Upham*; probably the more common form of the species in this state. *Gray's Manual* characterizes it as "a shaggy-hairy and larger-flowered variety." [Culm rather leafy, 1 to 2 feet high; leaves and sheaths decidedly pubescent or villous. *Letter of Dr. Vasey*, Sept. 30, 1884.]***PANICUM CONSANGUINEUM**, Kunth. Smooth or villous; culms (1 to 1½ feet high) at length excessively branched; leaves linear, erect; panicle long-peduncled, the flexuous widely spreading branches few-flowered; spikelets obovate, pale, pubescent; upper glume 7-nerved; upper palea of the neutral flower none; perfect flower acute. *Chapman's Flora of the Southern States*, appendix, p. 687.—Var. **LATIFOLIUM**, Vasey, ined. Culms weaker, leaves wider, and flowers more pubescent. Minnesota, *Oestlund*. *Letter of Dr. Vasey*, Sept. 30, 1884.

[Two others of the forms included under *P. dichotomum* in Gray's *Manual*, but separated from it by appendix of Chapman's *Flora of the Southern States*, with the descriptions here quoted, are recognized by Dr. Vasey (*Grasses of U. S.*) as distinct species, namely, *P. LAXIFLORUM*, Lam. (culms tufted, smooth, 6 to 12 inches high; leaves lanceolate, acuminate, ciliate, mostly pale yellowish-green, 2 to 3 inches long, the villous sheaths shorter than the internodes; panicle diffuse, plumose-bearded, rather few-flowered; spikelets scattered, oval, densely pubescent, the upper glume 7-nerved; neutral flower bipaleaceous; fertile flower acute: on dry sandy ground), and *P. BAMULOSUM*, Michx., in part (low, 6 to 8 inches high, tufted, very smooth and shining; culm mostly purple; leaves linear; panicle $1\frac{1}{2}$ to 2 inches long, diffusely branched, many-flowered; spikelets minute, purple, very smooth, the upper glume and neutral pale 5-nerved: in sandy woodlands); both of which are common in the eastern states, but have not yet been observed so far northwestward as Minnesota.]

P. depauperatum, Muhl. Panic-Grass.

Throughout the state. *Lapham*. Blue Earth county, *Leiberg*; Emmet county, Iowa, *Cratty*. [Lake Superior, *Whitney*; Manitoba, *Macoun*.]

P. Crus-galli, L. Barnyard-Grass.

Common throughout the state.

P. Crus-galli, L., var. **hispidum**, Gray. Cockspur Grass.

Rock and Pipestone counties, etc. (frequently seen attaining a very rank growth beside roads where they cross creeks or boggy land, apparently indigenous), *Leiberg*.

SETARIA, Beauv. BRISTLY FOX-TAIL GRASS.

S. verticillata, Beauv. Bristly Fox-tail Grass.

Mankato, *Leiberg*. Rare.

S. glauca, Beauv. "Pigeon-Grass." Foxtail.

Common, often abundant, throughout the state.

S. viridis, Beauv. "Pigeon-Grass." Green Foxtail. Bottle-Grass.

Also common, or abundant, in cultivated ground, with the last.

S. Italica, Kunth. Millet. Bengal-Grass.

Becoming a bad weed in flax-fields in the southern part of the state, *Leiberg*; New Ulm, *Juni*.

CENCHRUS, L. HEDGEHOG-GRASS. BUR-GRASS.

C. tribuloides, L. "Sand-bur." Hedgehog-Grass. Bur-Grass.

Common, or frequent, in sandy lands along the Mississippi and Minnesota rivers. (Occasionally attacked by smut, as at Minneapolis in 1884.)

ANDROPOGON, L. BEARD-GRASS.

A. furcatus, Muhl. "Blue-Joint." Beard-Grass. Forked Spike.

Common, or abundant, throughout the prairie region of the state: extending north-east at least to Crow Wing county, *Upham*, and the lake of the Woods, *Dawson*. Highly esteemed for hay; southward it is usually called "Blue-Joint," a name which properly belongs to *Deyeuxia Canadensis*.

A. scoparius, Michx. Beard-Grass. Broom-Grass.

Common, with same range as the last.

CHRYSOPOGON, Trin.* CHRYSOPOGON. BEARD-GRASS.

C. nutans, Benth. (*Sorghum nutans*, Gray.) Indian Grass. Wood-Grass.

Common, with same range as the two last; making good hay.

*CHRYSOPOGON, Trin. Flowers loosely paniculate. Fertile spikelets one-flowered, sessile between two pedicellate male or barren spikelets at the end of the slender

EQUISETACEÆ. HORSETAIL FAMILY.

EQUISETUM, L. HORSETAIL. SCOURING-RUSH.

[*E. Telmateia*, Ehrh., probably occurs in this state north of lake Superior.]

E. arvense, L. Common Horsetail.
Common throughout the state.

E. pratense, Ehrh. Meadow Horsetail.

Throughout the state, excepting perhaps far southward. Morrison county, *Upham*; Stearns county, *Campbell*; Saint Paul, *Kelley*.

E. sylvaticum, L. Wood Horsetail.

Throughout the state : common northward, but infrequent far southward.

[*E. palustre, L.*, will probably be found in the north part of the state.]

E. limosum, L. Swamp Horsetail.

Common, or frequent, throughout the state.

E. lævigatum, Braun. Horsetail.

Minneapolis, *Simmons*; Red river, near Saint Vincent, *Dawson*, *Scott*. South and west.

E. hiemale, L. Scouring-Rush. Shave-Grass.

Common throughout the state ; very abundant along the banks of the Minnesota river, *Parry*.

E. variegatum, Schleicher. Horsetail.

Throughout the state, excepting perhaps far southward. Near the Mississippi river, Anoka county, *Upham*; Minneapolis, *Simmons*. Infrequent.

E. scirpoides, Michx. Horsetail.

Range like the last, also infrequent. *Lapham*. Deep woods, St. Croix river, *Parry*.

FILICES. FERNS.

POLYPODIUM, L. POLYPODY.

P. vulgare, L. Common Polypody.

Abundant, or common, through the north half of the state ; frequent southeastward, on the rocky bluffs of the St. Croix, Mississippi and Minnesota rivers, and their tributaries ; rare south westward.

ADIANTUM, L. MAIDENHAIR.

A. pedatum, L. American Maidenhair.

Frequent, in many places common or abundant, throughout the state.

PTERIS, L. BRAKE OR BRACKEN.

P. aquilina, L. Common Brake. Bracken. Eagle Fern.

Common, or frequent, throughout the state.

branches of the panicle, with, sometimes, one to three pairs of spikelets on the branch below the terminal three. Fertile spikelets with the lower glume larger and coriaceous ; the second narrower, thick, keeled, pointed or awned ; the third hyaline and empty ; the fourth or flowering glume hyaline and awned. Palet minute or none. *Vasey's Grasses of U. S.*

CHEILANTHES, S.artz. LIP-FERN.

- C. lanuginosa**, Nutt. Lip-Fern.
Lapham, Miss Cathcart. Falls of the St. Croix, *Parry.* Rare.

PELLÆA, Link. CLIFF-BRAKE.

- P. gracilis**, Hook. Slender Cliff-Brake.

Throughout the state, but rare. Blue Earth river, and head of lake St. Croix, *Parry*; Saint Paul (rare), *Miss Cathcart*; cliffs forming the right bank of the Mississippi in Minneapolis, also at Minneopa falls, Blue Earth county, *Leiberg*; lake Pepin, *Miss Manning*; Martin county, and Emmet county, Iowa (rare), *Cratty*.

- P. atropurpurea**, Link. Clayton's Cliff-Brake.

Throughout the state, but infrequent. Stillwater, *Miss Field*; Saint Paul, *Miss Cathcart*; Hastings, *Oestlund*; lake Pepin, *Miss Manning*; Blue Earth county, *Leiberg*.

CRYPTOGRAMME, R. Br. (ALLOSORUS, Bernhardt, in part.)
ROCK-BRAKE.

- C. acrostichoides**, R. Br. (*Allosorus acrostichoides*, Sprengel.) Rock-Brake.

Isle Royale, lake Superior, thence westward and northward, *Gray's Manual*; doubtless in Minnesota.

ASPLENIUM, L. SPLEENWORT.

- A. Trichomanes**, L. Maidenhair Spleenwort. Dwarf Spleenwort.

Burnt Portage, Dawson road, near the northern boundary of Minnesota, *Macoun*; Taylor's Falls, *Miss Cathcart*; Lake City, *Mrs. Ray*. Throughout the state, but infrequent.

- A. ebeneum**, Ait. Ebony Spleenwort.

Taylor's Falls, *Miss Cathcart*. Rare. [*Nebraska, Aughey.*]

[*A. Ruta-muraria*, L., and *A. angustifolium*, Michx., should be looked for in this state.]

- A. thelypteroides**, Michx. Silvery Spleenwort.

St. Croix river, *Parry*; Stillwater, *Miss Field*; lake Pepin, *Miss Manning*; Blue Earth county, *Leiberg*. East.

- A. Filix-fœmina**, Bernh. Lady-Fern.

Common (having diverse forms, but probably not permanent varieties) in woodlands throughout the state.

CAMPTOSORUS, Link. WALKING-LEAF. WALKING-FERN.

- C. rhizophyllus**, Link. Walking-L af. Walking-Fern.

Throughout the state, but rare. Rocks, upper Mississippi river, *Geyer*; falls of the St. Croix, *Parry*; Taylor's Falls and Duluth, *Miss Cathcart*; Stillwater, *Miss Field*; Red Wing, *Oestlund*; lake Pepin, *Miss Manning*. [*Manitoba, Macoun; Nebraska, Aughey.*]

PHEGOPTERIS, Fée. BEECH-FERN.

- P. polypodioides**, Fée. Common Beech-Fern.

Abundant north of lake Superior, *Roberts*; extending south to the St. Croix river, *Parry*; Taylor's Falls (plentiful), *Miss Cathcart*. [*Manitoba, Macoun; Nebraska, Aughey.*]

P. hexagonoptera, Fée. Hexagon Beech-Fern.

Duluth (plentiful), *Miss Cathcart*; and through the south half of the state, but rare.

P. Dryopteris, Fée. Oak-Fern.

North of lake Superior (common), *Roberts*; St. Louis river, *Mrs. Herrick*; St. Croix river, *Parry*, *Miss Field*; Taylor's Falls (plentiful), Saint Paul (rare), *Miss Cathcart*. [Manitoba, *Macoun*.]

P. calcarea, Fée.* (P. *Dryopteris*, Fée, var. *Robertianum*, Davenport.) Beech-Fern.

"Collected in eastern Minnesota, growing on slaty rocks on the [west] bank of the St. Louis river, near [close north of] the crossing of the Northern Pacific Railway, by *Miss Ellen W. Cathcart*. Formerly attributed to America, but not clearly known as American till now. It is rather common in Europe, and has been found in the Himalayan regions of Asia. It will probably be found from Lake Superior to Idaho. This fern is very closely related to the common P. *Dryopteris*, and is often considered a variety of it." *Eaton's Ferns of North America*: 1880; vol. ii, p. 277. Since this was written, a second locality of this fern has been discovered by *Mr. E. W. Holway* at Decorah, Iowa, where it occurs only upon a space about six feet square, "in the crevices of the north side of a limestone bluff." *Arthur*; *Bulletin of Torrey Botanical Club*, vol. ix, p. 50. Still more recently it has been collected by *Prof. J. Macoun* in Anticosti island, and by *Drs. G. M. Dawson* and *R. Bell* in the country around and to the east of the lake of the Woods. *Science*, vol. iii, p. 676 (June 6, 1884).

ASPIDIUM, Swartz. SHIELD-FERN. WOOD-FERN.**A. Thelypteris**, Swartz. Marsh Shield-Fern.

Common, or frequent, throughout the state.

A. Noveboracense, Swartz. New York Shield-Fern.

Stearns county, *Campbell*; lake Pepin, *Miss Manning*. Infrequent. East.

A. fragrans, Swartz. Fragrant Wood-Fern.

Isle Royale, *Dr. Lyons*; Duluth and Taylor's Falls, *Miss Cathcart*; Kettle river in T. 42, R. 20, Pine county, *Upham*; falls of the St. Croix, *Parry*; Pipestone quarry, *Mrs. Bennett*. [Nebraska, *Aughey*.] North and southwest.

A. spinulosum, Swartz. Spinulose or Common Wood-Fern.

Throughout the state, but rare. *Lapham*. Duluth, *Miss Cathcart*; lake of the Woods, *Dawson*.

A. spinulosum, Swartz, var. *intermedium*, Eaton. Spinulose or Common Wood-Fern.

Common, or frequent, throughout the state, excepting far southward. Ramsey county, *Simmons*; Pine county, etc., *Upham*. [North of lake Superior, *Agassiz*; Nebraska, *Aughey*.]

A. spinulosum, Swartz, var. *dilatatum*, Hornemann. Spinulose or Common Wood-Fern.

Throughout the state, excepting far southward. Falls of the St. Croix, *Parry*; Duluth, *Miss Cathcart*; Cascade river, north of lake Superior, *Roberts*. [Manitoba, *Macoun*; Nebraska, *Aughey*.]

***PHLEGOPTERIS CALCAREA**, Fee. Rootstock slender, cord-like, widely creeping; stalks scattered, slender, glandular, chaffy near the base, six to twelve inches high; fronds herbaceous, rather rigid, minutely glandular, deltoid, four to eight inches long and about as broad at the base, ternate; primary divisions stalked, pinnate with oblong or ovate-oblong pinnæ, which are pinnately lobed or divided; lowest inferior pinna of the lateral divisions about equal to the third pinna of the middle division; lobes oblong, obtuse, crenately toothed, or if very large, pinnately lobed; veins pinnately branched, sori small, nearer the margin than the midvein. *Eaton's Ferns of N. A.*

A. Bootii, Tuckerman. (*A. spinulosum*, Swartz, var. *Bootii*, Gray.) Boott's Wood-Fern.

Kanabec county, *Upham*. Infrequent.

A. cristatum, Swartz. Crested Wood-Fern.

Throughout the state; frequent northward, rare southward. St. Croix river, *Parry*; Minneapolis, *Simmons*; Saint Paul and lake Harriet (near Minneapolis), *Miss Cathcart*; Blue Earth county, *Leiberg*. [Extending northwest to lake Winnipeg, *Eaton*; Nebraska, *Aughey*.]

A. Goldianum, Hook. Goldie's Wood-Fern.

Minnesota, *Davenport*; Minneopa falls, Blue Earth county, *Leiberg*. Rare. East.

A. Filix-mas, Swartz. Male-Fern.

North shore of lake Superior, near Beaver Bay, *Campbell*. Rare. North.

A. marginale, Swartz. Marginal Shield-Fern. Evergreen Wood-Fern-
Lapham, Davenport. Infrequent. [Nebraska, *Aughey*.]

A. acrostichoides, Swartz. Christmas-Fern.

Lapham, Miss Cathcart. Fort Snelling, *Parry*. East.

A. Lonchitis, Swartz. Holly-Fern.

South of lake Superior, *Whitney*; doubtless also north of this lake in Minnesota. [Nebraska, *Aughey*.]

[*A. aculeatum*, Swartz, var. *Braunii*, Doell, will also probably be found in the north-east part of this state.]

CYSTOPTERIS, Bernhardi. BLADDER-FERN. CYSTOPTERIS.

C. bulbifera, Bernh. Bulblet Cystopteris.

Frequent, or common, throughout the state.

C. fragilis, Bernh. Brittle Fern.

Also frequent, or common, throughout the state. Very variable; the form named var. *dentata*, Hook., has been observed at Cascade river, north of lake Superior, *Roberts*; Taylor's Falls, *Miss Cathcart*; and in Iowa (common), *Arthur*.

C. montana, Bernh. Bladder-Fern. Cystopteris.

In a swamp at the silver mine three miles up the bay from Port Arthur, *Macoun*; probably also to be found north of lake Superior in Minnesota. [Deltoid-ovate, delicately triplinnate, and almost quadripinnate fronds, and a long, slender, creeping root-stock. *Eaton* in *Wheeler's Report of Surveys west of the One Hundredth Meridian*.]

ONOCLEA, L. SENSITIVE FERN.

O. Struthiopteris, Hoff. (*Struthiopteris Germanica*, Willd.) Ostrich-Fern.

Common, or frequent, throughout the state, excepting southwestward.

O. sensibilis, L. Sensitive Fern.

Common throughout the state, excepting perhaps near its west side. (A frond eighteen inches high, sterile on one side of the stipe, but wholly fertile on the other side, was found by the writer in Todd county. The form called var. *obtusilobata*, Torr., has been noted at Taylor's Falls, *Miss Cathcart*, and Mankato, *Gedge*.)

WOODSIA, R. Br. WOODSIA.

W. obtusa, Torr. Obtuse Woodsia.

Throughout the state, but local. Taylor's Falls [falls of the St. Croix], *Parry*,

(abundant) *Miss Cathcart*, *Miss Field*; Rock county, *Leiberg*; Pipestone quarry, *Mrs. Bennett*. [Manitoba, *Macoun*; Nebraska, *Aughey*.]

W. Ilvensis, R. Br. Rusty Woodsia.

Throughout the state, excepting far southward. North of lake Superior (abundant), *Roberts*; lake of the Woods, *Dawson*; Taylor's Falls and Duluth (common), *Miss Cathcart*, *Miss Field*; Stearns county, *Mrs. Blaisdell*; upper Minnesota river, *Parry*; Redwood Falls, *Miss Butler*. "A dwarf form. one to three inches high, yet fruiting freely, was common in the clefts of the rocks on the summit of Carlton's Peak." *Roberts*.

[*W. hyperborea*, R. Br., found by *Prof. Macoun* on the north shore of lake Superior, should be looked for in northern Minnesota. It is nearly related to *W. Ilvensis*, but is tenderer in its texture, much less chaffy, and narrower in outline, with shorter, more obtuse, and less divided pinnæ. *Eaton's Ferns of N. A.*]

W. glabella, R. Br. Smooth Woodsia.

North of lake Superior (at Kakabeka falls), *Macoun*; doubtless also to be found in northern Minnesota; Stillwater, *Miss Field*.

W. Oregana, Eaton. Oregon Woodsia.

South shore of lake Superior and westward [Keweenaw peninsula and lake Winnipeg]; doubtless in northern Minnesota; also at Stillwater, *Miss Field*.

W. scopulina, Eaton.* Rocky Mountain Woodsia.

Collected by *Miss Cathcart* at Duluth, and at Taylor's Falls on the St. Croix river; Lyons creek below Minneopa falls, Blue Earth county, *Gedge*. "Growing in dense masses on rocks and in crevices, from Oregon to Mono Pass, California, and extending eastward to Dacotah, Minnesota and Colorado. . . . The largest specimens are from Minnesota and Colorado." *Eaton's Ferns of North America*.

DICKSONIA, L'Her. DICKSONIA.

D. pilosiuscula, Willd. (*D. punctilobula*, Kunze.) Fine-haired Mountain Fern. Hay-scented Fern.

Miss Cathcart. Stearns county, *Campbell*; lake Pepin, *Miss Manning*. Rare. Southeast.

OSMUNDA, L. FLOWERING FERN.

O. regalis, L. Royal-Fern. Flowering Fern.

Frequent throughout the state, excepting far southward. North of lake Superior (common along Devil's Track river), *Roberts*; Anoka county, etc., *Upham*; Saint Paul and northward, *Miss Cathcart*, *Miss Field*.

O. Claytoniana, L. Clayton's (Interrupted) Flowering Fern.

Common, or frequent, throughout the state.

O. cinnamomea, L. Cinnamon-Fern.

Throughout the state, excepting perhaps northwestward. Common north of lake Superior and at Minneapolis, *Roberts*; Anoka county, etc., *Upham*; Taylor's Falls, *Miss Cathcart*, *Miss Field*; Northfield, Rice county, *Chaney*; lake Pepin, *Miss Manning*.

*WOODSIA SCOPULINA, Eaton. Root-stocks short, creeping, chaffy, forming large tufts or patches; stalks two to four inches high, not jointed, bright ferruginous near the base, paler and stramineous upwards, puberulent like the rachis and the under surface of the frond, with minute jointed hairs and stalked glands; fronds lanceolate-oblong, four to eight inches long, pinnate; pinnæ numerous, eight to fifteen lines long, oblong-ovate, sub-acute, deeply pinnatifid with five to eight pairs of short ovate or oblong obtuse crenulate or toothed divisions; sori sub-marginal; indusium very delicate, deeply cleft into narrow segments which terminate in short hairs composed of irregular cylindrical cells. . . . Nearly like *W. Oregana*. *Eaton's Ferns of N. A.*

OPHIOGLOSSACEÆ. ADDER'S-TONGUE FAMILY.

BOTRYCHIUM, Swartz. GRAPE-FERN. MOONWORT.**B. Lunaria**, Swartz. Moonwort.

North shore of lake Superior, *Macoun*; doubtless to be found in northern Minnesota.

B. simplex, Hitchcock. Hitchcock's Grape-Fern.

Thomson, Carlton county (rare), *Miss Cathcart*. [Abundant at Fort William, north of lake Superior, *Macoun*.] North.

[*B. lanceolatum*, Angström, and *B. matricariæfolium*, Braun, probably occur in northeastern Minnesota. The latter is distinguished from *B. lanceolatum* by having the sterile segment petioled, diverging but little and embracing the fertile when young, oblong and only in the largest plants deltoid, with its divisions and lobes oblong or ovate and obtuse; panicle with stalk usually half as long as the sterile segment, and sometimes longer than it; and by its fruiting two or three weeks earlier. *Eaton's Ferns of N. A.*]

B. Virginianum, Swartz. Virginia Grape-Fern. Rattlesnake Fern.

Frequent, or common, throughout the state.

B. ternatum, Swartz. (*B. lunarioides*, Swartz. *B. australe*, R. Br.) Ternate Grape-Fern.

Throughout the state, but infrequent. St. Croix river, *Parry*; St. Croix Falls (rare), *Miss Field*; lake Pepin, *Miss Manning*; near Lake Crystal (station now obliterated), *Leiberg*; lake of the Woods at mouth of Rainy river, *Dawson*. [Var. *obliquum*, Milde, and var. *dissectum*, Milde, probably also occur in this state.]

OPHIOGLOSSUM, L. ADDER'S TONGUE.

O. vulgatum, L. Adder's-Tongue.

Lake of the Woods at mouth of Rainy river, with the last, *Dawson*. Rare.

LYCOPODIACEÆ. CLUB-MOSS FAMILY.

LYCOPodium, L. CLUB-MOSS. TRAILING EVERGREEN.**L. lucidulum**, Michx. Shining Club-Moss.

Mouth of Devil's Track river, lake Superior, and on Carlton's Peak (abundant), *Roberts*; lake of the Woods, *Dawson*; Kettle river, Pine county (common), *Upham*; St. Croix river, *Parry*; Blue Earth county, *Leiberg*. [Hesper, Iowa, *Mrs. Carter*; the sole species of this genus, and its only locality, known in Iowa, *Arthur*.] North.

L. Selago, L. Fir Club-Moss.

North shore of lake Superior, *Juni*, *Roberts*. Rare. North.

L. inundatum, L. Marsh Club-Moss.

Palisades, north shore of lake Superior, *Juni*; Stillwater, *Miss Butler*. North.

L. annotinum, L. Club-Moss.

Common through the north part of the state; extending southwestward to Pine county (common), *Upham*, and the sources of the Mississippi, *Houghton*.

L. dendroideum, Michx. Tree-like Club-Moss. Ground-Pine.

Common northward, extending southwest to Wadena county; the most plentiful species of club-moss in Pine county, *Upham*.

L. clavatum, L. Common Club-Moss.

Common northward, extending thus south at least to Pine county.

L. complanatum, L. Club-Moss. Festoon Ground-Pine.

Common northward; extending south to Wadena and Pine counties (next in abundance after *L. dendroideum*, Michx.), *Upham*. This and the three species next preceding are bounded within nearly the same limits as the pines, spruce and fir.

L. complanatum, L., var. sabinæfolium, Spring. Club-Moss. Ground-Fir.

Frequent far northward; upper Mississippi river, *Garrison*.

SELAGINELLEÆ.

SELAGINELLA, Beauv. DWARF CLUB-MOSS. SELAGINELLA.**S. selaginoides, Link.** Dwarf Club-Moss.

Isle Royale, *Dr. Lyons*; north shore of lake Superior, *Macoun*; doubtless to be found in northern Minnesota.

S. rupestris, Spring. Dwarf Club-Moss.

Throughout the state. Lake of the Woods, *Dawson*; Morrison, Benton and Stearns counties, *Upham*; upper Minnesota river and falls of the St. Croix, *Parry*; Blue Earth county, *Leiberg*; Redstone, near New Ulm, *Juni*; Redwood Falls, *Miss Butler*; Pipestone quarry, *Mrs. Bennett*.

[*S. apus*, Spring, will probably be found in the south part of the state.]

[*Isoetes lacustris*, L., *I. echinospora*, Durieu, var. *Braunii*, Engelm., *I. riparia*, Engelm., and *I. melanopoda*, J. Gay, should be looked for in this state.]

MARSILIACEÆ.

MARSILIA, Lam. MARSILIA.**M. vestita, Hook. & Grev.*** Marsilia.

"Dry swamps in the prairies near Devil's lake," in northeastern Dakota, *Geyer*; "near the Mississippi river," in Iowa, *Dr. Cousens*; probably also in Minnesota. (See notes on this species in *Arthur's Contributions to the Flora of Iowa, No. VI.*)

[Prof. Eaton writes that the Marsilia cited as collected by Geyer is the original of *M. mucronata*, Braun; but it is regarded by Prof. Eaton as a form of *M. vestita*, as at first determined by Dr. Torrey, differing from the ordinary type in having longer peduncles and less hairy sporocarps. *M. uncinata*, Braun, is found, according to Prof. Eaton, in Texas, Louisiana and Florida.]

SALVINIACEÆ.

AZOLLA, L. AZOLLA.**A. Caroliniana, Willd.** Azolla.

Lapham. [The range of this species is stated by Prof. Eaton in the *Botany of California* to be from "Oregon to Arizona, eastward to the Atlantic, and southward to Brazil."]

*MARSILIA VESTITA, Hook. & Grev. Leaflets broadly cuneate, usually hairy, entire, 2 to 7 lines long and broad; petioles 1 to 4 inches long; peduncles free from the petiole; sporocarps solitary, short-peduncled, about 2 lines long, very hairy when young; upper tooth longest, acute, straight or curved; lower tooth obtuse, the sinus between them rounded. . . . Oregon to Texas. *Eaton in Botany of California.*

APPENDIX.

Since the date of the acknowledgments made on page 10, contributions to this catalogue have been received from Mrs. C. L. Herrick, of Minneapolis; Mr. A. W. Jones, of the state university; Mr. W. H. Kelley, of Saint Paul; and Mr. O. W. Oestlund, of Minneapolis. Three varieties of grasses, described by Dr. Vasey, are first published, with his permission, on pages 161 and 172. Mr. Kelley also supplied a copy of notes on the "Botany of Winona county," by J. C. Norton, M. D., printed in the *Winona Republican*, July 14 to Sept. 22, 1857, including a list of 211 species. Several of these are accessions to the foregoing catalogue, while for other species their known geographic range in this state is extended. Items from this source, and others sent by correspondents too late for insertion in their regular places, are as follows:

- Nasturtium obtusum**, Nutt. Water-Cress.
Winona county, *Norton*; Minnehaha falls, *Miss Butler*. South.
- Cardamine rotundifolia**, Michx. (Including *C. rhomboidea*, var. *purpurea*, Torr.) Mountain Water-Cress.
Winona county, *Norton*. Infrequent.
- Arabis petræa**, Lam. Rock Cress.
Winona county, *Norton*. [Ranging from southern Michigan to the shores of lake Superior, Isle Royale, and far northward.]
- Hypericum perforatum**, L. Common St. John's-wort.
Winona county, *Norton*. Infrequent. South.
- Stellaria uliginosa**, Murr. Swamp Stitchwort.
Fond du Lac, at west end of lake Superior, *Mrs. Herrick*. North.
- Cassia Marylandica**, L. Wild Senna.
Winona county, *Norton*. Infrequent. South.
- Cassia nictitans**, L. Wild Sensitive-Plant.
Lily lake, Stillwater, *Miss Butler*. Rare. South.
- AMMANNIA humilis**, Michx. Ammannia.
Lake City, *Gibson*. Infrequent. South.
- Cornus florida**, L. Flowering Dogwood.
Upper Mississippi river, *Garrison*; northern Minnesota, *Sargent's Catalogue of the Forest Trees of N. A.*; Ramsey county, *Winchell*. Rare. South.
- Lepachys columnaris**, Torr. & Gray, var. **pulcherrima**, Torr. & Gray.
Lepachys.
Red river valley near Saint Vincent, *Scott*. West. [Differs only in having a part or even the whole upper face of the ray brown-purple; varies southward into more slender and branching forms, some with rays reduced to a quarter-inch. *Gray's Synoptical Flora of N. A.*]
- Quercus nigra**, L. Black Jack or Barren Oak.
Southern Minnesota, *Sargent's Catalogue of the Forest Trees of N. A.*

ADDITIONAL LOCALITIES.

- Nelumbium luteum*, Willd.; in lake Pepin near Frontenac, *Miss Manning, Mrs. Ray*.
Cardamine pratensis, L.; Winona county, *Norton*.
Oxalis Acetosella, L.; Winona county, *Norton*. [Extending south in Michigan to lake St. Clair.]
Trifolium hybridum, L.; Minneapolis, *A. W. Jones*.
Desmodium rotundifolium, DC.; Winona county, *Norton*.
Vicia sativa, L.; Washington county, Minneapolis and Saint Cloud.
Spiræa tomentosa, L.; Winona county, *Norton*.
Myriophyllum heterophyllum, Michx.; West Saint Paul, *Miss Butler*.
Oenothera fruticosa, L.; Winona county, *Norton*; Waseca county, *Miss Thrall*.
Berula angustifolia, Koch; Winona county (abundant in cold spring brooks, and most abundant in the coldest water), *Norton*.
Cephalanthus occidentalis, L.; Winona county, *Norton*.
Houstonia purpurea, L., var. *ciliolata*, Gray; Winona county, *Norton*.
Solidago ulmifolia, Muhl.; Rice county (rare), *Chaney*.
Ambrosia trifida, L., var. *integrifolia*, Torr. & Gray; common in the Red river valley, *Leiberg*.
Helianthus hirsutus, Raf.; Rice county, *Chaney*.
Coreopsis trichosperma, Michx.; Saint Cloud, *Campbell*.
Lobelia cardinalis, L.; Owatonna, Steele county, *Chaney*.
Asclepias verticillata, L.; add: common southwestward.
Cycloloma platyphyllum, Moquin; bank of Cannon river, Northfield, Rice county, *Chaney*.
Chenopodium capitatum, Watson; Stockton quarries, near Winona, *Holzinger*.
Fœrlichia Florida, Moquin; near Red Wing, *Sandberg*.
Polygonum virginianum, L.; Ramsey county, *Oestlund*.
Dioscorea villosa, L.; Red river valley, *Leiberg*.
Sporobolus asper, Kunth; Minneapolis, *Oestlund*.

CORRECTIONS IN NOMENCLATURE.

Prof. C. S. Sargent has kindly permitted the perusal of proofs of his *Catalogue of the Forest Trees of North America*, a report soon to be published for the Tenth Census of the United States, according to which several changes in nomenclature are required by species in this catalogue, making them read thus: *QUERCUS OBTUSILOBA*, Michx.; *Q. PRINOIDES*, Willd., (*Q. Prinus*, vars. *acuminata*, Michx., and *humilis*, Marshall); *BETULA PAPIRIFERA*, Marshall (*B. papyracea*, Ait.); *ALNUS INCANA*, Willd. [only the type occurs here, while var. *virescens*, Watson (var. *glauca*, Regel, in part), ranges from the Saskatchewan to British Columbia, and thence south in the mountains to New Mexico]; *ALNUS SERRULATA*, Willd.; and *ABIES BALSAMEA*, Miller. Of *Populus balsamifera*, L., var. *candicans*, Gray, Prof. Sargent writes: "Rare and perhaps unknown in a wild state; very common in cultivation."

REVIEW OF THE CATALOGUE.

The total number of plants, including both species and varieties, enumerated in this catalogue and appendix, is 1650, belonging to 557 genera, and representing 118 families or orders. Seventenths of the whole are exogenous: of which 480 are polypetalous, 512 gamopetalous, 149 apetalous, and 14 gymnospermous. Of the remaining three-tenths 427 are endogenous, and 68 are vascular cryptogams.

One-twelfth of this flora consists of introduced species, numbering 138: of which 120 are exogenous, 54 being polypetalous, 44 gamopetalous, and 22 apetalous; and 18 are endogenous. The twelve orders contributing most to this number are Compositæ, 18;

Gramineæ, 17; Cruciferæ, 12; Caryophyllaceæ, 9; Leguminosæ, 9; Labiataæ, 8; Polygonaceæ, 7; Solanaceæ, 6; Chenopodiaceæ, 6; Malvaceæ, 5; Umbelliferæ, 5; and Borraginaceæ, 5. One order and fifty-five genera are represented only by introduced species; leaving 117 orders, 502 genera, and 1512 species and varieties, occurring indigenously in this state.

Counting only indigenous plants, the twelve largest orders are as follows: Compositæ, 204; Cyperaceæ, 129; Gramineæ, 122; Leguminosæ, 62; Rosaceæ, 62; Ranunculaceæ, 45; Filices, 43; Orchidaceæ, 41; Cruciferæ, 39; Liliaceæ, 39; Scrophulariaceæ, 37; and Ericaceæ, 34; making 857, or nine-sixteenths of our native flora.

Again counting only indigenous species and varieties, the forty largest genera are *Carex*, 89; *Aster*, 34; *Solidago*, 28; *Polygonum*, 20; *Ranunculus*, 18; *Viola*, 17; *Potamogeton*, 16; *Helianthus*, 15; *Juncus*, 15; *Potentilla*, 14; *Salix*, 14; *Aspidium*, 13; *Asclepias*, *Habenaria*, and *Panicum*, each 12; *Euphorbia*, *Quercus*, and *Scirpus*, each 11; *Anemone*, *Rubus*, *Galium*, *Artemisia*, *Gerardia*, and *Gentiana*, each 10; *Erigeron*, *Vaccinium*, *Pyrola*, *Eleocharis*, and *Poa*, each 9; *Arabis*, *Hypericum*, *Astragalus*, *Desmodium*, *Ribes*, *Cornus*, *Cnicus*, *Trillium*, *Cyperus*, *Elymus*, *Equisetum*, and *Lycopodium*, each 8. In thirty-one of these genera, including the first three, no introduced plant is found.

Of the 412 species in Sargent's *Catalogue of the Forest Trees of North America* [north of Mexico], 81 occur indigenously in Minnesota; but eight of these, though becoming trees in some portions of the United States, do not here attain a tree-like size or habit of growth, while forty-eight (mostly noticed on pages 13 to 15) become large trees, at least forty or fifty feet high. Besides these, about 125 indigenous shrubs belong to this flora, making its whole number of woody plants about 206. Two species of *Smilax* are the only endogenous plants in this number.

In the statements of geographic range northward, very important aid has been derived from lists by Prof. John Macoun, of plants found in British America north of Minnesota, published in *Reports of Progress of the Geological and Natural History Survey of Canada* for 1875-76, 1878-79, and 1879-80; from his *Catalogue of Canadian Plants; Part I. Polypetalæ*, published as a report of the same survey, in 1883; and from manuscript notes, communicated by Professor Macoun, respecting the divisions of the flora after Polypetalæ. Toward the east, south and southwest, similar aid was found in Wheeler and Smith's *Catalogue of the Phænogamous and Vascular Cryptogamous Plants of Michigan*: 1881 (containing 1634 species and varieties, of which 1476 are indigenous);

COMPARISON WITH OTHER STATES AND WITH EUROPE.

ORDERS.	Genera.	Indigenous genera.	Species & varieties.	Indigenous species and varieties.	Indigenous species and varieties in the flora of Minnesota, also indigenous in						
					Eu- rope.	N. Eng- land.	Mitch- ell- gud.	Wis- consin.	Iowa.	Ne- braska	Cal- ifornia.
Ranunculaceæ.....	12	11	49	45	12	31	34	35	33	35	8
Menispermaceæ.....	1	1	1	1	.....	1	1	1	1	1	.....
Berberidaceæ.....	3	2	3	2	.....	2	2	2	2	2	.....
Nymphæaceæ.....	4	4	8	8	2	6	6	4	4	4	1
Sarraceniaceæ.....	1	1	1	1	.....	1	1	1	1	1	.....
Papaveraceæ.....	2	2	2	1	.....	1	1	1	1	1	.....
Fumariaceæ.....	3	2	7	6	.....	4	4	5	2	4	.....
Cruciferae.....	18	13	51	39	11	20	27	27	28	27	11
Capparidaceæ.....	2	2	2	2	.....	1	1	2	2	2	.....
Violaceæ.....	1	1	18	17	2	15	14	12	10	8	2
Cistaceæ.....	3	3	3	3	.....	3	2	3	2	2	.....
Droseraceæ.....	1	1	3	3	1	2	3	3	.....	1	1
Hypericaceæ.....	2	2	10	9	.....	6	8	7	7	6	.....
Caryophyllaceæ.....	7	5	24	15	8	11	13	11	8	10	5
Paronychiæ.....	1	1	1	1	.....	1	1	1	1	1	.....
Flocoideæ.....	1	1	1	1	.....	1	1	1	1	.....	1
Portulacaceæ.....	3	3	5	4	.....	2	1	3	4	4	1
Malvaceæ.....	6	4	9	4	.....	.....	.....	2	3	3	.....
Tiliaceæ.....	1	1	1	1	.....	1	1	1	1	1	.....
Linaceæ.....	1	1	4	3	.....	1	1	2	1	3	1
Geraniaceæ.....	4	3	9	8	2	8	8	8	6	7	2
Rutaceæ.....	2	2	2	2	.....	1	2	2	2	2	.....
Anacardiaceæ.....	1	1	7	7	.....	7	7	5	5	5	.....
Vitaceæ.....	2	2	5	5	.....	5	4	4	4	3	.....
Rhamnaceæ.....	2	2	3	3	.....	3	3	3	2	3	1
Gelastraceæ.....	2	2	3	3	.....	1	3	2	2	3	.....
Sapindaceæ.....	3	3	8	8	.....	7	8	8	6	5	.....
Folygalææ.....	1	1	6	6	.....	6	6	6	3	6	.....
Leguminosæ.....	27	24	71	62	4	31	38	42	43	52	6
Rosaceæ.....	13	13	62	62	12	49	51	49	39	42	12
Saxifragaceæ.....	8	8	23	22	4	16	19	19	8	17	4
Crassulaceæ.....	2	1	2	1	.....	1	1	1	1	1	.....
Hamamelaceæ.....	1	1	1	1	.....	1	1	1	1	.....	.....
Haloragææ.....	2	2	4	4	3	3	4	3	3	4	2
Onagraceæ.....	5	5	18	18	6	12	14	15	12	16	7
Lythraceæ.....	3	3	3	3	.....	1	2	3	2	2	1
Cactaceæ.....	1	1	3	3	.....	.....	1	3	2	3	.....
Cucurbitaceæ.....	2	2	2	2	.....	2	2	2	1	2	.....
Umbelliferæ.....	22	17	32	27	2	19	22	22	19	22	4
Araliaceæ.....	1	1	5	5	.....	5	5	5	3	4	.....
Cornaceæ.....	1	1	8	8	.....	7	7	6	5	7	1
Caprifoliaceæ.....	8	8	23	23	3	16	23	23	13	12	4
Rubiaceæ.....	4	4	14	14	4	11	14	13	10	11	5
Valerianaceæ.....	2	2	3	3	.....	.....	3	2	2	3	.....
Dipsaceæ.....	1	.....	1	.....	.....	.....	.....	.....	.....	.....	.....
Compositæ.....	58	48	222	204	9	101	141	151	139	154	32
Lobeliaceæ.....	1	1	6	6	1	6	6	5	4	5	.....
Campanulaceæ.....	2	2	4	4	1	3	4	4	4	4	2
Ericaceæ.....	16	16	34	34	12	31	29	26	3	10	9
Ilicineæ.....	2	2	2	2	.....	2	2	2	1	.....	.....
Plantaginaceæ.....	1	1	4	4	1	1	2	2	3	2	1
Primulaceæ.....	9	8	14	13	5	9	11	11	7	10	3
Lentibulaceæ.....	2	2	5	5	4	5	4	4	3	4	3
Orobanchaceæ.....	1	1	3	3	.....	1	2	2	2	3	3
Scrophulariaceæ.....	18	17	41	37	5	25	30	30	24	25	7
Acanthaceæ.....	1	1	1	1	.....	.....	1	1	1	1	.....
Verbenaceæ.....	3	3	8	7	.....	4	6	7	7	7	2
Labiatae.....	20	15	37	29	4	20	24	25	26	26	5
Borraginaceæ.....	8	6	20	15	2	3	10	10	12	13	2
Hydrophyllaceæ.....	3	3	5	5	.....	1	3	3	3	5	1
Polemoniaceæ.....	3	3	6	6	.....	.....	2	4	4	6	1
Convolvulaceæ.....	2	2	8	8	1	4	6	7	5	6	.....
Solanaceæ.....	6	2	14	8	1	1	6	7	5	5	2
Gentianaceæ.....	4	4	13	13	1	6	10	10	8	11	2
Apocynaceæ.....	1	1	2	2	.....	2	2	2	2	2	2

ORDERS.	Gen.	I. g.	Sp.	l. sp.	Eu.	N. E.	Mich.	Wis.	Iowa.	Neb.	Cal.
Asclepiadaceæ	2	2	17	17	.....	11	8	13	14	12	1
Oleaceæ	1	1	5	5	.....	4	5	5	4	5	.....
Aristolochiaceæ	2	2	2	2	.....	1	1	1	1	1	.....
Nyctaginaceæ	1	1	3	3	.....	.....	.....	3	3	2	.....
Phytolaccaceæ	1	1	1	1	.....	1	1	1	1	1	.....
Chenopodiaceæ	5	5	13	7	3	1	2	2	1	5	4
Amarantaceæ	3	3	5	3	.....	1	1	2	3	2	1
Polygonaceæ	3	2	33	26	5	21	24	22	19	19	9
Thymelacææ	1	1	1	1	.....	1	1	1	1	.....	.....
Elaeagnaceæ	2	2	3	3	.....	1	1	1	.....	2	1
Santalaceæ	1	1	3	3	.....	1	2	1	1	1	2
Saururaceæ	1	1	1	1	.....	1	1	1	1	1	.....
Ceratophyllaceæ	1	1	1	1	.....	1	1	1	1	1	1
Callitricheæ	1	1	1	1	.....	1	1	1	1	1	1
Podostemaceæ	1	1	1	1	.....	1	1	.....	.....	.....	.....
Euphorbiaceæ	2	2	13	12	.....	4	5	9	10	9	2
Empetraceæ	1	1	1	1	.....	1	1	1	.....	.....	.....
Urticaceæ	10	9	13	11	1	11	11	11	10	11	.....
Platanaceæ	1	1	1	1	.....	1	1	1	1	1	.....
Juglandaceæ	2	2	5	5	.....	5	5	5	4	4	.....
Cupulifereæ	4	4	15	15	.....	14	12	14	13	13	1
Mylricaceæ	2	2	2	2	1	2	2	2	.....	2	.....
Betulaceæ	2	2	8	8	2	8	7	6	3	5	2
Salicaceæ	2	2	23	19	1	18	17	17	14	13	4
Conifereæ	7	7	13	13	3	13	12	12	4	3	1
Taxaceæ	1	1	1	1	.....	1	1	1	1	.....	.....
Araceæ	4	4	5	5	2	5	5	5	4	4	.....
Lemnaceæ	3	3	4	4	3	4	4	3	3	3	3
Typhaceæ	2	2	7	7	4	7	6	5	4	4	3
Naidaceæ	3	3	18	18	10	16	16	12	13	7	12
Alismaceæ	5	5	10	10	4	8	9	6	7	7	4
Hydrocharidaceæ	2	2	2	2	1	2	2	2	2	2	1
Orchidaceæ	14	14	41	41	10	36	40	34	14	26	9
Amaryllidaceæ	1	1	1	1	.....	1	1	1	1	1	.....
Hæmodoraceæ	1	1	1	1	.....	1	1	.....	.....	.....	.....
Iridaceæ	2	2	2	2	.....	2	2	2	2	2	.....
Dioscoreaceæ	1	1	1	1	.....	1	1	1	1	1	.....
Smilacææ	1	1	4	4	.....	3	4	4	2	2	.....
Liliaceæ	18	17	40	39	4	25	34	31	25	32	5
Juncaceæ	2	2	18	18	9	12	16	12	9	10	7
Pontederiaceæ	2	2	2	2	.....	2	2	2	2	2	1
Commelynaceæ	1	1	1	1	.....	.....	1	1	1	1	.....
Xyridaceæ	1	1	1	1	.....	1	1	.....	.....	1	.....
Eriocaulonaceæ	1	1	1	1	.....	1	1	.....	.....	1	.....
Cyperaceæ	10	10	129	129	37	105	113	95	69	92	39
Gramineæ	47	42	139	122	30	89	96	92	79	89	43
Equisetaceæ	1	1	8	8	6	6	7	8	4	8	3
Filices	15	15	43	43	19	36	40	32	22	29	11
Ophioglossaceæ	2	2	5	5	4	4	4	3	2	2	2
Lycopodiaceæ	1	1	8	8	5	8	7	5	1	2	2
Selaginelleæ	1	1	2	2	1	2	2	2	1	1	1
Marsiliaceæ	1	1	1	1	.....	.....	.....	.....	1	1	1
Salviniaçæ	1	1	1	1	.....	.....	.....	.....	1	1	1
118 Orders.....	557	502	1650	1512	290	1048	1210	1176	949	1091	335

G. D. Swezey's *Catalogue of the Phænogamous and Vascular Cryptogamous Plants of Wisconsin*, forming chapter V in *Geology of Wisconsin*, vol. I: 1883 (containing 1473 species and varieties, of which 1337 are indigenous); J. C. Arthur's *Contributions to the Flora of Iowa*, numbers I to VI: 1876 to 1884 (containing 1210 species and varieties, of which 1097 are indigenous); and Prof. Samuel Aughey's *Catalogue of the Flora of Nebraska*: 1875 (containing 1718 species and varieties of phænogams and vascular cryptogams, of which

1648 are indigenous). Acknowledgment is also due to Mr. Arthur for valuable information and suggestions during this work.

The preceding table presents comparisons with the four state catalogues mentioned; and also with the *Botany of California* (1876 and 1880; by Brewer, Gray, and Watson; 2894 species and 339 varieties, including introduced plants); with the flora of New England, as indicated by Gray's *Manual* (approximately 1364 species and varieties of native phænogams, 243 introduced phænogams, and 74 vascular cryptogams); and with the flora of Europe, so far as it is represented in that of the northern United States, also shown by Gray's *Manual*. From this table it appears that 290 species and varieties of the indigenous flora of Minnesota are also found native in Europe; 1048 in New England; 1210 in Michigan; 1176 in Wisconsin; 949 in Iowa; 1091 in Nebraska; and 335 in California.

In submitting this catalogue to readers, students and botanists, it seems desirable to repeat that it claims to be merely a report of progress in an unfinished work. It is hoped that its publication will incite all the workers in this field to increased efforts, so that the final report of this part of the state survey shall be made as complete and accurate as possible. The cryptogamic vegetation, as mosses, liverworts, lichens, fungi, and algæ, will there be catalogued; and within the province of the present work, there will be incorporated additions and corrections, as well as extension or more exact limitation in statements of the range of species, so far as known. For this purpose, botanists are requested to keep full notes of all observations that supplement or amend this catalogue, and to send them, together with specimens of plants found in Minnesota but not herein recorded, to Prof. N. H. Winchell, curator of the state university museum, Minneapolis.

Probably about a tenth part of the total phænogamous flora of the state remains yet to be noted in neglected nooks, in marsh, dense woods, cool ravines, on cliffs and hills, in streams and lakes. Numerous species and varieties new to science quite certainly await discovery; and it will be interesting in many cases to compare our common and well known plants with specimens of the same gathered in distant portions of the country, or even in this region under differing conditions of soil, moisture, or shade. The greater part of the accessions must be expected, of course, near the borders of the state, being often species that are common or frequent beyond our limits but extend only scantily into Minnesota.

INDEX TO THE FLORA OF MINNESOTA.

Names of orders or families are in **SMALL CAPITALS**; [synonyms are enclosed in brackets;] introduced species, and genera represented only by introduced species, are in *Italic* type.

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