WISCONSIN
NATURAL HISTORY
SOCIETY

PROCEEDINGS

1884-1888
(1885-1889)

OCTOBER 10, 1884.

Dr. Dorner in the chair.

Election of officers: President, G. W. Peckham; Vice-President, Dr. H. Dorner; Corresponding Secretary, M. Grossmann; Recording Secretary, A. Conrath; Treasurer, C. Hennecke; Librarian, F. A. Camann.

DECEMBER 8, 1884.

Dr. Peckham in the chair.

Plan for future work reported by C. Doerflinger, chairman of the committee. Adopted.

B. F. Goss of Pewaukee, G. W. F. Smith, F. C. Winkler, C. F. Eschweiler and Paul Bechtner elected members.

FEBRUARY 3, 1885.

Dr. Peckham in the chair.

Lecture by Dr. Peckham on "The Relation of Insects to Flowers," illustrated by means of the Society's lantern.

The following persons were elected members: Drs. A. B. Farnham, H. M. Brown, H. V. Ogden, J. D. Fisher, R. Martin, F. E. Walbridge, E. Copeland, L. J. Olmsted, J. A. McLeod, W. A. Batchelor, J. P. Bading, S. Marks, G. D. Ladd, L. R. Esau, N. A. Gray, C. H. Ormond, W. Thorndyke, L. J. R. Wolcott, H. F. Sercombe, W. Fox, Louis Frank, F. B. Scribner, A. J. Burgess, and H. E. Hasse.

Messrs. Max Gessler, W. H. Metcalf, W. E. Anderson, Eduard Loéwe, O. P. Pillsbury, E. P. Allis, Jr., and P. Abbott.

MARCH 3, 1885.

Dr. Peckham in the chair.

The following papers, offered for publication, were referred to the committee on publications:

1. "Man's Influence on the Avifauna of Southeastern Wisconsin," by Dr. P. R. Hoy, of Racine.

2. A list of the Coleoptera of Wiseonsin, with notes, by Fr. Rauterberg.

3. "On Some New Genera and Speeies of the Family Attidæ from Madagascar and Central Ameriea," by G. W. and E. G. Peekham.

New members elected: Dr. J. J. Davies, of Raeine; Dr. C. J. Roehr, A. H. Schattenberg, Julius Lando, and E. E. Teller.

MAN'S INFLUENCE ON THE AVIFAUNA OF SOUTHEASTERN WISCONSIN.

By Dr. P. R. Hoy.

For eight or ten years, eounting from 1845, Racine was the ornithologist's "happy hunting-ground." Then the primitive forest occupied the country on the north and for a short distance south, and on the west approached the high rolling prairie, interspersed with groves, skirted by thickets of serub-oak, dogwood, hazel, cte.

Racine is situated on a projection of land on the west shore of Lake Michigan, six miles further east than Milwaukee and two and a half miles further east than Kenosha. Migrating birds make this point a kind of rendezvous, and are followed by a host of rapacious birds, sueh as hawks and owls. Herc southern birds come further north in summer, while northern birds eome further south in winter than they do east of the great lakes; hence there is an overlapping of two distinet faunas, the arctie and southern.

The physieal conditions suffieiently aceount for the great number of birds that visit this section. I call attention briefly to a few of the more remarkable ehanges that have taken place within the last thirty-nine years, since I began studying the birds of southeastern Wisconsin.

Hawks are not one-twentieth as numerous as they were, and, in fact, some species have entirely deserted this seetion. The Swallow-tailed Hawk (*Nauclerus furcatus*) was onee eommon,

nesting within ten miles of Racine, and I was able to furnish several naturalists with specimens of this beautiful kite. I have not seen one in this locality since 1856.

Owls are not now common within fifteen or twenty miles from this point.

Hawk Owls (*Surnia ulula*) were not uncommon during winter. I procured six or eight specimens. Now they are extremely rare.

Three specimens of the Great Grey Owl (*Syrnium cinereum*) were taken at Racine in the winters of 1858 and 1860.

The Turkey-Buzzard (*Cathartes aura*) was once common and nested near Racine. It occurred as far north as Lake Winnebago. Now it is seldom or never seen, having abandoned the locality; but why, is a mystery.

Ravens of the species *Corvus carnivorus* were quite numerous for two or three years. Since, I have seldom heard their hoarse calls.

Crows (*Corvus Americana*) were in early days rare, and none were discovered to nest within thirty miles of the Lake. The first I saw was in 1858. They began nesting in this section about twenty years since, and now are common. Perhaps the increase of domestic animals and the necessary losses from disease and accidents, may have been one remote cause of their increase.

The Yellow-breasted Chat (*Icteria viridis*) was once frequently met with. One pair nested near the Rapids, three miles from Racine. Two were picked up by the roadside, killed by coming in contact with telegraph wires during the night when migrating. They have left us, and we no longer hear their sprightly songs.

Warblers, as residents, have decreased, except the Yellow Warblers (*Dendroica æstiva*), which have rather increased in number. Their song is heard on every side during June, July and August.

The fine species Protonotary Warbler (*Protonotaria citrea*) nested on Root river, near Racine, in 1848 and 1849, in decayed stumps near the water. Willard found one recently near Green

Bay. Prof. Kumlien tells me they are not uncommon near Lake Koshkonong, Jefferson County. Prof. Cook also found them in Jefferson. I saw a pair feeding their young, in Grant County, in 1879.

Twenty or thirty years since the cheerful, chattering song of the active bird, the Short-billed Marsh Wren (*Cistothorus stellaris*) was heard in every low prairie covered with fine carex. The male industriously ties the grass together, making numerous nests, letting his demure mate select one of the number, as best pleases her, in which she deposits pure white eggs. The nests were so abundant that I collected some twenty for exchange. I have seen or heard scarcely a bird of this kind for fifteen or twenty years. Their song has been silenced by the click of the mower. The hay harvest comes before the young are fledged, hence the mower is fatal to this wren's best interests. They have gone, I hope, somewhere where carex abounds and mowers do not.

In the latter part of June, 1847, I visited the Rapids of Racine river, three miles from its mouth. The shore on either side was shaded by birch and Arbor vitæ. The limestone cliffs were covered with rare ferns. The charm of this picturesque spot was enhanced by the singular musical performance of the large Mocking Wren (*Thriothorus ludovicianus*).

Here I shot a female and a young bird which she was feeding; both of them are in my collection. After the next year, I have not seen this large wren near Racine. William Dudley killed one near Madison, which he preserved in his fine local collection. I heard one singing near Mazomanie, Dane County, in 1856. I have no doubt that it may be found still in some of the southwestern counties.

Mocking birds (*Mimus polyglottus*), nested freely in the near vicinity of Racine previous to 1856. I obtained three nests and knew of several that I would not molest, and of three others broken up by young egging-boys. This matchless songster was continually heard among the thorn thickets and witch-hazel bushes. The ax and plow have destroyed the haunts of this interesting bird. None have been seen for fifteen or twenty years.

The Finch family have held their own generally, and at least two species have increased in numbers since the country has been settled.

The Grass Finch (*Poœcetes gramineus*) was extremely rare for several years, say till 1855, since which time it has increased in numbers. Now more nests of this species are taken than of any other of this family.

The Field Sparrow (*Spizella pusilla*) is another of the seed-eaters which has increased in numbers since the country has been largely appropriated by man.

Three specimens of the Golden-crowned Sparrow (*Zonotrichia coronata*) were taken at Racine in the autumns of 1853 and 1854 and the spring of 1856. It is probable that this is not so rare a bird as we have supposed, for its resemblance to the White-crowned Sparrow may deceive us unless we have a close view.

I shot a pair of Cardinal Grosbeaks (*Cardinalis virginianus*) May 20, 1847, and one the next spring. These were the last seen here. They probably inhabited this section in early days.

Formerly the Evening Grosbeak (*Hesperiphona vespertina*) was not uncommon in the maple forests, on the seeds of which they feed, spending much time on the ground seeking them. They were more numerous in late fall and early spring. I procured a dozen pairs, some taken in spring when they visited the orchards and ate the cherry-blossoms. I have seen them as late as the 10th of May. None have been seen here for the last twenty years. The sugar-maple groves are nearly all converted into cord-wood, and wheat occupies the site once visited by this northwestern bird.

Formerly wild Pigeons (*Ectopistes migratorius*) were so abundant that any pot-hunter could shoot all he could carry in a half day.

Mr. Cox, in Caledonia, used to catch them in a net by the five hundred at a time. He sold them for from six to ten cents a dozen. He used to take a great number, put them in a cage and feed them with salted wheat, boiled. After a month the breasts became light-colored and much improved, commanding double price.

Since railroads and the telegraphs have enabled the speculators to follow them to their breeding-stations and take them by the thousand, to be shot by the few for the gratification of the few more, this wholesale slaughter has nearly destroyed the pigeons. We do not see one where hundreds were found thirty years ago.

Wild Turkeys (*Meleagris gallopavo*) were once abundant. The last known to occur in the eastern part of the State was on November 1st, 1846, when a small flock made their appearance near Racine. They were hunted with so much energy that the entire number was killed.

The Ruffed Grouse (*Bonasa umbellus*) was abundant, but is now scarce within twenty miles of Racine, though they still "hold the fort" in the northern part of the State, in spite of hunters and dogs.

Prairie-hens (*Cupidonia cupido*) were found in great numbers. A sportsman with a good dog generally bagged from forty to sixty in a day, sometimes even more.

No better ground for grouse-shooting could be found than the prairies near Racine in old times, or previous to 1858. Now there are many hunters and little game—a meagre gleaning in place of an abundant harvest. Railroads and hunters are responsible for the change.

The Sharp-tailed Grouse (*Pediœcetes phasianellus*) was not rare once. In September, 1848, I shot an entire covey of eighteen and found them in fine condition and of good flavor. For thirty years none have been seen.

Quails (*Ortyx virginianus*) were so numerous, years ago, that they came in coveys into the town. I have shot them in my garden. In the fall and winter of 1849 and 1850, C. A. Orvis collected and shipped to the city of New York two tons of quail. Since this enterprise they became greatly diminished and have never recovered from that attack. Since, there has been a cold winter when many quails froze in their roosting-places; hundreds were thus frozen in bunches of ten to fifteen. I have not seen a quail near Racine for two years.

The first Woodcock (*Philohela minor*) seen near Racine was in the spring of 1849, since which time they have steadily increas-

ed. Now they are common, and large numbers are taken every summer. Angle-worms have increased, and as they are the favorite food of the Woodcock, this fact may in part account for the presence of the bird.

Sandhill Cranes (*Grus Canadensis*) were so common that one could not go any considerable distance on the prairie without seeing numbers of these stately birds. In the spring when they were preparing to nest, they were in the habit of holding a sort of Indian dance, circling about and making their own music at the same time. Farmers frequently kept pet cranes, finding their antics and races with the children very laughable.

They are easily domesticated when taken early from the nest. They are seldom seen on the prairies now.

The Whooping Crane (*Grus Americanus*) was never so abundant as the Sandhill. I presume I never saw more than a dozen in our vicinity.

In rough, mountainous countries, where much land is not tillable and lies unmolested when surrounding country is cultivated, the birds need not so soon entirely desert their usual haunts; but on the open prairie or thinly-wooded country, such as ours, the approach of man to cultivate the soil must steadily and inevitably drive the birds away. There is no fastness to which they can retreat to temporize. They must follow Greeley's advice and go west.

COLEOPTERA OF WISCONSIN.

The following is a list of the beetles collected by me in Wisconsin, mostly in the neighborhood of Milwaukee, during the course of the past ten years, with notes on the locality and time of their occurrence. FR. RAUTERBERG.

[The numbers in the second column correspond with Crotch's check list and Austin's supplement to the same.]

CICINDELIDÆ, Linn.

Wis. No.	Amer. No.	CICINDELA, Linn.	
1.	18.	*6-guttata*, Fabr.	In the lighter parts of the woods. May to August. Quite rare.
2.	19.	*patruela*, Dej.	In woods mixed with foliage and pine-trees. June to August. Quite rare.
3.	22.	*purpurea*, Oliv.	On the clayey banks of Lake Michigan. At times quite common, mixed with a black variety. May be found during the whole summer.
4.	28.	*vulgaris*, Say	City streets and country roads. All summer. Very common.
5.	30.	*12-guttata*, Dej.	On turf-ground. June and July. Quite rare.
6.	30*a*.	*oregona*, Lec.	The same as the preceding.
7.	32.	*repanda*, Dej.	On sandy places of meadows and on the lake shore. Common.
8.	33.	*hirticollis*, Say	The same as the preceding. A little rarer.
9.	45.	*macra*, Lec.	On the clayey banks of Lake Michigan. All summer. Rare.
10.	51.	*punctulata*, Fabr.	On sandy places in light foliage woods. All summer. In some years rare.

CARABIDÆ, Linn.

OMOPHRON, Latr.

11.	72.	*americanum*, Dej.	On gravel mixed with sand, by small ponds and rivers. Very early. Spring to fall. Common.

Wis. No.	Amer. No.	OMOPHRON, Latr.—*Continued.*
12.	73.	*tessellatum*, Say.....On the banks of Menomonee River and Muskego Lake. All summer. Quite common.
13.	76.	*nitidum*, Lee. .....On the banks of Milwaukee River. July. Very rare.
		ELAPHRUS, Fab.
14.	78.	*Clairvillei*, Kirby.....On the banks of small streams and on loamy grounds. Early spring. Very rare.
15.	82.	*fuliginosus*, Say.....On the banks of the Menomonee River. May to September. Quite common.
16.	85.	*ruscarius*, Say.....On the shores of lakes and rivers. All summer. Very eommon.
		BLETHISA, Bon.
17.	87.	*multipunctata*, Linn. ..On the shore of Muskego Lake, and in woods under high old trees. Not before August. Very rare.
18.	88.	*quadricollis*, Hald. ....On the shores of Muskego Lake and Lake Miehigan. July and August. Quite rare.
		LORICERA, Latr.
19.	91.	*cærulescens*, Linn. ....On the shore of Lake Michigan. July. Very rare.
		NOTIOPHILUS, Dum.
20.	103.	*semistriatus*, Say.....In the forest under logs of wood. June to September. Quite rare.
21.	104.	*confusus*, Lee. .....Same as the preceding.
22.	106.	*sibiricus*, Mots.....Same as the preceding.
		CALOSOMA, Web.
23.	134.	*scrutator*, Fabr.....On the shore of Lake Michigan, under logs. In August. Common.
24.	135.	*Willcoxi*, Lee. .....The same as the preeeding, only rarer.
25.	136.	*frigidum*, Kirby.....On the banks of Lake Michigan, and in woods under logs. June. Quite rare.
26.	143.	*calidum*, Fabr. .....The same as the preceding, only not so rare.
		CARABUS, Linn.
27.	155.	*serratus*, Say. .....In woods on loamy places. All season. Quite common.
28.	156.	*maeander*, Fisch .....In marshy woods under old cedar and hemlock stumps. June, July and August. Very rare.
29.	159.	*sylrosus*, Say.....Under old stumps in the woods. July to August. Quite rare.

Wis. No.	Amer. No.		
		CYCHRUS, Fabr.	
30.	170.	*stenostomus*, Web.	Under stones and small pieces of wood. In the fall. Very rare.
31.	170*a*.	*Lecontei*, Dej.	The same as the preceding, only not so rare.
32.	173.	*elevatus*, Fabr.	The same as the preceding. Very rare.
		PASIMACHUS. Bon.	
33.	200.	*elongatus*, Lec.	On the shores of Lake Michigan and Muskego Lake, under stumps and stones. All summer. Quite rare.
		DYSCHIRIUS, Bon.	
34.	215.	*nigripes*, Lec.	On the sandy shores of Milwaukee, Menomonee and Kinnickinnick Rivers. July to September. Rare.
35.	220.	*globulosus*, Say	The same as the preceding.
36.	224.	*sphæricollis*, Say	The same as the preceding.
37.	226.	*truncatus*, Lec.	The same as the preceding, only rarer.
38.	240.	*setosus*, Lec.	The same as the preceding. Not so rare.
		CLIVINA, Latr.	
39.	266.	*ferrea*, Lec.	On the sandy banks of Lake Muskego. All summer. Quite rare.
		SCHIZOGENIUS, Putz.	
40.	276.	*lineolatus*, Say	On some moist places near the Menomonee River, under stones. Spring to fall. Quite common.
		BRACHYNUS, Web.	
41.	285.	*minutus*, Harr.	In woods, meadows and fields under stones and boards. All summer. Not rare.
42.	287.	*medius*, Harr.	Same as the preceding.
43	289.	*conformis*, Dej.	Same as the preceding.
44.	290.	*cyanipennis*, Say	Same as the preceding, only somewhat rarer.
45.	297.	*cordicollis*, Dej.	Same as the preceding.
		PAGANÆUS, Latr.	
46.	307.	*fasciatus*, Say.	On the shore of Lake Michigan. July. Very rare.
		MICRIXYS, Lec.	
47.	309.	*distinctus*, Hald.	Same as the preceding.
		GALERITA, Fabr.	
48.	318.	*janus*, Fabr.	On dry places in woods and meadows under stones and stumps. All summer. Very common.

Wis. No.	Amer. No.	
		CASNONIA, Latr.
49.	329.	*pensylvanica*, Linn.....On the sandbanks of Lake Michigan. Under stones and wood. All summer. Quite common.
		LEPTOTRACHELUS, Lat.
50.	331.	*dorsalis*, Fabr.....In the woods under old timber. August. Very rare.
		ANCHUS, Lec.
51.	7496.	*pusillus*, Lec.....In woods under old stumps. All summer. Common.
		LOXOPEZA, Chaud.
52.	340.	*grandis*, Hentz.....In woods and meadows under old stumps and loose bark. All summer. Quite common.
53.	341.	*atriventris*, Say.....Same as the preceding. Somewhat rarer.
54.	342.	*tricolor*, Say.....With the sweep-net on flowers and under stones and old stumps. More in the fall than in the spring. Quite rare.
		LEBIA, Latr.
55.	345.	*pulchella*, Dej.....With the sweep-net on flowers. Fall. Very rare.
56.	346.	*cyanipennis*, Dej.....Same as before, only common.
57.	349.	*viridis*, Say.....Same as the preceding.
58.	351.	*pleuritica*, Lec.....Same as the preceding. Somewhat rarer.
59.	354.	*ornata*, Say.....Same as the preceding.
60.	356.	*analis*, Dej.....Same as the preceding, only more common.
61.	357.	*fuscata*, Dej.....Same as the preceding, only rarer.
62.	358.	*frigida*, Chd.....Same as the preceding.
		DIANCHOMENA, Chd.
63.	360.	*scapularis*, Dej.....Same as the preceding. Not so rare.
		DROMIUS, Bon.
64.	375.	*piceus*, Dej.....Under stones and wood. All summer. Rare.
		METABLETUS, Schmidt.
65.	380.	*americanus*, Dej.....With the sweep-net on flowers and grasses. Fall. Quite common.
		BLECHRUS, Motsch.
66.	382.	*linearis*, Lec.....The same as the preceding.

Wis. No.	Amer. No.		
		CYMINDIS, Latr.	
67.	397.	*Laticollis*, Say	Under wood, stones and stumps. All summer. Quite rare.
68.	401.	*cribricollis*, Dej.	Same as the preceding.
69.	404.	*pilosa*, Say	Same as the preceding.
70.	405.	*borealis*, Lec.	Same as the preceding, but more rare.
		PINACODERA.	
71.	410.	*limbata*, Dej.	Same as the preceding, only common.
72.	411.	*platicollis*, Say	Same as the preceding.
		CALLIDA, Dej.	
73.	414.	*purpuria*, Say	On the shore of Lake Michigan. August. Very rare.
74.	419.	*punctata*, Lec.	With the sweep-net on flowers. Fall. Quite common.
		CALATHUS, Bon.	
75.	427.	*gregarious*, Say	On very dry places in the woods and meadows under stones. During the whole season. Very common.
76.	428.	*ingratus*, Dej.	Same as the preceding, but rarer.
77.	429.	*opaculus*, Lec.	On somewhat moister places and rarer. Otherwise the same as the preceding.
78.	437.	*impunctatus*, Say	Same as the preceding, but not so rare.
		PLATYNUS, Bon.	
79.	441.	*caudatus*, Lec.	In the woods and on the shores of Muskego Lake. July. Very rare.
80.	451.	*cincticollis*, Say	In the woods under logs and pieces of wood. During the whole season. Common.
81.	454.	*brunneomarginatus*, M.	Same as the preceding.
82.	456.	*decens*, Say	Same as the preceding.
83.	457.	*sinuatus*, Dej.	Same as the preceding.
84.	461.	*extensicollis*, Say	Same as the preceding, but rarer.
85.	461*b*.	*viridis*, Lec.	On the stony shores of the Menomonee. All summer. Very common.
86.	463.	*decorous*, Say	In the woods under stumps and pieces of wood. Whole season. Quite common.
87.	468.	*mœrens*, Dej.	In the fall. Otherwise the same as the preceding.
88.	470.	*melanarius*, Dej.	Same as the preceding. Somewhat rarer.
89.	474.	*affine*, Kirby	Same as the preceding.

Wis. No.	Amer. No.	PLATYNUS, Bon.—*Continued.*	
90.	475.	*propinquus*, Lec.	Same as the preceding.
91.	481.	*cupripennis*, Say	In woods under stones. All summer. Very common.
92.	483.	*punctiformis*, Say	In the woods under stumps. All summer. Quite common.
93.	484.	*rubripes*, Zimm	Same as the preceding, but somewhat rarer.
94.	486.	*crenistriatus*, Lec.	Same as the preceding.
95.	487.	*æruginosus*, Dej.	Same as the preceding. More common.
96.	492*a*.	*subcordatus*, Lec.	On moist places, especially outlets of sewers and in the grass under stones. All summer. Quite rare.
97.	498.	*nutans*, Say	In the woods under old stumps. All summer. Quite rare.
98.	499.	*striatopunctatus*, Dej.	Same as the preceding.
99.	503.	*ruficornis*, Lec.	Same as the preceding, but somewhat rarer.
100.	505.	*picipennis*, Kirby	Same as the preceding.
101.	506.	*lutulentus*, Lec.	Same as the preceding.
102.	507.	*nigriceps*, Lec.	On the shores of Milwaukee River, under stones. In July. Very rare.
103.	508.	*octopunctatus*, Fabr.	On the shores of Menomonee River, under stones. All summer. Quite rare.
104.	514.	*placidus*, Say	In woods under stones and old stumps. All summer. Quite rare.
105.	520.	*obsoletus*, Say	Same as the preceding.
106.	524.	*quadripunctatus*, Dej.	Same as the preceding.
107.	7507.	*reflexus*, Lec.	Same as the preceding.
		OLISTHOPUS, Dej.	
108.	528.	*parmatus*, Say	With the sweep-net on flowers standing along fences. Fall. Quite rare.
		EVARTHRUS, Lec.	
109.	550.	*sigillatus*, Lec.	In the woods under logs. August to November. Quite rare.
110.	552.	*orbatus*, Newm.	The same as the preceding.
111.	557.	*colossus*, Lec.	The same as the preceding.
112.	558.	*sodalis*, Lec.	The same as the preceding.
		PTEROSTICHUS, Bon.	
113.	588.	*castanipes*, Men.	In woods on dry places. Fall. Very rare.
114.	593.	*congestus*, Men.	The same as the preceding, but not so rare.

Wis. No.	Amer. No.		
		PTEROSTICHUS, Bon.—*Continued.*	
115.	606.	*lachrymosus*, N.	The same as the preceding. Very common.
116.	607*b*.	*flebilis*, Lec.	The same as the preceding, but not so common.
117.	608.	*stygicus*, Say	The same as the preceding, but very common.
118.	624.	*Sayi Brullé*	In meadows and fields. All summer. Very common.
119.	625.	*lucublandus*, Say	The same as the preceding.
120.	627.	*convexicollis*, Say	In the woods under logs. All summer. Very rare.
121.	630.	*luctuosus*, Dej.	The same as the preceding.
122.	633.	*mutus*, Say	The same as the preceding.
123.	637.	*orinomum*, Leach	The same as the preceding, but quite common.
124.	640.	*erythropus*, Dej.	The same as the preceding. Quite rare.
125.	642.	*patruelis*, Dej.	The same as the preceding.
126.	643.	*femoralis*, Kirby	The same as the preceding, only very common.
127.	643*b*.	*femoralis*, Lec.	The same as the preceding. Somewhat rarer.
128.	644.	*corrusculus*, Lec.	The same as the preceding.
129.	657.	*mandibularis*, Kirby	The same as the preceding.
		LOPHOGLOSSUS, Lec.	
130.	662.	*scrutator*, Lec.	In foliage woods on moist places under logs. Fall. Quite rare.
		MYAS, Dej.	
131.	664.	*coracinus*, Say	In woods on dry places under logs. All summer. Very rare.
132.	665.	*cyanescens*, Dej.	The same as the preceding. Not so rare.
		AMARA, Bon.	
133.	666.	*avida*, Say	On the sandy places along the shore of Lake Michigan under wood. All summer. Quite common.
134.	667.	*arenaria*, Lec.	In woods and meadows under stones. Summer. Quite rare.
135.	673.	*carinata*, Lec.	Same as the preceding.
136.	685.	*latior*, Kirby	On the lake shore under pieces of wood, etc. Spring. Quite rare.
137.	688.	*angustata*, Say	Meadows, on dry places under stones. Summer. Quite rare.
138.	690.	*scitula*, Zimm.	Same as the preceding.
139.	694.	*impunctico*llis, Say	Same as the preceding.
140.	7540.	*cupreolata*, Putz	Same as the preceding.

Wis. No.	Amer. No.	AMARA, Bon.—*Continued.*	
141.	699.	*fallax*, Lec.	On the shore of Lake Michigan under wood, etc., and in meadows under stones. Summer. Very common.
142.	702.	*polita*, Lec.	On dry places under wood and stones. Summer. Very common.
143.	707.	*farcta*, Lec.	In the spring on sidewalks in moist places. Quite rare.
144.	709.	*obesa*, Say	On the shore of Lake Michigan, under wood, etc. All summer. Very common.
145.	717.	*gibba*, Lec.	Dry places of woods and meadows. Spring. Quite rare.
146.	719.	*rubrica*, Hald.	The same as the preceding.
147.	720.	*subænea*, Lec.	The same as the preceding.
148.	721.	*musculus*, Say	The same as the preceding.
		BADISTER, Chairv.	
149.	725.	*notatus*, Hald.	Moist places under stones in the woods. Summer. Very rare.
150.	726.	*pulchellus*, Lec.	Same as the preceding. Not quite so rare.
151.	728.	*flavipes*, Lec.	Same as preceding.
152.	729.	*micans*, Lec.	Same as preceding.
153.	729*a*.	*minor*, Lec.	Same as preceding.
		DIPLOCHILA, Brullë.	
154.	733.	*laticollis*, Lec.	In the woods near marshes under stones and wood. Summer. Common.
155.	733*a*.	*major*, Lec.	Same as the preceding.
156.	734.	*impressicollis*, Dej.	The same as the preceding. May also be found on lake shore. More rare.
		DICÆLUS, Bon.	
157.	741.	*purpuratus*, Bon.	In the woods under stones and moss. Summer. Rare.
158.	745.	*sculptilis*, Say	On Lake Michigan shore. Otherwise same as preceding.
159.	750.	*simplex*, Dej.	Same as 741.
160.	752.	*elongatus*, Dej.	Same as preceding. Not quite so rare.
161.	756.	*politus*, Dej.	Same as the preceding
		ANOMOGLOSSUS, Chd.	
162.	758.	*emarginatus*, Say	Under stones along the shore of Menomonee River. All summer. Very common.
163.	759.	*pusillus*, Say	The same as the preceding, only very rare.

Wis. No.	Amer. No.		
		BRACHYLOBUS, Chd.	
164.	7548.	*lithophilus*, Say	In woods under logs and stones. Also along the shores of Lake Michigan. Summer. Rare.
		CHLÆNIUS.	
165.	765.	*erythropus*, Germ.	In woods under stones along marshes. Summer. Common.
166.	768.	*laticollis*, Say	Rare. Otherwise same as the preceding.
167.	774.	*sericeus*, Forster	All over, under stones and wood. All season. Very common.
168.	775.	*prasinus*, Dej.	Along the shore of Menomonee River under flat stones; also on small islands. Summer. Rare.
169.	778.	*leucoscelis*, Chevr.	Under stones along the shore of Menomonee River and in lighter woods. All summer. Very common.
170.	780.	*solitarius*, Say	In darker woods on moist places under logs. Summer. Rare.
171.	781.	*nemoralis*, Say	Dark woods. Summer. Quite rare.
172.	782.	*pensylvanicus*, Say	Under stones along the shores of Menomonee River. Summer. Common.
173.	783.	*tricolor*, Dej.	Under wood, etc., along the shore of Lake Michigan. All summer. Quite rare.
174.	791.	*impunctifrons*, Say	Moist places under stones and logs. Summer. Quite rare.
175.	792.	*niger*, Randall	Under stones in woods, containing high old trees. Summer. Some years very rare.
176.	794.	*purpuricollis*, Randall	Same as the preceding, only exceedingly rare.
177.	795.	*tomentosus*, Say	Under wood, etc., along the shore of Lake Michigan. All summer. Very common.
178.	7549.	*diffinis*, Chd.	Dark woods along any small stream of water. Summer. Quite rare.
179.	7551.	*platyderus*, Chd.	Same as preceding.
		LACHNOCREPIS, Lec.	
180.	797.	*parallelus*, Say	In the city under building-stones and all kinds of rubbish. In former years very common; now quite rare.

Wis. No.	Amer. No.		
		OODES, Bon.	
181.	800.	*americanus*, Dej.	On moist sandy places along the shore of Muskego Lake. June to September. Quite rare.
		NOMIUS, Lap.	
182.	813.	*pygmæus*, Dej.	Under stones on sandy places along shore of Pewaukee Lake. Summer. Very rare.
		NOTHOPUS, Lec.	
183.	815.	*zabroides*, Lec.	Under wood, etc., along shore of Lake Michigan. All summer. Rare.
		GEOPINUS, Lec.	
184.	816.	*incrassatus*, Dej.	On the sand along Lake Michigan. Summer. Common.
		CRATACANTHUS, Dej.	
185.	818.	*dubius*, Beauv.	Under stones along Milwaukee River. Summer. Common.
		AGONODERUS, Dej.	
186.	822.	*lineola*, Fabr.	In the city under stones and lumber. Summer. The last few years very rare.
187.	824.	*comma*, Fabr.	All the region around very common. Fly into the rooms through the open windows in summer.
188.	825.	*pallipes*, Fabr.	The same as the preceding.
189.	827.	*partiarius*, Say	Under stones in woods and meadows. June to September. Quite rare.
		ANISODACTYLUS, Dej.	
190.	843.	*rusticus*, Dej.	Under logs in the woods. Summer. Rare.
191.	846.	*carbonarius*, Say	Same as preceding, only common.
192.	849.	*punctulatus*, Lec.	Same as the preceding.
193.	852.	*nigrita*, Dej.	Same as the preceding, only rarer.
194.	852*a*.	*interpunctatus*, Kirby	Same as the preceding.
195.	853.	*Lecontei*, Chd.	Same as the preceding.
196.	855.	*semipunctatus*, Lec.	Very rare. Otherwise same as preceding.
197.	859.	*discoideus*, Dej.	Under stones and boards near dunghills. Quite rare.
198.	860.	*baltimorensis*, Say	Common. Otherwise the same as the preceding.
199.	871.	*sericeus*, Harris	Under wood, etc., along Lake Michigan. Early in the spring. Quite rare.

Wis. No.	Amer. No.		
		XESTONOTUS, Lec.	
200.	872.	*lugubris*, Dej.	In dark woods on moist places under logs. Fall. Very common.
		SPONGOPUS, Lec.	
201.	873.	*verticalis*, Lec.	On hills in woods. Under logs. Summer. Quite rare.
		AMPHASIA, Newm.	
202.	874.	*interstitialis*, Say	In woods under stones and logs. All summer. Very common.
		ANISOTARSUS, Chd.	
203.	877.	*piceus*, Lec.	Same as the preceding.
204.	878.	*terminatus*, Say	Same as the preceding.
205.	880.	*nitidipennis*, Lec.	Same as the preceding, only rarer.
		GYNANDROPUS, Dej.	
206.	886.	*hylacis*, Say	In lighter woods and along the Menomonee River, under stones. June to September. Quite rare.
		BRADYCELLUS, Er.	
207.	888.	*dichrous*, Dej.	On dry places near marshes under logs. Summer. Very rare.
208.	889.	*vulpeculus*, Say	The same as the preceding, only not so rare.
209.	890.	*autumnalis*, Say	Very common. Otherwise the same as 888.
210.	891.	*badiipennis*, Hald.	The same as the preceding.
211.	894.	*nigrinus*, Dej.	The same as 889.
212.	899.	*congener*, Lec.	Under stones along fences. Summer. Very common.
213.	900.	*rupestris*, Say	Very rare. Otherwise the same as the preceding.
214.	901.	*parallelus*, Chd.	Same as the preceding.
215.	908.	*linearis*, Lec.	Same as 901.
		SELENOPHORUS, Dej.	
216.	916.	*pedicularius*, Dej.	In woods under stones and along the shore of Lake Michigan. Summer. Very common.
217.	917.	*troglodytes*, Dej.	Same as the preceding.
		HARPALUS, Latr.	
218.	924.	*erraticus*, Say	Under moss and stones. Summer. Common.
219.	927.	*viridiæneus*, Beauv.	On dry places along fences in fields. Summer. Very rare.

Wis. No.	Amer. No.	HARPALUS, Latr.—*Continued.*	
220.	928.	*caliginosus*, Fabr.	Along the shore of Lake Michigan. At times very common.
221.	929.	*faunus*, Say	On moist ground under stones and wood in the meadows and woods. All summer. Rare.
222.	932.	*pensylvanicus*, Dej.	The same as the preceding, but common.
223.	933.	*compar*, Lec.	The same as the preceding.
224.	934.	*erythropus*, Dej.	The same as the preceding.
225.	936.	*spadiccus*, Dej.	The same as the preceding.
226.	938.	*fallax*, Lec.	The same as 932.
227.	940.	*herbivagus*, Say	On the shore of Lake Michigan under wood, etc. Summer. Quite common.
228.	944.	*nitidulus*, Chd.	The same as 940, but rarer.
229.	952.	*laticeps*, Lec.	Dark, moist woods under logs. June to September. Quite rare.
230.	961.	*basilaris*, Kirby	Along the shore of Muskego Lake. Summer. Quite rare.
		STENOLOPHUS, Dej.	
231.	974.	*fuliginosus*, Dej.	The same as the preceding; also along the shore of Lake Michigan. Quite common.
232.	976.	*conjunctus*, Say	The same as the preceding.
233.	982.	*ochropezus*, Say	Under wood and stones in the woods and fields. Summer. Quite common.
234.	983.	*dissimilis*, Dej.	The same as 982, but rare.
		PATROBUS, Dej.	
235.	992.	*longicornis*, Say	The same as 982.
		TRECHUS, Cl.	
236.	1015.	*chalybeus*, Mann.	Along the shore of Lake Michigan under wood, etc. Summer. Very rare.
		AMERIZUS, Chd.	
237.	1022.	*oblongulus*, Mannh.	The same as the preceding.
		BEMBIDIUM, Latr.	
238.	1023.	*punctatostriatum*, Say	In the sandy places and under stones along the shores of Milwaukee and Menomonee Rivers. All summer. Quite common.
239.	1024.	*impressum*, Fabr.	The same as the preceding.

Wis. No.	Amer. No.	BEMBIDIUM, Latr.—*Continued.*
240.	1025.	*paludosum*, Sturm. ....On the flat, grassy and moist sides of the clayey banks of Lake Michigan. Summer. Rare.
241.	1026.	*inæquale*, Say .....The same as the preceding.
242.	1029.	*coxendix*, Say .....On the sandy shores of the Menomonee River and Muskego Lake. If the sun shines strong, it is very hard to catch them, as they fly just like Cicindelidæ. Quite rare.
243.	1029*a*.	*nitidulum*, Dej.....Same as the preceding. Not rare.
244.	1030.	*nitidum*, Kirby.....On the sandy parts along the shore of Lake Michigan. All summer. Quite rare.
245.	1033.	*bifossulatum*, Lec.....Under stones along the shores of rivers. Summer. Rare.
246.	1034.	*americanum*, Dej.....Same as the preceding.
247.	1035.	*dilatatum*, Lec. .....Same as the preceding, but common.
248.	1037.	*chalceum*, Dej. .....Same as the preceding.
249.	1038.	*concolor*, Kirby .....Along the shore of Lake Michigan. All summer. Very common.
250.	1042.	*nigrum*, Say .....Under wood, etc., along the shore of Muskego Lake. June to September. Quite rare.
251.	1044.	*simplex*, Lec.....On the sandy shores of all rivers and lakes. All summer. Very common.
252.	1056.	*fugax*, Lec. .....Along the shore of Lake Michigan. Summer. Common.
253.	1067.	*lucidum*, Lec. .....The same as the preceding.
254.	1068.	*rupestre*, Dej.....The same as the preceding.
255.	1072.	*picipes*, Kirby.....Rare. Otherwise the same as the preceding.
256.	1073.	*scopulinum*, Kirby ....Under stones along the shores of all waters. Summer. Very common.
257.	1090.	*dorsale*, Say .....Like the preceding, but very rare.
258.	1095.	*patruele*, Dej. .....On the sandy places along the shores of all rivers and lakes. All summer. Very common.
259.	1096.	*varicgatum*, Say .....The same as 1095.
260.	1099.	*versicolor*, Lec. .....The same as the preceding.
261.	1100.	*pictum*, Lee. .....The same as the preceding.
262.	1116.	*assimile*, Gyll. .....In gardens on flowers and the loose earth. Quite rare.
263.	1119.	*quadrimaculatum*, Linn.The same as 1116, but common.

Wis. No.	Amer. No.		
		TACHYS, Ziegler.	
264.	1129.	*scitulus*, Lec.	In gardens and on the fields on flowers and under stones. All summer. Quite rare.
265.	1143.	*nanus*, Gyll.	Under the bark of fallen trunks, especially of Linden trees. From June to October. Common.
266.	1145.	*flavicauda*, Say	With the sweep-net on flowers. All summer. Rare.
267.	1149.	*virax*, Lec.	Same as preceding.
268.	1156.	*incurrus*, Say	Under stones and common. Otherwise the same as 1145.
		PERICOMPSUS, Lec.	
269.	1165.	*ephippiatus*, Say	With the sweep-net on flowers. All summer. Quite rare.

[TO BE CONTINUED.]

ON SOME NEW GENERA AND SPECIES OF THE FAMILY ATTIDÆ, FROM MADAGASCAR AND CENTRAL AMERICA.

By G. W. and E. G. Peckham.

[For several of the Madagascar species described in this paper, we are indebted to Mr. Thomas Workman, of Belfast, Ireland.]

FAMILY ATTIDÆ.

Sub-family Lyssomanæ.

Gen. nov. Simonella. [1]

Body long, slender, nodose.

Cephalothorax more than twice as long as wide; convex above; constricted near the middle. Thoracic part twice as long as cephalic.

Eyes very unequal in size, placed in four transverse rows of two each, those of the anterior row almost touching. The quadrangle formed by the second and fourth rows is wider behind than in front, and wider behind than long. Eyes of the third row very small, and nearer to the second than to the fourth

[1] We have named this genus for the distinguished French arachnologist, M. Eugène Simon.

row. Eyes of the fourth row on the upper margin of the cephalothorax.

Clypeus, in width, a little less than the radius of the anterior eyes; in direction, retreating.

Sternum long; narrower behind. Anterior coxæ separated by the width of the labium.

Maxillæ twice as long as labium, widest in the middle, tapering toward apex.

Labium as wide as long, truncated at tip.

Falces stout and long; vertical; slightly diverging.

Legs slender, differing but little in thickness; the third and fourth pairs devoid of spines. Relative length 4, 3, 1, 2. Patella with tibia of the third shorter than patella with tibia of fourth. Metatarsus with tarsus of the fourth shorter than patella with tibia.

Abdomen long, slender; much narrower in the middle.

Simonella makes the fifth genus of the sub-family Lyssomanæ, which includes those Attidæ which have the eyes in four transverse rows. Janus myrmeciæformis Tacz. is nearest to Simonella, and Dr. Taczanowski, in describing the species, suggests that it ought to constitute a new genus. It differs, however, from Simonella, in that the first row of eyes occupies the whole of the face, and in the quadrangle of the eyes being longer than wide. Simonella is easily distinguished by its nodose form from the other genera of this sub-family. In general appearance it most resembles Synemosyna Hentz.

Simonella americana sp. nov.

♂. Total length, 8.5 mm. Width of abdomen, 1.1 mm.
Length of cephalothorax, 3.5 mm.
Width " " 1.4 "
Height " " 1.2 "

Legs.	Fem.	Pat.	Tib.	Metat.	Tar.	Total.
1.	1.2	.5	.9	.8	.4	3.8
2.	1.	.4	.9	.8	.5	3.6
3.	1.4	.5	1.1	1.	—	4. +
4.	1.9	.8	1.8	1.	—	5.3+

The *cephalothorax* is nearly as high as wide; the cephalic and anterior thoracic parts are higher and more convex than the

remaining portion of the thoracic, from which they are separated by a well-marked constriction; the part of the thorax posterior to this constriction is highest in the middle, and slants off to form the narrow pedicle by which it is united to the abdomen. The cephalic and anterior thoracic parts are jet black and glabrous; the posterior thoracic part is pale yellow.

The quadrangle of the *eyes* is wider behind than long. The eyes of the first row are very large and almost touching; the second row is just behind the first. A straight line passing backward from the outer edge of the first would cut the second through the middle, pass through the small eye of the third row, and then pass inside the dorsal, or fourth eye.

The width of the *clypeus* is a little less than the radius of the anterior eyes. It is black, retreating, and is ridged above.

The *palpus* is black, long and slender, having on the outer side of the tibia a stout apophysis.

The *falces* are robust, narrowing toward the tip; the fang is as long as the palpus, slender, and yellowish black in color.

The *maxillæ* are also yellowish black, half as long as the palpus, more than twice as long as the labium, and widest at the extremity.

The *sternum* is yellowish, long, truncated in front, narrowing to a point behind.

The relative length of the *legs* is 4, 3, 1, 2. The patella, tibia, and metatarsus of the first pair are black on the inner side; otherwise all the legs are yellowish, with a darker coloring toward the distal end of the fourth pair. There are weak tibial and metatarsal spines on the first pair; the second, third, and fourth pairs are unarmed.

The *abdomen* consists of three portions, the anterior part being joined to the posterior by a narrow neck. The anterior is twice as long as the middle, and half as long as posterior part.

Habitat. Guatemala.

OBSERVATIONS: This species was found running on the ground among a number of leaf-cutting ants.

FAMILY ATTIDÆ.

Sub-family Attinæ.

Gen. nov. Ganesa. [1]

Cephalothorax very low and flat; slightly contracted in front and behind; twice as long as wide, and a little wider than the third row of eyes, with a depression limiting the cephalic part. Thoracic part twice as long as cephalic, truncated behind.

Eyes forming a quadrangle, a little more than 1/4 wider than long, and equally wide in front and behind. Anterior eyes all separated, forming a line slightly curved downward [2]; the middle are nearly three times as large as the lateral eyes. Eyes of the second row half way between the dorsal and the lateral eyes. Dorsal eyes further from each other than from the lateral borders.

Clypeus extremely low.

Sternum wide and oval; narrower behind than in front. Anterior coxæ separated by the width of the labium.

Maxillæ less than twice as long as labium, wider at the extremity, parallel.

Labium a little longer than wide, rounded at tip.

Falces nearly vertical, not diverging, robust, short, about as wide as long, narrower at the insertion of the fang.

Legs: 1, 4, 2, 3, in both sexes. First legs much the stoutest, with femur and tibia greatly enlarged, and patella slightly enlarged in both sexes. The patella with tibia of the third shorter than patella with tibia of the fourth; metatarsus with tarsus of fourth shorter than patella with tibia. The third and fourth pairs have no spines.

Abdomen long and slender, flattened above.

[1] Proper name: God of Wisdom—Sanscrit.

[2] We consider the anterior row of eyes *straight* when a straight line from the top of the middle eyes touches also the top of the lateral eyes; *curved*, when a straight line from the top of the middle eyes cuts the lateral eyes; *curved downward*, when a straight line from the top of the middle eyes passes above the lateral eyes.

GANESA WORKMANII sp. nov.

♂. Total length, 5 mm. Width of abdomen, 1.1 mm.
Length of cephalothorax, 2 mm.
Width " " 1.1 "
Height " " .7 "

Legs.	Fem.	Pat.	Tib.	Metat.	Tar.	Total.
1.	1.5	.8	1.6	.9	.5	5.3
2.	1.	.4	.6	.4	.2	2.6
3.	1.	.4	.6	.4	.2	2.6
4.	1.2	.7	1.	.6	.4	3.9

The *cephalothorax* is very low and flat, the thoracic part being much longer than the cephalic. The upper surface is glabrous black, with a median longitudinal line of white hairs throughout its length.

The quadrangle of the *eyes* is wider than long, and equally wide in front and behind. The dorsal eye is as large as the lateral. A straight line from the outer edge of the lateral would pass outside the small median eye and cut the inner edge of the dorsal eye. The small median eye is half way between the lateral and the dorsal eye. The anterior row of eyes is slightly curved downward. The middle are nearly three times as large as the lateral eyes, and all four are separated. The lateral are placed a little further back than the middle eyes.

The *clypeus* is very low.

The *palpus* has a weak spine on the femur.

The *falces* are stout, a little inclined forward; yellowish brown in color.

The *maxillæ* are less than twice as long as the labium; wider at the extremity; parallel.

The *labium* is a little longer than wide, rounded at the tip.

The *sternum* is very wide, and is rounded. Its color is dark brown.

The relative length of the *legs* is 1, 4, 2, 3. The first leg is much the stoutest, and is peculiar in form; the coxa and femur are very stout, the femur having one spine on the under border; the patella is enlarged at its distal end, where it joins the tibia;

the tibia is greatly dilated, and has on its under border three pairs of stout spines; the metatarsus is curved, and has two stout spines on the under border near the extremity. The color of this leg is dark brown, excepting the tarsus and the distal end of the metatarsus, which are light yellow. The other legs are weak, and in color pale yellow, with darker rings at each joint. The tibia of the second leg has two spines.

The *abdomen* is flat, long, and slender, tapering toward the posterior end. In color it is black, with a few white hairs at the base, and a median longitudinal line of white hairs continuing that on the cephalothorax. The spinnerets are long.

The *venter* is black.

♀. Total length, 4.3 mm. Width of abdomen, .9 mm.
Length of cephalothorax, 1.9 mm.
Width " " .9 "
Height " " .5 "

Legs.	Fem.	Pat.	Tib.	Metat.	Tar.	Total.
1.	1.	.4	.8	.5	.3	3.
2.	.8	.2	.4	.1	.1	1.6
3.	.8	.2	.4	.1	.1	1.6
4.	.8	.3	.6	.5	.3	2.5

The *maxillæ*, *labium*, *sternum*, *venter* and the ends of the *palpi* are pale yellow. The *abdomen* is more slender, and the spinnerets are longer than in the ♂.

Habitat. Madagascar.

From the collection of Mr. Thomas Workman, of Belfast.

In figures 2c and 2d the clypeus is drawn too high, and the quadrangle of the eyes relatively too long.

HOMALATTUS INSULARIS sp. nov.

♂. Total length, 3.3 mm. Width of abdomen, 1.8 mm.
Length of cephalothorax, 1.9 mm.
Width " " 1.8 "
Height " " 1.2 "

Legs.	Fem.	Pat.	Tib.	Metat.	Tar.	Total.
1.	1.1	.9	1.	.5	.4	3.9
2.	.7	.5	.6	.4	.4	2.6
3.	.6	.4	.5	.4	.3	2.2
4.	.8	.6	.8	.6	.5	3.3

The *cephalothorax* is very slightly convex above, and is a little contracted in front and behind. It is nearly as wide as long. The cephalic part, which occupies more than $\frac{3}{5}$ of its length, has its sides gently rounded and its upper surface a little inclined. The thoracic part is abruptly truncated behind. There is no depression between the cephalic and thoracic parts. The entire cephalothorax is of a soft brown color, sprinkled over with fine short white hairs.

The quadrangle of the *eyes* is $\frac{1}{3}$ wider than long, and is wider behind than in front. The first row of eyes is straight; the lateral are a little behind the middle eyes and are $\frac{1}{2}$ as large; the middle eyes are touching; the lateral separated from them by a space equaling $\frac{1}{2}$ their diameter. The eyes of the second row are small and are separated from the anterior lateral eyes only by a space equaling their own diameter. The dorsal eyes are as large as the lateral, are placed on the margin of the cephalothorax, and are further from each other than from the lateral borders. The frons is $\frac{1}{5}$ as wide as the middle anterior eyes.

The *clypeus* is $\frac{1}{2}$ as wide as the anterior middle eyes, retreating.

The *falces* are robust, short, and vertical; the fang is small, $\frac{1}{2}$ as long as the falx.

The *maxillæ* are wider and truncated at the extremity, parallel; dark brown in color.

The *labium* is about $\frac{2}{3}$ as long as the maxillæ, raised and rounded at base, wider and rounded at the extremity; brown in color.

The *sternum* is rounded behind and on the sides, pointed in front, and is about as wide as long; its color is brown. The anterior coxæ are separated by the width of the labium.

The relative length of the *legs* is 1, 4, 2, 3. The first is the stoutest, and has the femur and tibia much enlarged. The first and second pairs are brown, the third and fourth have alternate brown and white rings. There are spines on the femoral joints of the first and second legs, besides others, which are very stiff and strong, on the tibial and metatarsal joints of the first. The third and fourth legs are unarmed.

The *abdomen* is of the same soft brownish color as the cephalothorax, and has, in its anterior portion, six rather indistinct black dots, arranged in two longitudinal rows of three each.

The *venter* is brownish.

The ♀ is like the ♂, excepting that the relative length of the legs is 4, 1, 3, 2.

Habitat. Madagascar.

In the ♂ the tube in the palpus is sometimes coiled closely and sometimes drawn out, when it appears to be longer. The bulb is often more triangular than is shown in the drawing, and appears swollen.

Icius cornutus sp. nov.

♂. Total length 5.3 mm. Width of abdomen, 1.5 mm.
Length of cephalothorax, 2.5 mm.
Width " " 1.8 "
Height " " 1.2 "
Horns, 1.5 mm.

Legs.	Fem.	Pat.	Tib.	Metat.	Tar.	Total.
1.	1.9	1.2	1.8	1.	.5	6.4
2.	1.3	.8	1.	.7	.4	4.2
3.	1.3	.9	1.	.7	.5	4.4
4.	1.4	.8	1.2	.9	.5	4.8

The *cephalothorax* is low and flat, dilated behind the middle. The sides of the cephalic part are vertical; those of the thoracic are rounded, as is also the posterior slope. The cephalic and

thoracic parts are on the same plane. The cephalic part occupies ⅓ of the cephalothorax and has no limiting depression. In color the ocular region is yellowish, glabrous, with two dark spots in the middle. Behind this region is a median band covered with light-yellowish hairs. On each side of the cephalothorax are two blackish bands, extending from the anterior lateral eyes to the posterior margin. The sides of the cephalothorax are brown, lighter above than below. There are some rufus hairs just below the dorsal and small median eyes, and also above the anterior eyes.

The quadrangle of the *eyes* is wider than long and very slightly wider behind than in front. The anterior row of eyes is straight, the middle being more than twice as large as the lateral eyes. All four are almost touching. The small median eyes are nearer to the lateral than to the dorsal eyes. The lateral and dorsal eyes are equally large. A straight line from the inner edge of the lateral eye would pass just within the small median eye, and within the dorsal eye, distant from it by a space equal to its diameter. The dorsal eyes are situated on the sides of the cephalothorax.

The *clypeus* is only a line.

The *falces* are vertical, very short and weak, almost square; the fang is very small and weak. On the anterior upper edge of each falx is a stout horn, which is very slightly curved downward, and is more than twice as long as the falx.

The *maxillæ* are narrow at base, wider at extremity, slightly rounded, brownish.

The *labium* is a little more than half as long as the maxillæ, and about as wide as long, rounded, brownish.

The *sternum* is about as wide as long; yellow. The anterior coxæ are separated by the width of the labium.

The relative length of the *legs* is 1, 4, 3, 2, the first pair being very much the stoutest, the other pairs weak. The first leg is brown excepting the tarsus, which is yellow. The other legs are yellow. The first leg has one spine on the femur, three on the tibia and two pairs on the metatarsus; the second has two spines on the tibia and two pairs on the metatarsus; the third

and fourth legs are devoid of spines, but have stout hairs on the femoral joints.

The *abdomen* has a central longitudinal band formed of yellowish hairs, with a darker band on each side. The sides are yellowish.

The *venter* is yellowish, slightly darker than the sides.

The dorsal aspect of the spider presents a median yellowish band throughout the whole length, with a dark band on each side.

Habitat. Madagascar.

Plexippus ensifer Thorell, (Studi sui Ragni Malesi e Papuani, I, p. 267), has two spines on the clypeus. This species ought, perhaps, to form a new genus, as it differs in several respects from Icius E. S.; but we think it best to form new genera but slowly until we have made a more careful comparison of species.

ASTIA ORNATA sp. nov.

♂. Total length, 5.7 mm. Width of abdomen, 1.2 mm.
Length of cephalothorax, 3.1 mm. Coxa I, 1.1 mm.
Width " " 2. "
Height " " 1.3 "

Legs.	Fem.	Pat.	Tib.	Metat.	Tar.	Total.
1.	1.8	1.2	1.8	1.4	.8	7.
2.	1.7	.8	1.2	.9	.6	5.2
3.	1.4	.8	.9	1.	.5	4.6
4.	1.	.8	1.3	1.1	.6	4.8

The *cephalothorax* is moderately high, a little wider at the dorsal eyes, and about twice as long as wide. The cephalic part occupies about ⅔ of the cephalothorax; it is plane, and not inclined, with vertical sides. The thoracic part is a little convex, and is rounded behind and on the sides, slanting downward from a little distance behind the dorsal eyes. The color is dark brown, with some white hairs about the anterior eyes and on the thoracic part, which probably form distinct patterns, or cover the cephalothorax, but in our specimens are almost entirely rubbed off.

The quadrangle of the *eyes* is about ¼ wider in front than it is long, and is wider in front than behind. The anterior eyes are visible from above, are all touching, and are in a straight line; the lateral are placed a little further back than the middle eyes, and are less than half as large. The eyes of the second row are much nearer the lateral than the dorsal eyes. The dorsal eyes are about as large as the lateral, and are placed about double their own diameter inside the margin of the cephalothorax. They are nearer to each other than to the lateral borders. There is no frons.

The *clypeus* is retreating, and is scarcely ⅕ as wide as the large middle eyes.

The *falces* are very robust, short, a little inclined forward, and parallel. The fang is about ⅔ as long as the falx, and is weak. Color, dark reddish-brown.

The *maxillæ* are wider and rounded at the extremity, parallel, as long as the anterior coxæ. Color, like falces.

The *labium* is a little more than half as long as the maxillæ, nearly as wide as long, oval, rounded at extremity. Color, like maxillæ and falces.

The *sternum* is heart-shaped, truncated in front, about ¼ longer than wide. Its color is light yellowish-brown. The anterior coxæ are separated by the width of the labium and maxillæ at the base.

The relative length of the *legs* is 1, 2, 4, 3; the first is the stoutest, the second next; the coxa and trochanter of the first are visible from above. There are femoral, tibial and metatarsal spines on the four pairs; those on the tibiæ of the first and second are in a single row; on the tibiæ of the third and fourth they are irregular; on the metatarsi of the third and fourth they are found only in circles at the extremities of the articulations. The color of the first and second pairs is dark brown; of the third and fourth light brown; all are tipped with black.

The *abdomen* is slender and pointed; its color is light brown; on each side is a wavy white band, extending from the base to back of the middle; on the dorsal surface are four white spots, two, longitudinally elongated, just behind the middle, and two

others external to these, transversely elongated, and nearer the spinnerets; from the base, two slender black lines extend backward to about the middle of the dorsum, where they unite and merge into a series of small black chevrons, which extend nearly to the spinnerets.

The *venter* is light brown.

♀. Total length, 6.8 mm. Width of abdomen, 2.2.
Length of cephalothorax, 3. mm.
Width " " 2. "
Height " " 1.5 "

In general appearance the ♀ resembles the ♂, but the color is decidedly lighter, particularly that of the cephalothorax and the anterior pairs of legs. The labium is relatively a little longer, and the relative length of the legs is 4, 1, 2, 3. Femoral spines are found on the four pairs, and very weak spines in circles at the extremities of the metatarsi of the third and fourth.

Habitat. Madagascar.

Ergane madagascariensis sp. nov.

♂. Total length, 6.5 mm. Width of abdomen, 1.8.
Length of cephalothorax, 3. mm.
Width " " 2. "
Height " " 1.9 "

Legs.	Fem.	Pat.	Tib.	Metat.	Tar.	Total.
1.	2.2	1.3	1.9	1.	.8	7.2
2.	1.7	.8	1.	1.	.7	5.2
3.	1.9	.8	1.1	1.2	.9	5.9
4.	1.7	.6	.9	1.	.7	4.9

The *cephalothorax* is high, ⅓ longer than wide, with nearly parallel sides. The cephalic part occupies more than ⅓ of the cephalothorax, is plane, slightly inclined, and has nearly vertical sides. The thoracic part is a little convex with slightly rounded sides, and falls abruptly behind. There is a slight depression between the cephalic and thoracic parts. The color is black, or very dark brown.

The quadrangle of the *eyes* is nearly ⅓ wider than long, and equally wide in front and behind. The anterior row is visible from above and is straight. The lateral are placed slightly further back than the middle eyes, are a little more than half as large, and are slightly separated from them, while the middle eyes are touching. Both lateral and middle eyes are large. The eyes of the second row are half way between the lateral and dorsal eyes. The dorsal eyes are as large as the lateral, are placed below the margin of the cephalothorax, and are further from each other than from the lateral borders. There is no frons.

The *clypeus* is vertical, and a little more than ⅓ as wide as the large middle eyes.

The *falces* are robust, wider at the extremity, long, inclined forward, parallel; dark reddish-brown in color. The fang is ⅔ as long as the falx.

The *maxillæ* are narrow at base, wider at extremity, rounded, with a projection at the outer edge, parallel or slightly converging. Color, dark brown.

The *labium* is a little more than ½ as long as the maxillæ, slightly narrower and rounded at the extremity. Color, like maxillæ.

The *sternum* is nearly round, truncated in front. Color, black. The anterior coxæ are separated by more than the width of the labium.

The relative length of the *legs* is 1, 3, 2, 4; the first pair is much the stoutest. There are femoral, tibial and metatarsal spines on the four pairs, which are strong on the first, and grow weaker on the second, third and fourth successively; those on the metatarsi of the fourth extend to the base. The first leg is black, or dark brown; the others are pale yellowish-brown.

The *abdomen* is slender and pointed, and is covered with metallic scales which give it a purplish, iridescent appearance.

The *venter* is black.

Habitat. Madagascar.

PHILÆUS VINSONII sp. nov.

♂. Total length, 7.8 mm. Width of abdomen, 2.5 mm.
Length of cephalothorax, 3.8 mm.
Width " " 3. "
Height " " 1.9 "

Legs.	Fem.	Pat.	Tib.	Metat.	Tar.	Total.
1.	2.2	1.5	2.	1.1	1.	7.8
2.	2.	1.1	1.5	1.	.9	6.5
3.	2.2	.8	1.5	1.2	.9	6.6
4.	2.	.9	1.5	1.4	.9	6.7

The *cephalothorax* is high and convex, and dilated behind the middle. It is about 1/4 longer than wide. The cephalic part occupies a little more than 2/5 of its length, is inclined forward, and is separated by a slight depression from the thoracic part. The thoracic part has its sides widely rounded, and slants steeply to the posterior margin. The color of the cephalothorax is brown, darker in the thoracic part, with a narrow black line around the lower border, and a light yellowish central spot behind the dorsal eyes.

The quadrangle of the eyes is about 1/4 wider than long, and is slightly wider behind than in front. The anterior row is slightly curved; the lateral are placed a little further back than the middle eyes, and are half as large. The middle eyes are barely separated, and the lateral are distant from the middle eyes by a space equaling less than half their own diameter. The eyes of the second row are half way between the lateral and dorsal eyes. The dorsal eyes are a little smaller than the lateral, and are placed on the margin of the cephalothorax. They are further from each other than from the lateral borders. The frons is 1/6 as wide as the anterior middle eyes.

The *clypeus* is 1/3 as wide as the middle eyes, and is a little inclined backward; it has a few hairs.

The *falces* are stout, long, diverging, inclined forward; dark reddish-brown in color; the fang is as long as the falx.

The *maxillæ* are narrow at the base, wider and truncated at the extremity, nearly parallel; brown in color.

ERRATUM.

For "JOTUS SEMI-ATER sp. nov.," pages 37 and 42, and also plate, read "ERIS PRÆDATORIA KEYS."

Height_"

The *labium* is more than half as long as maxillæ; wide at the base; pointed at the extremity; brown.

The *sternum* is oval, truncated in front; more than half as wide as long; light yellowish-brown in color. The anterior coxæ are separated by the width of the labium.

The relative length of the *legs* is 1, 4, 3, 2; the first and second pairs are the stoutest. There are numerous strong spines on the femoral, patellary, tibial and metatarsal joints of the four pairs. In color the legs are all brown, growing lighter toward the tips.

The *abdomen* is brown, the posterior third being much lighter in tint than the anterior portion. A wide central longitudinal band of the lighter color passes forward to the anterior margin.

The *venter* is light brown.

Habitat. Madagascar.

JOTUS SEMI-ATER sp. nov.

♂. Total length, 7.1 mm. Width of abdomen, 2. mm.
Length of cephalothorax, 3. mm.
Width " " 2.8 "
Height " " 2. "

Legs.	Fem.	Pat.	Tib.	Metat.	Tar.	Total.
1.	2.3	1.5	2.	1.1	.9	7.8
2.	2.	1.2	1.2	1.1	.9	6.4
3.	2.3	1.	1.2	1.3	.9	6.7
4.	2.3	1.1	1.5	1.3	.9	7.1

The *cephalothorax* is high and the dorsum is hollowed in the middle behind the dorsal eyes. It is nearly as wide as long, and the cephalic and thoracic parts are separated by a depression. The cephalic part occupies ⅓ of the cephalothorax, and has its sides a little rounded; it is plane, not inclined. The thoracic part is a little convex; its sides round out widely to the lower border; its posterior slope is rounded. The color of the cephalothorax is jet black, with a large central spot of white hairs behind the dorsal eyes.

The quadrangle of the *eyes* is ¼ wider than long, and is equally wide in front and behind. The anterior row of eyes is

visible from above, and is a little curved. The lateral are placed further back than the middle eyes, and are less than half as large; the middle eyes are sub-touching and the lateral are separated from them by a space equal to ½ their own diameter. The eyes of the second row are nearer the lateral than the dorsal eyes. The eyes of the third row are as large as the lateral eyes, and are placed on the margin of the cephalothorax; they are equally distant from each other and from the lateral borders. There is no frons. There are a few long stiff black hairs in the eye region.

The *clypeus* is vertical, less than half as wide as the large middle eyes.

The *falces* are stout and moderately long, inclined forward, and diverging; their color is glossy black. The fang is nearly as long as the falx, and has a tooth near the tip.

The *maxillæ* are a little wider and rounded at the tip, and are nearly parallel. They are black, with the inner edges white.

The *labium* is more than half as long as the maxillæ; it is rounded at base, narrower at extremity. It is black, except the tip, which is white.

The *sternum* is wide and rounded behind, a little narrower and truncated in front; it is but little longer than wide. Its color is black. The anterior coxæ are separated by the width of the labium.

The relative length of the *legs* is 1, 4, 3, 2; the first and second pairs are the stoutest. There are numerous strong spines on the femoral, tibial and metatarsal joints of the four pairs, those on the metatarsi of the fourth extending to the base; and the patellæ of the third and fourth pairs have each one spine. The color of the legs is black, excepting the tarsi, which are white.

The *abdomen* is black; there is a large spot of white hairs at the base, and there are two short white transverse bands on each side, one in front of and one behind the middle.

The *venter* is black.

Habitat. Madagascar.

From the collection of Graf E. von Keyserling.

BAVIA ALBO-LINEATA sp. nov.

♂. Total length, 7.4 mm. Width of abdomen, 2 mm.
Length of cephalothorax, 3.2 mm.
Width " " 2.7 "
Height " " 2.1 "

Legs.	Fem.	Pat.	Tib.	Metat.	Tar.	Total.
1.	1.8	1.5	2.	.9	.8	7.
2.	1.8	1.3	1.5	1.	.6	6.2
3.	2.2	1.3	1.2	1.	.9	6.6
4.	1.9	.9	1.4	1.2	.9	6.3

The *cephalothorax* is high; the cephalic part is 1/6 shorter than the thoracic; it is plane and much inclined, with vertical sides, and is not limited by a depression. The thoracic part is convex, and slopes backward from the dorsal eyes; its sides are rounded. The cephalic part is brown, glabrous, with a central spot of white hairs; the eyes are situated on black spots. The thoracic part is darker brown, pubescent, also with a central white spot. A band of white hairs, on each side, passes from the anterior lateral eye to the posterior margin; below these bands the sides are dark brown.

The quadrangle of the *eyes* is wider than long, and equally wide in front and behind. The anterior row is straight; the lateral are placed a little further back than the middle eyes, and are 1/2 as large; they are very slightly separated from the middle eyes, which are touching. This row is visible when looked at from above. The eyes of the second row are half way between the dorsal and lateral eyes. The dorsal eyes are as large as the lateral, are placed on the margin of the cephalothorax, and are equally distant from each other and from the lateral borders. There is no frons.

The height of the *clypeus* is equal to 1/5 the diameter of the large middle eyes; in direction, it is vertical.

The *falces* are stout, long, inclined forward, diverging; the fang, which has a slight bend in the middle, is nearly as long as the falx.

The *maxillæ* are narrow at base, wider and rounded at the extremity, nearly parallel. Color, light brown.

The *labium* is nearly ½ as long as maxillæ, as wide as long, gently rounded at extremity. Color, brown.

The *sternum* is wide, oval, truncated in front, nearly as wide as long. Its color is light brown. The anterior coxæ are separated by the width of the labium.

The relative length of the *legs* is 1, 3, 4, 2; the first pair is the most robust. In color, the legs are light brown. There are spines on the four pairs, those on the metatarsi of the fourth extending to the base.

The *abdomen* is dark grey, with a few long white hairs and three white bands extending throughout its length, one central, and one on each side, these latter placed just high enough to be visible from above.

The *venter* is dark grey.

Habitat. Madagascar.

We have put this species into the genus Bavia with some hesitation, as it differs from it in several points. It might, perhaps, go as well into Mævia as Bavia.

Phyale tamatavi Vinson.

Syn: 1863. Attus tamatavi Vinson, Aranéides des iles de La Reunion, Maurice et Madagascar—p. 62.

1864. Phyale tamatavi Simon, Histoire Naturelle des Araignées—p. 315.

♀. Total length, 8.9 mm. Width of abdomen, 3 mm.

Length of cephalothorax, 3.2 mm.

Width " " 2.5 "

Height " " 1.5 "

Legs.	Fem.	Pat.	Tib.	Metat.	Tar.	Total.
1.	1.7	1.2	1.5	.9	.6	5.9
2.	1.5	.9	1.	.8	.5	4.7
3.	2.1	1.	1.2	1.2	.7	6.2
4.	2.	.9	1.4	1.3	.8	6.4

The *cephalothorax* is rather high at the dorsal eyes, much lower in front. It is about ¼ longer than wide. It is widest in the

middle, the thoracic part being dilated. The cephalic and thoracic parts are separated by a transverse depression. The cephalic part occupies ⅖ of the cephalothorax. It is plane and inclined, with rounded sides. The thoracic part is slightly convex; its sides round out widely toward the lower border; it slants rather steeply behind to the posterior margin. In color, the thoracic part and sides are yellowish-brown, with a good deal of short white down. From a spot behind the dorsal eyes several white rays on each side extend forward onto the anterior sides. The ocular region is black, also with white down. In fresh specimens it may be that the down entirely covers the cephalothorax.

The quadrangle of the *eyes* is ¼ wider than long, and is a little wider in front than behind. The anterior row is visible from above, and is curved, a straight line across the tops of the middle eyes cutting the lateral eyes above the middle. The lateral are placed further back than the middle eyes, are less than half as large, and are separated from them by more than half their diameter; the middle eyes are sub-touching. The eyes of the second row are nearer the lateral than the dorsal eyes. The dorsal eyes are as large as the lateral, and are on the upper margin of the cephalothorax, although this row of eyes is not so wide as the cephalothorax below; they are equally distant from each other and from the lateral borders. There is no frons.

The *clypeus* is vertical, with white hairs, and is about ¼ as wide as the large middle eyes.

The *falces* are moderately robust, vertical; a little longer than the face, and parallel. Their color is yellowish-brown. The fang is small and weak.

The *maxillæ* are wider, truncated at the extremity and parallel. Color, yellowish-brown.

The *labium* is more than half as long as the maxillæ, rounded at the base, slightly truncated at the extremity. Color, yellowish-brown.

The *sternum* is rounded behind, narrower and truncated in front; it is about twice as long as wide; color, yellowish-brown. The anterior coxæ are separated by the width of the labium.

The relative length of the *legs* is 4, 3, 1, 2; the first and second pairs are the stoutest. There are femoral, tibial and metatarsal spines on the four pairs, those on the metatarsi of the fourth extending to the base; the patellæ of the third and fourth pairs are also spined. In color the legs are yellowish-brown, tipped with black.

The *abdomen* is covered with fine golden down, and has four transverse white bands, curved forward. These bands have their edges outlined with brown. The first three are long and extend on to the sides; the fourth, near the spinnerets, is short.

The *venter* is light brown, with two fine, dark, longitudinal lines.

Habitat. Madagascar.

From the collection of Mr. Nicolas Pike, of Brooklyn, New York.

EXPLANATION OF PLATE I.

[1] Fig. 1. SIMONELLA AMERICANA, face and falces; 1a, dorsal view of eyes; 1b, palpus; 1c, profile.

2. GANESA WORKMANII, profile; 2a, palpus; 2b, epigynum; 2c, face and falces; 2d, dorsal view of male.

3. HOMALATTUS INSULARIS, epigynum; 3a, palpus of male.

4. ICIUS CORNUTUS, palpus; 4a, maxillæ, falces, and horns, from below.

5. ASTIA ORNATA, palpus of male; 5a, sternum of male; 5b, epigynum.

6. ERGANE MADAGASCARIENSIS, palpus.

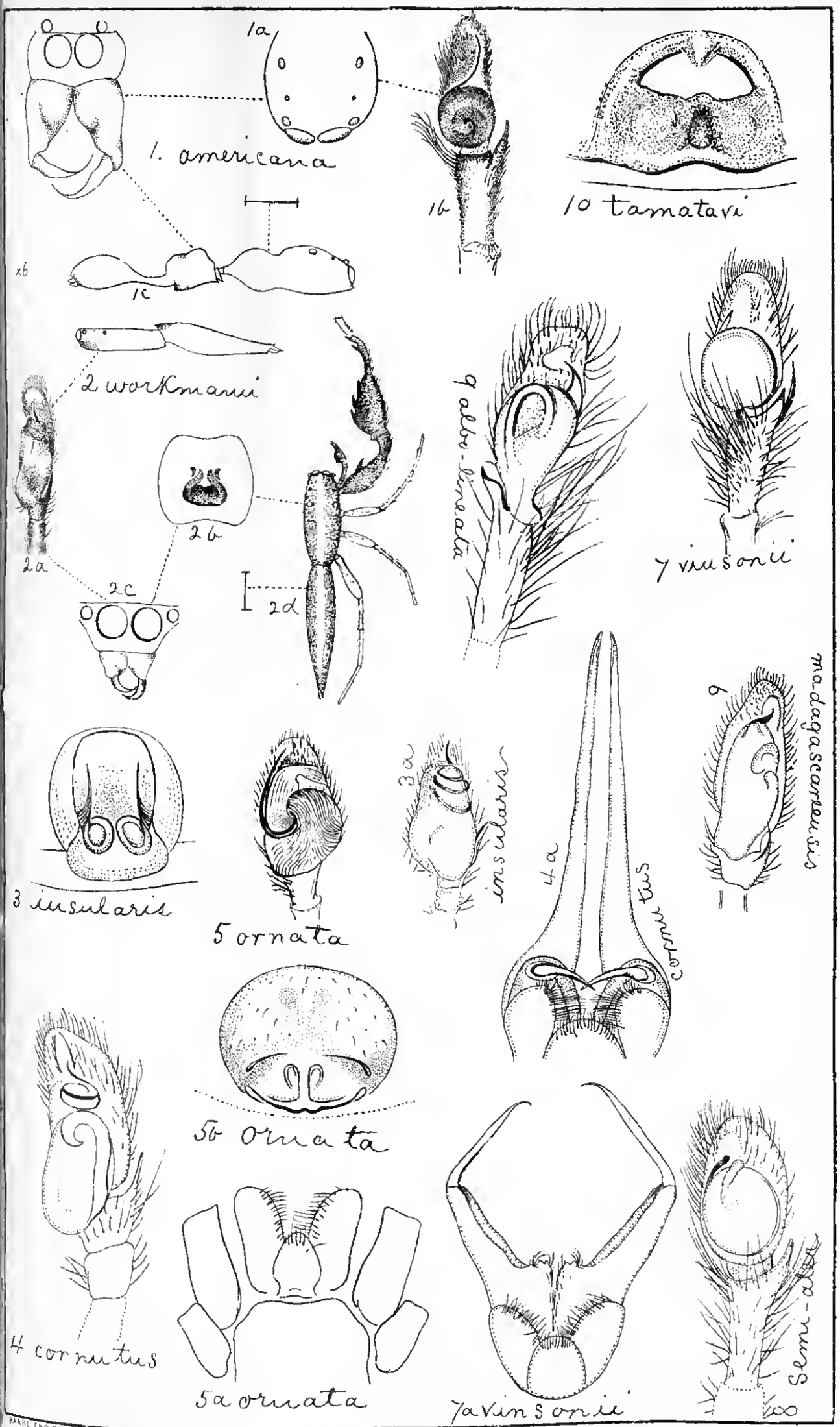
7. PHILÆUS VINSONII, palpus; 7a, falces and maxillæ.

8. JOTUS SEMI-ATER, palpus.

9. BAVIA ALBO-LINEATA, palpus.

10. PHYALE TAMATAVI, epigynum.

[1] We are indebted to Mr. Rudolph Haessler for the drawings of figures 1 and 2. For the other drawings to Mr. Fred Heath.



RAABE ENG CO MILWAUKEE.

April 6, 1885.

Dr. Peckham in the chair.

The chair announced that a Microscopical Section had been formed and the following officers elected for the Section: Vice-President, H. M. Brown, M. D.; Secretary, W. A. Batchelor, M. D.

Dr. Fr. Brendecke delivered, in German, the first of a series of popular lectures on "Micro-organisms Causing Fermentation and Diseases." Dr. B. gave a brief historical sketch of the researches in this field and described the principal forms of microscopical fungi, illustrating his remarks by drawings on the scale of 1,000 to 10,000 diameters and touching upon the following matters: Superstitions formerly connected with the origin of diseases.—Discoveries of Leuwenhoek and others in the latter part of the 17th century.—Investigations by the speaker's first teacher of botany, mineralogy and zoology (1825—1830), Prof. Dr. Wiegman, of Braunschweig, who at that early day, more than half a century ago and long before anything was known of Darwin's great work, asserted the evolution of new varieties of plants by culture.—Ehrenberg's microscopical discoveries, 1832 to 1834.—Investigations by Caigniard, Latour, Lehmann and Swann (fungus-cells the cause of fermentation).—Liebig's opposing theory (disturbance of molecular equilibrium of a component part of yeast).—Berzelius and Mitcherlich (theory of surface-attraction, based on experiments and essays of the speaker, Dr. Brendecke, that were published in scientific journals in 1844 and universally discussed).—A second series of experiments by Dr. Brendecke, made soon after the first, in which for the first time tartrate of ammonia was used for ferment-cultures. These experiments, referred to in Pasteur's biography by his son, led the illustrious investigator to use the tartrate of ammonia, a material element of the success of his cultures.—Davaine's discovery in 1863 (micro-organisms in the blood of animals that died of anthrax).—Investigations multiplying by a great number of celebrated naturalists.—Schizomycetes (*Bacteria*) the principal cause of epidemic diseases, of gangrene, blood-poisoning, etc.—Lister method of treating wounds.—Probability of a better

knowledge of these microbes and of the means of protection against them.

MAY 9, 1885.

Dr. Peckham in the chair.

F. C. Lau and Dr. Max Ohlemann, of Milwaukee, and H. P. Tormey, of Barton, elected members.

NOVEMBER 14, 1885.

Dr. Peckham in the chair.

Mr. Eschweiler read an interesting paper entitled, "A Plan in behalf of the Mounds." In the introduction attention was called to the fact that the mounds of Wisconsin are being "yearly plowed out of existence," and it was earnestly urged that all who are interested in archæology and its progress should put their shoulders to the wheel to secure some of the most interesting and valuable of these mounds for future study and investigation. Mr. Eschweiler further remarked that the mounds of this State were mostly effigy mounds, and that this variety of mound is rare outside of Wisconsin. It was shown that Désiré Charnay's conclusion, that the natives of Central America obtained their copper from ore mined in their own country was untenable. "The mines of Lake Superior were of great importance to the people of Central America. The great extent of the workings all over the copper-bearing rocks shows that thousands have been at work. * * * No one can bring conclusive evidence against the statement that these mines must have been worked for a century or more by the mysterious people. They could be worked but a short time during the year, and the workmen had to move southward when the birds did the same. The finding of copper ice-chisels lately is fair proof that some of them remained in the North during the cold season. This constant traveling to and from the North explains the presence of many mounds on the highway these ancient miners made." In conclusion, Mr. Eschweiler again called attention to the important matter of preserving the mounds, these last traces of a wonderful people.

Mr. Wm. Frankfurth moved that a committee be appointed to confer with the Wisconsin Academy of Arts, Sciences and Letters, the State Historical Society and the Board of Trustees of the Milwaukee Public Museum relative to the preservation of the more characteristic mound-builders' works located in different parts of Wisconsin. The motion was carried.

H. C. Schrank, John A. Dadd, Wm. M. Wheeler, and B. K. Miller, Jr., elected members.

A credit of $65 was voted to the Microscopical Section and of $100 to the Committee on Publications.

DECEMBER 7, 1885.

Dr. Peckham in the chair.

Treasurer C. Hennecke reported $333.23 on hand, $50.00 outstanding dues at this date, and a membership of 132.

Officers elected for the ensuing year:

President—Doctor G. W. Peckham.

Vice-President—A. Meinecke.

Corresponding Secretary—Wm. M. Wheeler.

Recording Secretary—A. Conrath.

Treasurer—C. Hennecke.

Librarian—A. Toellner.

Dr. Brendecke delivered his second popular lecture on micro-organisms, the subject being "Bacteria." He remarked on: Definition, organization, form, life-conditions, propagation and distribution of the Schizomycetes called *Bacteria*.—Timole, carbolic acid, corrosive sublimate, etc., prevent their multiplying, but do not destroy them.—Classification according to Cohn.—The membrane covering their protoplasmic body not affected by acids, etc.—Life extinguished by the temperature of boiling water. Their spores more enduring.—Zymotic micrococci, causing both fermentation and putrefaction.—Pigment-bacteria.—Occurrence of pathogenic micrococci in numerous diseases mentioned.—Bacilli the most dangerous class. Fortunately killed by drying, by hot water and a temperature below the freezing-point.—Spirilli and Vibriones.—Naegeli's opinion that some forms are only different stages of the development of others.—Tulasne's observations.—In conclusion, the speaker admonished communal authorities

and families to heed conscientiously all sanitary regulations and to consider it a duty to aid the men of science in their endeavors to elucidate this difficult subject and to find ways and means for reducing the dangers threatening man from the pathogenetic micro-organisms.

Fr. Rauterberg presented a continuation of his list of Wisconsin Coleoptera.

Dr. Peckham offered a paper entitled, "On some new Genera and Species of Attidæ from the eastern part of Guatemala, by G. W. and E. G. Peckham." All papers referred to the Committee on Publications.

COLEOPTERA OF WISCONSIN.

(CONTINUATION OF PAGE 23.)

HALIPLIDÆ.

Wis. No.	Amer. No.	
		HALIPLUS, Satr.
270.	1175.	*triopsis*, Say.....At times common in ponds and lakes. In spring and autumn.
271.	1180.	*ruficollis*, Dej.....Same as preceding.
272.	1181.	*longulus*, Lec.....Less common than preceding.
		CNEMIDOTUS, Er.
273.	1182.	*callosus*, Lec .....Common in spring and autumn in ponds and small lakes.
274.	1183.	*12-punctatus*, Say.....Very common with the preceding.

DYTISCIDÆ.

		HYDROVATUS, Mots.
275.	1188.	*cuspidatus*, Germ.....Abundant in Muskego Lake in autumn.
		HYDROPORUS, Clv.
276.	1190.	*inaequalis*, Fab.....Common in spring in pools and small lakes.
277.	1190. var.	*punctatus*, Say.....Same as preceding.
278.	1194.	*convexus*, Aubé.....Same as preceding.
279.	1199.	*picatus*, Kirby.....Same as preceding.

Wis. No.	Amer. No.	HYDROPORUS, Cly.—*Continued.*
280.	1200.	*impressopunctatus*, Sch.Same as preceding.
281.	1201. var.	*dispar*, Lec.....Rarer than preceding.
282.	1202.	*turbidus*, Lec.....Same as preceding.
283.	1210.	*nubilis*, Lec.....Common in pools and small lakes in spring.
284.	1213.	*granarius*, Aubé.....Same as preceding.
285.	1217.	*lacustris*, Say.....Same as preceding.
286.	1220.	*affinis*, Say.....Same as preceding.
287.	1225.	*alpinus*, Payk.....Less common than the preceding.
288.	1233.	*griseostriatus*, Dej.....Like the preceding.
289.	1235.	*sericeus*, Lec.....Very common in pools in spring.
290.	1237.	*spurius*, Lec.....Common with the preceding.
291.	1239.	*semirufus*, Lec.....Common in ponds in spring.
292.	1246.	*modestus*, Aubé.....Same as preceding.
293.	1247.	*dichrous*, Mels. .....Less common, mixed with the preceding.
294.	1262.	*concinnus*, Lec.....Rarer than most of the preceding species.
		HYDROCANTHUS, Say.
295.	1267.	*iricolor*, Say.....Very rare. In Lake Michigan.
		CYBISTER, Curt.
296.	1273.	*fimbriolatus*, Say.....Common in spring in the lake.
		LACCOPHILUS, Leach.
297.	1277.	*maculosus*, Germ.....Common in rivers and lakes. All summer.
298.	1279.	*proximus*, Say.....Less common than the preceding. In the same situations.
		AGABETES, Cr.
299.	1286.	*acuductus*, Harris.....Very rare. In Lake Michigan.
		ACILIUS, Leach.
300.	1287.	*semisulcatus*, Aubé.....Common in spring in the lake and in ponds.
		THERMONECTES, Esch.
301.	1291.	*ornaticollis*, Aubé.....Common in spring in the lake and in ponds.
		GRAPTODERES, Esch.
302.	1293.	*cinereus*, Linn.....Same as the preceding.
303.	1294.	*liberus*, Say.....Same as the preceding.
		HYDATICUS, Leach.
304.	1295.	*stagnalis*, Fab.....Less common than the preceding. In similar localities.
305.	1296.	*piceus*, Lec.....More common than the preceding.
		SCUTOPTERUS, Esch.
306.	1298.	*angustus*, Lec.....Quite rare. In the Lake. In spring.

Wis. No.	Amer. No.		
		COLYMBETES, Clv.	
307.	1300.	*sculptilis*, Harr.	Abundant in the lake as soon as the ice has left the shore. In early spring.
		DYTISCUS, Linn.	
308.	1308.	*Harrisii*, Kirby.	Quite rare in the lake and rivers. All summer.
309.	1310.	*confluens*, Say.	Same as the preceding.
310.	1312.	*marginicollis*, Lec.	Somewhat commoner than the preceding.
311.	1315.	*fasciventris*, Say.	Our commonest species. In the lake and rivers. Most abundant in spring.
312.	1316.	*hybridus*, Aubé.	Common in spring in the lake and ponds.
		RHANTUS, Esch.	
313.	1317.	*binotatus*, Harr.	In spring in ponds and in the lake. Rare.
314.	1321.	*bistriatus*, Bergst.	More common than the preceding. In same situations.
315.	1324.	*sinuatus*, Lec.	Common in very cold springs on the clayey lake banks near Whitefish Bay.
		ILYBIUS, Er.	
316.	1332.	*picipes*, Kirby	Common in lakes and ponds. In spring.
317.	1334.	*biguttatus*, Germ.	The same as the preceding.
		INATUS, Aubé.	
318.	1337.	*bicarinatus*, Say.	In Muskego Lake. Very rare.
		COPTOTOMUS, Say.	
319.	1338.	*interrogatus*, Fab.	Abundant in every pond in spring.
		COPELATUS, Er.	
320.	1340.	*glyphicus*, Say.	Common in some ponds in spring.
		GAURODYTES, Thoms.	
321.	1346.	*taeniolatus*, Harr.	In ponds and in the lake. In spring. Common.
322.	1351.	*semipunctatus*, Kirby.	Like the preceding.
323.	1352.	*aeneolus*, Cr.	Like the preceding.
324.	1365.	*parallelus*, Lec.	Like the preceding.
325.	1366.	*infuscatus*, Aubé.	Rare. With the preceding species.
326.	1367.	*scapularis*, Mannh.	The same as the preceding.
327.	1371.	*punctulatus*, Aubé.	The same as the preceding.
328.	1377.	*gagates*, Aubé	Very rare. In Lake Michigan.
329.	1379.	*lugens*, Lec.	Same as the preceding.

GYRINIDÆ.

Wis. No.	Amer. No.		
		DINEUTUS, Mac L.	
330.	1385.	*emarginatus*, Say	At times common on the surface of the lake and ponds.
331.	1389.	*assimilis*, Aubé	The same as the preceding.
		GYRINUS, Linn.	
332.	1390.	*confinis*, Lec	At times common in the same situations as the preceding.
333.	1398.	*ventralis*, Kirby	The same as the preceding.
334.	1399.	*aquiris*, Lec	Less common than the preceding.
335.	1400.	*maculiventris*, Lec	The same as 1390.
336.	1408.	*lugens*, Lec	Rare. On the surface of the lake.
337.	1409.	*analis*, Say	Like 1390.
338.	1412.	*minutus*, Fab	Like 1390.

HYDROPHILIDÆ.

		HELOPHORUS, Fabr.	
339.	1418.	*lacustris*, Lec	Rare. In ponds and in the lake.
340.	1423.	*lineatus*, Say	Abundant in ponds in spring. Also found clinging to bits of wood, etc., thrown on the sand by the lake waves.
341.	1424.	*inquinatus*, Mannh	Same as the preceding.
342.	1425.	*tuberculatus*, Gyll	Very rare. Lake shore in spring.
		HYDROCHUS, Leach.	
343.	1434.	*squamifer*, Lec	Same as 1423.
		HYDROPHILUS, Geoff.	
344.	1449.	*triangularis*, Say	In the lake and in ponds. More abundant in the former.
		TROPISTERNUS, Sol.	
345.	1450.	*nimbatus*, Say	In ponds and in the lake. Common.
346.	1455.	*glaber*, Hb	The same as the preceding.
347.	1456.	*mixtus*, Lec	The same as the preceding.
		HYDROCHARIS, Latr.	
348.	1461.	*obtusatus*, Say	Appears very early in spring on the wave-moistened sand of the lake shore. Common.
		BEROSUS, Leach.	
349.	1470.	*subsignatus*, Lec	In Muskego Lake in autumn. Rare.
350.	1472.	*peregrinus*, Hb	Common during spring and early summer in all ponds.
351.	1476.	*infuscatus*, Lec	In ponds and in the lake. Rare.
352.	1477.	*striatus*, Say	In all ponds in spring. Common.

Wis. No.	Amer. No.		
		LACCOBIUS, Er.	
353.	1480.	*agilis*, Rand	Near the edge of the water in streams. All summer. Apparently most abundant in autumn.
354.	1481.	*ellipticus*, Lec.	Rarer than the preceding.
		PHILHYDRUS, Sol.	
355.	1492.	*bifidus*, Lec.	In ponds and on the wet sand of the lake beach. Common.
356.	1493.	*ochraceus*, Mels.	Same as the preceding.
357.	1495.	*consors*, Lec.	Same as the preceding.
358.	1496.	*cinctus*, Say	The same as the preceding.
359.	1498.	*fuscus*, Mots	The same as the preceding.
		HYDROBIUS, Leach.	
360.	1507.	*fuscipes*, Leim.	In ponds and on the damp lake beach. Common.
361.	1516.	*subcupreus*, Say	The same as the preceding.
362.	1526.	*flavipes*, Er.	In fresh cow-dung. Common.
363.	1527.	*nigricollis*, Say	Same as the preceding.
364.	1533.	*centromaculatum*, St.	The same as the preceding.
365.	1538.	*unipunctatum*, Linn.	In fresh cow-dung. Said to be imported from Europe. Formerly rare. Apparently becoming more common yearly.
366.	1539.	*anale*, Payk.	In fresh cow-dung. Common.
		CRYPTOPLEURUM, Muls.	
367.	1545.	*vagans*, Lec	The same as the preceding.

TRICHOPTERYGIDÆ.

		TRICHOPTERYX, Kirby.	
368.	1579.	*Haldemanni*, Lec.	Found by sifting earth from woods. In the autumn.

STAPHYLINIDÆ.

		FALAGRIA, Leach.	
369.	1595.	*bilobata*, Say.	On the blossoms of Cratægi in spring. Common.
370.	1596.	*dissecta*, Er.	Under fragments of wood, etc. In spring. Less common than the preceding.
371.	1597.	*venustula*, Er.	The same as the preceding.
		HOPLANDRIA, Kraatz.	
372.	1600[1]	*ochracea*, Kraatz.	Under boards, etc. In spring. Not common.

Wis. No.	Amer. No.	
		HOMALOTA, Mann.
373.	1616.	*analis*, Grav.....Under boards and on trees. All summer. Common.
374.	1617.	*lividipennis*, Mann.....The same as the preeeding.
		ATEMELES, Steph.
375.	1656.	*cavus*, Lee.....Under wood in very dry spots. In fall. Rare.
		ALEOCHARA, Grav.
376.	1660.	*lata*, Grav.....In fresh cow-dung. All summer. Common.
377.	1662.	*bimaculata*, Grav.....More eommon than the preceding. Same plaees.
378.	1666.	*nitida*, Grav.....Less commion, otherwise the same as the preceding.
		ERCHOMUS, Kraatz.
379.	1691.	*punctipennis*, Lec.....Under bark, boards, etc. In spring. Common.
380.	1693.	*laevis*, Lee.....The same as the preeeding.
		TACHINUS, Grav.
381.	1694.	*luridus*, Er.....Under boards, etc., in damp localities. All summer. Rather common.
382.	1695.	*memnonius*, Grav.....The same as the preeeding. Less common. Also found on fungi.
383.	1696.	*fumipennis*, Say.....Rare. On fungi. In autumn.
384.	1703.	*fimbriatis*, Grav.....On fungi. In autumn. Rare.
385.	1705.	*limbatus*, Mels.....Same as the preeeding.
		TACHYPORUS, Grav.
386.	1707.	*acaudus*, Say.....Under bark, especially of the basswood. Common.
387.	1708.	*jocosus*, Say.....Same as the preeeding.
388.	1709.	*brunneus*, Fabr.....The same as the preceding.
389.	1712.	*chrysomelinus*, Linn....Under pieces of wood and under bark. All summer. Common.
		CONOSOMA, Kraatz.
390.	1714.	*crassum*, Grav.....Under bark. Somewhat rare.
391.	1715.	*basale*, Er.....Rare. Under bark. Summer.
392.	7679.	*scriptum*, Horn..... Rare. Under bark. In summer.
393.	7673.	*littoreum*, Linn.....The same as the preceding, but more common.
		BOLETOBIUS, Leaeh.
394.	1722.	*cincticollis*, Say.....On fungi. In fall. Common.
395.	1726.	*cinctus*, Grav.....With the preeeding. Rarer.
396.	7680.	*intrusus*, Horn.....Also on fungi. Common.
		MYCETOPORUS, Mann.
397.	1736.	*lepidus*, Grav.....On fungi. Very rare.

Wis. No.	Amer. No.	
		ACYLOPHORUS, Nordm.
398.	1744.	*pronus*, Er.....Under stones, bits of wood, etc. Rare.
		HETEROTOPS, Steph.
399.	1749.	*fumigatus*, Lec.....The same as the preceding.
		QUEDIUS, Stephens.
400.	1766.	*molochinus*, Grav.....In damp, rotten wood. All summer. Common.
401.	7690.	*ferox*, Lec.....Same localities as the preceding. Very rare.
		CREOPHILUS, Kirby.
402.	1771.	*maxillosus*, Linn.....On carrion. All summer. Common.
		LEISTOTROPHUS, Perty.
403.	1773.	*cingulatus*, Grav.....On fresh cow-dung. All summer. Very common.
		STAPHYLINUS, Linn.
404.	1777.	*maculosus*, Grav.....In damp woods, under pieces of wood. Not common.
405.	1778.	*mysticus*, Er.....Under stones. In spring. Formerly abundant on the lake beach.
406.	1781.	*vulpinus*, Nordm.....Same localities as preceding. Our commonest species.
407.	1784.	*tomentosus*, Grav.....Same as 1778.
408.	1786.	*badipes*, Lec.....Same as preceding.
409.	1787.	*cinnamopterus*, Grav...Under stones. All summer. Common.
410.	1791.	*violaceus*, Grav.....In rotting stumps and logs. Not uncommon.
		OCYPUS, Kirby.
411.	1799.	*ater*, Grav.....Sometimes found on carrion, sometimes under stones. Common.
		PHILONTHUS, Leach.
412.	1802.	*cyanipennis*, Fabr....On fungi. In autumn. Common at times.
413.	1803.	*aeneus*, Rossi.....Under stones, also on fungi. Common.
414.	1809.	*blandus*, Grav.....On fungi. In autumn. At times common.
415.	1816.	*debilis*, Grav.....With the preceding. Common.
416.	1820.	*thoracicus*, Grav.....Under stones. Muskego Lake. Rare.
417.	1821.	*lomatus*, Er.....Under stones, etc. All summer. Very common.
418.	1823.	*fulvipes*, Fabr.....On the edges of streams. Quite common, but isolated.
419.	1824.	*brunneus*, Grav.....Under stones, etc. Very common.
420.	1835.	*sobrinus*, Er.....Under stones, etc. Not common.

Wis. No.	Amer. No.		
		PHILONTHUS, Leach.—*Continued.*	
421.	1837.	*paederoides*, Lec.	Same as preceding.
422.	——	*quadricollis*, Horn.	Under stones, etc. Rare.
423.	——	*alumnus*, Er.	Same as preceding.
424.	——	*sordidus*, Grav.	Rarer than the preceding.
425.	——	*aurulentus*, Horn.	Same as preceding.
426.	——	*nigritulus*, Grav	Same as preceding.
427.	——	*microphthalmus*, Er.	Same as preceding.
		XANTHOLINUS, Serv.	
428.	1849.	*cephalus*, Say.	Under stones, etc. All summer. Quite rare.
429.	1851.	*obsidianus*, Mels.	Same as preceding.
430.	1853.	*obscurus*, Er.	Same as preceding.
		BAPTOLINUS, Kraatz.	
431.	1863.	*macrocephalus*, Nord.	Under stones, etc. Very rare.
		LATHROBIUM, Grav.	
432.	1867.	*angulare*, Lec.	Under stones, etc. Very rare.
433.	1869.	*punctcolle*, Kirby	Under stones, etc. Common.
434.	1879.	*longiusculum*, Grav.	Under stones, etc. Rarer.
435.	1880.	*collare*, Er.	Same as preceding.
		CRYPTOBIUM, Mann.	
436.	1882.	*badium*, Grav.	Under wood and stones in dry woods. Hardly common.
437.	1884.	*bicolor*, Grav.	Same locality as preceding. Common.
438.	1887.	*sellatum*, Lec.	Under stones, etc., in dry woods. Rare.
439.	1889.	*pallipes*, Grav.	Same locality as preceding. Rare.
440.	1890.	*latebricola*, Nordm.	Same as preceding.
441.	1892.	*cribratum*, Lec.	Same as the preceding.
		STILICUS, Latr.	
442.	1897.	*dentatus*, Say	Under stones in spring. Very rare.
		LITHOCHARIS, Er.	
443.	1901.	*corticina*, Grav.	Under stones. Rare.
444.	1902.	*confluens*, Say	Same as the preceding.
		SUNIUS, Steph.	
445.	1907.	*binotatus*, Say	Throughout the year under sticks, etc. Common.
446.	1907.	*longiusculus*, Mann.	The same as the preceding.
		PÆDERUS, Grav.	
447.	1914.	*littorarius*, Grav.	Same as the preceding. Especially abundant in spring.
		PALAMINUS, Er.	
448.	1924.	*testaceus*, Er.	Under stones, etc. Rare.

Wis. No.	Amer. No.		
		STENUS, Latr.	
449.	1932.	*stygicus*, Say	Edges of streams. Common.
450.	1945.	*flavicornis*, Er	Same as preceding.
451.	1949.	*callosus*, Er	Edges of streams. Rare.
		OXYPORUS, Fabr.	
452.	1957.	*rufipennis*, Lec	On fungi in autumn. Very rare.
453.	1960.	*vittatus*, Grav	On fungi in autumn. Common.
454.	1962.	*lateralis*, Grav	Same as preceding.
		BLEDIUS, Leach.	
455.	1967.	*semiferrugineus*, Lec	On damp banks of streams. Quite rare.
456.	1968.	*rubiginosus*, Er	Common at Watertown, Wis.
457.	1974.	*cordatus*, Say	Same as 1967.
		OXYTELUS, Gray.	
458.	1989.	*rugosus*, Grav	Under stones in spring. Rare.
459.	1992.	*sculptus*, Grav	Under stones in spring. Scarcely common.
460.	1994.	*pensylvanicus*, Er	Same locality as preceding, but common.
		TROGOPHLOEUS, Mann.	
461.	7832[1].	*brunneipennis*, Lec	Under stones. Very rare.
		GEODROMICUS, Gray.	
462.	2010.	*caesus*, Er	Under stones, lying almost in the water at the edge of streams. Quite rare.
463.	2011.	*brunneus*, Say	On flowers. More common than the preceding.
		OLOPHRUM, Er.	
464.	2023.	*oblectum*, Er	Under stones.
465.	2024.	*marginatum*, Kb	Same as preceding.
		ANTHOBIUM, Leach.	
466.	2056.	*dimidiatum*, Mels	On flowers in autumn. Abundant.
		OLISTHÆRUS.	
467.	7888.	*substriatus*, Gyll	Under the bark of pine logs.

PSELAPHIDÆ.

		ADRANES, Lec.	
468.	2087.	*coecus*, Lec	In ants' nests and under bark and boards in early spring. Not common.
		CTENISTES, Reichenb.	
469.	2095.	*piceus*, Lec	Same as the preceding.
470.	2097.	*Zimmermanni*, Lec	Same as the preceding.
		PSELAPHUS, Hbst.	
471.	2102[a].	*longiclavus*, Lec	Same as preceding.

Wis. No.	Amer. No.		
		BRYAXIS, Leach.	
472.	2110.	*conjuncta*, Lec.	Same as the preceding.
		BATRISUS, Aubé.	
473.	2149.	*globosus*, Lec.	The same as the preceding.

SILPHIDÆ.

		NECROPHORUS, Fab.	
474.	2176.	*marginatus*, Fab.	On carrion., Common.
475.	2179.	*Sayi*, Lap.	On carrion. Very rare.
476.	2181.	*pustulatus*, Hersch.	On carrion. Rare.
477.	2183.	*americanus*, Oliv.	On carrion. Common at times.
478.	2184.	*orbicollis*, Say	The same as the preceding.
479.	2185.	*tomentosus*, Web.	The same as the preceding.
480.	2186.	*vespilloides*, Heb.	Rarer than the preceding.
		SILPHA, Fabr.	
481.	2187.	*surinamensis*, Fab.	On carrion all summer. Very common.
482.	2188.	*lapponica*, Hb.	The same as the preceding.
483.	2192.	*noveboracensis*, Forst.	The same as the preceding.
484.	2196.	*americana*, Linn.	Notably on dead fish.
		CHOLEVA, Payk.	
485.	2219.	*basillaris*, Say	From forest earth by sifting, in autumn. Rare.
		COLENIS, Er.	
486.	2246.	*impunctata*, Lec.	With the sweep-net or umbrella. Rare.
		LIODES, Er.	
487.	2249.	*polita*, Lec.	On fungi in autumn. Rare.
488.	2250.	*discolor*, Mels.	Like the preceding.
		AGATHIDIUM, Ill.	
489.	2253.	*oniscoides*, Beauv.	Under rotting wood in autumn. Rare.
490.	2254.	*exiguum*, Mels.	On fungi in autumn. Rare.
491.	2257.	*concinnum*, Mann	The same as the preceding.

SCYDMÆNIDÆ.

		EUMICRUS, Lap.	
492.	2271.	*Motschulskii*, Lec.	Under stones and sticks in early spring. Not uncommon.
		CHOLERUS, Lap.	
493.	2272.	*Zimmermanni*, Schaum.	The same as the preceding.

CORYLOPHIDÆ.

		ORTHOPERUS, Steph.	
494.	7963.	*scutellaris*, Lec.	On the under side of stones in early spring. Also abundant at times on aphid-injured plants.

Wis. No.	Amer. No.	
		CORYLOPHUS, Steph.
495.	2310.	*marginicollis*, Lec.....The same as the preceding.
		SERICODERUS, Steph.
496.	2312.	*flavidus*, Lec.....The same as the preceding, only rarer.

SCAPHIDIIDÆ.

		SCAPHIDIUM, Oliv.
497.	2325.	*quadriguttatum*, Say...In old stumps in early summer. Rare.
		SCAPHISOMA, Leach.
498.	2335.	*suturale*, Lec.....Sifted from forest earth in autumn. Rare.
499.	2338.	*pusillum*, Lec.....On fungi in autumn. Quite rare.
		TOXIDIUM, Lec.
500.	2339.	*gammaroides*, Lec.....On fungi in autumn. Rare.

LATRIDIIDÆ.

		LATRIDIUS, Heb.
501.	2350.	*minuta*, Linn.....On the wooden walls of sheds, barns, etc., in early spring. Also under stones and on the bark of trees. Common.
		CORTICARIA, Steph.
502.	2367.	*rugulosa*, Lee.....Same as the preceding.
503.	2374.	*americanus*, Mannh...The same as the preceding, only rarer.
504.	2387.	*pumilus*, Mels.....The same as the preceding.

DERMESTIDÆ.

		DERMESTES, Linn.
505.	2393.	*Mannerheimii*, Lec.....On carrion sometimes.
506.	2396.	*talpinus*, Mann.....The same as the preceding.
507.	2401.	*lardarius*, Linn.....A too common pest on furs, fatty meats, in museums, etc. The larder-beetle.
		ATTAGENUS, Latr.
508.	2405.	*pellio*, Linn.....In museums. Also on flowers.
509.	2406.	*megatoma*, Fab.....The same as the preceding.
		TROGODERMA, Latr.
510.	2415.	*ornata*, Say.....With the sweep-net on flowers. Very rare.
		ANTHRENUS, Geoff.
511.	2430.	*varius*, Fab.....With the sweep-net on flowers. Common.
512.	2432.	*musæorum*, Linn.....The well-known museum pest.

Wis. No.	Amer. No.	
		ORPHILUS, Er.
513.	2434[a].	*subnitidus*, Lec.....On flowers. Not rare.

ENDOMYCHIDÆ.

LYCOPERDINA, Latr.

514. 2435. *ferruginea*, Lec.....Under the bark of old logs. Rare.

MYCETINA, Muls.

515. 2436. *perpulchra*, Newm.....The same as the preceeding.
516. 2438. *testacea*, Lec.....The same as the preceeding.
517. 2439. *vittata*, Fab.....Somewhat commoner than the preceding.

EPIPOCUS, Germ.

518. 2449. *unicolor*, Horn.....In fungi in autumn. Common.

STENOTARSUS, Perty.

519. 2450. *hispidus*, Heb.....With the sweep-net. Very rare.

ENDOMYCHUS, Hellw.

520. 2451. *biguttatus*, Say.....On young branches of the aspen. With the sweep-net. Common.

RHANIS, Lec.

521. 2452. *unicolor*, Ziegl.....With the sweep-net. Rare.

MYCETÆA, Steph.

522. 2454. *hirta*, Msh.....The same as the preceding.

MYCETOPHAGIDÆ.

MYCETOPHAGUS, Hellw.

523. 2457. *punctatus*, Say.....Common in fungus in autumn.
524. 2458. *flexuosus*, Say. .....The same as the preceding.
525. 2459. *pluriguttatus*, Lec.....The same as the preceeding, but less common.
526. 2461. *bipustulatus*, Mels.....The same as the preceeding.

TRIPHYLLUS, Dej.

527. 2465. *humeralis*, Kirby.....Abundant in fungi. In autumn.

LITARGUS, Er.

528. 2467. *tetraspilotus*, Lec.....Rarer than the preceeding.
529. 2468. *6-punctatus*, Say.....The same as the preceding.

TYPHŒA, Curt.

530. 2474. *fumata*, Linn.....Found abundantly on the wall of a barn. 1885.

SPHINDIDÆ.

SPHINDUS, Chev.

531. 2476. *americanus*, Lec.....With the sweep-net.

CIOIDÆ.

Wis. No.	Amer. No.	
		CIS, Latr.
532.	2481.	*fuscipes*, Mell.....With the sweep-net. Common.
		CERACIS, Mell.
533.	2504.	*Sallei*, Mell.....The same as the preceding.

EROTYLIDÆ.

		LANGURIA, Latr.
534.	2506.	*Mozardi*, Latr.....On flowers. In autumn.
535.	2509.	*angustata*, Beauv.....The same as the preceding.
536.	2509[a]	*trifasciata*, Say.....The same as the preceding.
537.	2514.	*gracilis*, Newm.....The same as the preceding.
		DACNE, Latr.
538.	2515.	*4-maculata*, Say.....With the sweep-net. Common.
		MEGALODACNE, Cr.
539.	2518.	*heros*, Say.....On old oak stumps. Very rare.
		MYCOTRETUS, Lac.
540.	2524.	*pulchra*, Say.....On fungi. In autumn. Rare.
		CYRTOTRIPLAX, Cr.
541.	2526.	*humeralis*, Fab.....In small fungi. In autumn. Common.
542.	2531.	*angulata*, Say.....In fungi. Very common.
543.	2533.	*affinis*, Lac.....In fungi. Rare.
		TRIPLAX, Hb.
544.	2537.	*thoracica*, Say.....In fungi. In autumn. Very common.

ATOMARIIDÆ.

		ANTHEROPHAGUS, Latr.
545.	2542.	*ochraceus*, Mels..... On flowers. Common.
		PARAMECOSOMA, Curt.
546.	2561.	*serrata*, Gyll.....With the sweep-net. Rarer than the preceding.
		TOMARUS, Lec.
547.	2562.	*pulchellus*, Lec.....With the sweep-net. Common.
		ATOMARIA, Steph.
548.	2572.	*ochracea*, Zimm.....Under decomposing hay on the sand of the lake beach.
549.	2573.	*ephippiata*, Zimm.....With the sweep-net. Rare.
		DIPLOCŒLUS, Guer.
550.	2578.	*brunneus*, Lec.....With the sweep-net. Not uncommon.

Wis. No.	Amer. No.	SILVANUS, Latr.	
551.	2580.	*surinamensis*, Linn.	...Under bark. Rare.
552.	2581.	*bidentatus*, Fabr.	.....The same as the preceding.
553.	2582.	*planatus*, Germ.	.....Our common species. Under the bark of basswood.
554.	2583.	*imbellis*, Lec.	.....Under bark. Rarer than the preceding.

CUCUJIDÆ.

CATOGENUS, Wester.

555.	2592.	*rufus*, Fabr.	.....Under oak bark. Not nncommon.

CUCUJUS, Fabr.

556.	2594.	*clavipes*, Fabr.	.....Under the bark of the alder. Muskego Lake.

LÆMOPHLÆUS, Lap.

557.	2598.	*biguttatus*, Say	.....Under the bark of the basswood tree. Abundant.
558.	2602.	*punctatus*, Lec.	.....Under bark. Common.
559.	8006.	*convexulus*, Lec.	.....With the sweep-net. Very rare.

ULIOTA, Latr.

560.	2610.	*dubius*, Fabr.	.....Under the bark of the basswood. Common.

BITOMIDÆ.

BITOMA, Hb.

561.	2614.	*striatus*, Mels.	.....With the sweep-net on willows. Rare.
562.	2615.	*opaculus*, Lec.	.....The same as the last.

COLYDIIDÆ.

DITOMA, Er.

563.	2626.	*quadriguttata*, Say	.....With the sweep-net. Rare.

SYNCHITA, Hellw.

564.	2629.	*fuliginosa*, Mels.	.....With the sweep-net. Rare.

COLYDIUM, Fabr.

565.	2642.	*lineola*, Say	.....One specimen on an oak stump.

ENDECTUS, Lec.

566.	2649.	*hæmatodes*, Fab.	.....Under bark. Rare.

CERYLON, Latr.

567.	2654.	*castaneum*, Say	.....Like the last.

MONOTOMIDÆ.

RHIZOPHAGUS, Heb.

568.	2663.	*bipunctatus*, Say	.....Under bark. Rare.

BACTRIDIUM, Lec.

569.	2666.	*nanum*, Er.	.....The same as the preceding.

TROGOSITIDÆ.

Wis. No.	Amer. No.		
		TENEBRIOIDES, Pall.	
570.	2686.	*mauritanica*, Linn.	Under bark. Rare.
571.	2688.	*corticalis*, Mels.	Like the last.
572.	2688[b]	*dubia*, Horn.	Like the last.
573.	2693.	*castanea*, Mels.	Under bark. Common.
574.	2693[a]	*Laticollis*, Horn.	Like the preceding.
		GRYNOCHARIS, Th.	
575.	2700.	*4-lineata*, Mels.	Rare. Under bark.
		CALYTIS, Thoms.	
576.	2703.	*scabra*, Thunb.	Under bark. Rare. District of pine woods.
		THYMALUS, Duft.	
577.	2704.	*fulgidus*, Er.	With the sweep-net. Rare.

[TO BE CONTINUED.]

ON SOME NEW GENERA AND SPECIES OF ATTIDÆ FROM THE EASTERN PART OF GUATEMALA.

By G. W. and E. G. Peckham.

[*Continuation of page 42.*]

Gen. nov. Titanattus.

Cephalothorax high, plane, dilated behind dorsal eyes, sides nearly vertical; cephalic part about as long as thoracic, inclined forward; thoracic part slanting very steeply (more steeply than in *Amycus*), behind and on the sides, from the cephalic plate.

Quadrangle of *eyes* 1/4 wider than long, very slightly wider in front than behind; anterior row strongly bent, visible from above; middle more than twice as large as lateral eyes, and a little separated; lateral eyes a little more widely separated from middle eyes; eyes of second row small, a little nearer the lateral than the dorsal eyes; dorsal equal to lateral eyes, much nearer each other than the lateral borders; this row narrower than the cephalothorax at that place. Clypeus higher than middle eyes, retreating.

Falces rather stout, and short (about ⅔ as long as the face), parallel, vertical or a little retreating.

Maxillæ rather long, and but little enlarged at extremity, bluntly pointed, parallel. Labium ½ as long as maxillæ, about as wide as long.

Sternum heartshaped, projecting between anterior coxæ, which are separated by more than the width of the labium. Coxæ and trochanters I (especially coxæ) elongated.

Legs 1, 2, 4, 3; first pair stoutest, but all slender. Patella + tibia III shorter than patella + tibia IV; patella + tibia IV longer than metatarsus + tarsus IV. Weak femoral, tibial and metatarsal spines on the four pairs, on the metatarsi of the fourth only in a terminal circle.

Very near *Amycus* and *Triptolemus*.

TITANATTUS SÆVUS sp. nov.

♂. Total length 5 mm. Width of abdomen 1.5 mm.

Cephalothorax: length 2.3; width 2; height 1.9.

Legs 7.1, 5.1, 4.6, 5.1.

Coloration. The cephalothorax is dark brown, with a large white spot which occupies nearly the whole of the ocular area, and extends downward between the anterior middle eyes. The abdomen is white with a network of brown lines, one central and two lateral brown spots, and, on the posterior portion, six black dots. The clypeus and falces are dark brown; the maxillæ and labium very dark, almost black; the sternum brown; the coxæ pale; the legs pale, irregularly barred with brown; the palpus pale, with some brown hairs on the tarsus; the venter black, with a white longitudinal band on each side.

Habitat. Guatemala.

Gen. nov. Triptolemus. [1]

Cephalothorax high, plane, dilated behind dorsal eyes, sides nearly vertical; cephalic part as long as thoracic, inclined forward; thoracic part slanting steeply behind and on the sides from cephalic plate.

[1] Proper name (mythological).

Quadrangle of *eyes* ¼ wider than long, a little wider in front than behind; anterior row straight, visible from above; middle more than twice as large as lateral eyes, subtouching; lateral a little separated from middle eyes; eyes of second row small, a little nearer lateral than dorsal eyes; dorsal as large as lateral eyes, nearer to each other than to the lateral borders; this row narrower than the cephalothorax at that place. Clypeus a little higher than anterior middle eyes, and about as wide; vertical.

Falces not very stout, shorter than face, vertical, parallel.

Maxillæ diverging, a little enlarged and truncated at the extremity. Labium nearly ½ as long as the maxillæ, about as wide as long, slightly contracted and rounded at the tip.

Sternum heartshaped, about as wide as long, projecting between the anterior coxæ, which are separated by more than the width of the labium.

Legs, relative length 1, 3, 2, 4; relative stoutness 1, 2, 3, 4. Patella + tibia I longer than cephalothorax; patella + tibia III longer than patella + tibia IV; patella + tibia IV a little longer than metatarsus + tarsus IV. Femoral, tibial and metatarsal spines on the four pairs; metatarsi of the fourth armed to the base.

This genus is very near *Titanattus*, separated from it principally by the anterior row of eyes being straight, not strongly bent, and by the relative length of the legs.

Triptolemus benignus sp. nov.

♂. Total length 5.2 mm. Width of abdomen 1.3 mm.

Cephalothorax: length 2.3; width 1.9; height 1.7.

Legs 6.5, 5.2, 5.8, 4.7. Pat. + tib. I 2.7; pat. + tib. III 2.2; pat. + tib. IV 1.7; metat. + tar. IV 1.5.

Coloration. The cephalothorax has the eye-region light testaceous brown, with some red hairs above the anterior eyes, and the thoracic part and sides dark, almost black. The abdomen is drab, with two curved black bands, resembling a parenthesis, on the anterior part. The legs and palpi are pale testaceous,

excepting the patella, tibia, and metatarsus of the first leg, which are brown. The coxæ are palc; the clypeus, falces, mouthparts, sternum, and venter, dark brown.

Habitat. Guatemala.

Amycus C. K.

C. Koch, in defining the genus *Amycus*, took for the type *Saltieus igneus* Perty (*A. igneus* Walck.) He stated that the eyes of the second row were placed half-way between the eyes of the third row and the anterior lateral eyes. Walckenær, in describing this species, notes that the eyes of the second row are nearer the lateral than the dorsal eyes. Of the four species described by C. Koch under this genus, only one has the small eyes half-way.

We define this genus as follows:

Cephalothorax high and nearly plane, a little dilated behind the dorsal eyes, and narrower in front than behind; anterior sides nearly vertical, posterior sides and slope a little rounded; cephalic part occupying ½ the cephalothorax, and a little inclined forward; thoracic part falling steeply from just behind dorsal eyes.

Quadrangle of *eyes* ¼ wider than long, a little wider behind than in front. Anterior row visible from above, slightly curved, the middle eyes projecting considerably in front of the lateral eyes, and subtouching; the lateral less than ½ as large, and separated from the middle eyes by ¼ their own diameter. Eyes of second row nearer together than the anterior lateral eyes, and half as far from them as from the dorsal eyes. Dorsal larger than lateral eyes, much nearer each other than the lateral borders, in a row which is as wide as the cephalothorax at that place. Clypeus vertical, higher, but not wider than the two middle eyes. Frons ½ as high as anterior lateral eyes.

Falces a little wider than two middle eyes, about as long as face, vertical, a little divergent at the extremities, compressed. Fang short.

Maxillæ divergent, long, a little enlarged and truncated at extremity, pointed at outer corner, slanting within toward labium. Labium ⅓ as long as maxillæ, square.

Sternum heartshaped, but little longer than wide, projecting between the anterior coxæ, which are separated by at least the width of the labium.

Relative length of *legs* 3, 1, 2, 4; relative stoutness $\overline{1, 2, 3}$, 4. Femoral, tibial, and metatarsal spines on the four pairs, those on the metatarsi of the fourth extending to the base. Patella + tibia III longer than patella + tibia IV; patella + tibia IV a little shorter than metatarsus + tarsus IV.

Amycus longi-palpus sp. nov.

♂. Total length 5.8 mm. Width of abdomen 1.4 mm.

Cephalothorax: length 2.8; width 2.3; height 1.9.

Legs 7, 5.8, 8.1, 5.9.

Palpus 5 mm.

This species has the palpus as long as the femur, patella, and tibia of the first leg, and has patellary spines on the third and fourth pairs of legs.

The abdomen is slender and pointed.

Coloration. The cephalothorax is all brown excepting a small central white spot on the thoracic part behind the dorsal eyes. The abdomen is drab, with a central longitudinal white band, on each side of which, on the posterior part of the abdomen, are three black spots. The clypeus and falces are brown; the sternum, coxæ, and the proximal part of the femoral joint of the first leg are pale, the legs otherwise being brownish; the maxillæ are pale, the labium brown; the palpus is pale with the tarsus brownish. The venter is drab.

Habitat. Guatemala.

Philæus ruber sp. nov.

♂. Total length 6 mm. Width of abdomen 1.7 mm.

Cephalothorax: length 2.3; width 2; height 1.6.

Legs 8.9, 4.6, 3.9, 4.9. Pat. + tib. I 3.8; pat. + tib. III 1.6; pat. + tib. IV 2.1; metat. + tar. IV 1.6.

Small ♂. Total length 4.5 mm.

The *cephalothorax* is high, and is dilated behind the dorsal eyes. The cephalic part is separated from the thoracic, and occupies ⅖ of the cephalothorax; it is nearly plane, slightly inclined forward, and is widely rounded on the sides. The thoracic part is convex, and a little contracted behind. It falls from the dorsal eyes.

The quadrangle of the *eyes* is ⅓ wider than long, and is a very little wider behind than in front. The anterior eyes are in a curved row; they are all small, the middle being a little less than twice as large as the lateral, and are placed on a ridge; the middle eyes are a little separated, and the lateral are separated from them by ½ their own diameter, and are much further back. The eyes of the second row are a little nearer the lateral than the dorsal eyes. The dorsal are a little smaller than the lateral eyes; they are on the margin of the cephalothorax, and are further from each other than from the lateral borders. The clypeus is a little less than ⅓ as high as the anterior middle eyes, and is vertical.

The *falces* are as wide as the first row of eyes, and are as wide at the base as long, bulging out in front, twice as long as face, diverging a little at the extremity, and inclined forward. There is a short tooth on the inner anterior edge of each falx. The fang is about as long as the falx.

The *maxillæ* are long; they are rounded, and a little enlarged at the extremity. The labium is a little more than ½ as long as the maxillæ, ½ longer than wide, a little contracted, and blunt at the tip.

The *sternum* is narrow, truncated in front and rounded behind. It projects between the anterior coxæ, which are separated by the width of the labium, and are stout and long.

The relative length of the *legs* is 1, 4, 2, 3; the first pair is much the stoutest. There are femoral, patellary, tibial and metatarsal spines on the four pairs, those on the metatarsi of the fourth extending to the base.

Coloration. The cephalothorax is dark brown with a few white hairs on the middle portion, and a wide white band on each upper side, which includes the small median and the dor-

sal eye; the abdomen is dark brown with a white longitudinal band down the middle and one on either side. The legs are brown, the first pair being much the darkest; the palpi, clypeus, and falces are brown; the sternum is black; the anterior coxæ are very dark brown, the other coxæ and the mouthparts light brown, and the venter dark brown.

Habitat. Guatemala.

Plexippus puerperus Hentz.

Syn: 1832. Attus puerperus Hentz. On North American Spiders, Silliman's Journal of Science and Arts, xxi., pp. 99–152.

♂. Total length 11 mm. Width of abdomen 2.4 mm.

Cephalothorax: length 4; width 2.4; height 2.8.

Legs 12.3, 10.3, 10.5, 10.8. Pat. + tib. I 5.4; pat. + tib. III 3.9; pat. + tib. IV 3.8; metat. + tar. 3.9.

The *cephalothorax* is high, rounded on the sides, and widest behind the dorsal eyes. The cephalic part occupies ⅖ of the cephalothorax; it is nearly plane, and slightly inclined. The thoracic part is somewhat rounded, but falls steeply from the dorsal eyes.

The quadrangle of the *eyes* is ¼ wider than long, and is a little wider behind than in front. The anterior row, which is visible from above, is moderately curved; the middle eyes are subtouching, and are scarcely twice as large as the lateral eyes, the lateral being separated from the middle eyes by ⅓ their own diameter. The eyes of the second row are placed not quite twice as far from the dorsal as from the lateral eyes. The dorsal eyes are a little smaller than the lateral, and are placed by more than their diameter inside the margin; they are further from each other than from the lateral borders. The clypeus is ⅓ as high as the large middle eyes.

The *falces* are stout, being a little wider than the first row of eyes, and are flattened in front; they are twice as long as the face, parallel and vertical. The fang is short and moderately stout.

The *maxillæ* are long and parallel, enlarged and slightly rounded at the extremity. The labium is but little longer than

wide, slightly more than ½ as long as the maxillæ, a little contracted and rounded at the tip.

The *sternum* is 1 ½ times as long as wide, truncated in front, and rounded behind. It projects between the anterior coxæ, which are separated by the width of the labium.

The relative length of the *legs* is 1, 4, 3, 2; their relative stoutness 1, 2, 3, 4, the fourth being plainly more slender than the third. There are femoral, patellary, tibial and metatarsal spines on the four pairs, those on the tibiæ and metatarsi of the third and fourth being found both above and below, and those on the metatarsi extending to the base.

♀. Total length 13.6 mm. Width of abdomen 4.7 mm.

Cephalothorax: length 4.8; width 4.2; height 2.8.

Legs 10.6, 9.1, 10.4, 11.7. Pat. + tib. I 4.8; pat. + tib. III 3.9; pat. + tib. IV 4.1; metat. + tar. IV 4.3.

The cephalic plate is not so much raised as in ♂. The thoracic part falls gradually for ¼ of its length, not steeply from the dorsal eyes. The first row of eyes is but little curved, less than in ♂. The anterior eyes are all relatively larger than in the ♂, the middle eyes being more than twice as large as the lateral. The maxillæ are more widely rounded, and the labium shorter and more slender than in the ♂. The relative length of the legs is 4, 1, 3, 2, and the relative stoutness 1, 2, 3, 4. There are no patellary spines on the first and second pairs.

Coloration. (♂). The cephalothorax varies from reddish brown to black, and has a central spot and several lines white; the abdomen varies from light testaceous to dark brown, and has two longitudinal white bands, on each of which is a row of black dots. The legs and falces are dark brown; the clypeus is dark brown above, with a pale band just over the falces; on the upper portion two lines of white hairs beginning between the middle eyes, run obliquely outward to the insertion of the palpi; the palpus is brown, with a white line above, meeting that on the clypeus. The sternum, coxæ and mouthparts vary from light testaceous to dark brown; the venter is brown with a longitudinal white line on each side. (♀). The cephalothorax

is yellow, darkest in the eye region, with a brown spot just above the anterior middle eyes; the abdomen is light yellow, with three longitudinal white bands, and many black dots. The legs, palpi, falees and clypeus are yellow; the sternum, coxæ and venter pale brown, the venter having a line of white hairs on each side.

Habitat. Guatemala.

Hyllus pratensis sp. nov.

♂. Total length 10 mm. Width of abdomen 3 mm.

Cephalothorax: length 4.2; width 3.6; height 3.1.

Legs 15.5, 11.4, 12.1, 11.1. Pat. + tib. I 6.8; pat. + tib. III 4.6; pat. + tib. IV 3.9; metat. + tar. IV 3.9.

Small ♂. 8 mm.

The *cephalothorax* is very high and convex, widest at the dorsal eyes, and more contracted in front than behind. The cephalic part is distinctly separated from the thoracic, and occupies a little more than ⅓ of the cephalothorax; its sides are widely rounded, and its upper surface nearly plane, and a little inclined forward. The thoracic part falls abruptly from the dorsal eyes for ⅔ its length, and then still more abruptly to the posterior border. It is rounded behind and on the sides. The cephalothorax is peculiar from the elevated head-plate, from which it slants away in all directions.

The quadrangle of the *eyes* is ¼ wider than long, and is equally wide in front and behind. The first row of eyes is strongly curved and is visible from above. The middle eyes of this row are twice as large as the lateral, and are subtouching; the lateral are separated from the middle eyes by ¼ of their own diameter. The eyes of the second row are, by a space equaling their own diameter, nearer the lateral than the dorsal eyes. The dorsal are nearly as large as the lateral eyes, and are placed inside the margin of the cephalothorax by a space equaling twice their own diameter. They are much nearer to each other than to the lateral borders.

The *clypeus* is vertical and is ½ as high as the middle eyes of the first row.

The *falces* are stout, their width exceeding that of the first row of eyes. They are nearly three times as long as the face, inclined forward, and diverging at the tips. The fangs are moderately long.

The *palpus* has one strong spine on the distal end of the femur.

The *maxillæ* are parallel, and are enlarged and rounded at the extremities. The labium is a little more than ½ as long as the maxillæ, longer than wide, rounded and slightly contracted at the tip.

The *sternum* is as long as the anterior coxæ, and about ½ as wide as long. It projects between the anterior coxæ, which are separated by the width of the labium.

The relative length of the *legs* is 1, 3, 2, 4; the first and second are the stoutest, and are equal; the third is a little stouter than the fourth. There are long spines on the femoral, patellary, tibial and metatarsal joints of the four pairs, those on the tibiæ and metatarsi of the third and fourth being in both superior and inferior rows, and those on the metatarsi of the fourth extending to the base.

Coloration. The cephalothorax is black with three wide white bands, a central one beginning in the middle of the ocular area, and one on each side beginning under the dorsal eye, all extending to the posterior border. The abdomen is of a rich red color, encircled by a black band, and having a central longitudinal white band extending throughout its length; the sides, below the black band, are white; the spinnerets, black. The legs, palpi and falces are brown. The sternum, coxæ, mouthparts and venter vary from light testaceous brown to black.

Habitat. Guatemala.

JOTUS OPIMUS sp. nov.

♂. Total length 8 mm. Width of abdomen 2.5 mm.

Cephalothorax: length 3.9 mm; width 2.5 mm; height 2 mm.

Legs 6.7, 6.5, 8, 8.4. Pat. + tib. I 2.6; pat. + tib. III 2.9; pat. + tib. IV 2.8; metat. + tar. IV. 3.

The *cephalothorax* is high and convex, and is a little dilated behind the dorsal eyes. The cephalic and thoracic parts are separated by a depression. The cephalic part occupies ⅔ of the cephalothorax; it is inclined forward and has its sides vertical. The thoracic part falls gradually in the first half, abruptly in the second; it is rounded behind and on the sides.

The quadrangle of the *eyes* is a little less than ⅛ wider than long, and is equally wide in front and behind. The first row of eyes, which is moderately curved, is barely visible from above; the middle eyes are subtouching, and are about 1 ½ times as large as the lateral eyes, from which they are a little separated. The eyes of the second row are half-way between the dorsal and lateral eyes. The dorsal eyes are as large as the lateral; they are placed on the margin of the cephalothorax, and are further from the lateral borders than from each other. The frons is only a line.

The *clypeus* is a little inclined backward, and is ⅗ as high as the middle eyes.

The *falces* are robust, nearly equalling the first row of eyes in width, and are a little longer than the face. They are parallel, and inclined backward. The fang is very short.

The *maxillæ* are enlarged and slightly rounded at the extremity. The labium is as wide as long, and is a little contracted and blunt at the tip. It is ½ as long as the maxillæ.

The *sternum* is but little longer than wide. It is rounded behind, and truncated in front, and it projects between the anterior coxæ.

The relative length of the *legs* is $\overline{4, 3}$, 1, 2. The first, second and third pairs are stouter than the fourth. The anterior coxæ are separated by the width of the labium. There are femoral, patellary, tibial and metatarsal spines on the four pairs, on both upper and under surface. On the patella and tibia of the first, and on the patella, tibiæ and metatarsi of the second and third legs are fringes of stout hairs, stoutest on the third.

♀. Total length 10.7 mm. Width of abdomen 3.4 mm.

Cephalothorax: length 5 mm; width 3.7 mm; height 2.7 mm.

Legs 8.6, 9.1, 10.8, 10.9. Pat. + tib. I 3.9; pat. + tib. III 4.2; pat. + tib. IV 4.1; metat. + tar. IV 3.8.

The posterior slope of the cephalothorax is less rounded than in the ♂. The quadrangle of the eyes is 1/3 wider than long. The anterior lateral eyes are somewhat more separated from the middle eyes than in the ♂, and the sternum is more sharply truncated in front. The labium is a little longer than wide, and a little more than half as long as the maxillæ. The relative length of the legs is 3, 4, 2, 1, the first and second pairs being the stoutest. There are spines on the upper surface of only the third and fourth pairs.

Coloration. ♂. ♀. The cephalothorax is black; there is an indistinct patch of whitish hairs just above the middle anterior eyes, and a smaller patch behind each of the eyes of the second row. A little way behind the dorsal eye, on each side, is a longitudinal band of white hairs which becomes narrower and somewhat curved as it passes backward. These bands are sometimes united behind. It seems probable that the upper surface of the thoracic part was originally covered with white hairs, which have been more or less rubbed off in the different specimens. On the lower borders of the cephalothorax are bands of white hairs which extend from about opposite the dorsal eyes to that part of the cephalothorax which is overlapped by the abdomen. The ground color of the abdomen is black. At the base it is covered with whitish yellow hairs, through which there sometimes runs a transverse line of white hairs. Just behind this region is a large spot of bright red hairs which occupies the central anterior portion of the dorsum, and which, in the ♂, takes somewhat the form of an obtuse triangle. Behind this spot, and touching it, is a transverse band of white hairs (broader in the ♀), which is frequently (especially in the ♀) interrupted by black in the middle line. Behind this band the color of the middle region of the abdomen varies from whitish to yellowish. Near the spinnerets is a line of white hairs which, in the ♀, is parallel with the white band; in the ♂ it takes the form of a

V pointing backward. The palpus is brown, the distal end of the femur and the patella being darker than the rest. The sternum, coxæ and falces are brown. The maxillæ and labium are brown, usually tipped with white. The venter is brownish or black; on each side is a longitudinal band of white hairs, narrowing behind, and sometimes curving toward the spinnerets. In front there is sometimes on each side a line of straggling white hairs which comes off from the anterior end of the white band, and passes upward on to the side. The legs are brownish or black. In the ♂ the patella of the third has a brilliant bluish metallic lustre.

Habitat. Guatemala.

Cytæa (?) con-cinna sp. nov.

♀. Total length 8 mm. Width of abdomen 2.2 mm.

Cephalothorax: length 3.5; width 2.8; height 2.

Legs 7.4, 7.1, 8.7, 8.4. Pat. + tib. I 2.8; pat. + tib. III 3.3; pat. + tib. IV 3.2; metat. + tar. IV 2.8.

The *cephalothorax* is moderately high and convex; it is a little dilated opposite the dorsal eyes, and is more contracted in front than behind. The cephalic and thoracic parts are separated by a slight depression. The cephalic part occupies $\frac{2}{5}$ of the cephalothorax; it is inclined forward, with vertical sides. The thoracic part slopes gradually from the dorsal eyes; it is rounded behind and on the sides.

The quadrangle of the *eyes* is $\frac{1}{4}$ wider than long, and is equally wide in front and behind. The eyes of the first row are small, placed on a projecting ridge, and visible from above. They are in a moderately curved line, and are all subtouching, the middle being scarcely twice as large as the lateral eyes. The eyes of the second row are nearer the lateral than the dorsal eyes by a space equalling their own diameter. The eyes of the third row are on the margin of the cephalothorax, and as large as the lateral eyes, and are further from the lateral borders than from each other.

The *clypeus* is vertical, and is $\frac{1}{3}$ as high as the middle eyes.

The *falces* are rather stout, being nearly as wide as the first row of eyes. They are twice as long as the face, parallel and vertical. The fang is short and moderately stout.

The *maxillæ* are parallel, and are enlarged and rounded at their extremities. The labium is ⅔ as long as the maxillæ, is longer than wide, and is a little contracted and rounded at the tip.

The *sternum* is very deepset. It is ¼ longer than wide, and truncated in front. It projects between the anterior coxæ.

The *palpus* has one spine on the distal end of the femur.

The relative length of the *legs* is 3, 4, 1, 2. They are equally stout. The spines are strong and numerous, and are found on the femoral, patellary, tibial, and metatarsal joints of the four pairs. On the patella, tibiæ and metatarsi of the first and second pairs there are inferior rows, and scattered spines above; on the third and fourth pairs they are in rows both above and below.

Coloration. The ground color of the cephalothorax is black; the sides are reddish, covered with white hairs; a red band crosses above the first row of eyes and passes back on each side to the dorsal eyes. There is a longitudinal white band, widest in the middle and tapering at the ends, which begins in the middle of the cephalic part and extends nearly to the posterior border. Two oblique white lines start from a point between the middle anterior eyes and extend nearly to the dorsal eyes. Around the lower border is a narrow black line. The ground color of the abdomen is rich red. It is encircled by a black band, below which the sides are white. On the anterior middle part is a large white spot, pointed in front and widening behind; and a little behind the middle is a short transverse white band; two black bands, beginning at the anterior point of the white spot, diverging a little as they go, and interrupted by the white band, pass backward to the spinnerets; on each of these, behind the white band, are two white dots. All the other parts of the spider are light brown covered with white hairs. The colors are much paler in some specimens than in others.

Habitat. Guatemala.

Gen. nov. Rudra[1].

Cephalothorax very low and flat; slightly wider behind the dorsal eyes; but little longer than wide. Thoracic part twice as long as cephalic part, rounded behind.

Eyes forming a quadrangle nearly twice as wide as long, and equally wide in front and behind. Anterior row of eyes slightly curved downward; the middle subtouching, the lateral a little more separated, the middle a little more than twice as large as the lateral eyes. Eyes of the second row small, and placed half-way between the dorsal and lateral eyes. Dorsal eyes smaller than the lateral, and much further from each other than from the lateral border.

Clypeus only a line.

Sternum oval, rounded behind, truncated in front. Anterior coxæ separated by width of the labium.

Maxillæ less than twiee labium, enlarged and rounded at extremity; parallel.

Labium about $\frac{1}{3}$ longer than wide, narrow and rounded at tip.

Falces as wide as middle eyes, and but little longer than the face; nearly vertical.

Legs 1, 4, 2, 3. First legs much the stoutest, with femur, tibia and patella much enlarged. The patella with tibia of the third shorter than the patella with tibia of the fourth; metatarsus with tarsus of the fourth about equal to patella with tibia.

Abdomen but little longer than wide.

This genus is near *Ganesa* P., but differs in the quadrangle of the eyes being much wider, and the cephalothorax being about as wide as long. The first row of eyes is not so large. *Holoplatys* E. S. is not far away. The ocular quadrangle and the legs, however, easily distinguish it.

[1]Proper name—Sanscrit.

RUDRA GENICULATA sp. nov.

♀. Total length 5 mm. Width of abdomen 1.8 mm.

Cephalothorax: length 2; width 1.5; height 5.

Legs 5.4, 3.5, 2.7, 3.9. Pat. + tib. I 2.3; pat. + tib. III 1.1; pat. + tib. IV 1.5; metat. + tar. IV 1.4.

The *cephalothorax* is very low and flat, and is a little dilated behind the dorsal eyes. The cephalic is not separated from the thoracic part; it occupies ⅓ of the cephalothorax, and does not slant forward; its sides are vertical. The thoracic part, which is also not inclined, is a little rounded behind and on the sides.

The quadrangle of the *eyes* is nearly twice as wide as long, and is equally wide in front and behind. The anterior row, which is visible from above, is slightly curved downward. The middle are a little more than twice as large as the lateral eyes, and are subtouching, while the lateral are separated from the middle eyes by ½ their own diameter; the lateral are placed very little further back than the middle eyes. The eyes of the second row are half-way between the dorsal and lateral eyes. The dorsal are smaller than the lateral eyes, and are placed just within the margin of the cephalothorax; they are much further from each other than from the lateral borders. There is no frons, and the clypeus is only a line.

The *falces* equal, in width, the two middle eyes; they are a little longer than the face, parallel and vertical, with the fangs weak.

The *maxillæ* are a little enlarged and rounded at the extremity, and parallel. The labium is ⅓ longer than wide, a little more than ½ as long as the maxillæ, slightly contracted and rounded at the tip.

The *sternum* is truncated in front, and rounded behind, and is ½ longer than wide. It projects between the anterior coxæ, which are separated by the width of the labium.

The relative length of the *legs* is 1, 4, 2, 3; the first pair is much the stoutest, the others being slender. The patella of the first is considerably smaller than the femur and tibia. The first leg has femoral, tibial and metatarsal spines; those on the femur

are weak, while those on the other joints are long and stout, the tibia having three and the metatarsus two pairs on the under side. The second leg has moderately stout, and the third extremely weak spines on the femur, tibia and metatarsus; while the fourth leg has only weak femoral spines.

Coloration. The cephalothorax and abdomen are pale, and each is encircled by a brown band; a central longitudinal band, also brown, extends from the anterior eyes beyond the middle point of the abdomen, and terminates in a short transverse brown bar; there are also two transverse parallel brown lines across the posterior part of the abdomen, near the spinnerets. The anterior pair of legs and the palpi are brown, the posterior three pairs of legs pale; the clypeus, falces and mouthparts are brown the sternum, coxæ and venter pale.

Habitat. Guatemala.

Gen. nov. Paradamœtas.

Cephalothorax not very high, moderately convex, slightly dilated opposite dorsal eyes, sides vertical in front, a little rounded behind, posterior slope rounded; cephalic part as long as thoracic, and slightly inclined forward; thoracic part sloping gradually from dorsal eyes.

Quadrangle of *eyes* about ⅕ wider than long, a little wider behind than in front. Anterior row straight, visible from above; middle eyes of this row twice as large as the lateral eyes, and touching; lateral eyes subtouching. Eyes of second row very small, further from dorsal than from lateral eyes. Eyes of the third row as large as lateral eyes, and further from each other than from lateral borders; this row as wide as the cephalothorax at that place. Clypeus very narrow.

Falces (♂) as wide as first row of eyes, three times as long as the face, horizontal, parallel; (♀) little wider than two middle eyes, but little longer than face, vertical, parallel.

Maxillæ (♂) narrow at base, truncated at tip; (♀) wider, blunt at tip; in both sexes excavated on inner edge, for labium.

Labium a little more than ½ as long as maxillæ, very little longer than wide, somewhat contracted and blunt at tip.

Sternum oval, ⅓ longer than wide, projecting between anterior coxæ, which are separated by the width of the labium, and are much elongated (twice as long as the other coxæ).

Legs (♂) 1, 4, 2, 3; (♀) 4, 1, 2, 3; femoral joints of first pair enlarged and compressed; otherwise all the legs slender and ant-like. Patella + tibia III shorter than patella + tibia IV; patella + tibia IV (♂) equal to, (♀) longer than metatarsus + tarsus IV. Femoral, tibial, and metatarsal spines on the four pairs, in terminal circles on the metatarsi of third and fourth, with one or two weak spines nearer the base.

Very near *Damœtas P.*, but having the quadrangle of the eyes wider than long, and the anterior row straight. The shape of the cephalothorax, the labium. and the anterior coxæ also separate it from this genus.

Paradamœtas formicina sp. nov.

♂. Total length 4.6 mm. Width of abdomen .9 mm.

Cephalothorax: length 1.9 mm; width 1.3 mm; height .8 mm.

Legs 4, 2.8, 2.8, 4. Pat. + tib. I 1.7; pat. + tib. III 1; pat. + tib. IV 1.5; metat. + tar. IV 1.5.

♀. Total length 4.8 mm. Width of abdomen 1.6 mm.

Cephalothorax: length 1.8 mm; width 1.3 mm; height .6 mm.

Legs 2.9, 2.4, 2.4, 4. Pat. + tib. I 1; pat. + tib. III .8; pat. pat. + tib. IV 1.3; metat. + tar. IV 1.1.

The abdomen of this species has a slight constriction.

Coloration. The cephalothorax and abdomen are black, the cephalothorax being covered with white, and the abdomen with greenish golden scales. The legs and palpi are light testaceous brown; the falces and mouthparts are reddish brown, the coxæ pale, and the sternum and venter black.

Habitat. Guatemala.

BAVIA ORNATA sp. nov.

♂. Total length 8 mm. Width of abdomen 2 mm.

Cephalothorax: length 4.1 mm; width 3.4 mm; height 2.5 mm.

Legs 9.9, 7.3, 6.8, 9.2. Pat. + tib. I 4.2; pat. + tib. III 2.4; pat. + tib. IV 3.4; metat. + tar. IV 3.

The *cephalothorax* is low, and is a little dilated behind the dorsal eyes. The cephalic and thoracic parts are separated. The cephalic part occupies a little less than ½ of the cephalothorax; it is flat, a very little inclined forward, and has its sides nearly vertical. The thoracic part is a little convex. It falls gradually in the first half, more abruptly in the second; it is rounded behind and on the sides.

The quadrangle of the *eyes* is ⅓ wider than long, and is a little wider in front than behind. The anterior row of eyes, which is straight, is visible from above; the lateral are less than ½ as large as the middle eyes, and are separated by ¼ their own diameter from them. The middle eyes are subtouching. The eyes of the second row are about three times as far from the dorsal as from the lateral eyes. The dorsal eyes are as large as the lateral, are placed on the upper margin of the cephalothorax, and are further from each other than from the lateral borders. There is no frons.

The *clypeus* is vertical, and is ⅕ as high as the middle eyes.

The *falces* are robust, wider than the two middle anterior eyes, about twice as long as the face, and a little inclined forward.

The *maxillæ* are enlarged and rounded at the extremity.

The *labium* is blunt at the tip. It is ⅔ as long as the maxillæ and is ½ longer than wide.

The *sternum* is ½ longer than wide; it is rounded behind, contracted in front.

The relative length of the *legs* is $\overline{1, 4}$, 2, 3; the first pair is the stoutest. The coxæ of the first pair are nearly touching. There are femoral, patellary, tibial and metatarsal spines on the

four pairs, those on the third and fourth pairs being weaker than those on the first and second. The spines on the metatarsi of the fourth pair extend to the base.

The abdomen is long, slender, and pointed.

♀. Total length 11 mm. Width of abdomen 2.7 mm.

Cephalothorax: length 4.1 mm; width 3 mm; height 1.4 mm.

Legs 9.6, 7.4, 6.8, 9.2. Pat. + tib. I 4.2; pat. + tib. III 2.5; pat. + tib. IV 3.9; metat. + tar. IV 2.9.

In shape the ♀ is like the ♂.

Coloration. ♂. ♀. The cephalothorax is testaceous, varying in color from pale to dark brown, but always darkest in the eye-region. A black band includes all the eyes, extending around three sides of the cephalic part, and between the dorsal eyes is a dark spot. There are sometimes a few white and red hairs on the thoracic part. The abdomen has two reddish longitudinal bands, which are sometimes continuous at the base, between which is a central white or pale band dotted with brown. The sides are pale streaked with brown. The face and falces are dark reddish brown; the palpus is brownish, with brown and white hairs; the mouthparts are usually dark brown, sometimes pale; the sternum is pale, as is also the venter, the latter having sometimes a dark central band and a dark spot near the spinnerets. The legs vary in color from pale to dark brown, the first and second pairs being darker than the third and fourth; all are tipped with black.

Habitat. Central America.

Gen. nov. Zygoballus.

Cephalothorax but little longer than wide, high, plane, widest opposite dorsal eyes, sides nearly vertical, behind truncated or hollowed; cephalic part occupying $\frac{3}{5}$ of the cephalothorax, slightly inclined forward; thoracic part falling steeply from dorsal eyes.

Quadrangle of *eyes* about $\frac{1}{5}$ wider than long, a little wider behind than in front; anterior row visible from above, nearly

straight; middle eyes twice as large as lateral, subtouching; lateral but little more separated from middle eyes than these from each other; eyes of second row small, plainly nearer lateral than dorsal eyes; third row as wide as cephalothorax at that place, the eyes as large or nearly as large as the lateral eyes, and more widely separated from each other than from the lateral borders. Clypeus 1/4 as high as middle anterior eyes, vertical.

Falces stout, (♂) twice as long as face, (♀) much shorter.

Maxillæ a little enlarged, and rounded at extremity. Labium about 1/2 as long as maxillæ, but little longer than wide, truncated.

Sternum (♂) heartshaped, but little longer than wide, (♀) more oval; projecting between the anterior coxæ, which are separated by more than the width of the labium, and elongated.

Abdomen short, overlapping cephalothorax.

Legs (♂) long, slender, glabrous, relative length 1, 4, 2, 3; (♀) relative length 4, 1, 2, 3; first pair stoutest in both sexes. Spines (on first pair moderately stout, on the others extremely weak), on the femoral, tibial, and metatarsal joints of the four pairs, and on the patellæ in ♂. Metatarsi of fourth pair armed to base. Patella + tibia III shorter than patella + tibia IV; patella + tibia IV longer than metatarsus + tarsus IV.

Nearest *Ballus* C. K., and having some general resemblance to *Agobardus* Keys.

Zygoballus rufipes sp. nov.

♂. Total length 4 mm. Width of abdomen 1.3 mm.

Cephalothorax: length 2 mm; width 1.6 mm; height 1.2 mm.

Legs 6.4, 3.8, 3.5, 5.1. Pat. + tib. I 3; pat. + tib. III 1.3, pat. + tib. IV 2.1; metat. + tar. IV 1.7. Coxa + trochanter I 1.4; coxa + trochanter II .8.

The coxæ and trochanters of the first pair are visible from above. When looked at from above, at the inner edge, near the base of each falx, there is seen a long vertical horn. Looked at from below there is seen, coming off from the under part of each falx opposite the horn, a curved apophysis.

Coloration. The cephalothorax, abdomen, clypeus, sternum, and venter are jet black. The legs are light brownish red above; below, the first pair (with the coxæ), is brown; the second, third and fourth pairs (with the coxæ), pale, with the exception of a black longitudinal line, which is visible from below, on the anterior side of each leg. The other parts are all reddish brown.

Habitat. Guatemala.

Gen. nov. Pensacola.[1]

Cephalothorax very little longer than wide, moderately high, convex, a little contracted behind, anterior sides nearly vertical, rounded behind and on posterior sides; cephalic part occupying ½ cephalothorax.

Quadrangle of *eyes* ⅓ wider than long, equally wide in front and behind; anterior row slightly curved downward, with the eyes all subtouching, the middle a little more than twice as large as the lateral eyes; eyes of second row very small, placed halfway between lateral and dorsal eyes; third row as wide as cephalothorax at that place, the eyes projecting, as large as the lateral, and further from each other than from the lateral borders. Clypeus very low, about ⅕ as high as the anterior middle eyes.

Falces (♂) stout, about twice as long as face, widest in the middle, with complicated apophyses; (♀) about as wide as two middle eyes, nearly twice as long as face; retreating, parallel.

Maxillæ narrow at base and enlarged at extremity; (♂) with projection at outer corner; (♀) rounded. Labium less than ½ as long as maxillæ, but little longer than wide, blunt at tip.

Sternum oval, about ½ longer than wide, projecting between anterior coxæ, which are separated by at least the width of the labium.

Abdomen small, oval.

Legs (♂) 1, 3, 4, 2; (♀) 3, 4, 1, 2, nearly equally stout. Patella + tibia III longer than patella + tibia IV; patella +

[1]Geographical name.

tibia IV equal to metatarsus + tarsus IV. Femoral, patellary, tibial and metatarsal spines on the four pairs, those on the metatarsi of the fourth extending to the base.

Near *Bianor* P., but having the cephalothorax much higher, and the quadrangle of the eyes equally wide in front and behind; the anterior row of eyes, moreover, is in this genus as much bent downward as in *Bianor* it is bent upward.

Pensacola signata sp. nov.

♂. Total length 6 mm. Width of abdomen 1.8 mm.

Cephalothorax: length 3; width 2.4; height 2.

Legs 7.6, 4.9, 8, 6.3. Pat. + tib. I 3.5; pat. + tib. III 3; pat. + tib. IV 3.2; metat. + tar. IV 2.1.

This species has two male forms: In the first, which is a little the larger, the falces are more than twice as long as the face, slightly retreating, narrow at base and extremity but dilated in the middle, when looked at from in front. Near the anterior inner edge, in the middle is a strong apophysis or spine in each falx, which reaches nearly to the end of the fang. Fang long, slightly bent. The maxillæ (first form) are narrow at base and much enlarged at tip, prolonged on the outer edge to form a stout apophysis, and rounding gently toward labium. In the second form the falces are relatively shorter, and are very little dilated in the middle, so that the curve on the inner edge is not marked, and the spine is less than ½ as long as in the first form. The maxillæ have not so strong a projection. We find other forms intermediate between these two extremes.

♀. Total length 6 mm. . Width of abdomen 2.2 mm.

Cephalothorax: length 2.8; width 2.3; height 1.4.

Legs 4.4, 3.9, 5.7, 5.2. Pat. + tib. I 1.7; pat. + tib. III 2.3; pat. + tib. IV 1.8; metat. + tar. IV 1.8.

Coloration. (♂.) The cephalothorax is brown, with a diamond-shaped white spot in the middle, and a white band on each side. The abdomen is brown, with a longitudinal white band on either side of the middle; the legs are brown; the palpi

are pale, with snowy white hairs; the clypeus and falces are dark brown, the falces being somewhat iridescent; the sternum, coxæ, and mouthparts are dark brown; the venter is brown with a curved longitudinal white line on each side. (♀). The cephalothorax and abdomen are light reddish brown, nearly covered with fine white hairs, which form a row of chevrons on the central posterior portion of the abdomen; on each side of these chevrons is a square black spot. The legs and palpi are light brown; the clypeus and falces darker brown, with white hairs; the sternum, coxæ and mouthparts are light yellowish brown; the venter is pale brown, dotted with dark brown or black.

The ♂ of this species is most easily recognized by its conspicuously white palpi.

Habitat. Guatemala.

EXPLANATION OF PLATE II.

Fig. 1. TITANATTUS SÆVUS ♂; 1a, face and falces; 1b, palpus; 1c sternum and mouthparts ♂.

2. TRIPTOLEMUS BENIGNUS, face and falces ♂; 2a, palpus; 2b, sternum and mouthparts ♂.

3. AMYCUS LONGIPALPUS, palpus.

4. PHILÆUS RUBER, palpus.

5. PLEXIPPUS PUERPERUS HENTZ ♂; 5a, ♀, abdomen; 5b, palpus; 5c, epigynum.

6. HYLLUS PRATENSIS, palpus.

7. JOTUS OPIMUS ♀; 7a, palpus; 7b, epigynum.

8. CYTÆA (?) CONCINNA ♀; 8a, epigynum.

9. RUDRA GENICULATA ♀; 9a, epigynum.

10. PARADAMŒTAS FORMICINA, palpus; 10a, sternum, etc., ♂.

11. BAVIA ORNATA, ♀; 11a, epigynum; 11b, palpus.

12. ZYGOBALLUS RUFIPES, ♂; 12a, palpus; 12b, sternum and mouthparts ♂.

13. PENSACOLA SIGNATA, ♂ side view; 13a, ♀ abdomen; 13b, face and falces of ♂; 13c, palpus; 13d, epigynum; 13e, sternum and mouthparts ♂.

Figs. 1, 9, and 13a were drawn from specimens under alcohol; figs. 5, 5a, 7, 8 and 11, from dried specimens.

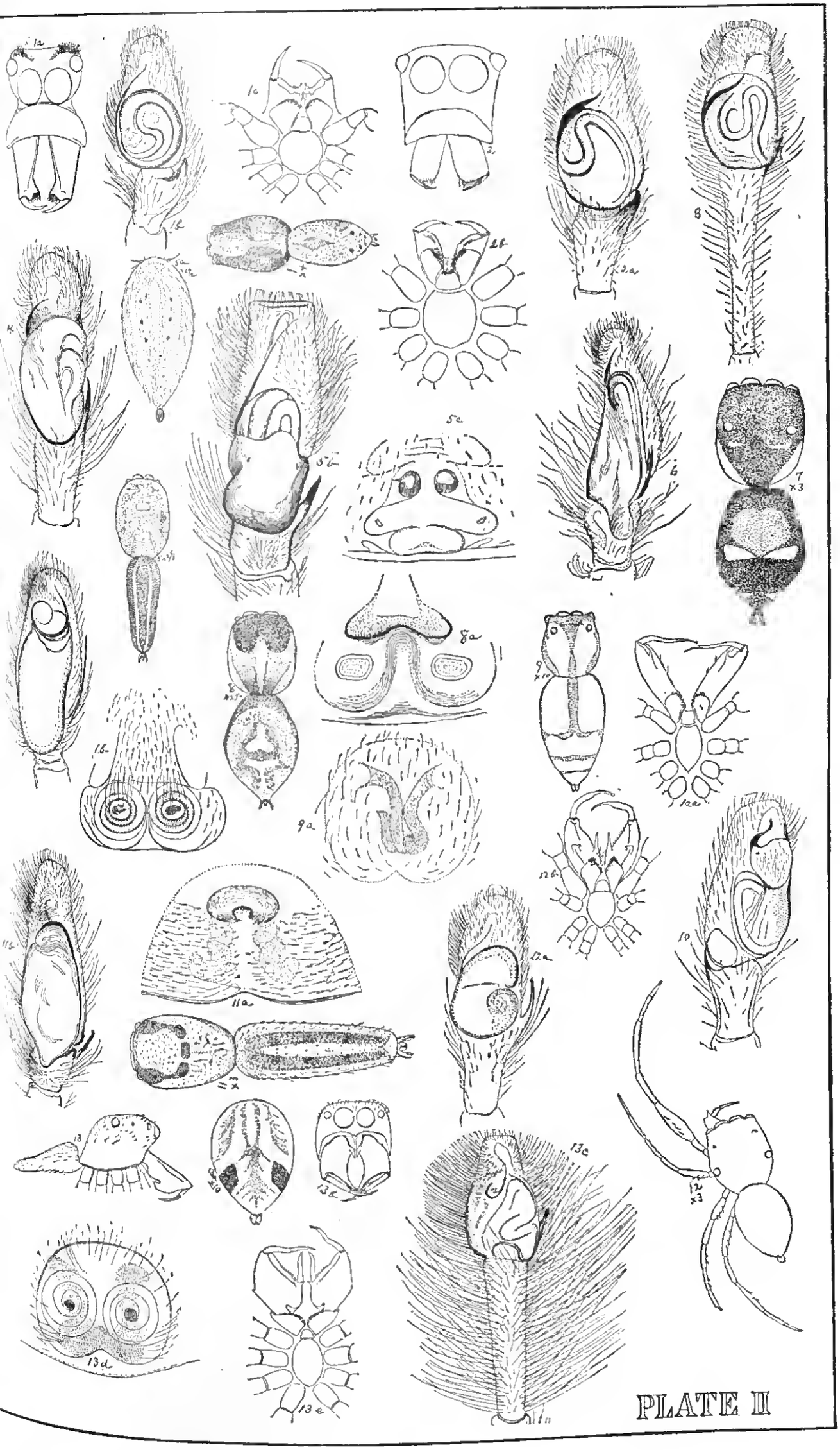

1a
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PLATE II

JANUARY 11, 1886.

President Peckham in the chair.

The following gentlemen were elected members: John W. O'Neil, Dr. R. N. Hawley, Dr. William H. Washbourne and G, Kuehnel.

The librarian, Mr. Toellner read his report which was received and placed on file.

He recommended that the library of the Society be open every Saturday evening from 8 to 10 o'clock for the benefit of the members. It was decided that, for trial, the library be kept open as stated, to ascertain whether the members would avail themselves of the opportunity.

Several other recommendations embodied in the report were discussed, but no further action taken on any.

Mr. Wm. M. Wheeler then read a paper on "The Distribution of Coleoptera" along the Lake Shore of Milwaukee County. He called attention to the very great number of species and specimens tossed upon the lake beach of the county by the water, to the increasing scarcity of insects in the county as contrasted with their abundance in former years, and suggested a possible explanation for some of the species discussed. Several points brought out by the paper were discussed by members of the Society.

MARCH 7, 1886.

Mr. Meinecke in the chair.

Many members and officers being absent, it was decided to begin with the paper of the evening by Mr. A. Toellner.

The subject was: "The Social Life of American Aboriginies." A meeting of the directors followed the meeting of the Society.

NOVEMBER 1, 1886.

Dr. Peckham in the chair.

Mr. Wm. M. Wheeler read a paper on "Cytology," illustrating it by a drawing. Mr. Wheeler gave a resumé of the history of

Histological science, and gave a brief description of the morphology of the animal and vegetable cell. The president and several other gentlemen present then made some remarks on "Cellular Science or Cytology."

DECEMBER 13, 1886.

Dr. Peckham in the chair.

Mr. Edwin Schmidt was elected member of the Society. The president, Dr. Peckham, them read a very interesting paper on wasps, the condensed results of a great number of valuable experiments made during the summer of 1886 on the mental habits and peculiarities of these insects. The paper was followed by some remarks on wasps and their habits from various members.

SOME OBSERVATIONS ON THE SPECIAL SENSES OF WASPS.

BY G. W. AND E. G. PECKHAM.

GENERAL HABITS.

Our knowledge of the habits of ground-wasps dates only from the latter part of July. To render our account more complete we transcribe from others the history of a nest from its beginning in the spring up to the time when our observations commenced.

It is generally supposed that before spring comes all the wasps die except a few fertilized queens, and that these, when the first warm days arrive, go out to search for suitable places for their nests. Very commonly a deserted hole in the ground is selected, but it is said that if the queen can find no hole ready-made she will dig one for herself. Having put her future home in good order she forms, from the fibers of weather-worn wood, which she cuts off and chews up, a sort of glutinous substance, ductile and easily moulded into any shape. Of this matter she forms an overhanging roof attached to the ceiling of her excavated nest by means of one or several columns of the same material; in like manner she constructs several hexagonal cells on the under side of the roof, in each of which she deposits a single egg. In the course of a few days these eggs develop into worms which, after being carefully fed for some time by the queen-mother, undergo a metamorphosis after which each worm is known as a chrysalis. The chrysalis refuses all food and soon closes the open end of its cell, which is turned downward, with a fine white silken cover which it spins itself. In from eight to ten days the perfect wasp is formed and, gnawing away the silken cover, it emerges from its cell ready to assume its share of responsibility in carrying on the work of the nest. These first wasps are always neuters, and hereafter all the duties which the queen has been obliged to perform, with the single exception of egg-laying, fall upon them. Another layer or story of comb is formed, and as soon as the workers are ready with the cells the queen deposits her eggs in them as before. The history of the second set of wasps is merely

a repetition of the first. Before long there are many hundreds of neuters busy at work. When we found the nest upon which we experimented it was nearly the first of August, and the swarm was very strong in numbers and very thrifty and energetic in the performance of household duties.

It is said by the Rev. Dr. Bingley that it requires eight days for the egg to develop into the worm, and that nine or ten days are occupied in the chrysalis stage. He does not give the time required for the worm to develop into the chrysalis but probably six or seven days would be sufficient; and in that case the whole period would not exceed twenty-five days. Possibly, as in the caso of bees, the drones, or males, may require a few days more, and the queens a few days less for their metamorphosis. At the beginning of August, then, there must have been both queen and drone eggs deposited, since when we opened the nest, on August 25, we found perfect queens and drones.

The life of wasps is divided between collecting food, enlarging their nests and rearing their young. The first function, carried on as it is outside of the nest, is easily observed, and we are therefore able to offer many facts concerning it.

Our wasps usually began work from one to two hours after sunrise and kept busy until dusk. In endeavoring to estimate the amount of labor daily performed by an outside worker we frequently counted the number of wasps that arrived at and left the nest during a certain number of minutes, making these observations at many different hours of the day. In one instance we watched the nest continuously from 4:40 A. M., until 12 M., one of us counting those that arrived while the other counted the departures. So many times did we do this that we were able to estimate, before we opened the nest, that we should find from 2,500 to 3,000 wasps in all, and we actually counted, after it was opened 2,563.

Most of our notes on departures and arrivals will be found in the appendix, but we give here the observation of August 18, when we watched the nest from 4:40 A. M. to 12 M. The temperature at 4:40 was 56° F.

	Arrived.	Left.	
4:40- 5:30	3	—	
5:30- 5:45	1	—	We noticed that these
5:45- 6:08	1	—	early arrivals brought
6:08- 6:40	1	—	loads.
6:40- 6:45	1	—	
6:45- 7:04	1	—	
7:04- 7:18	1	—	
7:18- 7:25	1	—	
7:25- 7:27	—	2	
7:27- 7:29	2	4	
7:29- 7:30	7	60	
7:30- 7:38	3	38	
7:38- 7:55	7	107	
7:55- 8:00	16	11	
8:00- 8:10	19	55	
8:10- 8:15	18	22	
8:15- 8:20	19	56	
8:20- 8:25	14	40	
8:25- 8:30	17	36	
8:30- 8:35	14	35	
8:35- 8:40	19	24	
8:40- 8:45	24	52	
8:45- 8:50	19	55	
8:50- 8:55	23	23	
8:55- 9:00	31	133	
9:00- 9:05	36	125	
9:05- 9:10	25	47	
9:10- 9:15	71	253	
9:15- 9:20	60	106	
9:20- 9:25	80	109	
9:25- 9:30	95	44	
9:30- 9:35	75	77	
9:35- 9:40	108	227	
9:40- 9:45	90	124	
9:45- 9:50	98	150	
9:50- 9:55	109	144	
9:55-10:00	100	32	
10:00-10:05	98	39	
10:05-10:10	91	18	
0:10-10:15	84	39	
10:15-10:20	87	48	
10:20-10:25	77	184	Temperature 76° F.

	Arrived.	Left.
10:25–10:30	80	135
10:30–10:35	95	101
10:35–10:40	74	123
10:40–10:45	98	120
10:45–10:50	107	119
10:50–10:55	129	100
10:55–11:00	105	113
11:00–11:05	130	97
11:05–11:10	122	17
11:10–11:15	99	84
11:15–11:20	106	79
11:20–11:25	137	54
11:25–11:30	77	11
11:30–11:35	99	142
11:35–11:40	134	195
11:40–11:45	96	54
11:45–11:50	73	9
11:50–11:55	116	88
11:55–12:00	139	365
Total	3,662	4,534

It appears from an examination of these observations, that at 9:55 A. M., 1,050 more wasps had left than had entered, or, in other words, that there were at that time, 1,050 wasps out at work. By 12 M., this number had been reduced to 872. The observations extended over seven hours and twenty minutes, but it was nearly 7:30 A. M., before they began to leave the nest, so that at noon they had only worked four hours and a half, during which time there had been 4,534 departures of workers in search of food or building material.

In order to determine the average length of time occupied in one of these trips we formed the following table, assuming to start with that the wasps that entered before 7:50 A. M. had been out all night. We also assumed that the first ones to go out were the first to return. This must come near enough to the truth for all practical purposes, especially as we are dealing with the work of several hours. We counted those that went out between 7:55 and 8:00 as going out at 8:00 and so on.

2 left at 7:27 and returned in 25 minutes.
4 " " 7:29 " " " 25 "
60 " " 7:30—
Of these 16 " " 30 "
10 " " 35 "
Of these 9 " " 40 "
18 " " 45 "
7 " " 50 "
38 left at 7:35—
Of these 12 " " 45 "
14 " " 50 "
12 " " 55 "
17 left at 7:40—
Of these 5 " " 50 "
12 " " 55 "
30 left at 7:45—
Of these 2 " " 50 "
19 " " 55 "
9 " " 60 "
30 left at 7:50—
Of these 15 " " 55 "
15 " " 60 "
30 left at 7:55—
Of these 4 " " 55 "
23 " " 60 "
3 " " 65 "
11 left at 8:00 " " 60 "
28 " " 8:05—
Of these 17 " " 55 "
11 " " 60 "
27 left at 8:10—
Of these 25 " " 55 "
2 " " 60 "
22 left at 8:15 and " " 55 "
56 " " 8:20—
Of these 1 " " 50 "
55 " " 55 "
40 left at 8:25—
Of these 16 " " 50 "
24 " " 55 "
36 left at 8:30 and " " 50 "
35 " " 8:35 " " " 50 "
24 " " 8:40 " " " 45 "

52 left at 8:45—
Of these 21 returned in 40 minutes.
31 " " 45 "
55 left at 8:50 and " " 40 "
23 " " 8:55—
Of these 9 " " 35 "
14 " " 40 "
133 left at 9:00—
Of these 61 " " 35 "
72 " " 40 "
125 left at 9:05—
Of these 36 " " 35 "
89 " " 40 "
47 left at 9:10—
Of these 1 " " 35 "
46 " " 40 "
253 left at 9:15—
Of these 52 " " 35 "
109 " " 40 "
92 " " 45 "
106 left at 9:20—
Of these 8 " " 40 "
98 " " 45 "
109 left at 9:25—
Of these 91 " " 45 "
18 " " 50 "
44 left at 9:30 and " " 45 "
77 " " 9:35—
Of these 22 " " 40 "
55 " " 45 "
227 left at 9:40—
Of these 32 " " 40 "
77 " " 45 "
80 " " 50 "
38 " " 55 "
124 left at 9:45—
Of these 57 " " 50 "
67 " " 55 "
150 left at 9:50—
Of these 7 " " 50 "
98 " " 55 "
45 " " 60 "

It will be noticed that when an unusually large number left the nest, a correspondingly large number entered from 35 to 45 minutes later.

144 left at 9:55—
Of these 62 returned in 55 minutes.
82 " " 60 "
32 left at 10:00 and " " 55 "
39 " " 10:05—
Of these 15 " " 50 "
Of these 24 " " 55 "
18 left at 10:10 and " " 50 "
39 " " 10:15 " " " 45 "
48 " " 10:20—
Of these 42 " " 40 "
6 " " 45 "
184 left at 10:25—
Of these 124 " " 40 "
60 " " 45 "
135 left at 10:30—
Of these 62 " " 40 "
73 " " 45 "
101 left at 10:35—
Of these 26 " " 40 "
75 " " 45 "
123 left at 10:40—
Of these 31 " " 40 "
92 " " 45 "
120 left at 10:45—
Of these 45 " " 40 "
75 " " 45 "
119 left at 10:50—
Of these 2 " " 40 "
99 " " 45 "
18 " " 50 "
100 left at 10:55 and " " 45 "
113 " " 11:00—
Of these 16 " " 40 "
80 " " 45 "
17 " " 50 "
97 left at 11:05—
Of these 56 " " 45 "
41 " " 50 "
17 left at 11:10 and " " 45 "
84 " " 11:15
Of these 58 " " 40 "
26 " " 45 "

79 left at 11:20 and returned in 40 minutes.
54 " " 11:25
Of these 32 " " 35 "

Six wasps, then, were gone 25 minutes; 16, 30 minutes; 201, 35 minutes; 962, 40 minutes; 1,340, 45 minutes; 387, 50 minutes; 526, 55 minutes; 198, 60 minutes, and 3, 65 minutes.

With these figures as a basis of calculation we find that on an average, one trip occupies 43 minutes. We had supposed the time to be much shorter. The wasps entered and left the nest as though they were in great haste, and this gave a strong impression of celerity. But on thinking the matter over the necessity for rapid action at the point of entering or leaving became apparent; the entrance was small and the numbers using it very large, and had they not moved quickly both in-going and out-going wasps would have been delayed and inconvenienced. As it was we frequently saw them jostle each other in passing When once away from the nest they take things more easily. We have often noticed them lingering about certain spots to which they were especially attracted, alternately walking over the ground and flying just above it for half an hour at a time. We have seen them strike at an insect, and failing to secure it, fly to a little distance and then return and repeat the attempt two or three times, moving deliberately and with rather an indifferent air, frequently giving up their object in the end and going away to search for something else. This seems at first to be inconsistent with the observations of Sir John Lubbock on the wasps which he fed with honey. In one instance a wasp visited the honey four times an hour for eleven hours; in another thirty-eight times in a little less than eight hours; and in still another a wasp made one hundred and sixteen visits in fifteen hours and a half, making about seven trips an hour. Here, however, the conditions were different. A plentiful supply of food was provided at a certain spot and all that the wasp had to do was to fly to it, take a load and return to the nest. Our wasps, under like circumstances, were also very industrious, for when we supplied them with a quantity of dead wasps they worked away at them with remarkable perseverance. On the afternoon of August 26

we noticed that a large hornet (Vespa maculata Linn) had settled on the ground near two dead yellow-jackets (V. germanica). The hornet seized one, flew up to the branch of a tree near by, and having cut off the wings and separated the abdomen from the thorax and dropped the thorax and flew away with the abdomen. Thinking that it might return we placed five or six dead wasps near the one that was left and stationed ourselves near by to keep watch. In fifteen minutes a hornet came hawking over the ground and settled among the wasps. That we might identify him another time we now snipped a bit of one wing off with a pair of scissors. After a moment's delay the hornet flew to a branch seven or eight feet above the ground, carrying a wasp. We could plainly see it cutting off the wings and legs. In five minutes it flew away with the thorax. We now took ten dead wasps and pinned them in a row on a board. In sixteen minutes back came the hornet. When about twenty feet distant it came down to within two feet of the ground and, flying about in a zig-zag fashion, soon found the row of dead wasps. The state of affairs seemed to be appreciated at once. The hornet fell to work on a wasp, and after cutting off the wings and legs separated the abdomen and carried it away. This time and in all its subsequent visits, it did not alight on a tree but flew directly out of sight. In two hours this hornet carried off a piece of each of the ten wasps which had been pinned to the board. When one part of a wasp had been carried away it paid no attention, upon returning, to the part remaining, even when it was free from the pin and ready for transportation, but began on a new wasp. Sometimes an abdomen was taken and sometimes a thorax. We were not noticed although we sat close by. During this time no other hornet came to aid in the work. After the last wasp had been taken the hornet did not return.

Half an hour later we pinned ten more dead wasps to the board. Before dark they were discovered by wasps of the same species (V. germanica) and two were carried away. The plan of work followed by these yellow-jackets was like that of the hornet. Two or three were working at a time but each in-

dependently. On returning to the spot on the next day at 7:30 A. M., we found them just removing the last body, all the others having been cut away and carried off.

A few days later we saw a wasp (V. vidua) settle over a dead grasshopper. While it was cutting off one of the large legs we snipped off a piece of its wing. In four minutes the leg was carried away; ten minutes later the wasp returned to the grasshopper. It began to cut off the head but after working a few moments flew away and hawked about near the ground for four or five minutes. It then returned to the grasshopper and began to cut off a wing but after a little flew away again. It worked in this way for over an hour accomplishing nothing. After having left the grasshopper for a minute or two the wasp seemed to recollect it and came back with a rush. The next day the grasshopper was still on the spot. Evidently the wasp lacked either the persistence or the inclination to do anything more with it.

We have frequently seen individuals of V. germanica and V. vidua cutting up insects and carrying portions away, but we never saw them take their prey up into a tree before dismembering it as hornets of the species V. maculata usually do.

With regard to the character of the food of wasps it seems probable that during the summer months, while insects are abundant they live almost entirely upon animal diet. We have never found them upon strawberries, raspberries nor currants, nor upon any fruits that ripen early, but in September insects are not so numerous, and we have found many wasps upon the grapes. Prof. Jeffries Wyman in a paper "On the Habits of a Species of Hornet (Vespa) which builds its nest in the ground,"* writes regarding their feeding habits. "The few experiments which I have made show their carnivorous propensities but do not manifest the same tendencies to eat sugar and fruits which are said to be so common in the species of Europe. Some sugar which was placed near the entrance was not touched by them and was eventually carried away by the ants, who were not molested. Fruit was also left without being eaten by the hornets. Insects thrown down near the hole were at once seized and car-

*Boston Society of Natural History, November, 1860, p. 411.

ried in. A dragon-fly, which, after several attempts, proved too heavy for them, was cut in two by a few strokes of the jaws and the hinder part of the abdomen carried off."

MENTAL POWERS.

In experimenting on the mental powers of wasps our method was of necessity entirely ejective, and we endeavored to keep constantly before our minds the limitations imposed by the profound differences between the human and the wasp intellect. Still, as Romanes says,* "Taking it for granted that the external indications of mental processes which we observe in animals are trustworthy, so that we are justified in inferring particular mental states from particular bodily actions, it follows that in consistency we must everywhere apply the same criteria.

"For instance if we find a dog or a monkey exhibiting marked expressions of affection, sympathy, jealousy, rage, etc., few persons are skeptical enough to doubt that the complete analogy which these expressions afford with those which are manifested by man sufficiently prove the existence of mental states analagous to those in man of which these expressions are the outward and visible signs. But when we find an ant or a bee apparently exhibiting by its actions these same emotions, few persons are sufficiently non-sceptical not to doubt whether the outward and visible signs are here trustworthy as evidence of analogous or corresponding inward and mental states. The whole organization of such a creature is so different from that of a man that it becomes questionable how far analogy drawn from the activities of the insect is a safe guide to the inferring of mental states—particularly in view of the fact that in many respects, such as in the great preponderance of 'instinct' over 'reason' the psychology of an insect is demonstrably a widely different thing from that of a man. Now it is, of course, perfectly true that the less the resemblance the less is the value of any analogy built

*Animal Intelligence, p. 8. This work, and the work on "Mental Evolution in Animals," by the same author seem to us by far the most able contributions to comparative psychology thus far published. The author is what so few writers upon this subject have been, a profound psychologist.

upon the resemblance, and therefore that the inference of an ant or a bee feeling sympathy or rage is not so valid as is the similar inference in the case of a dog or a monkey. Still it *is* an inference, and, so far as it goes, a valid one—being, in fact, the only inference available. That is to say, if we observe an ant or a bee apparently exhibiting sympathy or rage, we must either conclude that some psychological state resembling that of sympathy or rage is present, or else refuse to think about the subject at all; from the observable facts there is no other inference open. Therefore having full regard to the progressive weakening of the analogy from human to brute psychology as we recede through the animal kingdom downwards from man, still as it is the only analogy available I shall follow it throughout the animal series.

"It may not, however, be superfluous to point out that if we have full regard to this progressive weakening of the analogy, we must feel less and less certain of the real similarity of the mental states compared, so that when we get down as low as the insects, I think the most we can confidently assert is that the known facts of human psychology furnish the best available pattern of the probable facts of insect psychology."

Prof. C. Lloyd Morgan, in a critical essay "On the Study of Animal Intelligence," Mind, No. XLII, April, 1886, p. 174., objects to the method used by Romanes in the study of animal psychology. While appreciating the force of his argument we venture to suggest that it applies rather to the hasty and incautious use of ejective inferences than to their more temperate and philosophical application as instanced in the work of Romanes.

SENSE OF SMELL.

Our first experiment in testing the sense of smell in wasps was to saturate a paper which surrounded the nest with oil of peppermint. The powerful odor at first caused some disturbance; the returning wasps hesitated and circled about the nest several times before entering. Before long, however, they became accustomed to it and went on with their work as usual. We next used the oil of wintergreen in the same way, and this

time we counted those which entered as usual and those which noticed the odor with the following results:

From 2:45–2:50 P. M. of 84 which entered the nest 27 noticed the odor, starting back, circling around, etc.

" 2:52–2:57 P. M. of 116 entering 28 noticed the odor.

We now placed a plate of maple syrup six inches from the nest but this attracted no attention from the wasps, which were flying just above it, although it was visited by many ants and flies and by one bumble bee.

We were led to our next experiment by noticing the troubles of some kittens at the house near by which were daily fed with meat and bones. The wasps swarmed about them, settling thickly upon the food, and could only be safely removed by a mixture of persuasion and force in which the kittens, after they had been stung several times, became quite skillful. Following the suggestion that the scent of animal food might prove attractive to the wasps, we hid some fresh warm chicken bones under several thicknesses of gauze which matched in color the paper around the nest, and this bundle we placed four inches to one side of the entrance; four inches to the opposite side we placed, as a control experiment, a bundle of exactly similar appearance which consisted only of some pieces of the gauze rolled together and contained no bones. The wasps immediately began to settle on the bundle containing the bones, walking over it in an excited manner and trying to reach the contents. Even when returning loaded to the nest they frequently seemed unable to resist the appetizing odor and alighted on the gauze. In fifteen minutes twenty-five different wasps had visited this bundle, some of them working over it from one to two minutes. During this time not a single wasp visited the empty bundle.

This experiment was repeated. In twelve minutes nineteen wasps alighted on the gauze and very persistently tried to get in. None visited the empty bundle.

Again, in eleven minutes seven wasps came to the bundle; three of the 7 remained on the gauze fifteen minutes trying to get at the bones and we had to drive them away when we took the bundle up. None visited the empty bundle.

We now repeated the experiment with the same conditions excepting that the bones were cold, and that the wasps seemed to be unusually busy as they were working very rapidly.

In nine minutes nine wasps noticed the bundle containing the bones, circling around it once or twice, but only two alighted. The empty bundle was noticed by one wasp.

Two days after this experiment we used the bones once more. They were now cold and dry and gave off little if any odor. In five minutes of 129 wasps which entered the nest two settled on. and walked over the gauze containing the bones. None visited the empty bundle.

We frequently killed wasps by striking them with a small board or a folded paper (so that they were probably more or less crushed) and left them near the nests; the others would quickly cut them up and carry them away. We once placed one, killed in this way, in the grass so that it was entirely hidden. Five settled above it and one at last dragged it up and carried it away. Three or four others afterwards visited the spot where it had lain probably attracted by the scent of blood which remained on the ground. At another time we killed two and then smoothed the ground over (it was dry) and threw the wasps away. In fifteen minutes nine wasps came to the spot. all of which were caught and killed.

We conclude from these experiments that wasps have a strong sense of smell but that they pay little attention to odors, however powerful, which do not denote the presence of something which they can utilize as food.

HEARING.

Chosing a time when the wasps were entering the nest very rapidly (200 in five minutes) we stood one foot away and made several kinds of loud noises—shouting, clapping our hands, and whistling. They gave no sign of hearing anything. We then tried blowing several kinds of whistles close to the nest, the wasps took no notice. This experiment was repeated three times with the same results.

This agrees with Sir J. Lubbock's results.

SENSE OF COLOR.

Our next experiments with the wasps were for the purpose of determining whether they were capable of distinguishing and remembering colors. Sir John Lubbock had already made some valuable experiments with this end in view. His method consisted in putting a glass slip with honey upon colored paper and, after the wasps had become accustomed to one color, substituting another and removing the first paper to a distance of from twelve to eighteen inches. The colors used were white, yellow, orange, green, blue, purple, vermillion and brick-red. His results indicate, but scarcely prove, first, that wasps are capable of distingnishing color, and second, that they are not to any great extent guided by it. The matter seemed of sufficient importance to warrant us in making a good many detailed experiments which were undertaken largely with the idea of verifying Sir John Lubbock's conclusions. Our results, however, are somewhat at variance with his as they tend to prove that wasps rely very greatly upon color for guidance.

It must be remembered that we were watching the wasps at their busiest season, and were watching them in large numbers, as sometimes 500 passed into and out of the nest in five minutes. Moreover we worked to better advantage in the more complicated experiments becausc there were two of us so that different sets of wasps could be watched and counted at the same time; and for the same reason we gained in accuracy as each was ready to correct the other's mistakes.

The colors used were two shades of yellow, green, blue, pink and red.

On August 7 at 8:30 A. M. we took a sheet of bright red paper and cutting in the middle of it a hole 4½ inches in diameter (the diameter of the hole which served as entrance to the nest was 1½ inches) we placed it above the nest in such a way that the entrance was not at all impeded and could be plainly seen from above. This, and all the papers subsequently used measured 24¼x20¾ inches. The red paper was the source of a good deal

of disturbance among the returning wasps. They did not enter the nest but circled about just over it, seeming greatly excited. After sometime one, more intelligent or venturesome than the others flew in, and sooner or later, all followed. In the course of three hours all became accustomed to the paper and worked as usual.

On August 9 at 2:40 P. M., we substituted a blue paper for the red. The wasps seemed as much confused as in the preceding experiment, becoming reconciled to the blue, however, in a little more than two hours.

On August 10, at 9 A. M., wishing to try an experiment on the sense of direction, we removed the blue paper, caught a cage full of wasps and took them away, leaving the ground around the nest exposed. On our return, one hour afterward, we found twenty-five or thirty wasps buzzing about, apparently not knowing how to get into the nest. We replaced the blue paper when all immediately went in.

On August 10 at 4:50 P. M., we substituted a yellow paper for the blue and during the next ten minutes one of us counted 130 wasps which noticed the change, while the other counted eight which seemed not to notice it. The 130 circled around the nest once or twice, or in some cases four or five times, before entering. We now went away for a time but returned at 5:30 P. M. for another observation. During the following ten minutes one hundred wasps entered the nest, seventy of which flew about awhile before going in, while the other thirty did not notice the yellow paper, having, very probably, passed through it before. On August 11 at 9:30 A. M., the yellow paper having been over the nest for about three working hours, of 200 wasps only eight hesitated before entering. At 10 A. M. we placed three dark red nasturtium blossoms on the yellow paper two inches from the hole. In the next five minutes of the 146 which entered forty-six noticed the flowers by flying to them and almost alighting, and of these quite as many were flying well to one side of the flowers as were passing directly over them. In the next five minutes 10:05–10:10, twenty-nine out of 126 noticed the nasturtiums.

We now substituted for the nasturtiums some escholtzia blossoms which nearly matched the yellow paper in color.

From 10:15–10:20 only 6 out of 173 noticed the flowers.
" 10:20–10:25 of 153, 9 noticed flowers.
" 10:25–10:30 " 156, 6 " "

We now changed back to the dark red nasturtiums.

From 10:32–10:37 of 141, 25 noticed flowers.

As the nasturtiums had a strong perfume and escholtzia none at all we thought that the wasps probably visited the nasturtiums because they smelled them rather than because they saw them. To settle this point we took three light yellow nasturtiums which matched the paper even more nearly than the escholtzias and placed them as before, two inches from the hole, removing the other flowers.

From 11:00–11:05 of 72 wasps 3 visited nasturtiums.
" 11:05–11:10 " 38 " 1 " "
" 11:10–11:15 " 32 " 1 " "
" 11:15–11:20 " 42 " none " "

The wasps, then, were even less attracted by the light yellow nasturtiums than by the odorless escholtzias, while the dark red nasturtiums were visited much more frequently than either. As the light nasturtiums were as fragrant as the dark ones we concluded that it was the color, not the odor, which attracted the wasps to the flowers.

On the same day (August 11) at 10:30 A. M. we substituted for the yellow paper one of light green which, in the sunlight, had yellowish reflections. From 11:30–11:40 of 172 wasps 100 clearly noticed the change but in not nearly so marked a manner as they had the other changes.

On the following day, August 12:

From 8:30–8:36 A. M. of 100 wasps 2 hesitated before entering.
" 8:36–8:41 A. M. of 200 " 9 " " "

On the same day at 8:50 A. M. we substituted a red paper for the green.

From 8:50–9:10 of 191 wasps 107 noticed the change.
" 9:10–9:15 of 187 " 112 " " "

Being now satisfied that the wasps distinguished colors and were disturbed by a change from one color to another we endeavored to determine more exactly how strong was the impression which a color made upon them.

On returning to the nest the wasps usually approached from the southwest, west or northwest. On August 13, after the red paper had been over the nest for twenty-four hours, we substituted a blue paper, moving the red a foot and a half to the south. As the ground was covered with grass both papers were slightly raised. Our object was to see whether any of the returning wasps would enter the hole in the red paper, to which they were accustomed, instead of going to the hole in the blue paper which was above the entrance to the nest. For convenience we shall speak of the blue as the true, and of the red as the false entrance. In this and in the subsequent experiments, when it was possible, both of us sat close to the nest—one counting the wasps that went into the true, and one those that went into the false entrance. When only one of us could be present three successive counts were made, taking the same length of time for each; first, of those that entered the false hole; second, of the entire number that entered the true, and third, of those that entered the true without hesitation.

In the first ten minutes (9:35--9:45 A. M.), after we had substituted the blue paper for the red and moved the red to one side, 76 wasps went in at the true entrance of which 54 first hovered over the false, about half of them actually entering and exploring the grass beneath. Several, not finding the entrance here, flew away entirely. Most of those that flew directly into the true entrance came from the northwest and therefore did not pass above the red paper.

From 9:45–9:52 of 78 wasps 50 flew first to the false entrance and afterward found the true.

After four hours we counted them again for five minutes during which time out of 125 wasps 15 were deceived.

We did not repeat this experiment for forty-eight hours as we wished to leave the blue paper over the nest long enough for the wasps to become thoroughly familiar with it. On the morning

of the second day, August 15, we moved the blue paper a foot and a half to the west, thus placing it as nearly as possible in their line of flight, and substitute for it a yellow paper which was a more decided contrast to the blue than the blue had been to the red. In the first seven minutes after the change, from 9:40–9:47, 270 wasps returned. None of these flew straight into the true entrance although many passed directly over it; all hovered first over the false, many going in; some came out and went back into it eight or ten times, after flying over the true and returning to it. So closely was the sensation of the blue color associated with the idea of their nest.

From 9:50–9:55 205 wasps entered first the false and then the true hole; not one flew straight into the true, but six hesitated over it and then went in without going to the false.

We now left the nest for forty-five minutes. At 10:40 one of us returned to see how far they had become reconciled to the yellow paper.

From 10:40 to 10:45, 184 entered false hole.
" 10:45 " 10:50, 202 " true " (This includes those that went first to the false hole as well as those that flew directly into the true.)

From 10:55 " 10:55, 32 flew straight into the true hole.

The nest was then left for an hour and fifty minutes.

From 12:45 to 12:50, 76 entered the false hole. Many came to it but discovered their mistake before entering.
" 12:55 " 1:00, 191 " true " (This includes those that went first to the false.)
" 1:00 " 1:05, 81 flew straight into true hole.

Later in the afternoon other observations were taken.

From 3:30 to 3:35 of 100 wasps 49 entered false hole.
" 3:36 " 3:41 " 108 " 33 first visited false hole.
" 5:33 " 5:38 " 46 " 13 " entered " "
" 5:40 " 5:46 " 49 " 5 " visited " "

On the next day at 9:25 A. M. two wasps entered the false hole. The first stayed some time, came out, hovered and went back

five or six times and finally entered the true hole. The second went in and stayed a short time and then flew away. A new hole had been started under this false paper. Of the throngs of wasps (about 290 in five minutes) going into the true entrance almost all flew directly over the false to the true; occasionally one hovered a moment over the false.

From 9:30 to 9:35 200 wasps entered the true hole, and two entered the false, one of these come immediately out and entered the true; the other stayed in some time and then flew away. We now removed the false (blue) paper. One wasp came and hunted about in the grass where the blue paper had been and where a new hole had been started.

After the yellow paper had been over the nest for three days we substituted, on August 18, one of a very slightly darker shade of yellow, moving the false hole to the south. Those counted below as deceived include three sets of wasps: those that hesitated over the true entrance and then went in without visiting the false; those that went into the false entrance and those that only hovered over it before going to the true.

From 2:50–2:55 P. M. of 87 wasps 26 were deceived.
" 2:55–3:00 " 74 " 10 " "
" 3:00–3:05 " 121 " 12 " "
" 3:05–3:10 " 99 " 12 " "
" 3:10–3:15 " 93 " 12 " "

Some flew directly across the true entrance to go in at the false; some flew directly across the false to go in at the true.

From 3:30–3:35 of 102 wasps 13 went to the false entrance.
" 5:05–5:10 " 64 " 3 went into " "
" 5:10–5:15 " 77 " 7 " " " "

Considering the very slight difference in the two shades of yellow a surprisingly large number of wasps noticed the change.

Before leaving the nest for the night we replaced the first yellow paper, taking the second away.

On the morning of August 20, we moved the yellow paper ten inches to the south, leaving the ground about the nest exposed. It had been covered with one paper or another for sixteen days.

From 9:10--9:15 of 130 which entered the false hole 61 finally

found the true. Not one flew straight into the nest. One, distinguished by carrying a long worm, entered the false hole four times and then rose, and circling more widely, flew into the true.

From 9:20--9:25 of 152 which entered the false 89 afterward found the true hole. Not one flew straight into the nest, although the wasps were coming out in a steady stream which might have indicated the entrance.

We now moved the false hole two feet to the south of the nest, leaving it just east of a tree while the true hole was northeast.

From 9:28--9:33 107 entered the true hole, 103 the false. None flew straight into the true but some did not go near the false. Some settled on the ground trying to find the hole. We received no stings although excited swarms were flying about us. The wasps found their nest under a paper of a color new to them much more readily than they found it when the paper was taken away entirely and the ground left exposed.

In the afternoon of the same day we moved the yellow paper so that the hole in it was six inches south of the entrance, and put a red paper over the nest.

From 4:18–4:23 10 entered false hole, 37 the true hole.
" 4:23–4:28 16 " " " 57 " "
" 4:28–4:33 9 " " " 47 " "
" 4:33–4:38 14 " " " 53 " "
" 4:40–4:45 17 " " " 61 " "

The wasps seemed to remember these changes and to look for the entrance itself. We thought that many flew a little way toward the false hole and then turned back to the true. Although so many entered the false hole not one returned to it nor circled about it as they had so commonly done. We had changed the position of the yellow paper several times within a few hours and once while we were absent it flew over the hole and remained there for some time.

On the morning of August 23, the red paper having been over the nest for two days and a half, we substituted the green paper and moved the red twelve inches to the south.

From 8:47–8:52 60 entered true hole, 42 first visited false.
" 8:55–8:59 29 " " " 24 " " "

We now placed another red paper to the west of the true hole.

From 9:05--9:10 29 went to the false holes of which only 23 afterward found the true. Eight of the 29 went from one false hole to the other before entering the true. It was plain that they remembered the changes and did not linger so long in the false holes. We now removed the second red paper.

From 10:30–10:35 202 entered true hole.
" 10:35–10:40 114 visited false hole.
" 10:40–10:45 96 " " "
" 10:45–10:50 142 entered true hole.

Going in at 10:50 one wasp worked for ten minutes in the false hole cutting a blade of grass which it finally carried into the true hole. Two others were going in and out, carrying out pellets of earth.

From 3:05–3:10 P. M. 131 entered true hole and 15 went to the false, 7 entering.
" 3:10–3:15 " 117 entered true hole and 15 went to the false, 7 entering.

Of the above 30 visiting the false hole at least half flew across the true to enter the false.

From 4:01–4:06, 61 entered true hole, 2 visited false.
" 4:06–4:11, 37 " " " none visited false.

On August 24, the green paper being still over the true hole and the red paper remaining near, from 1:45–1:50, P. M. 263 entered the true hole, while 12 visited the false, 7 entering.

At 3:30 P. M., while we were working with the nest, the green paper blew over the hole and the wasps could not get in. At least 100 collected. Many settled in the false hole. We took the green paper away exposing the ground around the nest, but only 3 or 4 entered. We then replaced the green paper with the hole above the entrance when they swarmed in 6 or 7 at a time, and in a moment they had all disappeared. It was plainly the color that had directed them.

SENSE OF DIRECTION.

The problem as presented by wasps suggests two questions. First, the question of fact, that is whether they possess any such power; and second, if they do possess it, is it some mysterious additional sense not possessed by man, or rather, as seems more probable, is it the result of a process of dead-reckoning, half unconscious, whereby the various turns and objects in a long journey are remembered and utilized when a return to the starting point is deemed desirable?

The life and habits of many animals, and more especially of insects, have such a remoteness from human affairs that they often seem to pass beyond the boundary of the natural, and if they do not enter the region of the supernatural they are certainly mysterious and incomprehensible. Sir John Lubbock, in dealing with the sense of direction in ants, concluded, after a number of observations, that they were endowed with this sense in a high degree.

Subsequently he discovered, quite accidentally, that the ants found their way by observing the direction in which the light was falling. As long as the source of light was stationary no matter how many times he turned them around upon a rotating table, when the rotations ceased they knew their way to and from the nest as well as they did before the rotation; whereas when the source of light was shifted the insects at once became confused as to their bearings even though not rotated at all.

Our object in the following experiments was to determine whether wasps possess any mysterious sense which enables them to fly in a straight line to any point they wish to reach, even though they have never been over the line before. We thought that the best way of deciding the point would be to carry a number of wasps to some remote and unfamiliar spot and there to set them free, when, if they possessed such a sense, they would probably start directly for home, unless, indeed, they stopped to gather a load before returning to the nest; if they flew a little way in another direction than toward the nest and then returned

to the starting point, and repeated this short flight several times we should conclude that they were not waiting to gather a load, but that they were confused and did not know what direction to take.

On August 10 we placed a wire cage having a hole in the bottom over the opening of nest number two and caught 63 wasps (workers). These we carried two hundred yards to the west to top of a hill, within sight of their nest. Placing the cage on a stump we opened the door a little way and allowed 10 wasps to go out, marking them with a spot of blue paint as they passed through the aperture. They flew off in all directions, not choosing the east, toward their nest, oftener than the other points of the compass. Three wasps, after circling about over head, returned to the stump and settled, but, after some hesitation, again started off. We then moved one hundred yards down the other side of the hill to a spot three hundred yards from the nest which was now entirely out of sight, and stopping in the woods opened the cage and marked 7 escaping wasps green. All of these flew in directions away from the nest; 3 returned, after a few seconds, to take a new start.

We now rowed out on to the lake with our captive wasps. The nest with which we were experimenting was located about twenty feet from the water, and a little to one side of the center of a bay about a half a mile in width. We went out a third of a mile to a spot slightly north of the nest. Quite a breeze was blowing from a little to the south of the nest. We marked 10 wasps dark red, and allowed them, in company with ten unmarked wasps, to pass out of the cage. Nearly all flew in the direction of the wind, toward their nest.

The last experiment of that day consisted in taking 26 wasps (16 of them being marked bright red) on to the lake half a mile from the nest, where we set them free. The wind blew toward their nest. They took different directions; 6 flew toward an island in a direction opposite to their nest; 10 returned to the boat and seemed loathe to leave it but finally did so; several, after starting, seemed to change their minds and altered their courses.

On August 12 we took 32 wasps from nest number two half a mile north of the nest, on the lake. 16 of them were marked bright red. While we were setting them free the boat was either touching the shore, or was only ten or fifteen yards distant from it; the wind blew toward the shore so that it was difficult to keep off. 8 of the wasps returned to the boat, some of them once, some of them twice. 6 or 7 flew in a straight line toward their nest, over the water and against the wind; the remaining 17 or 18 flew toward the shore, taking a northerly, northeasterly or northwesterly course.

On the same day we set free 40 wasps two hundred yards south of the nest on the shore of the lake. Of these 16 were marked blue. They seemed to fly in all directions but our observations were made under difficulties as most of them returned and alighted either on the cage or on us. We received three stings in driving them away as they came back. Toward the end of the experiment, when we had their movements more under control, 4 marked wasps returned to the cage after they had been gone two minutes.

In our two days' experimenting we had set free from this nest 135 wasps at different points and varying distances, and it seemed fairly certain that until they were lost to view they did not fly toward their nest so frequently as they flew in an opposite direction; and it appeared that they were at a loss to know which way to go, since they so often returned once or twice to the cage to take a new start. It is of interest to remember in this connection that carrier-pigeons, when making long journeys, often return to the starting point when they have lost their way, and try a new direction.

What was the ultimate fate of these wasps? Were they so completely lost that they never returned to the nest? or did they, after some difficulty and delay, succeed in finding their way back? To settle this question we at once began to take large numbers from the nest and to kill them by heat. We then examined them to see if we could find any of those that we had marked.

On August 12, among 157 wasps killed we found 4 marked

bright red, 2 dark red and 5 blue—11 in all. On August 13 among 227 killed we found 4 marked green, 4 blue and 1 red—9 in all. Out of 384 wasps, then, 20 were marked, or about 1 in every 19. The marked wasps in the last lot that we killed had color nearly eaten off so that we did not take any more.

We had painted some of these wasps by putting a long slender brush through the door of the cage and touching them as they clung to the sides ; but as they immediately began to clean each other off we changed our plan and painted them as they passed out.

From the results of our killing and counting we concluded that although the wasps started from the cage in wrong directions, they, after a time, succeeded in reaching home. All of they wasps marked green started wrong and yet we found 4 out of 7. 20 wasps out of the 75 that we marked, started directly toward the nest upon being liberated, but even if 4 of those marked green had been among them we should have thought it extremely improbable that these were identical with the 20 we afterwards found marked in the nest. However, any doubts which we might have had about it would have been settled by our other experiments.

On August 10 we took 20 wasps from nest number one, which was situated in the woods on a plateau, one hundred and fifty yards from the lake, and set them free on the water a quarter of a mile from the shore. Five started off but soon returned to the boat; after a few moments they flew away again, but returned a second time and alighted ; they then took their final departure in different directions. The 15 remaining wasps took various courses, no more going towards the nest than away from it.

On the evening of August 18, after all the wasps had gone in, we closed the entrance to the nest so that none could pass in nor out. Early on the morning of the 19th we went to the nest. There were no wasps to be seen, but after a little time a few came straggling home and these we killed ; there were 19 in all, and all were carrying loads. We waited for some time

and then, as no more returned, we placed the cage over the nest and opened it. The wasps came out very slowly, so that although we put the cage in position at 7:40 A. M., it was 8:30 before 55 workers had entered. We now closed the nest and one of us took the 55 wasps out on to the lake while the other remained at the nest to watch for their return.

At 8:53, 20 of the wasps were liberated an eighth of a mile from shore and near the end of an island. All, without exception, flew toward the island and away from the nest; whether they settled on the island or not could not be determined. The boat was then moved an eighth of a mile beyond the island to the north, where, at 9:10, the remaining wasps were set free. They seemed a good deal confused and flew in *all* directions. Many returned to the boat and alighted, but soon flew away again. Two of the wasps that settled on the boat were knocked into the water, but they instantly rose and circled up into the air until out of sight.

From 7:40 to 8:58 no wasps returned to the nest.

At 8:58	1	arrived	and	was	killed.
" 9:03½	1	"	"	"	"
" 9:06	1	"	"	"	"
" 9:09	2	"	"	were	"
" 9:11½	1	"	"	was	"
" 9:13	1	"	"	"	"
" 9:14½	1	"	"	"	"
" 9:19	2	"	"	were	"
" 9:23	1	"	"	was	"
" 9:24½	1	"	"	"	"
" 9:27	1	"	"	"	"
" 9:27½	2	"	"	were	"
" 9:30	1	"	"	was	"
" 9:33½	2	"	"	were	"
" 9:34	1	"	"	was	"
" 9:36	1	"	"	"	"
" 9:37½	1	"	"	"	"
" 9:39	1	"	"	"	"
" 9:41	1	"	"	"	"
" 9:42	2	"	"	were	"
" 9:45	1	"	"	was	"

At 9:47	1	arrived
" 9:50	2	"
" 9:52	1	"
" 9:52½	1	"
" 9:54	1	"
" 9:55	1	"
" 9:56	1	"
" 9:56½	1	"
" 9:58	2	"
"10:00	2	"

These were not killed, but attempted to enter, and remained about the hole so that they were all there at the same time. The mistake of counting one wasp thirteen times was not made.

None of these wasps were loaded.

Of the fifty-five wasps that we set free thirty-nine returned to the nest by ten o'clock; five were of those that flew toward the island; they evidently soon found their bearings and came directly home, reaching the nest before the wasps of the second lot were liberated.

Of the thirty-five wasps that were set free at the second point at least twenty started in wrong directions; adding these to the first twenty, we have left only fifteen that appeared to know where to look for their home, and yet thirty-nine reached the nest in a little more than an hour from the time the first wasps were set free. It therefore seems quite clear that wasps have no sense of direction as understood by either of the definitions suggested above. They apparently fly around and around, as did Bates' wasp, until they recognize some object, and then make that the starting point for their return to the nest.

On the evening of August 23d, we closed the entrance to the nest as before. On the morning of the 24th we caught thirty-eight workers. Leaving a third person behind to note the time of their return to the nest, we took them to a boat-house which was due west of the nest on the shore of the lake. The second story of the boat-house was simply a large room with two good sized windows, both wide open; one looked west over the lake and away from the nest; the other, east, toward the nest. The west window was the lighter, but the other was light, for, although the woods made a darker background, they still allowed some sunlight to come through into the room.

We placed the cage in the middle of this room, and at 9:10

A. M., opened the door, and stationed ourselves well to one side so as not to interfere with the movements of the wasps. They came out very naturally, usually pausing a moment before flying. They followed each other so slowly that we could easily see which window each went out of; twenty-two flew through the west window, away from the nest, and sixteen through the east toward the nest. The first wasp left the boat-house at 9:10, the others following at intervals of from half a minute to a minute. The record of the watcher at the nest was as follows:

At 9:11	1	arrived	and	was killed.
" 9:11½	2	"	"	were "
" 9:12	1	"	"	was "
" 9:12½	1	"	"	" "
" 9:13	1	"	"	" "
" 9:13½	1	"	"	" "
" 9:14	1	"	"	" "
" 9:14½	1	"	"	" "
" 9:15	2	"	"	were "
" 9:15½	2	"	"	" "
" 9:16½	1	"	"	was "
" 9:17	1	"	"	" "
" 9:17½	1	"	"	" "
" 9:18	1	"	"	" "
" 9:18½	1	"	"	" "
" 9:19	2	"	"	were "
" 9:20	3	"	"	" "
" 9:20½	2	"	"	" "
" 9:21	2	"	"	" "
" 9:22	2	"	"	" "
" 9:23	2	"	"	" "
" 9:24	2	"	"	" "
" 9:24½	2	"	"	" "
" 9:25	3	"	"	" "
" 9:26	1	"	"	was "
" 9:27	2	"	"	were "
" 9:29	1	"	"	was "
" 9:31	1	"	"	" "
" 9:32	2	"	"	were "
" 9:34	1	"	"	was "
" 9:36	1	"	"	" "
" 9:38	1	"	"	" "
" 9:39	1	"	"	" "

A few of these wasps carried loads.

From 9:39 to 10 no wasps arrived. It is apparent that those liberated in the boat-house came home as soon as they could find their way. Although on the morning of the 24th we did not see any wasps flying about the nest and trying to get in, there must have been a few out since forty-nine were killed while we only set free thirty-eight; and these were probably the ones which were bringing loads. The close relation between the departure of the wasps from the boat-house and their arrival at the nest, and the fact that we watched for twenty-one minutes after the last one came makes it reasonably sure that nearly all of the thirty-eight wasps found their way home. We studied this nest so closely that we feel very confident that not more than fifteen or twenty workers are likely to get belated and thus be unable to reach the nest for the night.

We have watched this nest as well as others after dark by means of artificial light or moon-light and never found a single wasp at work. On several warm nights we found wasps huddled together on the outside of paper nests, but when we turned the light toward them they always slowly crawled inside.

At 10:45 A. M. on August 24 we took fourteen wasps from nest number one and carried them seventy-three yards to the southeast. The cage was opened so that they could fly out in any direction they chose. They all started in a straight line for the nest.

On the same day at 1:15 P. M., we took forty-five wasps from this nest and set them free one hundred and seventy-six yards to the south. Seven flew north toward the nest, twenty-one south, eight west and seven east; the other two circled around as they rose higher and higher into the air until they were lost to view. None, in this experiment, returned to take a fresh start.

On the same day at 2:40 P. M. we took twenty-three wasps three hundred yards southeast of the nest and liberated them in an open field. Thirteen flew east or south, away from the nest; seven west or northwest, toward the nest; four returned to the

starting place and seemed unwilling to venture out again. They were still on the ground when we left the spot.

Our experiments all serve to show that the two species of wasps with which we experimented have no sense of direction in the form of a mysterious additional sense, nor yet in the form of a power by which they keep a register of the turns and changes in a journey and thus are able to retrace their way. Our cage was of wire, and so open that they could see all about as we carried them from place to place, yet when they flew out they most frequently started in a wrong direction and toward a point that we had not passed. In many instances, however, these wasps returned to the nest, and it seems highly probable that as they rose higher and higher into the air, circling as they rose, they discoveredsome high tree-top or other object that had before served them as a land-mark, and that in this way they were able to make their way home—unless, indeed, they had been taken so far away that the overlooked country presented no familiar object to their view.

May not the action of the wasps experimented upon by Sir John Lubbock in always flying to the closed window that was in the "wasp-line" to its nest, have been due to the relative amount of light coming in at the two windows?

MEMORY.

The facts related regarding the visits of the hornet to the wasps pinned to a board prove a limited degree of memory, as do also the experiments on the color sense. Some other observations, however, that we have made show that wasps have a very good memory. We found a hornet's nest suspended from the rafters of the upper room of the boat-house. In order to reach the nest the wasps passed in through a window, which instead of moving up and down slid back and forth in a groove when opened and closed. When we first noticed them the window stood three-quarters open. This left about six inches of glass projecting into the space and opposing their passage. When coming in, their line of flight was often toward the projecting glass, but they never flew against it during the many

hours that we watched them. They had already learned the properties of glass. After watching them for some days we pushed the window entirely open so that all the glass was out of sight and let it remain so for ten or twelve days. At the end of this time we closed it entirely and stood by to watch the result. The wasps, on returning, flew toward the window but seemed to understand at once the futility of trying to force a passage in that direction and buzzed upwards and sideways, close to the wall, thus working toward the roof. They were evidently looking for an opening and they all eventually found a space through which they could pass just below the roof. They seemed to know where the nest was located on the other side of the wall, for by far the greater number (out of about two hundred wasps) passed in just opposite to it, only a few entering at a distance. After watching the wasps for an hour and a half we concluded that they remembered the characteristics of glass for at least ten days. We found, as did Sir John Lubbock, that their memory varied greatly in different individuals. In our color experiments we repeatedly noticed that many wasps made the mistake of flying into the wrong hole several times while others would only fly into it once, and still others would only hover over it and then, as if remembering their former mistakes, would turn to the true opening.

EMOTIONS.

Our conclusions on this subject agree with those of Sir John Lubbock. Wasps seem to have but little sympathy for the suffering of their fellows. To be sure when we caught numbers of them and painted them within the cage they at once went to work to clean each other, and this seems to show that they have some desire to aid and comfort their friends. But we have often seen them continue to eat, with entire composure, near the body of one of their number that had just been crushed to death; and they frequently fall upon a dead relative, cut it up, and carried it into the nest to feed their young. An overpowering sense of utility is probably the cause of this canibal propensity; as was

case in Terra del Fuego where the natives were frequently forced, through stress of weather and scanty food supply, to eat their old women.

POWERS OF COMMUNICATION.

Having exposed numbers of wasp larvæ (to the use of which as food wasps are extremely partial) we found that although a number came to them and went backward and forward a good many times they never announced their discovery in such a manner as to induce others to return with them. We tried this experiment repeatedly but obtained no evidence to support Huber's statement that when one wasp finds a store of food it returns to the hive and shortly brings back a large number of friends. Taking into consideration the feeding habits of wasps and bees and the improbability of their often finding any large store of food, more evidence seems necessary to prove that they possess any extended powers of communication in relation to their food supply. *

GENERAL INTELLIGENCE.

In his work on Animal Intelligence, Romanes notes an observation by the Rev. Mr. J. W. Mossman to the effect that when a wasp must come out of a narrow opening it will come sting foremost, not to expose its head unnecessarily. In our experiments on the sense of direction, we frequently carried caged wasps to a distance and then allowed them to depart through a narrow aperture, sometimes inserting the end of a glass tube into an opening cut in the side of the cage, and sometimes letting them pass through this hole without using the tube. We liberated at

* Mr. Josiah Emery, in a communication made to Nature, in commenting on Sir John Lubbock's experiments, remarks that the faculty of communication which bees possess is so well known to the bee-hunters of America, that they catch a bee and feed it with honey and then set it free, and it soon returns with many others. These are caught and set free from different points, and then the hive is found by a kind of triangulation. (See Animal Intelligence page 158.) One of the writers of this paper has taken part in bee-hunts on many different occasions both in Southern California and in Kentucky. Often the trees were found by accident and were marked for future occasions; frequently, however, bees were allowed to feed from honey which was carried about from place to place, and were then followed as far as possible when they started from home, and thus, by the system of triangulation mentioned by Mr. Emery, an occasional hive was found. The bee-hunters told a great many stories to prove that bees were very intelligent, and that they conversed freely together. We never heard, during the year that we lived among bee-hunters, of any method of hunting which took into account their ability to communicate with one another.

least one hundred and fifty wasps in this way, and as we were standing over the cage with brushes ready to paint them they certainly had every reason to use caution, yet they invariably came out head first.

To see how far their intelligence would aid them in unusual difficulties, we once placed across their hole two slender blades of grass.

From 9:00–9:15 A. M., 225 entered, all being hindered by the grass.
" 9:15–9:20 " " 45 " " " " " " " "

We put on two more blades of grass so that the entrance was quite obstructed.

From 9:20–9:25, forty-eight entered, crawling through the grass, while one came up as far as the grass and then went back into the nest.

We added eight blades.

From 9:25–9:30, forty entered; four gave it up and flew away.

We had supposed that such busy, energetic creatures as these wasps seemed to be, would quickly remove any slight obstacle that hindered their work, but in this case they seemed to have no idea of doing so. No attempt was made to remove the blades of grass, though they were lighter than the ordinary load of a wasp. Thinking that perhaps this was because they were coming home and were carrying loads, we tried the experiment again at a busy hour when many were going out as well as coming in, but with no different results.

Toward the end of August we decided to kill all the wasps in nest number one, and to do the same with the other nests that we had under observation at intervals of from one to two weeks. Having closed the opening on the evening of August 24th, on the following morning we poured into the nest two ounces of cyanide of potassium dissolved in a pailful of water, and then immediately closed the entrance. An hour afterward we dug out the nest, hoping now to obtain information upon three points: First, the number of wasps in a nest; second, the proportion of the different sexes; and third, the fate of the males and of any undeveloped insects.

We found the number of wasps far greater than we had supposed it to be when we began our investigations a month earlier.

Nest No. 1. (V. germanica.)

Opened Aug. 25th, contained 2,269 ☿, 297 ♂, 1 ♀ =2,573.

We found a great many eggs and larvæ, especially in the queen cells, but unfortunately did not count them.

Nest No. 3. (V. germanica.)

Opened Aug. 30th, contained 1,506 ☿, 585 ♂, 54 ♀ =2,145.

We found eggs and larvæ as in the first nest.

Nest No. 4. (V. germanica.)

Opened Sept. 17th, contained 1,438 ☿, 695 ♂, 683 ♀ =2,816.

It also contained 50 eggs; 512 ♀ larvæ and pupæ; and 1,283 ☿ and ♂ larvæ and pupæ, making the total number of wasps, in various stages, 4,661.

Nest No. 5. (V. germanica.)

Opened Oct. 8th, was deserted. We counted 1,097 ♀ cells.

Nest No. 6. (V. germanica.)

Opened Oct. 8th, was also deserted. We found 97 ♀ undeveloped, and 536 ♀ cells, giving a total of 633 ♀

Prof. Wyman, in the paper referred to p. 414, speaks of opening a nest of either V. germanica or V. vidua on October 12 in Massachusetts, where the autumn is a little later than with us in Wisconsin. He found the adult population of the nest nearly as follows: ♀ 24, ♂ 236, ☿ 388, = 648. He is not explicit as to the number of undeveloped queens, but since he states that the nest was four stories high, *nearly spherical*, and five inches in diameter, and that the fourth or lower comb was of queen cells, and that "the larger portion of the cells for the females had been used and *others* were still occupied by pupæ, and the entrances were still sealed up," we are safe in supposing that there must have been, taking mature and immature together, at least 200 queens. He evidently did not count the cells since he says "there were also between 100 and 200 larvæ." We counted the cells in a ♀ comb from a nest of the large hornet V. maculata. The comb was five inches in diameter and contained 332 cells; and as the queen cells of the smaller hornet measure one-third

less it is as probable that there were 300 as 200 queens in this comb.

The relative number of male and female wasps differed so much in the nests that we opened that the statements seemed unreconcilable until we remember that only a few queens are hatched in the late summer, while a much larger number mature toward the time when the nest is to be deserted. Nest number four, opened on September 17, had 1,195 queens in different stages, and about the same number of males. In nest number five there were 1,097 queen cells and the number of male cells was probably a little larger. It seems, then, that most of the males are developed considerably earlier than the females, as is the case with nearly all insects; and that the males and females are about equal in number. Herman Mueller, as quoted by Darwin*, found, in studying several species of bees, that in some the sexes were nearly equal, that in others the males greatly exceeded the females, and that in some cases the females exceeded the males.

"Every nest," says the Rev. Dr. Bingley,† "about the beginning of October presents a singular and cruel scene. At this season, the wasps not only cease to bring nourishment to their young, but drag the grubs from their cells and carry them out of the nest, where, exposed to the weather, and deprived of food, they all unavoidably perish, if the wasps neglect, which they seldom do, to kill them with their fangs. This mode of procedure would at first seem a strange violation of parental affection; but the intentions of nature, though they often elude our researches, are never wrong. What appears to us cruel and unnatural in this instinctive devastation, committed annually by the wasps, is perhaps an act of the greatest mercy and compassion that could possibly have taken place. Wasps are not, like the honey-bees, endowed with the instinct of laying up a store of provisions for winter subsistence. If not prematurely destroyed by their parents, the young must necessarily die a cruel and lingering death, occasioned by hunger. Hence this seemingly harsh conduct in

* Descent of Man, p. 254 (Am. Ed. 1875). † Animal Biography, London, 1803, Vol. III., p. 348.

the economy of wasps, instead of affording an exception to the universal benevolence and wisdom of nature, is, in reality a most merciful effort of instinct."

Romanes, in his work on Animal Intelligence, pages 167-168, says that he considers the philosophy of drone-killing in wasps even more difficult than in the case of bees. "As this season of universal calamity approaches, the workers destroy all the larval grubs—a proceeding which, in the opinion of some writers, strikingly exemplifies the beneficience of the Diety! Now it does not appear to me easy to understand how the presence of such an instinct in this case is to be explained. For, on the one hand, the individual females which are destined to live through the winter cannot be conspicuously benefited by this slaughter of grubs; and, on the other hand, the rest of the community is so soon about to perish, that one fails to see of what advantage it can be to it to get rid of the grubs. If the whole human race, with the exception of a few women, were to perish periodically once in a thousand years, the race would profit nothing by destroying, a few months before the end of each millenium, all sick persons, lunatics, and other useless mouths! I have not seen this difficulty with regard to the massacring instinct in wasps mentioned before, and I only mention it now in order to draw attention to the fact that there seems to be a more puzzling problem presented here than in the case of the analogous instinct as presented by bees. The only solution that has presented itself to my mind is the possibility that in earlier times, or in other climates, wasps may have resembled bees in living through the winter, and that the grub-slaying instinct is in them a survival of one which was then, as in the case of the bees now a clearly beneficial instinct."

With such weighty considerations before us we felt anxious to ascertain the exact facts relating to the grub-slaying and drone-slaying habit, and if possible, to gain some hints that might aid in the solution of the problem. We obtained sufficient evidence on this point to prove that the workers of two species of our wasps, V. maculata and V. germanica, possessing less Spartan heroism, or perhaps less intelligence than their European cousins,

do not take it upon themselves to determine the fate of their less happily conditioned brothers and undeveloped relatives; but that when the time comes for the dissolution of the hive, the males and larvæ are deserted and soon die of hunger.

Nest No. 7 (V. maculata) was opened on August 31st. It was a rather small nest, under the eaves of the boat-house. We found that all the cells were empty (the larvæ had probably matured) and that the hive was deserted by all the inhabitants excepting 46 males. These looked lean and hungry. When we let them go they appeared perfectly bewildered and helpless, and after a short flight many of them dropped to the ground and seemed not to know what to do with themselves.

On September 5th we took a very small nest (No. 8 V. maculata) from a cedar tree in a ravine. The workers and queens had left, only nineteen males and a few pupæ remaining behind; the latter were uninjured.

On September 17th we opened a very large nest (No. 9, V. maculata). As in the other cases, all the queens were gone, but here we found one hundred and fifty males and about half as many workers, beside one hundred pupæ (none of them queen pupæ). The wasps were all dying from the effects of the cold weather, but a number of the workers had enough vitality to fly away.

In all these cases the queens had, doubtless, been impregnated, and the nest had then been deserted by most of the workers and males. It may be true that in the marriage flight, if indeed the marriage is not consummated inside the hive, many of the males wander so far from home that they never find their way back.

We are unable to find any authority for the assumption of Romanes that the drones are killed by the workers. Dr. Bingley implies that they are not killed, in stating that it is doubtful whether any of the males survive the rigors of winter. Also, in a paper by Messrs. Riley and Walsh in the American Entomologist, Vol. I, page 140, we find the statement that "as soon as the cold weather commences, the males and the workers all

perish." Nothing that we have seen indicates that the males perish from any other cause than hunger and cold.

On October 8th we opened two nests of V. germanica (No. 10 and No. 11). Both were ground nests, and both had evidently been deserted for some time since the combs were partly covered with mould, and the larvæ of a fly were found occupying a number of the cells and feasting upon the larvæ of the wasps. In one of the nests we found a number of larvæ and pupæ in various stages; those not injured by the flies were in good condition, and a few were just ready to come out.

In the other the same state of affairs prevailed, we counted ninety-seven queen larvæ and about twice as many neuters and males, many of them being alive. No adult males were found in either nest. The difference in this respect between V. germanica and V. maculata may be explained by supposing that while in V. germanica the males do not return to the nest after the marriage flight, in V. maculata they do return—or that perhaps they never leave the nest, the ceremony being performed inside.

Our wasps are evidently not so high in the scale of life as the bees. The specialization of function in the queen bee, the reduction in the number of the queens, and the slaughter of the drones after their usefulness ceases show a higher form of social life than is found among the wasps. It is difficult to understand why, in animals so highly developed as bees, a reduction in the number of drones has not taken place before this. Or, as Romanes suggests, it is remarkable that they have not learned to kill the drones at the most profitable time in the larval or ôval state. But, after all, this is looking at the matter from so entirely human a stand point that it is, perhaps, open to the charge of narrowness. The life of the bees is dependent upon the welfare of the flowers; and if the bees did not gather the pollen with which they feed the useless drones the flowers might be less abundant, and thus the bees would be the sufferers in the end.

"It hath been an opinion," says Lord Bacon, "that the French are wiser than they seem, while the Spaniards seem wiser than

they are." We leave it to our readers to decide whether the bees and wasps are wiser than they seem or seem wiser than they are.

APPENDIX.

We give below all our observations on arrivals and departures with the exception of those made on the morning of August 18. We sometimes counted those arriving, sometimes those departing and sometimes both arrivals and departures at the same time.

			Arrived.	Left.	
August	7,	3:30– 3:50 P. M.	50		Warm, bright.
"	"	4:15– 4:35 " "	60		
"	9,	2:30– 2:35 " "	140		
"	"	4:50– 4:56 " "	200	20	
"	"	4:58– 5:00 " "		100	
"	10,	8:40– 9:02 A. M.	650	359	Cloudy, cool.
"	"	3:22– 3:29 P. M.	100		
"	"	4:50– 5:00 " "	140		
"	11,	9:31– 9:39 A. M.	200	26	
"	12,	8:00– 8:06 " "	100		
"	"	8:11– 8:15 " "		200	
"	"	9:10– 9:15 " "	191	256	Very dark, thunder.
"	"	9:23– 9:28 " "	187		
"	13,	9:10– 9:30 " "	528	45	
"	"	1:39– 1:44 P. M.	125		Clear, cool.
"	"	3:04– 3:09 " "	120		
"	"	3:09– 3:14 " "	100		
"	14,	10:45–10:50 A. M.	130		Warm, cloudy.
"	"	10:50–10:55 " "	237		
"	"	11:12–11:15 " "		100	
"	"	11:15–11:17 " "		611	
"	"	11:20–11:25 " "	191		
"	15,	8:35– 8:42 " "	200		Clear, cool
"	"	8:38– 8:48 " "		238	
"	16,	3:11– 3:16 P. M.	200	5	
"	"	3:16– 3:20 " "		0	
"	"	3:20– 3:25 " "	127	65	
"	"	3:43– 3:48 " "	128	90	
"	"	7:00– 7:30 " "	2	0	
"	17,	9:05– 9:10 A. M.		13	
"	"	9:10– 9:15 " "	185		

			Arrived.	Left.	
August	17,	9:15– 9:20 A. M.		230	
"	"	9:20– 9:25 " "		290	
"	"	9:80– 9:35 " "			
"	"	4:25– 4:30 P. M.		0	
"	18,	12:55– 1:00 " "	191		
"	"	1:00– 1:05 " "	81		
"	"	3:30– 3:35 " "	100		
"	"	3:36– 3:41 " "	108		
"	"	3:33– 5:38 " "	46		
"	"	5:40– 5:46 " "	49	9	Cool, clear.
"	"	5:50– 5:55 " "	45	0	
"	"	6:50– 6:55 " "	43	1	
"	"	7:40– 7:50 " "	0	0	
"	19,	3:40– 3:45 P. M.		0	
"	"	3:45– 3:50 " "	109	13	
"	"	5:05– 5:10 " "	54	0	
"	"	5:10– 5:15 " "	77	1	
"	"	5:15– 5:20 " "	76	3	
"	20,	6:50– 6:55 A. M.	201	153	Cloudy, 66° F.
"	"	7:49– 7:54 " "	154		
"	"	8:00– 8:05 " "	126		
"	"	8:13– 8:18 " "	173		
"	"	8:20– 8:25 " "	153		
"	"	3:45– 8:50 " "	168		
"	"	8:54– 8:59 " "	141		
"	"	9:10– 9:15 " "	180		
"	"	9:20– 9:25 " "	152		
"	"	9:28– 9:33 " "	107		
"	"	11:30–11:35 " "	72	0	
"	"	11:35–11:40 " "	38	0	
"	"	11:40–11:45 " "	32	0	
"	"	11:45–11:50 " "	42	0	
"	"	4:18– 4:23 P. M.	47	0	
"	"	4:23– 4:28 " "	72	0	
"	"	4:28– 4:33 " "	56	4	
"	"	4:33– 4:38 " "	67	8	
"	"	4:40– 4:45 " "	78		
"	21,	9:00– 9:15 A. M.	225		
"	"	9:15– 9:20 " "	45		
"	"	9:20– 9:25 " "	48		
"	22,	9:25– 9:30 A. M.	40		
"	"	9:40– 9:45 " "		4	

		Arrived.	Left.
August 22,	2:45– 2:50 P. M.	84	
" "	2:52– 2:57 " "	116	0
" "	7:45– 8:00 " "	0	0
" 23,	8:47– 9:10 A. M.	42	0
" "	10:30–10:35 " "	202	
" "	10:35–10:40 " "	114	
" "	10:40–10:45 " "	96	
" "	10:45–10:50 " "	142	
" "	3:05– 3:10 P. M.	131	
" "	3:10– 3:15 " "	107	
" "	4:01– 4:06 " "	61	
" "	4:06– 4:11 " "	37	

ON THE DISTRIBUTION OF COLEOPTERA ALONG THE LAKE MICHIGAN BEACH OF MILWAUKEE COUNTY.

By Wm. W. Wheeler.

Those who have frequently strolled along the Lake-beach north of our city, cannot fail to have noticed a long, almost unbroken, sinuous band of drift wood and debris of every description extending along the sand. The more careful observer will also have seen lying here and there on the beach or clinging languidly to pieces of refuse a great number of insects of all orders. These too, he will conjecture, have been cast up by the water. Should the same observer have pushed aside a part of the drift-wood, he will have seen many active beetles and larvæ run over the damp sand which was previously protected from the sun's rays by the fragments of wood. Why are these insects under this isolated belt of chips? is a question, which naturally presents itself. These were phenomena which deeply interested me when, years ago, I began the study of insects. A few years of careful collecting among these piles of refuse revealed a great number of rare and beautiful Coleoptera. I then found at least 1,000 species of this one order, and my friend, Mr. Rauterberg, who had collected for many years previous, obtained several species which I have been unable to procure. Surely this is a

remarkable littoral distribution. To what degree is this distribution accidental, *i. e.* to what extent influenced by the action of the lake water? What are the causes of this accidental distribution? To what degree is this distribution natural? These are the questions which I shall attempt to answer in the following paper.

Before proceeding, however, to answer these questions, let us consider the extent of shore examined. My observations have been limited to the portions of beach north of the river-mouth, partly because they were more easy of access, partly because repeated visits to the southern beach of the county failed to reveal any specimens. Within the city limits the improvements of the Chicago & North-Western R. R. have obliterated all but a small portion of the original shore line. This is a short but very broad sandy beach at the northern corner of the bay where the railroad leaves the lake shore. Trespassing on the shore between this beach and the "water works" is forbidden. The beach most thoroughly examined, however, begins just north of the "water works" and extends to White Fish Bay. It is lined on the west by a wall of low bluffs, sometimes covered with grassy pastures, sometimes crowned with dense woods. This wall of bluffs is broken every now and then by ravines, worn by little streams which flow into the lake. The mouths of these ravines are often broad, and have an unusually great accumulation of drift-wood. This long stretch of beach is far from being regular. In places it is broad and sandy, more frequently it is narrow and covered with coarse, wave-worn pebbles. At times it is crowded with boulders, which project into the water and serve as a landing place for many insects.

Let us first consider what I call the *accidental* distribution of the Coleoptera over this area. The waves washed up thousands and thousands of beetles of many genera. Had these any peculiarity in common? Without exception they were all flying Coleoptera, The plant-eating genera endowed with the greatest powers of flight were the most abundantly represented. The greater number of species were nocturnal, though the *Coccinellidæ* and *Chysomelidæ* which were at times exceedingly

numerous, formed a marked exception to this rule. Most of the specimens found were limp and exhibited only faint signs of life, many were dead, and many in all stages of decay. The matted hairs of the pubescent species and a lack of that freshness of coloring so marked in scaly beetles were evidence of the continued action of water.

Most of the beetles of this accidental distribution were the very common species of our county and state, species met in every wood, and along every country roadside. Such were the species of *Coccinellidæ*, numerous *Chysomelidæ* and *Rhynchophoridæ*, many *Elateridæ* and several species of the genus *Lachnosterna*. What I wish more especially to call your attention to, is the fact that there appeared in this accidental distribution a number of Coleoptera which years of careful search on the part of Mr. Rauterberg and myself throughout the county have failed to secure. I will mention only a few of the more striking examples. *Calosoma Willcoxi* is a beetle which I have never seen alive, yet one spring no less than 500 dead specimens of this large Carabid were found on the little beach south of the "water works." *Odontæus cornigerus*, *Bolboceras lazarus*, *Lachnosterna tristis*, *Chalipus trachypygus*, *Ligyrus gibbosus*, *Ligyrus rugiceps*, *Xyloryctes satyrus*, *Cremastochilus knochii*, *Gnorimus masculosus*. *Iphthimus opacus*, and about ten species of *Cerambycidæ*, among which were the beautiful *Tragidion coquus*, *Calloides nobilis*, and several *Monohammus*, are some of these beetles which, to my knowledge, have not been found heretofore in Milwaukee County. Some of these species are evidently peculiar to pine-forests and as coniferous trees are very scarce in the county must be regarded as extra-limital. It is probable that they have been wafted to us from the northern counties.

There were collected, moreover, a number of species, which, though always rare inland, were at times very common on the lake shore. *Calosoma scrutator* is not a common beetle in the county, yet I have seen dozens of dead specimens scattered for miles along the beach. *Calosoma frigidum*, a very rare beetle inland, was very common at times, more common, in fact, than *Calosoma calidum*, a species which abounds in fields and woods.

Lucanus dama and *Lucanus placidus* are rare, but both sexes of these stag-beetles, especially the females, were frequently common. *Euphoria fulgida* and *Orthosoma brunneum* were often abundant. *Chrysomela multiguttis*, a beautiful and uncommon beetle, appeared in great numbers. Many species of *Sphenophours* and *Balaninus*, rare elsewhere, were common along the lake beach. Many other illustrations of the strange phenomena of this accidental distribution might be given, but these will suffice.

How shall we account for these facts? There seem to me to be three probable causes why we should find so many insects on the beach. The first of these is the winds. It is a well-known fact that the winds of our lake shore alternate in direction. During the day there is a wind from the lake and during the night a wind from the shore. Now we have already drawn attention to the fact that most of the beetles of this accidental distribution were nocturnal, and all of them flying insects. Certainly it seems very probable that these Coleoptera, while attempting long flights during the night, had been carried out into the lake and had fallen into the water to be wafted in by the waves when the lake wind set in toward the land. There was no means of determining how long these beetles had been in the water. The time, of course, varied with the distance they fell from land and depended on the tranquil or convulsed condition of the water.

The second cause seems to be the river and streams. It was observed that Coleoptera were especially abundant after rains. This was, no doubt, partly due to the greater violence of the winds during the rain storms, but the streams and the river also were active agents in causing this accidental distribution. The foliage surrounding streams and pools is usually the haunt of a great number of insects. A sudden rain causes the streams to rise and increase in rapidity. These carry away many insects, tearing them from the shrubs and grass near and over which they flow. Many species, common on the damp earth of the banks, unable to escape from the rising water, are borne along. Such are the numerous species of *Bembidium* and *Heteroceras*, the less common *Omophron* and *Elaphrus*. These helpless insects

are, no doubt, speedily poured into the river and thence into the lake. Many too, unquestionably pass down the streams of the small ravines, which we mentioned as cutting the hilly walls along the shore.

These two causes, the winds and the streams, will account for all the species known to occur within the county limits. But how are we to explain the appearance of the extralimital pine-boring *Monohammi?* There must be still another agency at work. This can be no other than lake currents, which sweep from the north and deposit such insects along the shore of our county. Some of these extralimital species must fly or creep up into the woods and fields on the bluffs of the shore. It is interesting to conjecture what effect they might have on our county insect-fauna.

Let us now pass to the consideration of the natural distribution of Coleoptera along our county beach. The words "natural and accidental distribution" are hardly correct, but they are the best terms I could find to designate these two groups of phenomena. Those Coleoptera which were not wafted to the beach by any physical agency, but which took up their abode under the drift-wood for the purpose of feeding on edible refuse and the dead or living bodies of other insects, which were often so numerous as to produce a most unpleasant stench, constitute the natural distribution. It is clearly evident that the beetles of this distribution were without exception rapacious species and feeders on decomposing animal and vegetable matter. No plant-inhabiting species would stray to a spot as barren in vegetation as the hot, sandy and pebbly beach. This distribution is thus seen to be dependent in great measure on the accidental distribution. The more insects washed ashore by the waves, the more thriving the condition of the predaceous and carrion-eating species and their larvæ.

Though less wonderful than the accidental distribution, this distribution offers many remarkable facts. It too presents us with numerous beetles found no where else in the county. Such are, for example, *Blethisa quadricollis*, *Loricera cærulescens*, *Casnonia pensylvanica*, *Callida purpurea*, *Amara avida* and many

other species of Carabidæ. As might be expected the *Staphylinidæ* and *Carabidæ* were abundantly represeuted. Of the former family Mr. Rauterberg enumerates almost 100 species as inhabiting Milwaukee County, and probably three-fourths of these occur in the natural littoral distribution. The largest species of the group, *Staphylinus maculosus* has not, however, been observed. The beautiful tiger-beetle, *Cicindela limbalis*, is confined almost entirely to the lake beach north of the "water works." *Geopinus incrassatus* and *Polpochile capitata* were often found half buried in the sand, which seems to be their proper element.

A great number of species, rare elsewhere in the county, were very common under the drift-wood. *Chlænius erythropus* is an example. Every collector knows that the genera *Platynus*, *Pterostichus*, *Chlænius*, *Amara*, *Bembidium* and *Tachys* are abundantly represented under stones along every road-side and in every meadow in spring. He also knows that, as the season advances, these disperse and are met with but rarely. Strange to say, these genera remained under the refuse on the beach during the entire summer, and species which, during this season were to be found no where else, seemed to have found happy hunting-grounds on the lake sands. The Coleoptera, which are usually found in fungi and in decayed wood were rarely seen. The sexton-beetles, *Necrophoridæ*, appeared on the carcasses of dogs, etc., cast up with the other refuse. The species of *Hister* were common. I remember once finding a fine specimen of *Hister bimaculatus* on the sand.

Among the other Coleoptera of the lake beach were found numbers of water-beetles of the families *Haliplidæ*, *Dytiscidæ*, *Hydrophilidæ*, and *Gyrinidæ*. The insect-fauna of Milwaukee County embraces 97 species belonging to these four families. Probably all of these occurred along the beach. I deem this very likely because aquatic distribution is more general than terrestrial distribution, and because the streams and pools of the county are so intimately connected with one another and with the lake that the distribution of the various species cannot be clearly defined. While speaking of aquatic beetles I will call attention to the fact that species of *Elimidæ* are very rare in our

county, and that only one species of the *Parnidæ* is common, *Helichus lithophilus*.

Thus far we have considered only the littoral distribution of Coleoptera in space. It remains for us to consider this distribution in time. My attention was first directed to the distribution of Coleoptera in 1879. Mr. Rauterberg, whose accuracy as an observer and whose pains and diligenee as a collector are well known to us all, states that previous to this date the number of Coleoptera found on the beach, even within the city limits, on that part of the shore since improved by the railroad, was truly wonderful. He has told me frequently, that he has filled bottle after bottle in a few minutes, that he eould almost shovel the specimens up. From 1879 to 1883 we both observed the distribution and have noticed a steady decline in the number of specimens during these five years. Being absent from town during 1884 I was unable to continue my observations, but Mr. Rauterberg says that he could obtain but very few beetles. During the last summer, 1885, repeated visits to the beaches, which in former years had yielded such a rieh harvest, were rewarded by nothing. How are we to explain this? We cannot consider this problem without regarding the distribution in time throughout the county. There seems to have been a slight decrease in the number of Coleoptera inland, but a deercase scarcely sufficient to explain the abrupt falling off in the littoral distribution. We are therefore obliged to ask the question: Can the building of embankments and piers of late years have anything to do with this problem? Can they have deflected the lake currents in anyway? This question I am unable to answer. More lengthy and more thorough observations on the part of our county naturalists are required, both on this point and on many others touching this distribution. Perhaps an examination of the beach south of the city would aid in solving some of these problems.

As would readily be surmised, the distribution throughout the different seasons has been simultaneous with the distribution of the inland species. As soon as the iee leaves the beach in early spring water-beetles are almost the only Coleoptera

found. Later the Carabidæ predominate. With the unfolding of leaves and flowers the *Coccinellidæ* and *Chrysomelidæ* make their appearance. Still later come the *Buprestidæ* and the Longicorns. A more or less protracted pause usually marks the hottest part of the summer and the autumn brings more Longicorns and *Carabidæ*.

Though I have thus far confined my words solely to the Coleoptera, it must not be supposed that other orders of insects did not send representatives to the lake beach. Even the distribution of the Lepidoptera presented something anomalous. These too, it seems, though excelling all other insects in flight were sometimes carried out into the lake by winds. The common butterflies were frequently seen lying helplessly on the beach with wet wings. Few, if any, could ever again join their inland companions. They fell a prey to Carabids or were shriveled up on the hot sand. I remember once finding a number of females of a species of *Argynnis* washed up by the waves. I have never seen a living female in the county. They must exist but they are certainly very rare and the appearance of a number of them at once on the lake beach is strange, to say the least. The *Hemiptera* and *Hymenoptera* were numerously represented. The largest of our *Hemiptera*, the huge water-bug, *Bellostoma*, was once so common that I could have filled a peck-basket with specimens in walking two miles along the beach! Bees were very common, and, what seems remarkable, a number of queen bumble-bees were once found. A few *Diptera* were seen beside those that came to deposit their eggs on decomposing animal matter. Numerous species of the smaller *Neuroptera*, which had evidently passed their early life in the water of the lake, were frequently observed flitting about the sand.

The literature on this subject of littoral distribution is very scanty. The facts to which I have called your attention have not, of course, passed unobserved by others. I am informed that a similar distribution obtains at Sheboygan, Wis. The following is taken from Le Conte's Geology:

"In the Miocene of Europe, 1,550 species of insects have been found; and of these more than 900 species at Oeningen in

a stratum only a few feet thiek (Lyell). In places the stratum is black with the remains of insects. The same stratum is also full of leaves of *Dicotyls*, of whieh Heer has described 500 species. Mammalian remains and fishes are also found in them.

"It is interesting to inquire the eonditions under which these strata were formed and filled with these remains. On Lake Superior, at Eagle Harbor, in the summer of 1844, we saw the white sands of the beaeh blackened with the bodies of insects of many speeies, but mostly beetles, east ashore. As many species were here eolleeted in a few days, by Dr. J. L. Le Conte, as could have been eollected in as many months in any other plaee. The inseets seem to have flown over the surface of the lake; to have been beaten down by winds and drowned, and then slowly earried shoreward and aeeumulated in this harbor and finally east ashore by winds and waves. Doubtless at Œningen, in Mioeene times, there was an extensive lake surrounded by dense forests, and the inseets drowned in its waters and the leaves strewed by winds on its surfaee were east ashore by its waves." Mr. Le Conte goes on to state that of these 900 species of Œningen insects over 500 were Coleoptera.

While in Roehester, N. Y., I visited the beaehes of Lake Ontario with a view to seeing whether like phenomena occurred there. Once I observed a vast number of a Curculionid, since known to feed on the red clover, elinging to the stones and pebbles.

There is seareely a doubt that a similar distribution to the one deseribed as occurring along the lake shore of our county, also obtains along the entire shore line of the Great Lakes. It must exercise a vast influenee on the inland fauna and flora, either by thus diminishing the number of individuals and species by drowning such great numbers, or by increasing them through the aeeidental introduetion of extralimital species. Certainly there is room for much investigation and much speculation in this distribution, and I would earnestly request those who visit the lake beaehes the eoming summer to observe and note any faets whieh may prove of value.

MARCH 14, 1887.

President Peckham in the chair.

Mr. Wm. Segall was unanimously elected member of the Society. The resignation of Mr. E. Loewe was accepted.

Hereupon Mr. E. E. Teller read a paper on the Paleontology of Eastern Wisconsin. Mr. Teller's paper contained lists of the fossils found in the various formations in the vicinity of Milwaukee. Messrs. Greene and Toellner then made various remarks relative to the subject treated by Mr. Teller.

MAY 2, 1887.

President Peckham in the chair.

The president remarked on opening the meeting that the proceedings of the Wisconsin Natural History Society for 1886 had been printed and were ready for distribution among the members of the Society and the corresponding societies abroad.

Mr. B. F. Goss, of Pewaukee, Wis., then read a popular paper on Birds. A brief, but pleasing account was given of the derivation, migrations, songs, moulting, incubation, etc. of Birds. The lecturer gave the various theories which have been advanced to account for the migration of birds over vast stretches of country. He moreover made some remarks on the importance of protecting our native birds.

After the reading of the paper various observations on birds were adduced by Prof. Peckham and Messrs Teller and Mann. The discussion concluded with a consideration of the so-called "sense of direction" in men and animals.

JUNE 13, 1887.

President Peckham in the chair.

Mr. W. M. Wheeler read a paper on Taxidermy considered

as a fine art. He attempted to show the importance of good taxidermy in our biological museums, its influence on intellectual and æsthetical education. He defined the relation of taxidermy to the fine arts, sculpture and painting, and called attention to its advantages and disadvantages as compared with these fine arts. A brief sketch of the history of taxidermy was given with the reasons for its late appearance in civilization.

After the reading of the paper the society adjourned to meet again in the autumn.

NOVEMBER 14, 1887.

Dr. Peckham in the chair.

After the reading and approval of the minutes of the preceding meeting, the chair announced that an election of officers would be in order at the next meeting of the society, and further, that the society ought to consider in that meeting what should be done with the library. The president called attention to the very disorderly condition of the library and suggested that it might be most profitable to deposit the same with the Milwaukee Public Museum. The custodian of that institution could see that the books were properly kept, and that the foreign exchanges with the society were properly carried on. The Natural History Society could still reserve the privilege of consulting the library whenever desirable.

Dr. F. Brendecke then lectured on "Preventive Measures against Bacteria." The Doctor, whose long experience as a practicing physician gave force and authority to his remarks, insisted on the greatest cleanliness in the household, during the prevalence of contagious disease, the careful abstinence from all foods exhibiting the least signs of decomposition, and the avoiding of damp localities, especially of such as abound in putrefactive organic matter. The doctor then proceeded to remarks on diet during prevalence of epidemic diseases. He suggested as food the least amount of meat compatible with

the maintenance of life, plenty of vegetables, especially of those which are not completely digested in the stomach. Graham bread and similar food stuffs, he said, prevented the formation of zooglææ of bacteria in the alimentary tract. All handling of infected objects must, of course, be avoided, and under no circumstances should such objects be brought in contact with the mucous membranes of the body or with wounds or abrasures of the epidermis. Sunlight and fresh moving air retard the multiplication of disease germs. During times of contagious disease alcoholic drinks should be indulged in as little as possible. After dwelling on these important hygienic regulations Dr. Brendecke spoke of the bad effects of fear and terror, especially when Asiatic cholera is raging, and on the soothing influence of philosophy and religion. The lecture showed throughout the long experience in the treatment of the sick and merited a much larger audience than was present.

MONDAY, DECEMBER 19, 1887.

Presidents Peckham and Meinecke in the chair.

Prof. Peckham announced that an election of officers for the following year, 1888, was in order, and appointed Messrs. Mann, Rauterberg and Wheeler a Committee on Nomination. The gentlemen nominated by the committee were unanimously elected by the society.

The officers for the year 1888 are as follows:

President—MR. A. MEINECKE.
Vice-President—MR. B. F. GOSS.
Treasurer—MR. C. HENNECKE.
Corresponding Secretary—MR. W. M. WHEELER.
Recording Secretary—MR. E. E. TELLER.
Librarian—PROF. G. W. PECKHAM.

The society next considered the question of transferring the library to the Public Museum. The transfer was unani-

mously approved. All future publications addressed to the Wisconsin Natural History Society and all exchanges, it was decided, should be given over to the Public Museum Library on the condition that that institution would carry on the exchanges of the society and on the further condition that members of the society should be permitted to consult the library when they felt so inclined.

Hereupon followed the lecture of the evening. Mr. W. M. Wheeler gave the results of some months of investigation on the development of the Croton Bug (Blatta Germanica). The insect's development was traced from the formation of the ovarian egg to hatching. Mr. Wheeler illustrated his lecture, which was necessarily much condensed, with blackboard, drawings of the embryos in different stages.

At the close of the lecture Prof. G. W. Peckham offered some remarks on animal development in general.

The following papers were read by title: "A Continuation of the List of Wisconsin Coleoptera," by Mr. F. Rauterberg; "The Flora of Milwaukee County," by W. M. Wheeler.

COLEOPTERA OF WISCONSIN.

BY F. RAUTERBERG.

(CONTINUED FROM PAGE 62.)

Since writing the former portions of my list of the Coleoptera of Wisconsin, I have re-arranged my cabinet in accordance with the List of North American Coleoptera published by Henshaw in 1885, in order to facilitate in corresponding and exchanging with other Coleopterists. This change merely affects the second row of numbers, and to a very limited degree the systematic arrangement of the families.

PHALACRDÆ.

Wis. No.	Amer. No.	
		PHALACRUS, Payk.
578.	2990.	ovalis, Lec.....With the sweep-net. Common.
579.	2993.	politus, Melsh.....Same as the preceding.
		OLIBRUS, Er.
580.	2996.	vittatus, Lec.....With the sweep-net. Rare.
581.	2997.	bicolor, Gyll.....With the sweep-net. Rare.
582.	2998.	striatulus, Gyll.....With the sweep-net. Common.
583.	3005.	consimilis, Marsh..With the sweep-net. Common.
584.	3007.	nitidus, Melsh.....In spring, very common under stones. Later, on flowers.
585.	3008.	pusillus, Lec.....Same as the preceding.

CORYLOPHIDÆ.

		SACIUM, Lec.
586.	3019.	misellum, Lec.....Under stones. In spring. Common.

COCCINELLIDÆ.

		ANISOSTICTA, Duponchel.
587.	3033.	strigata, Thumb...On the lake-beach, also on foliage. Common.
		NAEMIA, Muls.
588.	3035.	episcopalis, Kirby...On foliage. Very rare.
		MEGILLA, Muls.
589.	3036.	maculata, DeG.....Very common, especially in early spring and in autumn, in swarms.

Wis. No.	Amer. No.	
		HIPPODAMIA, Muls.
590.	3044.	glacialis, Fab.....Especially along the lake. Common.
591.	3046.	convergens, Guer...On foliage. Rare.
592.	3050.	13-punctata, Linn.On foliage. Very common.
593.	3051.	parenthesis, Say....On foliage. Common.
		COCCINELLA, Linn.
594.	3055*a*.	venusta, Melsh.....On the lake-beach. Rare.
595.	3056.	trifasciata, Linn....On foliage. Not common.
596.	3058.	9-notata, Hbst.....Everywhere.
597.	3059.	transversoguttata, Fab. On foliage. Rare.
		ADALIA, Muls.
598.	3066.	bipunctata, Linn...On foliage. Rare.
		HARMONIA, Muls.
599.	3069.	picta, Rand.....On foliage. Rare.
600.	3072.	12-maculata, Gebl.On foliage. Very rare.
		MYSIA, Muls.
601.	3073.	pullata, Say.....On foliage. Formerly were rare, in 1887 common.
		ANATIS, Muls.
602.	3075.	15-punctata, Oliv.Especially on Crataegus. Very common.
		PSYLLOBORA, Muls.
603.	3078.	20-maculata, Say..On oaks and hickories. Common.
		CHILOCORUS, Muls.
604.	3080.	bivulnerus, Muls...On foliage. Common.
		BRACHYACANTHA, Chev.
605.	3095.	ursina, Fab.....On foliage. Very rare.
606.	3098.	Bollii, Cr.....On foliage. Rare.
		HYPERASPIS, Chev.
607.	3102.	lateralis, Muls.....On foliage. Common.
608.	3105.	undulata, Say.....Formerly rare, in 1887 common on Viburnum.
609.	3110.	signata, Oliv.....Common everywhere.
610.	3112.	proba, Say.....Found with undulata.
611.	3114.	bigeminata, Rand..On Crataegi. Rare.
612.	3121.	annexa, Lec.....On foliage. Very rare.
613.	3123.	moerens, Lec.....On foliage. Rare.
		SCYMNUS, Kug.
614.	3138.	americanus, Muls..With the sweep-net. Common.
615.	3146.	haemorrhous, Lec. Same as the preceding.
616.	3148.	collaris, Melsh.....Same as the preceding.
617.	3152.	puncticollis, Lec....Same as the preceding.
618.	3155.	marginicollis, Mann. Same as the preceding.
619.	3161.	icteratus, Muls.....Same as the preceding.
620.	3162.	punctatus, Melsh..Same as the preceding.

CRYPTOPHAGIDÆ.

(The other species, now included in this family, were enumerated under Atomariidæ in the previous part of my list.)

CRYPTOPHAGUS, Hbst.

621. 3364. cellaris, Scop.....On old wood. Common.

HISTERIDÆ.

HOLOLEPTA, Payk.

622. 3461. fossularis, Say.....At Muskego Lake, under bark of alder. Very rare.

HISTER, Linn.

623. 3474. lucanus, Horn.....In cow-dung. Common.
624. 3480. interruptus, Beauv. In cow-dung. Less common.
625. 3485. remotus, Lec.....In cow-dung. Rare.
626. 3486. foedatus, Lec.....In fungi. Very common.
627. 3487. coenosus, Er.....In cow-dung. Rare.
628. 3491. civilis, Lec.....In fungi. Rare.
629. 3495. furtivus, Lec.....In cow-dung. Rare.
630. 3503. bimaculatus, Linn. In pigeon-dung. Rare.
631. 3505. 17-striatus, Say....On fungi. Common.
632. 3507. americanus, Payk..Common everywhere.
633. 3508. perplexus, Lec.....On fungi. Quite rare.
634. 3515. subrotundus, Say..In cow-dung. Rare.
635. 3520. Lecontei, Mars.....Under bass-wood bark. Common.
636. 3522. parallelus, Say.....Under bass-wood bark. Rarer.
637. 3524. coarctatus, Lec.....Same as the preceding.

SAPRINUS, Leach.

638. 3571. rotundatus, Kug...In cow-dung.
639. 3585. Pennsylvanicus, Payk .....In manure. Rare.
640. 3590. assimilis, Payk.....In cow-dung. Rare.
641. 3609. plenus, Lec.....In manure. Common.
642. 3617. fraternus, Say.....The same as the preceding.
643. 3618. mancus, Say.....The same as the preceding. Rarer.
644. 3631. sulcifrons, Lec.....The same as the preceding.

NITIDULIDÆ.

BRACHYPTERUS, Er.

645. 3661. urticae, Fab.....On nettles. Quite common.

CERCUS, Lat.

646. 3664. abdominalis, Er.....With the sweep-net. Rare.

CARPOPHILUS, Steph.

647. 3678. niger, Say.....With the sweep-net. Common.
648. 3681. brachypterus, Say. On willow catkins, in swarms.

Wis. No.	Amer. No.	
		COLASTUS, Er.
649.	3689.	truncatus, Rand....Common with the sweep-net.
		CONOTELUS, Er.
650.	3692.	obscurus, Er.....In Callistegia blossoms. Common.
		EPURÆA, Er.
651.	3697.	rufa, Say.....With the sweep-net. Common.
652.	3701.	rufida, Melsh.....Same as the preceding.
653.	3703.	corticina, Er.....Same as the preceding.
654.	3706.	avara, Rand.....Same as the preceding.
		NITIDULA, Fab.
655.	3719.	bipustulata, Linn..On dead animals, etc.
656.	3721.	ziczac, Say.....On decaying fruit.
		STELIDOTA, Er.
657.	3722.	geminata, Say.....On flowers. Rare.
		PROMETOPIA, Er.
658.	3725.	6-maculata, Say....Under beech-bark.
		PHENOLIA, Er.
659.	3726.	grossa, Fab.....On fungi. Abundant.
		OMOSITA, Er.
660.	3727.	colon, Linn...On carrion. Abundant, especially on bones.
		SORONIA, Er.
661.	3730.	undulata, Say.....Under bark. Rare.
		CYLLODES, Er.
662.	3746.	biplagiatus, Lec....In fungi. Rare.
		CYCHRAMUS, Kug.
663.	3748.	adustus, Er.....On fungi. Rare.
		CRYPTARCHA, Shuck.
664.	3752.	ampla, Er.....On oaks, where the sap is escaping.
665.	3753.	strigata, Fab.....Under bark. Rare.
666.	3754.	concinna, Melsh....Under bark. Rare.
		IPS, Fab.
667.	3755.	obtusus, Say.....Under oak bark, where the sap is escaping.
668.	3756.	fasciatus, Oliv.....Common everywhere, playing in many varieties.
669.	3757.	sanguinolentus, Oliv .....On freshly felled tree-trunks, feeding on the flowing sap. Rare.
		RHIZOPHAGUS, Hbst.
670.	3770.	bipunctatus, Say...Under bark.
		BYRRHIDÆ.
		CYTILUS, Er.
671.	3887.	sericeus, Forst.....On flowers, occasional.
672.	3888.	trivittatus, Melsh..Also on flowers. Very rare.

Wis. No.	Amer. No.	
		BYRRHUS, Linn.
673.	3889.	americanus, Lec....On flowers. Rare. Once abundant on the lake-beach.
674.	3892.	Pettitii, Horn.....On the lake-beach only. Rare.
		SYNCALYPTA, Steph.
675.	3898.	echinata, Lec.....On flowers. Rare.
		LIMNICHUS, Lat.
676.	3901.	punctatus, Lec.....The same as the preceding.

PARNIDÆ.

		PSEPHENUS, Hald.
677.	3914.	Lecontei, Lec.....Bank of Milwaukee river, under stones in the damp sand. Rare.
		DRYOPS, Oliv.
678.	3921.	lithophilus, Germ..Common, clinging to the under surfaces of stones in streams.
		STENELMIS, Dup.
679.	3948.	crenatus, Say.....Under stones in streams. Rare.
680.	3951.	vittipennis, Zinn...Rare in Milwaukee. Very common in Lake La Belle, Oconomowoc, Wis.
		MACRONYCHUS. Mull.
681.	3952.	glabratus, Say.....Rare in Milwaukee county, in water under stones.

HETEROCERIDÆ.

		HETEROCERUS, Fab.
682.	3958.	auromicans, Kies..In the sand on the banks of streams, especially at the opening of sewers. Quite rare.
683.	3962.	substriatus, Kies...Common in the same places as the preceding.
684.	3964.	mollinus, Kies.....Same as the preceding.
685.	3965.	collaris, Kies.....Rarer than the last. In the same places.
686.	3966.	limbatus, Kies.....Same as the preceding.
687.	3969.	pusillus, Say.....More common than the preceding.
688.	3970.	undatus, Melsh.....Same as limbatus.

DASCYLLIDÆ.

		PHILODACTYLA, Lat.
689.	3986.	serricollis, Say.....Common on flowers.
		EUCINETUS, Germ.
690.	3993.	terminalis, Lec.....On flowers. Rare.
		DICRANOPSELAPHUS, Guir.
691.	3996.	variegatus, Horn..On flowers. Common.
		PRIONOCYPHON, Redt.
692.	3998.	discoideus, Say.....On flowers. Very rare.

Wis. No.	Amer. No.	
		HELODES, Lat.
693.	4003.	pulchella, Guir.....Same as the preceding.
694.	4005.	thoracica, Guir.....Same as the preceding.
		SCIRTES, Ill.
695.	4006.	orbiculatus, Fab...Same as the preceding.
696.	4007.	tibialis, Guir.....On trees. Common.
		CYPHON, Payk.
697.	4015.	collaris, Guir.....Same as the preceding.
698.	4016.	variabilis, Thunb..On trees. Very common.
		ELATERIDÆ.
		THAROPS, Lap.
699.	4027.	ruficornis, Say.....On old stumps. Rare.
		DELTOMETOPUS, Bonv.
700.	4030.	amoenicornis, Say.On foliage. Rare.
		DROMÆOLUS, Kies.
701.	4033.	cylindricollis, Say..Same as the preceding.
		FORNAX, Lap.
702.	4041.	calceatus, Say.....On flowers. Very rare.
		MICRORRHAGUS, Esch.
703.	4049.	humeralis, Say.....On old stumps. Rare.
704.	4057.	imperfectus, Lec....Same as the preceding.
705.	4055.	treangularis, Say..On flowers. Rare.
		PHLEGON, Lap.
706.	4063½	Ulkei, Horn.....On foliage. Very rare.
		ADELOCERA, Lat.
707.	4078.	aurorata, Lec.....In old logs. Rare.
708.	4081.	obtecta, Say.....Same as the preceding.
709.	4082.	brevicornis, Lec.....Same as the preceding.
		ALAUS, Esch.
710.	4093.	oculatus, Linn. Formerly common, growing rarer of late.
711.	4094.	myops, Fab.....In pine logs in North Wisconsin.
		CARDIOPHORUS, Esch.
712.	4108.	convexulus, Lec.....In the pineries. Rare.
		HORISTONOTUS, Caud.
713.	4129.	curiatus, Say.....On flowers. Very rare.
		CRYPTOHYPNUS, Esch.
714.	4149.	abbreviatus, Say...Common under stones in woods and fields.
715.	4153.	tumescens, Lec.....Under stones in the Menomonee Valley. Rare.
716.	4156.	guttatulus, Melsh..Same as the preceding.
717.	4159.	ornatus, Lec.....Under stones. Very rare.
718.	4161.	pectoralis, Say.....Same as the preceding.
719.	4163.	obliquatulus, Melsh.Same as the preceding.

Wis. No.	Amer. No.	
		MONOCEPIDIUS, Esch.
720.	4190.	auritus, Hbst.....Under stones, in fields. Quite rare.
721.	4191.	bellus, Say.....Under stones. Very rare.
		ELATER, Linn.
722.	4212.	cordifer, Lec.....In decaying logs. Rare.
723.	4214.	manipularis, Cand.On flowers. Rare.
724.	4217.	pedalis, Gem.....Same as the preceding.
725.	4218.	nigrinus, Payk.....More common than the last.
726.	4219.	mixtus, Hbst.....On willows, occasionally common.
727.	4221.	nigricollis, Hbst....In old stumps. Common.
728.	4222.	linteus, Say.....Same as the preceding.
729.	4224.	vitiosus, Lec.....In old stumps. Rare.
730.	4227.	impolitus, Melsh...In old stumps. Rare.
731.	4229.	rubricollis, Hbst....Same as the preceding.
732.	4230.	semicinctus, Rand..Same as the preceeding.
733.	4231.	militaris, Harr.....On flowers. Rare.
734.	4234.	luctuosus, Lec.....On flowers. Rare.
735.	4235.	nigricans, Germ.....Same as the preceding.
736.	4236.	rubricus, Say.....Same as the preceding.
737.	4242.	sanguinipennis, Say.....On flowers. Common.
738.	4244.	dimidiatus, Lec.....In old logs. Rare.
739.	4247.	obliquus, Say.....On flowers. Common.
		DRASTERIUS, Esch.
740.	4253.	elegans, Fab.....In open fields, under stones. Very common at times.
		LUDIUS, Lat.
741.	4275.	abruptus, Say.....On stumps. Rare.
		AGRIOTES, Esch.
742.	4279.	mancus, Say.....On flowers. Rare.
743.	4280.	stabilis, Lec.....On scrub-oaks. Common.
744.	4282.	fucosus, Lec.....On flowers. Rare.
745.	4286.	pubescens, Melsh...On flowers. Common.
746.	4287.	limosus, Lec.....Same as the preceding.
747.	4290.	oblongicollis, Melsh.On crataegi. Common.
748.	4293.	avulsus, Lec.....Same as the preceding.
749.	4294.	Thevenetii, Horn...Rarer than the last.
		DOLOPIUS, Esch.
750.	4297.	lateralis, Esch.....On Crataegi. Common.
		GLYPHONYX, Caud.
751.	4299.	recticollis, Say.....On flowers. Rare.

Wis. No.	Amer. No.	
		MELANOTUS, Esch.
752.	4313.	depressus, Melsh...On foliage. Common.
753.	4315.	trapezoideus, Lec..Rarer than the last.
754.	4318.	scrobicollis, Lec.....On foliage. Rare.
755.	4320.	castanipes, Payk...Like the last.
756.	4322.	fissilis, Say.....Like the last.
757.	4323.	communis, Gyll.....Everywhere.
758.	4325.	parumpunctatus, Melsh.....On foliage. Rare.
759.	4332.	paganus, Caud.....Same as the preceding.
760.	4335.	tenax, Say.....Same as the preceding.
761.	4336.	americanus, Hbst..More common than the preceding.
762.	4343.	sagittarius, Lec.....On foliage. Common.
		LIMONIUS, Esch.
763.	4348.	auripilis, Say.....On foliage. Rare.
764.	4353.	aurifer, Lec.....On hickory. Rare.
765.	4361.	aeger, Lec.....On flowers. Rare.
766.	4363.	quercinus, Say.....On oaks. Common.
767.	4375.	agonus, Say.....On foliage. Common.
		CAMPYLUS, Fisch.
768.	4380.	denticornis, Kirby.On foliage. Closely resembles Telephorus; probably a case of mimicry.
		ATHOUS, Esch.
769.	4384.	Brightwelli, Kirby.On foliage. Common.
770.	4385.	acanthus, Say.....On foliage. Rare.
771.	4390.	cucullatus, Say.....On foliage. Common.
772.	4391.	ferruginosus, Esch.On foliage. Rare.
773.	4395.	scapularis, Say.....On foliage. Very rare.
774.	4399.	rufifrons, Rand.....From logs. Rare.
775.	4402.	scissus, Lec.....On foliage. Rare.
		SERICOSOMUS, Steph.
776.	4420.	incongruus, Lec.....On foliage. Very rare.
777.	4421.	viridanus, Say.....On flowers. Rare.
778.	4422.	silaceus, Say.....Very common on Crataegi.
		CORYMBITES, Lat.
779.	4428.	tesselatus, Linn.....On foliage. Rare.
780.	4434.	cylindriformis, Hbst.On foliage. Rare.
781.	4438.	limoniiformis, Horn..Same as the preceding.
782.	4439.	fulvipes, Bland.....On foliage and flowers. Common.
783.	4443.	pyrrhos, Hbst.....On dead trees. Rare.
784.	4449.	spinosus, Lec.....On foliage. Rare.
785.	4450.	tarsalis, Melsh.....Same as the preceding.

Wis. No.	Amer. No.	CORYMBITES, Lat.—*Continued.*
786.	4466.	sulcicollis, Say.....In logs. Common.
787.	4476.	medianus, Germ....On foliage. Rare.
788.	4478.	triundulatus, Raud. In the pineries.
789.	4479.	hamatus, Say.....On foliage. Very rare.
790.	4480.	propola, Lec.....Same as the preceding.
791.	4482.	hierglyphicus, Say. On oaks. Common.
792.	4487.	splendens, Ziegl.....On foliage. Rare.
793.	4495.	metallicus, Payk...On foliage. Rare.
794.	4496.	inflatus, Say.....On foliage. Common.
		OXYGONUS, Lec.
795.	4499.	obesus, Say.....On flowers and foliage. Common.
796.		ASAPHES, Kirby.
797.	4509.	decoloratus, Say...On foliage. Common.
798.	4510.	memnonius, Hbst..Flying about in the twilight. Common.
799.	4511.	bilobatus, Say.....On foliage. Common.

(TO BE CONTINUED.)

THE FLORA OF MILWAUKEE COUNTY.

BY W. M. WHEELER,

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It has become customary of late to publish lists of the species of plants and animals occurring in limited areas of the country. To the student of the distribution of organisms these lists are of great value. They are the necessary basis of fact from which generalizations can some day by some one be drawn to throw light on the exceedingly complex inter-relations of organisms. Though these lists necessarily occupy obscure places in the pages of little-read proceedings and transactions, they are, nevertheless, when accurate, quite as valuable as any other mere facts, whether morphological or physiological. The following list of the plants observed within the limits of our county, is intended as a very small though not valueless contribution to the flora of Wisconsin. It has been compiled largely from my own observations, but to some extent also from the observations of our county botanists and from authentic specimens in the herbarium of the Milwaukee Public Museum.

It is well known that the geological structure, altitude, annual temperature, hydrography and annual rain fall of a country directly determine its flora. Hence it will not be out of place briefly to consider these different conditions in Milwaukee County.

The county has an area of about 240 square miles. It has the shape of an oblong figure, one of the long sides of which is irregularly and often deeply sinuous. This sinuous line would represent the Lake Michigan or eastern boundary.

The county is about 24 miles long from north to south and 12 miles from east to west in its broadest part.

The county is completely underlain by the Niagara formation, which is common to the Lake Michigan shore of Wisconsin. In some places this formation is covered by the Lower Helderberg limestone, a shaly, almost pure dolomite, hard, brittle, of a light gray color and distinguished by numerous angular cavities which give it a porous structure. Both these formations, the Niagara and the Lower Heldeberg, are overlain in the extreme north-east corner of the county by a bluish gray, impure dolomite, the Hamilton Cement Rock.

These paleozoic formations are covered with the drift of the second glacial epoch common to eastern Wisconsin. This drift is a gray pebble clay, replaced in the north-eastern part of the county by a red pebble clay of beach formation. The subsoil covering this last is a red marly clay. In the south-west corner the subsoil is a light marly clay; and with the exception of a little humus subsoil and prairie loam which projects across the southern boundary from Racine County, the remaining subsoil of the county is a heavy marly clay. The soil in the north-eastern part of the county is a clayey loam, derived from the underlying red lacustrine clay. Throughout the greater part of the county the soil consists of medium and heavy loams. Humus soil occurs in a few isolated patches south-east and south-west. The soil of the south-west corner consists of light clayey loams.

The altitude of the land above the level of Lake Michigan varies considerably. In the eastern half of the county it ranges from 1 to 100 feet, in the western half from 100 to 200 feet and is still higher in the extreme south-western portions. The lake beach is bounded by bluffs, which are interrupted for some distance at the mouths of the rivers.

The principal stream is the Milwaukee River which enters

the county from Ozaukee County in the north-east and flowing parallel to the lake shore meets the Menomonee River in about the middle of the eastern part of the county. The Menomonee flows eastward through the western part of the county before uniting with the Milwaukee River. The two rivers are joined where they fall into Lake Michigan by the Kinnikinnick River which comes from the south, flowing parallel to the lake shore except in the southern part of the county, where its trend is eastward. Of the smaller streams may be mentioned Oak Creek, which waters the south-eastern corner of the county, flowing into Lake Michigan at Oak Creek Post Office, and Root River, which enters Racine County after flowing through the south-western portion of Milwaukee County. Small tributaries to the above mentioned streams are, of course, abundant everywhere. Ponds and marshes are common, the latter being mostly confined to the lowlands about the mouths of the rivers.

The mean annual temperature is about 47° F. In summer the temperature sometimes rises to 100° F. and in winter it occasionally falls to—25° F. The spring is characterized by much cold, rainy and changeable weather. The growth of vegetation in spring in the western part of the county is sometimes fully two weeks in advance of the vegetation on the Lake bluffs.

The average annual rainfall is about 30¼ inches. Most rain falls on an average in June, the least in February. The three summer months are supplied on an average with most rain, the three winter months with least. The spring months are somewhat more rainy than the autumn months. It seems that the average rain fall is less in Milwaukee than in other parts of the state.

Different parts of the county are characterized by a slight difference in vegetation. Generally speaking, the woods of the north-eastern portion are characterized by maples and

beeches. In a broad strip through the county, from north-west to south-east maples predominate. In the south central and south-western parts oaks prevail. In the southern part of the county grasses and sedges represent the prairie flora, which has extended into the county a little distance from the south and west.

The pine flora, so well developed in the northern part of Wisconsin and which extends down to the lake shore of Ozaukee county has sent a few straggling specimens into the extreme northeast corner of our county near Whitefish Bay. The tamaracks, formerly common in different parts of the county are fast disappearing.

Of the 691 Phaenogams and vascular Cryptogams composing my list, 567 are indigenous to Wisconsin. These, with the exception of *Tradescantia Virginica*, *Iva xanthiifolia* and possibly a few others, are also indigenous to the county. The former of these two plants has certainly been introduced from Waukesha county where it is abundant in some places; the seeds of the latter have probably been accidentally transported from the northwestern part of the state.

The remaining 124 species marked with an asterisk in the list, have been introduced. Of this number, seven species: *Argemone Mexicana*, *Cleome pungens*, *Helianthus annuus*, *Nicotiana rustica*, *Amaranthus hypochondriacus*, *A. reflexus* and *A. albus*, have come from Tropical America; one species, *Onosmodium Carolinianum*, is from the Southern States, one species, *Polygonum maritimum*, from the Eastern States, one species, *Grindelia glutinosa* from the Western States (California) and one, *Galinsoga parviflora*, is from South America. Subtracting these eleven species from the total number of introduced species we get the number of species from Europe, 113.

Of the whole 124 introduced species, seventy-five have escaped from gardens, where they were cultivated for food,

ornament, etc., the remaining sixty-nine species are weeds, —among them the worst weeds we have—which have been accidentally introduced into our flora.

As Milwaukee has long been a centre of immigration from Europe we are not surprised to find that the great majority of our adventitious plants are European, and as most of the immigrants are German we should expect these introduced forms to be largely German. Actually the whole 113 species occur in Germany. Each year marks the arrival of some German plant not before found in the country. The immigrants, largely peasants from the rural districts of Germany, often bring with them much household furniture which must frequently contain seeds of the commoner German plants. These people often intentionally bring with them seeds of the food plants and garden flowers which they have learned to prize in their fatherland. The railway trains, too, continually entering the county from points, north, west and south, introduce many plant seeds with the cattle, grain, etc.

Several of the species enumerated in the following list have probably disappeared from the county forever. Our native orchids are fast vanishing, partly because their damp haunts are being rapidly converted into spots more accessible and useful to man, and partly because, like the majority of our more delicate native species, they are unable to compete in the struggle for existence with those robust European weeds, which can adapt themselves to all sorts of conditions and are consequently flooding our country.

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LIST OF SPECIES OCCURRING IN MILWAUKEE COUNTY.

RANUNCULACEÆ.

1. Clemantis Virginiana, L. (Common Virgin's Bower.) Common in Wauwatosa and the S. W. portions of the county.
2. Anemone patens, L. var. Nuttalliana, Gray. (Pasque Flower.) Found by Mr. Wernich near Milwaukee.
3. A. cylindrica, Gray. (Long-Fruited Anemone.) Occasional throughout the county.
4. A. Virginiana, L. (Virginian Anemone.). S. and W. portions of the county.
5. A. nemorosa, L. (Wind Flower.) Common in different places.
6. Hepatica triloba, Chaix. (Round-lobed Hepatica.). Not common.

7. H. acutiloba, D. C. (Sharp-lobed Hepatica.) Very common in all the woods of the county.
8. Thalictrum anemoides, Michx. (Rue Anemone.) Common in the S. and W. parts of the county.
9. T. dioicum, L. (Early Meadow Rue.) Commoner, in the same parts as the preceding.
10. T. Cornuti, L. (Fall Meadow Rue.) Especially common in Wauwatosa and along the Kinnikinnick River.
11. Ranunculus aquatilis, L. var. trichophyllus, Chaix. (White Water Crowfoot.) Occasional S. and W.
12. R. multifidus, Pursh. (Yellow Water Crowfoot.) Common throughout the county.
13. R. alismæ folius, Geyer. (Water Plantain Spearwort.) Found by the Rev. T. Bruhin a mile S. of the Wisconsin House on the Western Line road.
14. R. abortivus, L. (Small-flowered Crowfoot.) Common, especially S. and W. Occasionally the var. micranthus.
15. R. sceleratus, L. (Cursed Crowfoot.) Occasional S. and W.
16. R. recurvatus, Poir. (Hooked Crowfoot.) Found by Rev. T. Bruhin at New Cœln.
17. R. fascicularis, Muhl. (Early Crowfoot.) In damp places, S. and W.
18. R. repens, L. (Creeping Crowfoot.) Very common, especially S. and W.
19. *R. bulbosus, L. (Bulbous Crowfoot..) Mr. Runge gave me a specimen which he found growing in the Menomonee Valley.
20. Isopyrum biternatum, T. & G. In Wauwatosa, not common.
21. Caltha palustris, L. (Marsh Marigold.) Very abundant W. and S.
22. Aquilegia Canadensis, L. (Wild Columbine.) Scattered through the county, not rare.
23. *Delphinium consolida, L. (Field Larkspur.) Escaped from the gardens in the city.
24. Hydrastis Canadensis, L. (Orange-root.) Near New Cœln and in Wauwatosa, common.
25. Actæa spicata, L. var. rubra, Michx. (Red Baneberry.) In woods throughout the county.
26. A. alba, Bigel. (White Baneberry.) With the preceding, but less abundant.

MENISPERMACEÆ.

27. Menispermum Canadense, L. (Canadian Moonseed.) Near water in the N. W., W. and S. parts of the county, widely scattered.

BERBERIDACEÆ.

28. *Berberis vulgaris, L. (Common Barberry.) Escaped from gardens and growing wild on the lake bluffs.
29. Caulophyllum thalictroides, Michx. (Blue Cohosh.) Common in Wauwatosa, apparently rarer S.
30. Jeffersonia diphylla, Pers. (Twin Leaf.) Very abundant in some woods in E. Wauwatosa.
31. Podophyllum peltatum, L. (Mandrake.) Abundant in all woods.

NYMPHAEACEÆ.

32. Nymphæa odorata, Ait. (Sweet-scented Water Lilly.) Seems to be gradually disappearing from the rivers of the county.
33. Nuphar advena, Ait. (Yellow Pond Lily.) With the preceding, most common S. and W.

SARRACENIACEÆ.

34. Sarracenia purpurea, L. (Pitcher Plant.) Slowly disappearing from Larkin's tamarack swamp where it was once abundant.

PAPAVERACEÆ.

35. *Papaver somniferum, L. (Poppy.)
36. *P. Rhœas, L. Both species escaped from gardens S. of the city, the latter rare.
37. *Argemone Mexicana, L. (Rough-fruited Corn Poppy.) There is a specimen in the Milwaukee Public Museum herbarium marked "south side, Milwaukee." The species is given in Swezey's Catalogue of Wisconsin Plants.
38. Sanguinaria Canadensis, L. (Blood-root.) Abundant, especially N.

FUMARIACEÆ.

39. Dicentra cucullaria, D. C. (Dutchman's Breeches.) Rare in Wauwatosa, common in E. Waukesha county.
40. Corydalis aurea, Wild. (Golden Corydalis.) I once found specimens on the sandy Lake Michigan beach in the N. E. part of the county. They have since disappeared.

CRUCIFERÆ.

41. *Nasturtium officinale, R. Br. (True Water Cress.) Rare, in clear streams, especially S. and W.
42. N. palustre, D. C. (Marsh Cress.) Much commoner than the preceding, S. and W.
43. *N. Armoracia, Fries. (Horse-radish.) Escaped from gardens and now growing wild in some places.

44. Dentaria laciniata, Muhl. (Tooth-wort.) Near St. Francis Seminary and in Wauwatosa.
45. Cardamine rhomboidea, D. C. and var. purpurea, Tor. (Spring Cress.) Common, especially S. and W.
46. Arabis lævigata, D. C. In the S. part of the county.
47. A. Canadensis, L. (Sickle-pod.) Lake shore, S. E. part of the county.
48. Erysimum cheiranthoides, L. (Worm-seed Mustard.) Mr. A. Conrath has collected this species in Wauwatosa.
49. *Sisymbrium officinale, Scop. (Hedge Mustard.) Common in different places.
50. *Hesperis matronalis, L. Escaped from different gardens and growing wild S.
51. *Brassica sinapistrum, Boirs. (Charlock.) A weed in many parts of the county.
52 *Camelina sativa, Crantz. (False Flax.) Becoming naturalized in fields S. and W.
53. *Capsella bursa pastoris, Mœnch. (Shepherd's Purse.) Everywhere.
54. Lepidium Virginicum, L. (Wild Pepper-cress.) A weed along roads.
55. Cakile Americana, Nutt. (American Sea Rocket.) On the sandy lake beach S. of the Water Works.

CAPPARIDACEÆ.

56. *Cleome pungens, Willd. Found by Dr. L. Sherman at Milwaukee.
57. Polanisia graveolens, Raf. Mr. F. Runge has collected specimens in the Menomonee Valley.

VIOLACEÆ.

58. Viola lanceolata, L. (Lance-leaved Violet.) Reported by Dr. L. Sherman as occurring in the county.
59. V. blanda, Willd. (Sweet White Violet.) Common in the Menomonee Valley marshes.
60. V. cucullata, Ait. (Common Blue Violet.) Very common throughout the county.
61. V. canina, L. var. sylvestris, Regel. (Dog Violet.) Common with the preceding.
62. V. pubescens, Ait. (Downy Yellow Violet.) Abundant, especially S. and W.

DROSERACEÆ.

63. Drosera rotundifolia, L. (Round-leaved Sundew.) Mentioned by T. Bruhin as occurring in a small lake in the S. W. corner of Town Lake. Probably disappearing or already gone.

HYPERICACEÆ.

64. Hypericum pyramidatum, Ait. (Great St. Johns-wort.) I have found isolated specimens of this species in different parts of the county.
65 *H, perforatum, Muhl. (Common St. Johns-wort.) Along roads near the Forest Home Cemetery.
66. H. corymbosum, Muhl. A single specimen found by Mr. F. Runge at Wauwatosa.
67. Elodes Virginica, Nutt. (Marsh St. Johns-wort.) Found by Rev. Bruhin along Howell's road near New Cœln.

CARYOPHYLLACEÆ.

68. *Saponaria officinalis, L. (Common Soap-wort.) Growing wild abundantly in the Menomonee Valley.
69. *Vaccaria vulgaris, Host. (Cow-Herb.) Occasional along railroads, common S. among the grain.
70. Silene stellata, Ait. (Starry Campion.) Common throughout the county.
71. *S. Armeria, L. (Sweet-William Catchfly.) Escaped from gardens and growing wild, rare.
72. S. antirrhina, L. (Sleepy Catchfly.) Mr. Runge gave me a specimen found near the city.
73 *S. noctiflora, L. (Night-flowering Catchfly.) Within the city limits, (Conrath); in fields (Bruhin).
74. *Lychnis Githago, Lam. (Corn Cockle.) Along the R. R. tracks, also S. among the grain.
75. Arenaria lateriflora, L. Very common in Wauwatosa.
76. *Stellaria media, Smith. (Common Chick-weed.) In damp yards in the city.
77. S. longifolia, Muhl. (Long-leaved Stitch-wort.)
78. S. longipes, Goldie. (Long-stalked Stitch-wort.) Both species in the woods of the Menomonee Valley.
79. *Cerastium vulgatum, L. (Mouse-ear Chickweed.) In yards.
80. *C. viscosum, L. (Larger Mouse-ear Chickweed.) Very common throughout the county.

PORTULACEÆ.

81. *Portulaca oleracea, L. (Purslane.) A troublesome weed in some gardens.
82. Claytonia virginica, L. (Spring-beauty.) Abundant in Wauwatosa, less common elsewhere.

MALVACEÆ.

83. *Malva rotundifolia, L. (Common Mallow.) A weed in lanes and barnyards.

84. *M. silvertris, L. (High Mallow.) A weed in gardens, escaping to woods.

85. *M. moschata, L. (Musk Mallow.) Specimens common S., with flowers either white or rose-color.

86. *Abutilon Avicennæ, Gaertn. (Velvet-leaf.) A weed along roads near the Forest Home. Also occasional in old gardens N.

87. *Hibiscus trionum, L. (Bladder Ketmia.) Near the Wisconsin House, escaped from gardens.

TILIACEÆ.

88. Tilia Americana, L. (Bass-wood.) Still a very common tree in the county, though T. Bruhin stated ten years ago that it was becoming rarer.

LINACEÆ.

89. *Linum usitatissimum, L. (Flax.) A weed along the R. R. tracks in the Menomonee Valley.

GERANIACEÆ.

90. Geranium maculatum, L. (Wild Cranesbill.) Common in all the woods of the county.

91. Flœrkia proserpinacoides, Willd. (False Mermaid.) Common along the Kinnikinnick R. near the old Howell's Road. (T. Bruhin.)

92. Impatiens fulva, Nutt. (Spotted Touch-me-not.) Very abundant in wet, shady places.

93. Oxalis stricta, L. (Yellow Wood Sorrel.) Common throughout the county.

RUTACEÆ.

94. Xanthoxylum Americanum, Mill. (Prickly Ash.) Common in open woods, S. and W.

95. Ptelea trifoliata, L. (Hop-tree.) I have observed this shrub only in E. Wauwatosa where it is common.

ANACARDIACEÆ.

96. Rhus typhina, L. (Staghorn Sumach.) Common, especially N. along the Milwaukee River.

97. R. glabra, L. (Smooth Sumach.) Common S.

98. R. venenata, D. C. (Poison Sumach.) Only in Larkin's tamarack swamp, near Greenfield Park.

99. R. toxicodendron, L. (Poison Ivy.) Everywhere.

VITACEÆ.

100. Vitis æstivalis, Michx. (Summer Grape.) Wauwatosa, not common.

101. V. cordifolia, Michx and var. riparia. (Winter Grape.) Common in the Menomonee Valley.

102. Ampelopsis quinquefolia, Michx. (Virginia Creeper.) Common throughout the county.

RHAMNACEÆ.

103. Rhamnus alnifolius, L'Her. In Larkin's tamarack swamp.

104. Ceanothus Americanus, L. (New Jersey Tea.) In the S. of the county, rare. I have often seen the species in Racine county.

CELASTRACEÆ.

105. Celastrus scandens, L. (Wax Work.) Common throughout the county.

106. Euonymus atropurpureus, Jacq. (Burning Bush.) Grows E. of the County Insane Asylum in Wauwatosa.

SAPINDACEÆ.

107. *Aesculus hippocastanum, L. (Horse Chestnut.) Planted in yards and streets as a shade tree.

108. Acer saccharinum, Wary and var. nigrum. (Black Sugar Maple.) Common throughout the county.

109. A. dasycarpum, Ehrlr. (Silver Maple.) Commonly planted along the streets.

110. A. rubrum, L. (Red Maple.) In the southern woods of the county.

111. Negundo aceroides, Moench. (Box-elder.) Now much planted in the city.

POLYGALACEÆ.

112. Polygala senega, L. (Seneca Snake-root.) Common in high woods in Wauwatosa.

LEGUMINOSÆ.

113. *Trifolium arvense, L. (Rabbit-root Clover.) Some specimens found near the stock yards in the Menomonee Valley.

114. *T. pratense, L. (Red Clover.) Everywhere.

115. T. repens, L. (White Clover.) Everywhere.

116. *T. hybridum, L. Specimens found by Mr. F. Runge in the Menomonee Valley.

117. *T. procumbens, L. (Low Hop Clover.) I have found this species sparingly in the extreme N. part of the county.

118. *Melilotus officinalis, Willd. (Yellow Melilot.) In a few spots in the N. part of the county.
119. *M. alba, L. (White Melilot.) A weed along roads, etc.
120. *Medicago sativa, L. (Lucerne.) A few specimens found along a road in the N. of city.
121. *M. lupulina, L. (Black Medick.) Common in a few scattered spots.
122. Astragalus Canadensis, L. Bruhin and Conrath report this species from the S. part of the county.
123. A. Cooperi, Gray. In a few places in the county.
124. Desmodium acuminatum, D. C. Everywhere in the woods.
125. D. Canadense, D. C. Common throughout the county.
126. Lespedeza repens, T. & G. In Wauwatosa.
127. L. capitata, Michx. Grows south of the nail factory in Bay View.
128. Vicia Caroliniana, Walt.
129. V. Americana, Muhl. Both species common throughout the county.
130. Lathyrus maritimus, Bigelow. (Beach Pea.) Northern part of the county, rare.
131. L. venosus, Muhl. S. and W. parts of the county.
132. L. ochroleucus, Hook. Common throughout the county.
133. L. palustris, L. (Marsh Vetchling.) Occasional S. and W.
134. Apios tuberosa, Moench. (Ground-nut.) In Wauwatosa, rare.
135. Amphicarpæa monoica, Nutt. (Hog Pea-nut.) Common on the bluffs at Whitefish Bay. Bruhin found it near New Cœln.
136. Baptisia leucantha, T. & G. A few specimens seen near the nail works in Bay View.

ROSACEÆ.

137. Prunus Americana, Marsh. (Wild Plum.) Common throughout the county.
138. *P. spinosa, L. var. insititia. (Sloe.) "Ein frei wachsendes Exemplar fand ich vor Jahren an der alten Howell's road beim Kinnikinnik," T. Bruhin.
139. P. Pennsylvanica, L. (Wild Red Cherry.) Not common.
140. P. Virginiana, L. (Choke Cherry.)
141. P. serotina, Ehrh. (Wild Beach Cherry.) Both species common, especially S. and W.
142. Spiræa opulifolia, L. (Nine-bark.) Banks of the Milwaukee River.
143. S. salicifolia, L. (Common Meadow Sweet.) Common in ditches and bordering pools, especially S. and W.

144. Agrimonia Eupatoria, L. (Agrimony.) Very common in open woods.
145. Geum album, Gr. In Wauwatosa and New Cœln.
146. G. Virginianum, L. In the S. part of the county.
147. G. strictum, Ait. Near the Forest Home Cemetery.
148. G. rivale, L. (Water Avens.) In New Cœln, near the stone quarries in Wauwatosa, and along Lake Michigan.
149. Potentilla Norvegica, L. Everywhere.
150. P. Canadensis, L. (Cinque-foil.) Scattered through the county.
151. P. Anserina, L. (Silver-weed.) Along the R. R. track near the Rolling Mills.
152. P. fruticosa, L. (Shrubby Cinque-foil.) Mr. Runge has found this species in the Menomonee swamps. I have seen it growing in great profusion in Waukesha County.
153. P. palustris, Scop. (Marsh Five-finger.) In Larkin's tamarack swamp; also near New Cœln, according to T. Bruhin.
154. Fragaria Virginiana, Ehr. var. Illinœnsis, Gray. (Wild Strawberry.)
155. F. vesca, L. (Wild Strawberry.) Both species are common in the W. and S.
156. Rubus triflorus, Richds. (Dwarf Raspberry.) S. part of the county.
157. R. strigosus, Michx. (Wild Red Raspberry.) In thickets throughout the county.
158. R. occidentalis, L. (Black Raspberry.) Rarer than the last.
159. R. villosus, Ait. (Common Blackberry.) "Pastures in New Cœln." T. Bruhin.
160. R. Canadensis, L. (Dewberry.) In the S. and W. portions of the county.
161. R. hispidus, Lr. (Running Swamp Blackberry.) In Larkin's tamerack swamp.
162. Rosa Carolina, L. (Swamp Rose.) Common near swamps.
163. R. lucida, Ehr. (Dwarf Wild Rose.) With the preceding.
164. R. blanda, Ait. (Early Wild Rose.) Common, also occurring with the two preceding.
165. Cratægus cordata, Ait. (Washington Thorn.) Mr. F. Runge reports this species near Greenfield.
166. C. coccinea, L. (Scarlet-fruited Thorn.) Common throughout the county.
167. C. tomentosa, L. var. pyrifolia, Gray. (Black Thorn.) Occurs in the county, according to Mr. A. Conrath. The var. punctata, Gray, is very common.

168. Pyrus coronaria, L. (Crab-apple.) Very common, especially S. and W.

169. P. arbutifolia, L. var. melanocarpa. (Choke-berry.) In Larkin's tamarack swamp.

170. P. Americana, D. C. (Mountain Ash.) Often planted in the city.

171. Amelanchier Canadensis. T. & G. var. botryapium and longifolia. (Shad Bush.) Throughout the county.

SAXIFRAGACEÆ.

172. Ribes Cynosbati, L. Common throughout the county.

173. R. hirtellum, Michx. In the S. part of the county.

174. R. rotundifolium, Michx. Common throughout the county.

175. R. floridum, L. (Wild Black Currant.) Rarer than the preceding.

176. Parnassia Caroliniana, Michx. (Grass of Parnassus.) At the Cement Works and at Whitefish Bay.

177. Saxifraga Pennsylvanica, L. (Swamp Saxifrage.) Common in Wauwatosa and N. W.

178. Heuchera hispida, Pursh. Occasional in W. and S. part of the county.

179. Mitella diphylla, L. (Mitre-wort.) Common throughout the county.

180. M. nuda, L. T. Bruhin found this species near New Cœln.

CRASSULACEÆ.

181. Penthorum sedoides, L. (Ditch Stone-crop.) Very common in ditches, etc.

182. *Sedum Telephium, L. (Live-for-ever.) Has established itself in a wood near New Cœln, (T. Bruhin).

HAMAMELACEÆ.

183. Hamamelis Virginica, L. (Witch-Hazel.) Common throughout the county.

HALORAGEÆ.

184. Myriophyllum spicatum, L. Common in the different waters of the county.

185. Proserpinaca palustris, L. (Mermaid-weed.) Kinnikinnik and Menomonee swamps.

ONAGRACEÆ.

186. Circæa Lutetiana, L. (Enchanter's Nightshade.) Common in damp woods.

187. C. alpina, L. With the last.

188. Epilobium angustifolium, L. (Great Willow Herb.) At Whitefish Bay and elsewhere.
189. E. coloratum, Muhl. Common in wet places.
190. Oenothera biennis, L. var. muricata, L. (Evening Primrose.) Abundant throughout the county.
191. Ludwigia polycarpa, S. & P. According to Bruhin very common with the following in a ditch on the town line near New Cœln.
192. L. palustris, Ell. (Water Purslane.) Commoner than the preceding.

LYTHRACEÆ.

193. Lythrum alatum, Pursh. In Town Franklin.

CUCURBITACEÆ.

194. Echinocystis lobata, T. & G. (Wild Balsam-apple.) Common in the Menomonee Valley.

UMBELLIFERÆ.

195. Sanicula Canadensis, L. Common in the Menomonee Valley.
196. S. Marilandica, L. Specimens collected by Mr. C. Doerflinger near Wauwatosa.
197. Eryngium yuccæfolium, Michx. (Button Snake-root.) Southern part of the county.
198. Polytænia Nuttalli, D. C. Menomonee Valley.
199. Heracleum lanatum, Michx. (Cow-parsnip.) Common, especially W.
200. *Pastinaca sativa, L. (Parsnip.) A weed everywhere; *not poisonous*.
201. Archemora rigida, D. C. (Cow-bane.) Found in Wauwatosa by Mr. A. Conrath.
202. Archangelica atropurpurea, Hoffm. (Great Angelica.) Common W. and S.
203. Coniosclinum Canadense, T. & G. (Hemlock Parsley.) Whitefish Bay.
204. Thaspium aureum, Nutt. var. apterum, Gray. Occurring S. and W.
205. Zizia integerrima, D. C. Menomonee Valley.
206. Cicuta maculata, L. (Water Hemlock.) Common near the Slaughter Houses.
207. C. bulbifera, L. With the last, rarer.
208. Sium linearc, Michx. (Water-parsnip.) Common S. and W.
209. Cryptotænia Canadensis, D. C. (Hone-wort.) Common throughout the county.

210. Osmorrhiza longistylis, D. C. (Smoother Sweet Cicely.) Occasional in woods.
211. O. brevistylis, D. C. (Hairy Sweet Cicely.) Commoner than the last.
212. Erigenia bulbosa, Nutt. (Harbinger-of-spring.) Near the County Insane Asylum in Wauwatosa.
213. *Carum carvi, L. (Caroway.) Common along roads, escaping from cultivation.

ARALIACEÆ.

214. Aralia racemosa, L. (Spikenard.) Scattered through the woods of the county.
215. A. nudicaulis, L. (Wild Sarsaparilla.) Occasional is the S. part of the county.
216. A. trifolia, Gray. (Dwarf Ginseng.) Like the last.

CORNACEÆ.

217. Cornus Canadensis, L. (Dwarf Cornel.) Abundant in Larkin's tamarack swamp.
218. Cornus sericea, L. (Silky Cornel.) Common. Bruhin says that this plant probably gave the Kinnikinnik River its name.
219. C. stolonifera, Michx. (Red-osier Dog-wood.)
220. C. paniculata, L'Her. (Panicled Cornel.) Occasional S. and W.

CAPRIFOLIACEÆ.

221. Linnæa borealis, Gronov. (Twin-flower.) Still lingering in Larkin's tamarack swamp.
222. Symphoricarpus racemosus, Michx. (Snow-berry.) Common in Wauwatosa.
223. Lonicera flava, Sims. (Yellow Honeysuckle.) Common S.
224. L. parviflora Lam. var, Douglasii. (Small Honeysuckle.) Occasional S. and in Wauwatosa.
225. L. ciliata, Muhl. (Fly Honeysuckle.) Common S. and W.
226. L. oblongifolia, Muhl. (Swamp Honeysuckle.) In a tamarack swamp near New Cœln, according to Bruhin.
227. Diervilla trifida, Mœnch. (Bush Honeysuckle.) Common throughout the county.
228. Triosteum perfoliatum, L. (Fever-wort.) Common, especially S. and S. W.
229. Sambucus Canadensis, L. (Elder.) Common W. and S.
230. Viburnum Lentago, L. (Sheep-berry.) In New Cœln. (T. Bruhin.)
231. V. pubescens, Pursh. (Downy Arrow-wood.) Occasional S.
232. V. acerifolium, L. (Maple-leaved Arrow-wood.) Common in the woods of the Menomonee Valley.

233. V. opulus, L. (Cranberry-tree.) Near the R. R. Shops in the Menomonee Valley and in Larkin's tamarack swamp. Bruhin mentions the var. rosea as also occurring in the county.

RUBIACEÆ.

234. Galium aparine, L. (Cleavers.) Occasional S. and W.
235. G. asprellum, Michx. (Rough Bedstraw.) Much commoner than the preceding.
236. G. concinnum, T. & G. I have found what I took to be this species near Wauwatosa.
237. G. triflorum, Michx. (Sweet-scented Bedstraw.) Common S. and W. with G. aparine, L.
238. G. boreale, L. (Northern Bedstraw.) Common near the Cement Mills.
239. Cephalanthus occidentalis, L. (Button-bush.) Southern and S. W. part of the county, rare.
240. Mitchella repens, L. (Partridge-berry.) In a tamarack swamp near New Cœln.

COMPOSITAE.

241. Liatris spicata, Willd. (Button Snakeroot.) Common near the Nail Works in Bay View.
242. Eupatorium purpureum. L. (Joe-Pye Weed.) Common throughout the county.
243. E. perfoliatum, L. (Thoroughwort.) Like the last.
244. E. ageratoide, L. (White Snakeroot.) Somewhat rarer than the two preceding.
245. Aster corymbosus, Ait. On the banks of the Milwaukee River.
246. A. macrophyllus, L. Scattered through the county.
247. A. laevis, L. Like the last.
248. A. undulatus, L. Milwaukee county. (Bruhin.)
249. A. cordifolius, L. Abundant, especially at Whitefish Bay.
250. A, sagittifolius, Willd. Found by Mr. A. Conrath in the county.
251. A. Tradescanti, L. Like the last.
252. A. longifolius, L. Whitefish Bay.
253. A. puniceus, L. Common throughout the county.
254. A. prenanthoides, Muhl. Whitefish Bay.
255. A. Novæ-Angliæ, L. Abundant near the cement works, where a few specimens of the var. roseus were also found.
256. A. ptarmacoides, T. & G. Near Larkin's tamarack swamp.
257. A. augustus, T. & G. In the streets of the city.
258. Erigeron Canadense, L. (Horse Weed.) Everywhere.
259. E. bellidifolium, Muhl. (Robins' Plantain.) Menomonee Valley.

260. E. Philadelphicum, L. (Common Fleabane.) Common through out the county.
261. Erigeron annuum, Pers. (Daisy Fleabane.) Common through out the county.
262. Solidago latifolia, L. (Golden rod.) Occurs W. and S.
263. S. caesia, L. Near New Cœln.
264. S. stricta, Ait. Southern part of the county.
265. S. Riddellii, Frank. I have found it common at the Cement Mills and at Whitefish Bay.
266. S. Houghtonii, T. & G. Occurs in the county, according to Dr. L. Sherman.
267. S. patula, Muhl. Whitefish Bay; common.
268. S. arguta, Ait. and its var. scabrella. In the open woods of Wauwatosa and also N.
269. S. altissima, L. At New Cœln. (T. Bruhin.)
270. S. ulmifolia, Muhl. Menomonee Valley.
271. S. nemoralis, Ait. I have collected this species near Whitefish Bay.
272. S. Canadensis, L. Common throughout the county.
273. S. serotina, Ait. Reported by F. Runge as occurring in the county.
274. S. laneeolata, L. Abundant, especially north at Whitefish Bay and along the lake shore. T. Bruhin found it near New Cœln.
275. *Inula Helenium, L. (Elecampane.) S. parts of the county.
276. Polymnia Canadensis, L. (Leaf-cup.) Woods in Wauwatosa.
277. Silphium terebinthinaceum, L. (Prairie Dock.) In Town Franklin.
278. S. integrifolium, Michx. Common near the nail works in Bay View.
279. Iva xanthiifolia, Nutt. (Marsh Elder.) Mr. F. Runge gave me a specimen which he found in the Menomonee Valley.
280. Ambrosia trifida, L. (Great Rag Weed.) Scattered through the county.
281. A. artemisiæfolia, L. (Roman Wormwood.) A weed along roads. Bruhin distinguishes the following varieties found near New Cœln: *Simplex*, *ramosissima*, *angustifolia*, *latifolia*, *villosa*, *glabriuscula*, *dichotoma*, *fasciata* and *cristata*.
282. Xanthium strumarium, L. (Cocklebur.) Common N., W. and S.
283. Heliopsis laevis, Pers. var. scabra. (Ox-eye.) Abundant throughout the county.
284. Rudbeckia laciniata, L. (Cone-flower.) S. part of the county.
285. R. hirta, L. Common throughout the county.
286. Lepachys pinnata, T. & G. Common in the Menomonee Valley.

287. *Helianthus annuus, L. (Common Sunflower.) Escaped from cultivation in some parts of the county.
288. H. giganteus, L. Specimens have been collected in the county by Mr. Conrath and Mr. Runge.
289. H. strumosus, L. Occasional S. and W.
290. H. divaricatus, L. Common S.
291. H. decapetalus, L. Common, especially at Whitefish Bay and in Bay View.
292. H. doronicoides, Lam. Collected by Mr. Runge in the county.
293. Coreopsis aristosa, Michx. var. mutica. Common in different places.
294. C. trichosperma, Michx. In Larkin's tamarack swamp.
295. Bidens frondosa, L. (Beggar-ticks.) Common everywhere.
296. B. connata Muhl. var. petiolata, Nutt. Occurs according to T. Bruhin in a tamarack near New Cœln.
297. B. chrysanthemoides, Mich. (Large Bur-Marigold.) S. W. part of the county.
298. Helenium autumnale, L. (Sneeze weed.) Common throughout the county.
299. *Galinsoga parviflora, Cav. Along Market Street in the City.
300. *Maruta Cotula, D. C. (May-weed.) A weed everywhere, along roads, etc.
301. Achillea millefolium, L. (Milfoil.) Common everywhere; specimens with rose colored flowers were found near Wauwatosa.
302 *Leucanthemum vulgare, Lam. (Ox-eye Daisy.) Abundant in fields in different parts of the county.
303. *Matricaria Chamomilla, L. (Wild Chamomile.) Wild along streets in the City.
304. *Tanacetum vulgare, L. (Tansy.) Common in many places.
305. *T. Balsamita, L. Escaping from gardens to roads and lanes.
306. Artemisia Canadensis, Michx. Along the lake shore, S.
307. *A. vulgaris, L. (Common Mug-wort.) Common throughout the county.
308. *A. Absinthium, L. (Common Worm-wood.) Escaped from gardens in a few places.
309. *A. pontica, L. Like the last; rarer.
310. Gnaphalium decurrens, Ives. (Everlasting.) Near St. Francis Seminary.
311. G. polycephalum, Michx. (Common Everlasting.) Common throughout the county.
312. G. uliginosum, L. (Low Cud-weed.) In the S. parts of the county.

313. Antennaria margaritacea, Brown. (Pearly Everlasting.) There are some beautiful specimens in the Milwaukee Public Museum herbarium collected by Rev. Bruhin, near New Cœln.
314. A. plantaginifolia, Hook. (Plantain-leaved Everlasting.) Mr. Runge brought me some specimens from Bay View.
315. Cacalia reniformis, Muhl. (Great Indian Plantain.) Very common in the Menomonee Valley.
316. C. atriplicifolia, L. (Pale Indian Plantain.) Bay View and S. parts of the county.
317. *Senecio vulgaris, L. (Common Groundsel.) Common S.
318. S. palustris, Hook.
319. S. aureus, L. (Golden Ragwort.) Both species in the Menomonee Valley and S. part of the county.
320. *Calendula officinalis, L. (Marigold.) Escaping from gardens in a very few places.
321 *Centaurea Cyanus, L. (Bluebottle.) Has been seen among the grain in the S. part of the county.
322. *Cirsium lanceolatum, Scop. (Common Thistle.) Common everywhere.
323. C. discolor, Sprcng. Scattered through the county.
324. C. altissimum, Sprcng. Menomonee Valley. (F. Runge.)
325. C. muticum, Michx. A mile E. of New Cœln. (T. Bruhin.)
326. *C. arvense, Scop. (Canada Thistle.) A troublesome weed, everywhere.
327. *Lappa officinalis, Allione, var. major., Gray. (Burdock.) Common everywhere.
328. *Cichorium Intybus, L. (Cichory.) Growing wild along roads, etc., in many parts of the county. Specimens may be found with white flowers.
329. Cynthia Virginica, Don. Common in many places.
330. Hieracium Canadense, Michx. (Canada Hawkweek.) Whitefish Bay.
331. H. venosum, L. (Rattlesnake-weed.) In pastures near New Cœln.
332. Nabalus albus, Hook. (White Lettuce.) Very abundant, especially N.
333. Taraxacum dens-leonis, Desf. (Dandelion.) Everywhere.
334. *Tragopogon porrifolius, L. (Oyster Plant.) I have found specimens growing wild along a R. R. track in Bay View, and along another R. R. track near the Seventh Ward Park. Mr. F. Runge has found specimens in the Menomonee Valley.
335. Lactuca Canadensis, L and vars. (Wild Lettuce.) Common, especially in Wauwatosa.

336 *Sonchus oleraceus, L. (Common Sow-thistle.) Scattered through the county.

337. *S. asper, Vill. (Spiny-leaved Sow-thistle.) Like the preceding.

338. *S. arvensis, L. (Field Sow-thistle.) Growing wild near the Reservoir Park in N. Milwaukee. Bruhin mentions it as occurring in New Cœln.

LOBELIACEÆ.

339. Lobelia cardinalis, P. (Cardinal-flower.) Occasional in different parts of the county. It seems to be much rarer than formerly.

340. L. syphilitica, L. (Great Lobelia.) With the last, not common.

341. L. inflata, L. (Indian Tobacco.) Common throughout the county.

342. L. spicata, Lam. I have often seen it near Whitefish Bay. Bruhin found it in the pastures near New Cœln.

343. L. Kalmii, L. Near the Cement Works.

CAMPANULACEÆ.

344. Campanula rotundifolia, L. (Harebell.) Common along the E. bank of the Milwaukee River above North Street bridge.

345. C. aparinoides, Pursh. (Marsh Bellflower.) In Larkin's tamarack swamp.

346. C. Americana, L. (Tall Bellflower.) Abundant, especially in the open woods of Wauwatosa.

ERICACEÆ.

347. Gaylussacia resinosa, T. & G. (Black Huckleberry.) Near New Cœln.

348. Vaccinium macrocarpon, Ait. (Large Cranberry.) In a small lake near the Wisconsin House on the Kilbourn road.

349. V. Pennsylvanicum, Lam. (Dwarf Blueberry.) Common in one spot near New Cœln. T. Bruhin has described a form *Novæ Coloniæ* from the same place.

350. V. corymbosum, L. (Common Blueberry.) I have found this species sparingly in Larkin's swamp.

351. Pyrola rotundifolia, L. (Shin-leaf.) In Larkin's swamp.

352. P. elliptica, Nutt. At Whitefish Bay. Common in Town Lake.

353. Monotropa umiflora, L. (Indian Pipe.) Whitefish Bay, Wauwatosa, St. Francis Seminary; rare.

AQUIFOLIACEÆ.

354. Ilex verticillata, Gray. (Black Alder.) Rare in the S. part of the county.

PLANTAGINACEÆ.

355. Plantago major, L. (Common Plantain.) Common everywhere.
356. P. cordata, Lam. Near the Chemical Works in Wauwatosa, and also near New Cœln.
357. *C. lanceolata, L. (Rib-grass.) A few specimens found on a lawn near the city.

PRIMULACEÆ.

358. Dodecatheon Meadia, L. (American Cowslip.) Scattered through the county, rare.
359. Trientalis Americana, Pursh. (Chickweed-Wintergreen.) Near St. Francis Seminary in beech woods.
360. Lysimachia thyrsiflora, L. (Tufted Loosestrife.) Occurs in the S. and W. parts of the county.
361. L. ciliata, L. Common throughout the county.
362. L. longifolia, Pursh. Near the Cement Works.

LENTIBULACEÆ.

363. Utricularia vulgaris, L. (Greater Bladder-wort.) In a pool near the Soldiers' Home.

SCROPHULARIACEÆ.

364. *Verbascum Thapsus, L. (Common Mullein.) Common throughout the county.
365. *V. Blattaria, L. (Moth Mullein.) Has made its appearance near the R. R. Shops in the Menomonee Valley.
366. *Linaria vulgaris, Mill. (Toad-Flax.) Abundant in many places.
367. Scrophularia nodosa, L. (Fig-wort.) Like the last.
368. Chelone glabra, L. (Turtle-head.) Common S. and W.
369. Pentstemon pubescens, Solander. Near the Cement Works. (F. Runge.)
370. Mimulus ringens, L. (Monkey Flower.) Common throughout the county. Specimens are sometimes found with white flowers.
371. Veronica Virginica, L. (Culver's-root.) Occasional throughout the county.
372. V. Anagallis, L. (Water Speedwell.) Larkin's tamarack swamp.
373. V. Americana, Schweinitz. (American Brookline.) Howell's Road, ½ mile N. of New Cœln.
374. V. scutellata, L. Marsh Speedwell.) Common S. and W.
375. V. serpyllifolia, L. (Thyme-leaved Speedwell.) Near the Soldiers' Home.
376. V. peregrina, L. (Neckweed.) In the same place.

377. *V. arvensis, L. (Corn Speedwell.) National Avenue. (A. Conrath.)
378. Gerardia tenuifolia, Vahl. (Slender Gerardia.) Near the Cement Works and in a few other spots in the N. part of the county.
379. Castilleia coccinea, Spreng. (Scarlet Painted Cup.) Scattered through the county; not common.
380. Pedicularis Canadensis, L. (Louse-wort.) Common, especially N.
381. P. lanceolata, Michx. Common in different places in all parts of the county.

VERBENACEÆ.

382. Verbena hastata, L. (Blue Vervain.) Common everywhere along the rivers.
383. V. urticifolia, L. (White Vervain.) Along roads; common.
384. Phryma leptostachya, L. (Lopseed.) In woods S. and W.; common.

LABIATÆ.

385. Teucrium Canadense, L. (Wood Sage.) Occasional throughout the county.
386. *Mentha viridis, L. (Spear Mint.) In the S. part of the county.
387. *M. arvensis, L. (Corn Mint.) Common about New Cœln, according to T. Bruhin.
388. M. Canadensis, L. (Wild Mint.) Common everywhere.
389. Lycopus Europæus L. var, sinuatus, Gray. (Water Horehound.) Abundant in many places.
390. Hedeoma pulegioides, Pers. (American Pennyroyal.) I once found this species in abundance in an open wood near Schwartzburg Station in the N. part of the county.
391. Monarda fistulosa, L. (Wild Bergamot.) Common throughout the county.
392. Blephilia hirsuta, Benth. Occasional S. and W.
393. Lophanthus scrophulariæfolius, Benth. (Giant Hyssop.) Like the last.
394. *Nepeta Cataria, L. (Catnip.) Common, especially in Wauwatosa.
395. *N. Glechoma, Benth. (Ground Ivy.) In Wauwatosa.
396. Physostegia Virginiana, Benth. (False Dragon-head.) Occasional throughout the county.
397. Brunella vulgaris, L. (Common Self-heal.) Everywhere.
398. Scutellaria versicolor, Nutt. (Skullcap.) In Wauwatosa.
399. S. galericulata, L. In the S. part of the county.
400. S. lateriflora, L. On the Milwaukee River banks N. of the Cement Works.

401. *Galeopsis Tetrahit, L. (Hemp Nettle.) T. Bruhin once found this species in New Cœln.

402. Stachys palustris, L. var. aspera, Gray. (Hedge Nettle.) Common in many places. The *var. cordata* is mentioned by Conrath as occurring within the city limits.

403. *Leonurus Cardiaca, L. (Mother-wort.) Fast becoming common throughout the county.

404 *Lamium amplexicaule, L. (Dead Nettle.) In Wauwatosa.

BORRAGINACEÆ.

405. *Symphytum officinale, L. (Common Comfrey.) Occasional in the woods S. and W.

406. *Onosmodium Carolinianum, D. C. (False Gromwell.) "Ich fand diese Species vor einigen Jahren an der Town Line zwischen der Howell's und Nicholson Road, suchte sie aber seither vergebens," T. Bruhin.

407. *Lithospermum officinale, L. (Gromwell.) I have found specimens near the R. R. shops in the Menomonee Valley.

408. L. hirtum, Lehm. (Hairy Puccoon.) S. part of the county; occasional.

409. *Myosotis palustris, Withening. (Forget-me-not.) Near the brick yards in Bay View.

410. Echinospermum Lappula, Lehur. (Stickseed.)

411. *Cynoglossum officinale, L. (Hounds-tongue.) Both species common everywhere.

412. C. Morisoni, D. C. (Beggar's Lice.) Common S. and W.

HYPDROPHYLLACEÆ.

413. Hydrophyllum Virginicum, L. (Water-leaf.) Common throughout the county.

POLEMONIACEÆ.

414. Polemonium reptans, L. (Greek Valerian.) Common throughout the county.

415. Phlox pilosa, L. In Wauwatosa.

416. P. divaricata, L. var. Laphami, Wood. In Wauwatosa and S. in New Cœln.

CONVOLVULACEÆ.

417. *Convolvulus arvensis, L. (Bind-weed.) Formerly abundant on the lake bluffs in the City; now occurring as a weed in some of the yards in the eastern part of the City.

418. Calystegia sepium, R. Br. (Hedge Bind-weed.) Common throughout the county.

419. Cuscuta chlorocarpa, Engelm. (Dodder.) "Auf Bidens frondosa bei New Cœln," T. Bruhin.

420. C. Gronovii, Willd. Occasional in different parts of the county.

SOLANACEÆ.

421 *Solanum dulcamara, L. (Bitter-sweet.) In the S. part of the county; rare.

422. *S. nigrum, L. (Common Nightshade.) Everywhere.

423. Physalis pubescens, L. (Ground Cherry.) Common in many places.

424. *Lycium vulgare, Dunal. (Matrimony Vine.) Escaping from cultivation near North Street bridge.

425. *Hyoscyamus niger, L. (Henbane.) Mr. F. Runge found a specimen growing wild near the stock yards in the Menomonee Valley.

426. *Nicotiana rustica, L. (Wild Tobacco.) "In New Cœln bei Milwaukee fand ich Examplare auf der Strasse *spontan*," T. Bruhin.

GENTIANACEÆ.

427. Gentiana quinqueflora, Lam. and its var. occidentalis. (Five-flowered Gentian.) Common near the Cement Works.

428. G. crinita, Froel. (Fringed Gentian.) I have seen this species growing in profusion near the Cement Works along the E. bank of the Milwaukee River, and in less numbers at Whitefish Bay. It occurs also in Town Franklin.

429. G. Andrewsii, Griseb. (Closed Gentian.) Occasional in Wauwatosa and S.

APOCYNACEÆ.

430. Apocynum androsæmifolium, L. (Spreading Dogbane.) Common throughout the county.

431. A. cannabinum, L. var. glaberrimum, D. C. (Indian Hemp.) Near Wauwatosa.

ASCLEPIADACEÆ.

432. Asclepias Cornuti, Decaisne. (Milkweed.) Common throughout the county.

433. A. phytolaccoides, Pursh. (Poke-Milkweed.) Common in woods, especially in Wauwatosa.

434. A. incarnata, L. (Swamp Milkweed.) Occasional throughout the county.

OLEACEÆ.

435. Fraxinus Americana, L. (White Ash.) In Wauwatosa.

436. F. sambucifolia, Lam. (Black Ash.) In Greenfield.)

ARISTOLOCHIACEÆ.

437. Asarum Canadense, L. (Wild Ginger.) Near the Chemical Works, east of Wauwatosa.

CHENOPODIACEÆ.

438. *Chenopodium album, L. (Pigweed.) Common everywhere.
439. *C. glaucum, L. (Oak-leaved Goosefoot.) In the S. part of the City.
440. *C. hybridum, L. (Maple-leaved Goosefoot.) Occasional S. and W.
441. *C. Botrys, L. (Jerusalem Oak.) Mr. Runge has found this species in the county.
442. Blitum capitatum, L. (Strawberry Blite.) Occasional in different parts of the county.
443. Atriplex patula, L. (Orache.) Within the City limits.
444. Salsola Kali, L. (Common Salt-wort.) Lapham mentions this form as occurring on the Lake beach at Milwaukee.

AMARANTACEÆ.

445. *Amarantus hypochondriacus, L. In Wauwatosa; rare.
446. *A. retroflexus, L. (Pigweed.) In the City; common.
447. *A. albus, L. In the City; common.
448. Montelia tamariscina, Gray. Occurs within the City limits according to Conrath.

POLYGONACEÆ.

449. Polygonum Pensylvanicum, L. This and the four following species occur in different places throughout the county.
450. *P. Persicaria, L. (Lady's Thumb.)
451. P. Hydropiper, L. (Smartweed.)
452. P. acre, H. B. K. (Water Smartweed.)
453. P. hydropiperoides, Michx. (Mild Water-Pepper.)
454. P. amphibium, L. (*aquaticum*) and var. *terrestre*, Willd. The former occurs in a few of the waters of the county. I have found the latter in the Menomonee Valley.
455. P. aviculare, L. (Door-weed.) Everywhere in yards and lanes; the var. erectum, Roth in the suburbs, less common.
456. *P. maritimum, L. (Coast Knotgrass.) A specimen of what is very probably this species was found on a R. R. track in Bay View by Mr. T. Kumlien.
457. P. sagittatum, L. (Arrow-leaved Tear-thumb.) In different places in the S. part of the county.
458. *P. convolvulus, L. (Black Bind-weed.) Everywhere.
459. P. cilinode, Michx. Lake shore N. of Oak Creek P. O.

460. P. dumetorum, L. (Climbing False Buckwheat.) Near New Cœln, according to Bruhin.

461. *Fagopyrum esculentum, Mœnch. (Buckwheat.) Occasionally growing wild.

462. Rumex verticillatus, L. (Swamp-dock.) Menomonee Valley; rare.

463. *R. crispus, L. (Curled Dock.) A common weed.

464. *R. obtusifolius, L. (Bitter Dock.) Near the Insane Ayslum in Wauwatosa.

465. *R. acetosella, L. (Sheep Sorrel.) Common in Wauwatosa and S.

THYMELEACEÆ.

466. Dirca palustris, L. (Leather-wood.) I have found this species common in the N. W. part of the county. Found by Mr. Bruhin in the S. part of the county.

ELÆAGNACEÆ.

467. Shepherdia Canadensis, Nutt. Abundant along the Milwaukee River banks near the Cement Works, on the lake bluffs at Whitefish Bay and S. of St. Francis.

SANTALACEÆ.

468. Comandra umbellata, Nutt. (Bastard Toad Flax.) In the Menomonee Valley, also near New Cœln.

CERATOPHYLLACEÆ.

469. Ceratophyllum demersum, L. (Horn-wort.) In the Menomonee Valley.

CALLITRICHACEÆ.

470. Callitriche verna, L. (Water Star-wort.) S. part of the county.

EUPHORBIACEÆ.

471. Euphorbia polygonifolia, L. On the sand of the lake beach.

472. E. maculata, L. Common in many places.

473. E. hypericifolia, L. In the Menomonee Valley.

474. E. corollata, L. (Flowering Spurge.) Common throughout the county.

475. *E. Cyparissias, L. Wild along a road in Wauwatosa.

476. *E. Peplus, L. A few specimens found by Mr. T. Kumlien near the Exposition Building in the City.

URTICACEÆ.

477. Ulmus Americana, L. (White Elm.) Common throughout the county.

478. Urtica gracilis, Ait. In different parts of the county.

479. *U. dioica, L. (Nettle.) A weed in many places.
480. Laportea Canadensis, Gaud. (Wood-Nettle.) Chiefly S. and W.
481. Pilea pumila, Gray. (Clear-weed.) Common in woods in Wauwatosa; also S.
482. Bœhmeria cylindrica, Willd. (False-Nettle.) Common along roads.
483. *Cannabis sativa, L. (Hemp.) Sometimes a few specimens are found wild.
484. Humulus Lupulus, L. (Hop.) Common along the R. R. tracks in the Menomonee Valley and in Wauwatosa.

JUGLANDACEÆ.

485. Juglans cinerea, L. (Butternut.) Common in different places.
486. J. nigra, L. (Black Walnut.) In the S. part of the county; rarer than the preceding.
487. Carya alba, Nutt. (Shag-bark Hickory.) Occasional W. and S.
488. C. porcina, Nutt. (Pig-Nut.) In Wauwatosa.
489. C. amara, Nutt. (Bitter-Nut.) Common S.

CUPULIFERÆ.

490. Quercus alba, L. (White Oak.) Common S. and W.
491. Q. obtusiloba, Michx. (Post Oak.) Rarer S. and W.
492. Q. macrocarpa, Michx. (Bur Oak.) Like the last.
493. Q. bicolor, Willd. (Swamp White Oak.) In Wauwatosa.
494. Q. rubra, L. (Red Oak.) Common S. and W.
495. Q. palustris, Du Roi. (Pin Oak.) Some specimens along the Milwaukee River north of the Cement Works; probably occurs also S. and W.
496. Fagus ferruginea, Ait. (American Beech.) Occurs N. along the Milwaukee River and S. near St. Francis.
497. Corylus Americana, Walt. (Wild Hazelnut.) Common throughout the county.
498. C. rostrata, Ait. (Beaked Hazelnut.) Near Whitefish Bay; rare.
499. Ostrya Virginica, Willd. (Hop-Hornbeam.) Common S. and W.
500. Carpinus Americana, Michx. (Hornbeam.) Also S. and W., but rarer than the preceding.

BETULACEÆ.

501. Betula papyracea, Ait. (Paper Birch.) Common near Whitefish Bay.
502. B. pumila, L. (Low Birch.) In Larkin's tamarack swamp.
503. Alnus serrulata, Ait. (Smooth Alder.) Common near Wauwatosa.

SALICACEÆ.

504. Salix tristis, Ait. (Dwarf Gray Willow.) Along the Kinnickinnick River.

505. *S. viminalis, L. (Basket Osier.) Common in some places N.

506. *S. alba, L. (White Willow.) A shade tree in the city.

507. S. longifolia, Muhl. (Long-leaved Willow.) Along the Menomonee River.

508. S. myrtilloides, L. (Myrtle Willow.) In a tamarack swamp near New Cœln.

(N. B.—This list of Salices is still incomplete. There are undoubtedly several other species in the county.)

509. Populus tremuloides, Michx. (American Aspen.) In different parts of the county.

510. P. grandidentata, Michx. (Large-toothed Aspen.) Like the last.

511. P. balsamifera, L. (Balsam Poplar.) Near Whitefish Bay. Its *var. candicans*, Gray, planted as a shade tree in the city.

512. *P. dilatata, Ait. (Lombardy Poplar.) Common throughout the city.

CONIFERÆ.

513. Larix Americana, Michx. (Black Larch.) Abundant in the tamarack swamps of the county.

514 Thuja occidentalis, L. (Arbor Vitæ.) A few straggling specimens still lingering at Whitefish Bay and S. of St. Francis.

515. Juniperus communis, L, (Common Juniper.) On a few wooded bluffs along the lake shore.

516. J. Sabina, L. var. procumbens, Pursh. In tamaracks. (T. Bruhin.)

ARACEÆ.

517. Arisæma triphyllum, Torr. (Indian Turnip.) Common throughout the county.

518. Calla palustris, L. (Water Arum.) "Ich fand diese Pflanze im Tamarack bei New Cœln und bei der Station Centreville im County Manitowoc." T. Bruhin.

519. Symplocarpus foetidus, Salisl. (Skunk Cabbage.) Common throughout the county.

520. Acorus Calamus, L. (Sweet Flag.) Scattered through the county.

LEMNACEÆ.

521. Lemna trisulca, L. (Duck-weed.) Common in the waters of the county.

522. L. minor, L. Abundant, especially S. and W. The var. *orbiculata*, Aust., is very common.

523. L. polyrrhiza, L. Mentioned by A. Conrath as occurring in the county.

TYPHACEÆ.

524. Typha latifolia, L. (Cat-tail.) Common throughout the county.
525. Sparganium eurycarpum, Engl. (Bur-reed.) Occasional in the Menomonee Valley; also S.

NAIADACEÆ.

526. Potamogeton natans, C. (Pond-weed.) Common in the different streams of the county.
527. P. pauciflorus, Pursh. Within the City limits. (N. B. This list of the species of Potamogeton is very incomplete.)

ALISMACEÆ.

528. Alisma plantago, L. var. Americanum, Gray. (Water Plantain.) Common everywhere in ditches, etc.
529. Sagittaria variabilis, Engl. (Arrow-head.) This species with many of its varieties is common throughout the county.

HYDROCHARIDACEÆ.

530. Anacharis Canadensis, Planchon. (Water-weed.) Common in all the waters of the county.
531. Vallisneria spiralis, L. (Tape Grass.) In the Milwaukee River in the N. part of the county.

ORCHIDACEÆ.

532. Orchis spectabilis, L. (Showy Orchis.) Scattered through the county; rare.
533. Habenaria viridis, R. Br. var. bracteata, Reichb. Occasional S. and W.
534. H. hyperborea, R. Br. In Larkin's tamarack swamp and elsewhere S. and S. W.
535. H. dilatata, Gray. Also in Larkin's swamp.
536. H. Hookeri, Forr. At St. Francis Seminary.
537. H. lacera, R. Br. In Larkin's tamarack swamp.
538. H. psychodes, Gray. (Purple Fringed Orchis.) Not rare in swampy spots in the woods, S. and W.
539. Pogonia ophioglossoides, Nutt. Near a small lake in the vicinity of the Wisconsin House. (T. Bruhin.)
540. Calopogon pulchellus, R. Br. In the same place.
541. Corallorhiza innata, R. Br. (Coral-root.) In Larkin's tamarack swamp.
542. Cypripedium parviflorum, Salisb. (Smaller Yellow Lady's Slipper.) Occasional S. and W.

543. C. pubescens, Willd. (Larger Yellow Lady's Slipper.) Scattered through the county.

544. C. spectabile, Swartz. (Showy Lady's Slipper.) In a few places; becoming very rare.

545. C. acaule, Ait. (Stemless Lady's Slipper.) In Larkin's tamarack swamp.

AMARYLLIDACEÆ.

546. Hypoxys erecta, L. (Star Grass.) Northern part of the county; rare.

IRIDACEÆ.

547. Iris versecolor, L. (Larger Blue Flag.) Common throughout the county.

548. I. lacustris, Nutt. (Lake Dwarf Iris.) In a few woods in Wauwatosa; becoming rare.

549. Sisyrinchium Bermudiana, L. (Blue-eyed Grass.) Common in a few places.

DIOSCOREACEÆ.

550. Dioscorea villosa, L. (Wild Yam-root.) In some woods near the Chemical Works in Wauwatosa.

SMILACEÆ.

551. Smilax hispida, Muhl. Rare in the S. part of the county.

552. S. herbacea, L. and var. pulverulenta. (Carrion Flower.) With Dioscorea villosa near the Chemieal Works. The species and its variety occurs also S.

LILIACEÆ.

553. Trillium grandiflorum, Salisb. (Large White Trillium.) In all the woods of the county.

554. T. cernuum, L. (Nodding Trillium.) Common, especially S.

555. Uvularia grandiflora, Smith. (Bell-wort.) Common in many woods.

556. Clintonia borealis, Raf. In Larkin's tamarack swamp.

557. Smilacina racemosa, Desf. (False Spikenard.) In the Menomonee Valley.

558. S. stellata, Desf. In the S. part of the county.

559. S. trifolia, Desf. In the tamarack near New Cœln.

560. S. bifolia, Ker. Common in many woods.

561. Polygonatum biflorum, Ell. (Smaller Solomon's Seal.) In the Menomonee Valley and S.

562. *Asparagus officinalis, L. (Garden Asparagus.) Growing wild in a few places. One will sometimes happen on a specimen in some secluded spot in the midst of the woods, far from gardens where the plant is raised.

563. Lilium Philadelphicum, L. (Wild Orange-red Lily.) I have found this species at Whitefish Bay.
564. L. Canadense, L. (Wild Yellow Lily.) Scattered through the county.
565. Erythronium Americanum, Smith. (Yellow Adder's Tongue.) In many places.
566. E. albidum, Nutt. (White Dog's-tooth Violet.) Common E. of New Cœln.
567. Allium tricoceum, Ait. (Wild Leek.) Near the Chemical Works at Wauwatosa, also S.
568. A. cernuum, Roth. (Wild Onion.) Near the Chemical Works.
569. A. Canadense, Kalm. (Wild Garlic.) Near the Cement Mills, also S.

JUNCACEÆ.

570. Luzula campestris. D. C. In a few places in the county.
571. Juneus effusus, L. (Common Rush.) Near Bay View and elsewhere.
572. J. marginatus, Roslk. Is reported from the county by Dr. L. Sherman.
573. J. bufonius, L. Common in several plaees.
574. J. alpinus. Villas, var. insignis, Eries. On the lake shore near the Rolling Mills.
575. J. nodosus, L. Common throughout the county.

COMMELYNACEÆ.

576. Tradescantia Virginica, L. (Spider-wort.) I have found a few speeimens along a R. R. track in Wauwatosa.

CYPERACEÆ.

577. Cyperus diandrus, Torr. Common W. and S.
578. C. strigosus, L. In a marsh 1½ miles N. of New Cœln. (T. Bruhin.)
579. C. Engelmanni. Steud. I have found this species near the Cement Mills.
580. Dulichium spathaeeum, Pers. Common, especially S. and W.
581. Eleocharis palustris, R. Br. (Spike Rush.) Common throughout the county.
582. E. compressa, Sullivant. Has been found near Milwaukee by Dr. L. Sherman.
583. E. tenuis, Schultes. In Town Lake.
584. Scirpus validus, Vahl. (Bulrush.) Common in many places.
585. S. atrovirens, Muhl. Common everywhere.
586. S. Eriophorum, Miehx. and var. eyperinus. Occurs S.

587. Eriophorum polystachyon, L. (Cotton Grass.) In swamps S. and W.
588. Cladium mariscoides, Torr. (Twig Rush.) Found by Dr. L. Sherman in the county.
589. Carex polytrichoides, Muhl. In Larkin's tamarack swamp.
590. C. bromoides, Schk. New Cœln. (T. Bruhin.)
591. C. siccata, Dew. In Larkin's swamp.
592. C. vulpinoidea, Mich. and var. setacea. Common, especially S.
593. C. stipata, Muhl. Within the city limits, according to Conrath.
594. C. sparganoides, Muhl. New Cœln. (T. Bruhin.)
595. C. cephalophora, Muhl. In the same place.
596. C. tenella, Schk. Occurs in the S. part of the county.
597. C. trisperma, Dew. In Larkin's tamarack swamp.
598. C. tenuiflora, Wahl. In the same place.
599. C. stellulata, L. In the same place.
600. C. scoparia, Schk. Within the city limits. (A. Conrath.)
601. C. stricta, Lam. Common in many places.
602. C. granularis, Muhl. Common S. near New Cœln.
603. *C. præcox, Jacq. Near New Cœln.
604. C. gracillima, Schn. New Cœln.
605. C. Pennsylvanica, Lam. Within the City limits.
606. C. pubescens, Muhl. New Cœln; rare.
607. C. filiformis, L. Southern part of the City.
608. C. Houghtonii, Torr. Found by Dr. L. Sherman in the county.
609. C. tentaculata, Muhl. Occasional S.
610. C. intumescens, Rudge. "Eine halbe Meile œstlich von New Cœln, Town Line zwischen Howell's und New Road." (T. Bruhin.)
611. C. lupulina. Muhl. Common in many places.
612. C. lupuliformis, Sartwell. Rarer than the preceding.
613. C. monile, Tuck. New Cœln.

GRAMINEÆ.

614. Leersia Virginica, Willd. (White Grass.) Common, especially S.
615. L. oryzoides, Schwartz. (Rice-cut Grass.) Commoner than the last.
616. Zizania aequatica, L. (Indian Rice.) Common in the Menomonee Valley.
617. Alopecurus aristulatus, Michx. (Wild Foxtail Grass.) Common, especially S.
618. *Phleum pratense, L. (Timothy.) Everywhere.
619. Sporobolus cryptandrus, Gray. In Bay View.

620. Agrostis perennans, Tuckerm. (Thin Grass.) Found by Lapham, and later by Conrath, in the county.
621. A. scabra, Willd. (Hair Grass.) Common in Town Lake.
622. A. vulgaris, With. (Red-top.) Within the City limits. (A. Conrath.)
623. Muhlenbergia Mexicana, Trin.
624. M. sylvatica, T. & G. Both species in Wauwatosa.
625. Brachyelytrum aristatum, Beauv. In Town Lake.
626. Calamagrostis Canadensis, Beauv. New Cœln.
627. Oryzopsis asperifolia, Michx. (Mountain Rice.) S. part of the county.
628. Spartina cynosuroides, Willd. (Fresh Water Cord Grass.) I have found this species on the Milwaukee River banks near the Cement Mills in the N. part of the county.
629. *Dactylis glomerata, L. (Orchard Grass.) Scattered through the county; rare.
630. Glyceria nervata, Trin. (Fowl-Meadow Grass.) S. part of the county.
631. G. aquatica, Smith. (Reed-Meadow Grass.)
632. G. fluitans, R. Br. Mr. A. Conrath has found both of these species in the county.
633. Poa annua, L. (Low Spear Grass.) Throughout the county.
634. P. compressa, L. (Wire Grass.) New Cœln, and neighborhood.
635. P. cæsia, Smith. Dr. L. Sherman has found this species near Milwaukee.
636. P. serotina, Ehrhd. Within the city limits.
637. C. pratensis, L. (Common Meadow Grass.) Everywhere.
638. P. debilis, Torr. Mentioned by Lapham as growing in Milwaukee.
639. Eragrotis reptans, Nees. Near the Forest Home Cemetery.
640. E. capillaris, Nees. New Cœln.
641. Festuca ovina, F. var. duriuscula. (Sheeps Fescue.) Mentioned by A. Conrath as occurring within the City limits.
642. F. nutans, Willd. New Cœln and elsewhere.
643. Bromus Kalmii, Gray. (Wild Chess.) Along a R. R. track near New Cœln.
644. B. ciliatus, L. In the S. part of the county.
645. Phragmites communis, Trin. (Reed.) Like the last.
646. *Lollium perenne, L. At Franklin.
647. Triticum repens, L. (Couch Grass.) Menomonee Valley and elsewhere.
648. Hordeum jubatum, L. (Squirrel-tail Grass.) Abundant in the northern part of the city and county.

649. Elymus Virginicus, L. (Lyme Grass.) Town Lake.
650. E. Canadensis, L. New Cœln.
651. E. molis, Trin. Lake shore near the Rolling Mills.
652. Gymnostichum Hystrix, Schreb. (Bottle-brush Grass.) Throughout the county.
653. Danthonia spicata, Beauv. (Wild-bat Grass.) Common throughout the county.
654. *Avena sativa, L. (Oat.) Escaped from cultivation and growing wild along R. R. tracks, etc.
655. Hierochloa borealis, R. & S. (Vanilla Grass.) I have found some specimens in the Menomonee Valley.
656. *Phalaris Canariensis, L. (Canary Grass.) Near the Sixth District School in the City.
657. P. arundinacea, L. (Reed Canary Grass.) In the Menomonee Marshes.
658. *Panicum glabrum, Gaudin. Town Franklin.
659. *P. sanguinale, L. (Common Crab Grass.) In New Cœln.
660. P. capillare, L. (Old-Witch Grass.) Common everywhere.
661. P. dichotomum, L. var. pubescens. New Cœln.
662. *P. Crus-galli, L. (Barnyard Grass.) Common in many places.
663. *Setaria glauca, Beauv. (Foxtail.) Common in many places.
664. *S. viridis, Beauv. (Green Foxtail.) Menomonee Valley and elsewhere.
665. Andropogon furcatus, Muhl. (Beard Grass.) Town Franklin.

EQUISETACEÆ.

666. Equisetum arvense, L. (Common Horsetail.) Everywhere.
667. E. sylvaticum, L. Scattered through the county; rare.
668. E. limosum, L. Occasional in the Menomonee Valley.
669. E. hyemale, L. (Scouring-rush.) New Cœln and elsewhere. (T. Bruhin.)
670. E. variegatum, Schleicher. Lake shore, four miles S. of the Rolling Mills.

FILICES.

671. Adiantum pedatum, L. (Maidenhair.) Abundant throughout the county.
672. Pteris aquilina, L. (Common Brake.) Scattered through the county.
673. Pellæa gracilis, Hook. (Cliff Brake.) In Town Franklin.
674. Asplenium filix-fœmina, R. Br. (Spleenwort.) Throughout the county.
675. Camptosorus rhizophyllus, Link. (Walking Leaf.) Mr. F.

Runge has given me some fine specimens of this strange fern which he found growing in Town Franklin.

676. Aspidium Thelypteris, Swartz. In the S. part of the county.

677. A. cristatum, Swartz. Swamps in different parts of the county.

678. Cystopteris bulbifera, Bernh. (Bladder-Fern.) About cold springs in the Menomonee Valley; rare.

679. C. fragilis, Bernh. Common in all the woods of the county.

680. Struthiopteris Germanica, Willd. (Ostrich Fern.) Near Wauwatosa.

681. Onoclea sensibilis, L. (Sensitive Fern.) Common, especially in the Menomonee Valley.

682. Osmunda regalis, Linn. (Flowering Fern.) I have found this species in several places near St. Francis.

683. O. Claytoniana, L. Common in many places, especially W. of Whitefish Bay.

684. O. cinnamomea, L. (Cinnamon Fern.) Common near St. Francis.

685. Botrychium Virginicum, Swartz. (Moon-wort.) In most of the woods of the county; common.

LYCOPODIACEÆ.

686. Lycopodium lucidulum, Michx. Near New Cœln.

687. L. clavatum, L. (Club Moss.) In the same woods with the last.

ADDENDA.

688. *Lychnis Chalcedonica, L. Escaped from gardens near St. Francis Seminary.

689. *Datura Stramonium, L. (Thorn-apple.) Scattered through the county; rare.

690. *Grindelia glutinosa, Dunal. A specimen of this plant, which is a native of California, was found on a R. R. track in the Menomonee Valley in the summer of 1887.

691. Trillium recurvatum, Beck. In Town Franklin.

January 23, 1888.

President Meinecke in the chair.

Prof. G. W. Peckham read a paper on the habits of Spiders. Prof. Peckham treated of the habits of several species, and addueed a long series of experiments performed by himself to prove that the Araehnida possess the senses of smell and hearing and that they can distinguish colors.

March 5, 1888.

Vice-President Goss in the chair.

Dr. F. Brendeeke read a paper on proteetion from Pathogenetic Bacteria which have gained aeeess to the body.

Dr. Brendeeke gave many exeellent hygienic measures to prevent eontagious diseases, the result of his long years of experienee as a practicing physieian. The leading idea of the paper was the great importanee of bodily cleanliness in preventing noxious baeteria whieh have gained aeeess to the body from destroying the tissues. He dwelt on the importance of daily bathing, on washing out the mouth and throat on arising early in the morning, on avoiding meat and other nitrogenous substanees and stimulants, such as wine, spiees, ete., etc. He claimed that the eonsumption of good ripe fruit in large quantities is benefieial during epidemies. In conclusion he showed that if digestion be kept up properly there is little danger from microorganisms.

Prof. E. B. Hamann, of Concordia College, and the well-known ornithologist, Mr. H. Nehrling, were elected members of the Society.

November 19, 1888.

President Meineeke in the chair.

Mr. Davenport Fisher read the paper of the evening on

Mineralogy, making use of glass models and designs to illustrate different points of the subject. Mr. Fisher gave a brief resume of the history of mineralogy up to the present day, touching on the leading attainments of each epoch. He gave an outline of the field covered by the mineralogist, and explained some of the fundamental chrystallographical and chemical principles involved in the study of minerals.

DECEMBER 17, 1888.

President Meinecke in the chair.

Mr. Carl Haug read a paper on his own recent archeological researches in the state of Ohio, with very full descriptions of the many caves and mounds visited and the carvings and remains examined. Mr. W. M. Wheeler then delivered a brief lecture on recent facts in cell division. Mr. Wheeler illustrated on the black-board the karyokmesis of the epithelial cells of a salamander according to Fleming and Rabl, and the karyokinesis of a lily cell according to Strasburger. He pointed out the salient points of resemblance between cell-division in animals and plants, and briefly gave the generalizations to which modern cytological research has attained.

Prof. E. Dapprich and Mr. F. Ruschhaupt were unanimously elected members of the Society.

EXPERIMENTAL RESEARCHES IN THE REDUCTION OF THE DIFFICULTLY REDUCIBLE METALS.

A. J. ROGERS.

Aluminium (Al) was probably first obtained by Woehler in 1827 by treating the chloride with the metal potassium (K.)

Sir Humphrey Davy obtained sodium (Na) and potassium (K) in 1808 by the electrolysis of the fused hydroxides of those metals.

He tried to obtain Al. by the same method from alumina but was unsuccessful. Bunsen first obtained minute quantities of the metal by the electrolysis of the fused double chloride of aluminium and sodium ($Al_3 Cl_6$ 2 NaCl) in 1854. In the same year Henry St. Claire Deville first prepared the pure metal in sufficient quantity to be able to study its properties. His process was by the reducing action of Na. upon $Al_2 Cl_6$ 2 NaCl, using about one-third of cryolite as a flux.

The Deville process has remained with but slight changes in detail as the only practical process for the extraction of pure Al. Deville first established a small plant at Javel, France, but later united with Debray, Morin and Rousseau Brothers. Still later, Merle and Usiglio in Salindres gave Deville's process the high perfection that it has to-day. By that process the largest item of cost is the sodium used. In 1852 Na sold at two hundred dollars a pound, but in 1862 by improvements in the process of manufacture it had been reduced to a dollar and a half a pound. $Al_2 Cl_6$ and $Al_2 Cl_6$ 2 NaCl are very hygroscopic, and, when heated in presence of air, moisture, hydrochloric acid and alumina are formed in considerable quantity. During the

reduction with Na it is claimed that alumina would form upon the surface of the minute globules of aluminium and thus prevent cohesion between them. Cryolite was used as a flux to assist in removing this oxide. Prof. H. Rose first used cryolite (the double fluoride of sodium and aluminium Al_2F_6 6 NaF) as a source of Al. He heated cryolite with Na in an iron crucible, using KCl as a flux, and stirring with an iron rod. His metal of course always contained some iron. Rose never obtained more than 80 per cent. of the theoretical amount of Al. in the cryolite, and many times not more than 33 per cent.

Basset affirmed that all metals will decompose Al_2Cl_6 or Al_2Cl_6 2 Na Cl which form chlorides that are more easily liquidfied or vaporized than these salts. Hence arsenic (As) antimony (Sb) mercury (Hg) and Zinc (Zn) would act as reducing agents of Al. Zinc would seem to be the best from its cheapness and the greater ease of separating from its alloy of Al by distillation of the zinc. According to Basset the operation consists in heating 3 parts of Al_2Cl_6 2 NaCl with 2 parts of zinc. By stirring, the chloride mass gets denser and finally solid, while the resulting Al alloy remains liquid. This salt mass and alloy are heated to a strong red heat for an hour or more. The molten mass is then stirred with an iron rod and the salt poured off after the solidifying of the metal. An alloy is obtained consisting of equal equivalents of Al and Zn. Basset's process was recommended by Wedding and others. Specht in 1860 decomposed Al_2Cl_6 by the use of Zn and recommended it as the best process in practice.

Dullo states that there is no difficulty in reducing the double chloride with Zn, but it is not as easy as with Na, and the loss of Zn is considerable and the high temperature required also burns a great deal of Al. My own experience is that the reduction is very incomplete and only a very small percentage of the Al contained in the salt can be obtained. The Zn process has been more recently

experimented upon by F. J. Seymour. He claims to use 100 parts of the Zn ore, 50 parts of kaolin, 125 parts of carbonaceous matter, 15 parts of pearl ash and 10 parts of NaCl. It is not probable that much Al would be obtained by this process; certainly not pure Al. Petitjean decomposes Sulphide of Al by heating in a crucible, through the bottom of which a stream of marsh gas passes. He also claims to have affected the reduction by mixing sulphide of Al with iron filings and igniting. Cumenge ignited sulphide of Al with clay or Al sulphate free from water. Corbelli in Florence took 100 parts of clay with 600 parts of $H_2 S O_4$ or concentrated H Cl and gradually heated to 500 degrees. This mass is mixed with 200 parts of K C N, 150 NaCl and heated to a white heat. Deville was unable to obtain Al by this process. Knowles reduced the chloride by K C N, Fleury is said to have produced Al from clay mixed with gas tar, rosin, petroleum or similar substances. This was made into a dough and formed into balls, which, after drying, were heated in a tube at a cherry red heat with marsh gas under 20 to 30 pounds pressure. The reduced Al in a fine powder was melted with Zn and the Zn afterwards distilled. None of these processes except Deville's sodium process have attained any prominence, and it would seem quite impossible to be able practically to reduce Al from its salts or ores by the use of ordinary reducing agents including the common cheaper metals. Some years ago I commenced a study of some of the problems involved in the production of the difficulty reducible metals from their fused salt by electrolysis. Some results of an investigation of the alkali metals were given, in a paper before the physical section of the American Association for the Advancement of Science, at its meeting in Ann Arbor in 1885. The principal points stated and conclusions reached in that paper I give in the following summary: I had observed, according to J. J. Thomson, that the heat of

chemical union of one pound (or kilogram) of Na with Cl to form NaCl is 4247 centigrade units; while that of carbon (C) with oxygen (O) is about 8000 units. Hence, in the combustion of one pound of C heat enough is obtained to reduce nearly two pounds of Na from NaCl if the heat energy could be utilized without loss. But no purely chemical method has even yet been suggested by which this kinetic heat energy of the coal or C can be transformed without loss into potential energy of separation of the Na and Cl in NaCl. If electrical energy can be applied without loss to produce the separation of NaCl into its constituent elements, we can easily compute the amount of coal used in a steam engine to give the necessary amount of electric energy in the dynamo machine to produce a given amount of Na. Thus one mechanical horse power per hour is equivalent to about 1425 heat units (pound degrees centigrade), and therefore this energy transformed without loss into electrical energy, and this electrical energy again into chemical work in decomposing NaCl, would give us (4247 divided into 1425) nearly one-third of a pound of Na per horse power per hour or 8 pounds a day of 24 hours. In practice one mechanical horse power applied to the dynamo machine generally yields not more than 80 to 90 per cent. of one electrical horse power. Thus, if there were no transfer resistance in the passage of the electric current through the molten NaCl electrolyte, but all the energy of the current were changed into chemical work, from 6 to 7 pounds of sodium would be set free at the negative electrode in 24 hours. Again, the electrochemical equivalent of Na is .000238 gms., i. e. with one ampere of current that amount of Na. should be deposited at the negative electrode in one second of time .8568 gms would be deposited in one hour or 20.56 gms. in 24 hours. Hence, 178 amperes would be required to deposit 8 pounds of Na in 24 hours. Since there are 746 watts to one elec-

trical horse power a voltage of (746 divided by 178) 4.2 would be necessary.

F. Exner (Wiedemann's Annalen Band, 6. Seite 353) gives the potential difference of Na and Cl at 2.06 to 2.08 Daniels, which would indicate, if correct under our given conditions, a deposit of nearly twice 8 pounds in 24 hours. In a similar manner I computed what should be the theoretical value for the amount of deposit of other difficulty reducible metals in the electrolysis of their fused salts. It seems probable that the electrolysis of NaCl and allied salts can never be carried on successfully in any aqueous or other ordinary solutions, on account of the secondary products that are formed by the action of the liberated ions. So it would seem that the salt must be rendered liquid by fusion. The temperature of fusion may be lowered considerably in many salts by the presence of other salts. e. g. Na Cl melts at 200 degrees below its ordinary melting temperature (776 degrees C, according to Carnelly) in the presence of a small amount of $CaCl_2$ and its temperature is considerably lowered by the presence of a small proportion of KCl. In my experimental work various kinds and forms of crucibles and electrodes were used without my being able to obtain very much pure metal. But my intent was mainly to get some quantitative results as to the amount of deposition of metal at the cathode. For measuring strength of current, water, silver and copper voltameters of my own construction were used as also a tangent galvanometer whose reduction factor had been carefully determined. The following results among many others were obtained at the time using a Grove battery, for electrical power, a Battersea crucible for containing the NaCl, a carbon anode and an iron cathode terminating in a tube of lime placed in the melted salt. As soon as metallic Na was seen to escape and burn at the surface o the liquid, the current was stopped, liquid cooled, crucible broken and the amount of Na determined by a standard

acid solution. Some of the Na was oxidized while a considerable amount would be found in the tube in the pure metallic state.

	Amperes.	Time in Seconds.	Observed Amount Na.	Theoretical Amount Na
Exp. 1	3.2	90	.04 gms.	.066 gms.
Exp. 2	2.5	480	.14	.286
Exp. 3	2.8	360	.16	.24
Exp. 4	2.8	300	.17	.20
Exp. 5	3.5	420	.2 +	.36
Exp. 6	2.	480	.13	.22

The loss can be accounted for from the escape of some of the volatilized Na into the air and from diffusion and recomposition with the liberated chlorine. The resistance measured by the method of substitution varied from one to 1.5 ohms, with an average of about 1.3. Four large chromic acid cells were used in series in much of the work. It thus seemed that, with suitable apparatus, from 5 to 6 pounds of Na could be produced in 24 hours to one electrical horse power. Thus, if there were no practical difficulties in the construction of crucibles and other apparatus involved, nor in working continuously on a large scale with a raw material so cheap and pure as NaCl, the metal could be obtained at small cost and could be applied to the reduction of other difficultly reducible metals, including that very valuable metal Al. Various forms of crucibles were used and attempts made to distil the metal when formed at the negative electrode. Na volatilizes at near 900 degrees C, and when obtained from the electrolysis of NaCl, carries with it a large amount of vapor of NaCl, so that distillation is attended with some difficulties. Small specks of Al were also obtained by direct electrolysis of Al_2Cl_6 2 NaCl, and of Al_2F_6 6 NaF, but only a small percentage of the theoretical yield could be obtained. Since the preparation of the paper of which the preceding is an outline, I have given attention more particularly to the direct electrolysis of salts of Al, using different salts

of the metal with different fluxes and different forms and materials for crucibles and electrodes. Some of the many points to consider in attempting to obtain Al by the direct electrolysis of its salts are the following:

1. Cheapness of the salt or material used.
2. A salt whose melting point is above the melting point of the Al and boiling point below that of Al.
3. That will to the least extent attack the material of the crucible and electrodes.
4. Which offers the least transfer resistance.
5. Which does not dissolve the metal when once liberated at the cathode.
6. That does not facilitate diffusion of the ions and thus permit their reuniting.

The salts that have been found in practice necessary to use, are the anhydrous chlorides and fluorides of Al; more commonly the double salts with sodium. The double chlorides, as given in Hoffmann's reports for 1872, cost at the factory in Salindres, France, 22 cents per pound, which would make its cost for a pound of Al $2.20. The Webster Castner works at Oldbury, near Birmingham, England, now have facilities for manufacturing the double chloride in much larger quantities than heretofore, and have undoubtedly made improvements in minor details; but the general process remains the same as it was in 1872, and no great reduction in cost can be expected. The double chloride can be made quite free from Silicon (Si), but always contains some iron (Fe). Cryolite is necessarily used as a flux when the double chloride is reduced by Na. The action of the cryolite has been explained as dissolving the thin coating of oxide that forms around the reduced particles of Al.

It may be, however, that the action of the cryolite is not that of a solvent of the oxide of the metal simply, but that it assists in decreasing the surface tension of the minute globules of metal, or otherwise mechanically causing

them to cohere. The native double fluoride (cryolite) can be obtained much cheaper than the double chloride.

From the Government reports of mining and mineral statistics the amount of cryolite imported into the United States is from 5000 to 8000 tons per year at a cost of about $15.00 per ton. This cost, the Pennsylvania Salt Co. (who control the cryolite business in this country), have told me is incorrect and too low.

They sell what they call pure cryolite at $125 per ton, or 6.5 cents per pound. This would make the cost of an amount sufficient for one pound of Al 65 cents, supposing the yield of Al is 10 per cent. of the salt (theoretically nearly 13 per cent.) This so-called pure cryolite from the Pennsylvania Salt Co. contains, I find, 2 per cent. of silica and 1 per cent. of Fe. I am confident that the artificial fluoride can be prepared at half the cost and of much greater purity than the natural cryolite.

The melting point of the double chloride is less than 200 degrees C, while that of pure Al is 700 degrees C, and of cryolite nearly 1000 degrees C, so the Al is perfectly fluid and readily coheres when reduced from cryolite. At the same time the temperature is not sufficiently high to volatilize the Al. Cryolite or other fluoride has the disadvantage as compared with the double chloride of tending to flux the containing vessel, and greater care is necessary in the selection of materials for crucibles or crucible linings, and the temperature must be kept as low as other circumstances will permit. There is little difference in the transfer resistance in either class of salts. The addition of chlorides of the alkalies or of the alkaline earths permits electrolysis with a somewhat lower electrical potential. It is probable that there is more solution of the metal, and diffusion and reunion of the ions generally in the electrolysis of the double fluoride than of the double chloride. I have repeatedly passed current of 60 to 80 amperes through pure melted cryolite for several hours without obtaining

more than a gram or so of the metal. In those experiments an alumina lined clay crucible was used containing 25 to 30 pounds of the salt with carbon cathode at the bottom of the crucible and a similar carbon anode passing in at the top. A tight fitting cover prevented access of air from the top. Drawing the electrodes farther apart increased the yield of metal from the same number of amperes. Mechanical agitation or boiling of the liquid would also tend to convey some of the Al through the molten mass and thus bring it in contact with the liberated fluorine. Cryolite, when solid, has a higher specific gravity than Al, but when liquid the Al will sink to the bottom of it. It is doubtless true that with the temperature very high the liberated Na from the cryolite does not reduce the Al but passes off as a vapor at the top of the bath or reunites with the fluorine and thus only a small amount of Al would be deposited at the cathode. I think it hardly probable that the reduced Al converts the Al_2F_6 of the cryolite to a lower fluoride.

It is probable that Al_2F_6 when pure is not an electrolyte, as the resistance increases as other salts present decreases. Prof. W. Hampe gives experimented proof in the *Chemiker Zeitung* August 3, 1887, that the pure chlorides, bromides and iodides are not electrolytes. That has been my experience with carefully prepared pure Al_2Cl_6. I attempted to pass the current from a 30 cell Grove battery in series, using carbon electrodes a sixteenth of an inch apart in Al_2Cl_6 without any deflection of the needle of a sensitive galvanoscope. The melting of the Al_2Cl_6 was made to take place, and the circuit closed, under paraffin and also in glass vessels in which there was no access of air. On account of the great volatility of the salt an exit was allowed for the large amount of vapor passing off in the melting. It is still more improbable that the oxide of Al is an electrolyte, although it is regarded as such by Heroult in U. S. patent, August, 1888

He passes the current through Al_2O_3, using copper as negative electrode on the bottom of a carbon crucible and a carbon rod as positive electrode, and extending down from the top nearly or quite touching the copper. A powerful current fuses the Al_2O_3, which, at this high temperature, in presence of the carbon and copper, is reduced, and forms with the copper Al bronze. That there is no electrolysis I am convinced from the following experiments:

I passed a current of 80 amperes for one-half hour through Al contained in a carbon crucible having copper in the bottom. Sometime after fusion took place, the current was broken and a sensitive galvanometer showed no deflection of the needle when put in the alumina current.

There seemed to be no electrolytic conduction, inasmuch as the current did not pass with 50 volts if the carbon electrode did not form at least a loose contact with the copper or was not connected by particles of carbon. Further, the direction of the current made no perceptible difference with the amount of Al set free to unite with the copper to form bronze. I also used an alumina crucible, with copper and platinum electrodes passing through the crucible nearly horizontally and forming loose contact in the center of the mass of alumina. No alloy of copper was formed containing Al and no polarization could be observed, though the fusion was complete, and of course, with it the copper and platinum.

What I desire more particularly to present in the present paper, are the results of some experimental work performed during the past three years in the electrolysis of mixed Na Cl and cryolite, using molten negative electrodes and more especially lead.

Lead (Pb), Tin (Sn), Zinc (Zn), Cadmium (Cd), Antimony (Sb), and Bismuth (Bi) were used. They all readily alloy with Na, and these alloys will give up the greater part of the Na when placed in melted cryolite, and

alloys of these metals with Al will be formed or the Al set free.

A large portion of the Na (or K) can be recovered from these various alloys by distillation in an iron crucible. They can be heated to a higher temperature than pure Na, or K. in acid crucibles without the Na, or K attaching the crucible. One part of Na added to 9 parts of Pb. and melted under paraffin forms an alloy (Na Pb probably) which still retains much of the appearance of the Pb., though harder and more brittle, and when placed in water acts very slowly upon it.

One part of Na to 4.5 parts of Pb (Na_2Pd) gives a brittle, almost granular alloy, having a blue black color, and acts quite rapidly upon water.

One part of Na to 2.25 parts of Pb (Na_4Pb), forms a dark blue iridescent alloy, quite compact, with a smooth cleavage, and acts very rapidly when thrown upon water.

One part of Na to 1.5 6 Pb is less homogenous than the preceding alloys, and cuts with a knife like Na.

One part of Na melted with 14 parts of Sn under paraffin, gives an alloy that is not homogenous, which is of a blue black color on the top of the mass and of a hard metallic, somewhat brittle, character on the bottom, forming two distinct alloys.

One part of Na to 6 parts of Sn, melted under paraffin, gives a more homogenous alloy than the first and of a darkish, compact character, not very brittle.

One part of Na to 3 parts of Sn gives a homogenous mass of blue black color, melting at a point just above the boiling point of paraffin and considerably above that of pure Sn.

One part of Na to 1 part of Sn gives a granular alloy that melts at about the melting point of Sn. When thrown upon the water the Na unites with considerable energy with the water.

One part of Na to 0.5 parts of Sn gives an alloy that cuts like Na and resembles it in appearance, and when thrown upon water the Na unites with so much energy that the liberated H ignites and the black powder of Sn falls to the bottom.

In a future paper I shall hope to give some of the physical and chemical properties of these alloys with varying amounts of Na and K.

In the following will be found a few typical experiments incidentally illustrating the preparation of a few of these alloys by electrolysis and especially the preparation of Al and its alloys. In a large portion of this work a 40 volt 90 ampere dynamo machine was employed, and Ayrton and Perry's instruments for measuring volts and amperes were used.

The following experiment illustrates the formation of Pb. and Sn. alloys:

EXPERIMENT 1. A current averaging 72 amperes and 33 volts was passed through melted NaCl contained in two No. P. Morgan crucibles, arranged in series, for two hours. Each crucible contained 30 pounds of the salt. In the bottom of the first crucible was placed 104 gms. of Sn, and of the second 470 gms. of Pb, each serving as cathode, connection being made through the bottom of the crucible. A carbon anode passed through the cover of the crucible and extended to within three inches of the molten metal cathode.

The crucible containing the Sn cathode was nearest the fire and constantly hotter, and had an average potential difference across the electrodes of 12 volts, while that containing the Pb cathode was 21 volts. At the end of two hours the carbons were removed, the liquid allowed to cool and crucibles broken open. The Pb alloy formed, was of an irridescent shining blueish cast and quickly dimmed on exposure to the air. It had a smooth cleavage and was very brittle. About 400 gms. of the pure alloy

was removed and the remainder with adhering NaCl put in water and the Na estimated by standard acid solution.

When a piece of the alloy was thrown into water the action was very energetic, and when the alloy was exposed to the air it rapidly oxidized and absorbed moisture from the air and became very warm. The bottom of the crucible was protected from excessive heat and the alloy produced no perceptible action upon it. The total amount of Na as sodium hydroxide was 165 gms. corresponding to 96 gms. of the metal Na. The theoretical amount of Na deposited in two hours with 72 amperes is about 122 gms. The tin alloy formed a solid mass of one-half inch in thickness and 4.5 inches in diameter. It had a fibrous or striated character in a vertical direction nearly or quite as soft as pure Na, and when freshly cut resembled Na somewhat in appearance, having a steel gray or ash color. It easily ignited spontaneously in the air, and when thrown upon water the energy was so great that combustion of the liberated hydrogen took place. In these rich alloys the Pb and Sn were found at the bottom of the vessel of water, in a finely divided state, after the Na had entirely united with the water. There was about 90 gms. of Na alloyed with the Sn. Some of this alloy was preserved under paraffin for more than a year with only slight oxidation of the Na upon its surface. These alloys reduce Al from cryolite or the chloride of Al though the Na does not entirely leave the Pb and considerable Na vapor passes off from the melted cryolite.

EXPERIMENT 2. This experiment was repeated under the same conditions, using 2 pounds cryolite mixed with 36 of NaCl in each crucible. About the same amount of Pb and Sn alloy of Na was obtained, together with a considerable number of small globules of comparatively pure Al. I collected the globules formed on the surface of the Pb alloy, and after re-melting first under NaCl then in the air, a single globule was obtained weighing 3.256

gms. and having a speeific gravity of 2.71. Traces of Pb. were present. The amount was decreased by remelting in the air. Three buttons of an alloy of Al and Sn in the crucible containing the Sn cathode, together weighed 4.46 gms., having a sp. g. of 4.69. This would indicate that the alloy contained about 45 per cent. of Sn and 55 per cent. of Al which would approach the formula Al_6Sn. There seemed to be little metallic Al present in the SnNa alloy. The liquid was agitated several times during the electrolysis with a carbon rod. The PbNa alloy contained some Al. which could be precipitated as hydroxide of Al from the aqueous solution of the alloy by neutralizing with acid.

EXPERIMENT 3. In another experiment I passed a current, having an average of 54 amperes and 10 volts, for 5.5 hours, through a mixture of 1 part cryolite and 5 parts NaCl in a single crucible having 370 gms. Pb as cathode. Upon opening the crucible 25 gms. of Al in globules, quite free from Pb and Na, were upon the top of the PbNa alloy. This Al had a specific gravity 2.67, and contained some iron and silicon from the cryolite and crucible. The very brilliant PbNa alloy contained some Al which could not be extracted by heating in air, but could be obtained by heating under NaCl.

The amount of Na present was 120 gms.; not much less than the theoretical amount. This was produced by a current of 54 amperes and 10 volts working 5.5 hours, which is equivalent to one electrical horse power for four hours.

EXPERIMENT 4. Another experiment with two crucibles having 500 gms. of Pb as cathode and with a current of 80 amperes, for four hours, and salt 1 to 5 of cryolite and NaCl, gave in one crucible 4 gms. of Al in small globules, and in the other no Al, with but a trace in the Pb Na alloy formed. It is thus seen that the Pb must ac-

These rods, if kept from action of the air during electrolysis, would last for forty-eight hours without much erosion. Carbon plates and cylinders were used, but the solid rods proved better in practice.

It is stated in Watt's Chem. Dict., under fluorine, that Cl displaces the F in any fluoride. In the preceding experiments Cl was certainly given off in large amount. The gases from the crucibles were allowed, however, to pass up the chimney, and I have as yet had no opportunity of analyzing them. I have used various basic linings for my clay crucibles, but alumina has thus far succeeded best. I tried some "shrunk" magnesia from basic steel works, but it contained so much iron that I could not use it. If free from Fe. it might answer very well. Lime can not be used as it fluxes very readily.

Analyses of various samples of Al, obtained by the use of a Pb cathode, showed Al varying in purity from 75 to 99 per cent. Silica was present in quantity varying from 25 per cent. to a trace, and iron varying from 5 per cent. to a trace, and admixed Pb varying from 3 per cent. to 0. There was but little loss in the quantity of Pb, and it could be repeatedly used.

The very low voltage and large quantity of metal obtained for a given number of amperes would seem to promise much for this method of extracting Al. More than a pound of Al to the electrical horse power for 24 hours has been actually obtained, and, undoubtedly, continued experience will give a much better result.

The best results, and in fact the only quantitative results that have yet been published, so far as I am aware, for the separation of Al by electrolysis, are reported by Dr. John Hopkinson of the Kleiner process, where 3 gms. were produced to the electrical horse power per hour, which would be about one-sixth of a pound in 24 hours.

Dr. Hopkinson reports that they used 60 volts to keep the cryolite in a state of fusion and electrolyse the salt. I cannot at present refer to details of work on the obtaining of pure salts of Al as electrolytes, and of durable crucibles, free from Fe and Si, besides mechanical arrangements and devices.

ON TWO NEW SPECIES OF CECIDOMYID FLIES PRODUCING GALLS ON ANTENNARIA PLANTAGINIFOLIA.

WM. M. WHEELER.

During the spring months of 1888 and 1889 I observed that the plantlets of *Antennaria plantaginifolia* covering a sloping pasture in an open wood near St. Francis, Milwaukee, had been so severely attacked by Cecidomyids as to have almost all their terminal buds converted into galls. As the plant infested is only a weed and the flies consequently of no agricultural interest, I at first determined to leave undescribed the two new species which I reared from the galls, but careful examination of the larvæ during pupation convinced me that I had found a subject which would reward careful morphological study, especially as there was no lack of material. I shall probably publish at some future time the results of my investigations on the tissue changes accompanying metamorphosis, and for this reason have concluded to describe the two new species.

CECIDOMYIA ANTENNARIÆ, N. SP.

Orum. Length, .404 mm; cylindrical, about 6 times as long as wide, slightly curved, with rounded poles; yolk orange red, chorion and vitelline membrane transparent.

Larva. Length, 4 mm; tapering at both ends; intersegmental constrictions not very deeply marked, orange red, the pigment, which is seated in the corpus adiposum, being slowly soluble in 70 per cent. alcohol; two minute black pigment dots close together in the median dorsal-line on the anterior segment; chitinous cutiele finely papillose under a high power; movements sluggish.

Pupa. Length, Female 3,5—3,75 mm. Male 2,75—3 mm; when young orange, the head, thorax and sheaths of all the cephalic and thoracic appendages red; when ready to hatch, sheaths of appendages

blackish olive, pronotum pale orange, edged with black, ornamented posteriorly with two irregular black spots, and a longitudinal black bar reaching from the anterior edge to the middle. Abdomen orange, the mesenteron shining through as a deep yellow spot. A black line (the ovipositor) shines through the transparent integument in the median dorsal line, from the middle to the terminal abdominal segment, which is truncated; front of thorax with four hair-like processes, the anterior pair being much closer together than the posterior pair, which are evidently projecting spiracles. The tips of the first pair of legs lie anterior to the mesothoracic leg tips, and these again lie anterior to the meta-thoracic leg tips by about two tarsal joints.

Imago. Female Length, 3,75—4 mm. Head small; eyes black, reniform, subcontiguous; vertex and cheeks fuscous, sparsely hairy, face and mouth parts pale yellowish, antennae 1½ times as long as the head and thorax, pale yellowish, covered with scattered brownish hairs, 16-jointed, all the joints sessile, the basal being broad and short, the second subspherical, the others oval. Thorax brown above, growing darker towards the anterior and lateral margins, with a dark median longitudinal bar not extending to the posterior edge; pronotum with a few dark brown hairs; pleurae pale brownish; scutellum more than twice as broad and long, rounded posteriorly, deeply emarginate laterally, concolorous with the pronotum, its lateral and posterior margin dark brown; legs pale yellowish; covered with straight dark brown hairs, coxae darker than remainder of legs; femora equalling the tibiae in length, basal tarsal joint short, second joint longer than the remaining three joints; wings with a very pale brownish tint, covered with sparse brown hairs and fringed with the same; trineurate, the second vein obsolescent towards its tip which ends almost at the apex of the wing; third vein obsolescent before its bifurcation which is difficult to trace; halteres pale yellowish, covered with the same brown hairs as the legs; abdomen much swollen before oviposition, bright orange red from the enclosed eggs and corpus adiposum; the tergum of each segment brown; ovipositor long and attenuated; whole abdomen sparsely hairy.

Male, Length 2,2—3 mm. Differs from the female in the following points: Antennae as long as the abdomen; basal joint subcalyculate, second joint spheroidal, joints 3—15 twice as long as the corresponding joints in the female, the basal half of each swollen and oval, the apical half only one-third as broad as the basal half, cylindrical gradually widening a little towards the apex; terminal joint oval; hairs on wings

much more sparse than in the female, no fringe of hair on margins of wings, apical half of third vein obsolete; no traces of bifurcation, abdomen cylindrical, attenuate, hairy, fuscous above, paler beneath.

I have placed this species in the typical genus *Cecidomyia* as defined by Schiner, the venation of the wings, the structure of the antennae, etc., leaving little doubt as to its position.

The gall of this species is produced from a puncture of the terminal bud of the plantlet early in April, the insects probably appearing soon after the snow melts from some gall on another plant unknown to me. The gall on *Antennaria*, which is from ⅓ to ½ an inch in diameter, is corm-shaped and is brought about by a check in the growth of the scape-like flower-bearing stem, the sessile leaves of which become somewhat succulent, broader and longer than under normal circumstances, and, excepting the tips, which are somewhat recurved, closely applied to one another like the leaves of an onion. Both surfaces of the component leaves of the gall are covered with woolly trichomes, while the parenchyma cells of their more succulent basal portions acquire a reddish coloring matter. Frequently all the terminal buds of a plant to the number of a dozen or more will be found to have been punctured by the flies and converted into galls, which form clusters remotely resembling bunches of young hazel nuts. The insect lays from 1 to 15 eggs in each bud—on an average from 3 to 7. The numerous larvæ are found imbedded in the woolly center of the gall, and though close together, are usually isolated by films of matted trichomes

Pupation takes place during the first week of May. The change from the larva to the pupa is very gradual, and owing to the transparency of the larval cuticle and the opaque orange tint of the enormous fat-body the conversion of the milk white imaginal discs into the antennæ, legs, wings and halteres of the imago may be traced with great ease.

The larval cuticle is not shed during pupation. The imagines leave the pupal envelope and the gall about a week after pupation, that is about the middle of May.

They are not very active flies, and the males seem not to comport themselves in a manner so strikingly different from the females as in the next species to be described. I am inclined to the opinion that the insects on emerging from the galls seek out some other plant for the second brood for the reason that I have been unable later in the season to find galls on such specimens of *Antennaria* as had escaped the terrible ravages of the insects during the spring months. Moreover the plant, though perennial, would not after anthesis offer the favorable conditions to a gall-forming insect which it offered when the flower-bearing stems were sprouting. One of the females which I kept in confinement deposited her orange-colored ova in the leaf axilla of a healthy green shoot of a plant, most of the terminal buds of which had been previously converted into galls. This fact, however, proves nothing, as the confined insect was prevented from seeking the plant on which the next crop of galls is probably produced. The severe ravages of the gall fly would undoubtedly result in the extermination of *Antennaria plantaginifolia*, at least in some localities, were it not that it is itself much infested by a minute Proetotrupid. Fully three-fourths of all the larvæ were found to contain from one to a dozen of the larvæ of this small Hymenopteron; though the infested Diptera often reached their full length, they died before pupation.

ASYNAPTA ANTENNARIAE, N. SP.

Larva. Length 5,5—6 mm. White, tapering posteriorly, the anterior end of the body being broad, owing to the fact that the small anterior segments are somewhat telescoped; the intersegmental constrictions very distinct; the jaws brownish; larva actively motile.

Pupa. Length 4,5 mm. Much stouter than the pupa of the preceding species; head and thorax proportionally much longer; flesh-colored

when young, head terminating anteriorly in two conical brown horns close together at their bases, but slightly divergent at their tips; in front of these, in a line with the upper margins of the eyes, is another pair of similar but much smaller projections; anterior to which, again, there is in the median line between the eyes, equidistant from their upper and lower margins, an unpaired minute projection. Tips of the prothoracic legs posterior to tips of the mesothoracic legs by one half a tarsal joint; metathoracic legs extending back further by one tarsal joint then the mesothoracic legs. Segments of abdomen strongly pronounced, each bearing dorsally three transverse rows of short and acute brown teeth, the last row on each segment being the most regular; lateral edge of each tergum with an indentation which presents three subtriangular glistening spots, so arranged as to resemble a clover leaf; thorax with four pale longitudinal lines and near the anterior edge with two curved bristles, each of which is mounted on a minute mammilla.

Imago. Female, Length 4–4, 5 mm., length of wings 3,5 mm. Black, the whole body covered with a glaucous bloom; antennae black, clothed with appressed black hairs; 14-jointed, basal joint broad and very short, enclosing the base of the short but narrower second joint; third joint the longest in the appendage; the succeeding joints very gradually diminishing in length to the end, which is formed by a small spherical joint; palpi pale, tipped with black; face and eyes deep black; front crowned with a number of long black hairs, the curved tips of which are bent forward; upper surface of thorax nearly bare, a few dark hairs on the pleurae; a pearly iridescence to the bloom of the thorax and scutellum, the latter with a few long pale hairs; wings large, rounded, very broad, subfuliginous, in oblique light corrugated and irideseent, quite thickly covered with black hairs, which form a fringe around the apical and posterior margins, the hairs of the fringe being longest on the anal angle; four apparently distinctly separated longitudinal veins; first vein entering the costal margin about one third the length of the wing from its base; second vein very straight, reaching to the tip of the wing; third vein slightly, fourth more strongly bent; feet pale but appearing dark because thickly covered with black hair-like scales; coxae with a few long silvery white hairs; ovipositor long, brown, bristle shaped, included between two orange yellow rods; often carried so that it protrudes beyond its sheath for a distance equal to the length of the latter.

Male, Length 2,75—3 mm. length of wings, 3 mm. Differs from the female in the following points: Body smaller, abdomen much shorter and more attenuated; antennal joints not diminishing in length towards the tip; thorax sparsely and venter thickly covered with long,

silvery white hairs; wings much paler than in the female, because the black hairs are much less numerous; only a slight indication of marginal fringes; legs much longer than in the female, the black scales being less densely aggregated.

This species I refer to the genus *Asynapta* of Loew, mainly on account of the peculiar neuration, which is precisely like that observed in the European species of the group. The palpi, which are of medium size, and the thorax which is not much elongated anteriorly, would place the species in Rondani's genus *Winnertzia*, but it is probably best, at least for the present, to follow Schiner who regards *Winnertzia* as of only subgeneric value. Up to the present no species of *Asynapta* have been described from North America, but this is not to be wondered at when we consider the little work that has been done on our dipterous gall-flies.

The galls of *Asynapta antennariæ* are easily confounded at first sight with those of the *Cecidomyia* to which I have given the same specific name. More careful examination, however, soon reveals enough differences to permit of distinguishing the two species.

The *Asynapta* gall is more elongate, while the tips of the component leaves are scarcely recurved. The development of white trichomes is more regular, giving the gall a satiny appearance. The inner or upper surfaces of the leaves do not produce trichomes as in the other gall, but are smooth and shining, and are found to be covered with minute drops of moisture when the leaves are stripped asunder. The cells of the leaves, too, contain none of the red coloring matter, which gives the galls of *Cecidomyia* a reddish cast. Each gall contains only a single insect, which is not swathed in woolly trichomes but hollows out for itself a smooth cavity with hard and nut-like walls. The galls of the *Asynapta* are much rarer than those of the other species, the proportion being about one in fifty.

Sometimes an *Asynapta* gall will be found on the same

individual plant or even in the same cluster with the galls of *Cecidomyia*. The former species also probably produces its next brood of galls on some other plant. The large white larva, which seems not to be infested by Hymenopterous parasites pupates some days later than the *Cecidomyia* larva, and the imago also appears later, from about the 17th to the 20th of May. The dark-colored fly emerges at the apex of the gall after dragging out its pupa case, which is left dangling among the woolly hairs on the outer surface of the leaves. The insect hops and flits about in a much more lively manner than the *Cecidomyia*.

The males and females differ considerably in appearance, as will have been gleaned from the above description. Their actions are as different as their appearance. The female carries her wings horizontally and overlapping on the abdomen after the manner of the Hemiptera. The long yellow oviposter is often carried protruding. The males are at once recognized by their smaller size, greater grace of form and movement, and by the peculiar manner in which they carry their wings. These are held out at right angles to the long axis of the body and allowed to droop somewhat. From what I have observed I am inclined to believe that copulation is preceded by a kind of courtship in every way comparable to what is observed in higher animals. The males ran about over the leaves in the jar to which they were confined in pursuit of the females. They seldom used their wings but seemed to rely for progression almost exclusively on their long and delicate legs. Whenever one approached a female, she rose into the air and alighted some distance off. I have repeatedly observed this coquettish action which had every appearance of being a test of the ardor and agility of the male, as with higher animals.

Further studies of the habits of such of our insects as present striking sexual differences will undoubtedly reveal many cases of courtship, no less wonderful than those observed in birds.

The following observation of Fr. Dahl from an article entitled "Die Insecten koennen Formen unterscheiden" in the Zoologischer Anzeiger for April, 1889, is so similar to the one which I have given above that I quote it *in extenso*. After dealing with Plateau's recently published experiments on vision in insects, he says:

"Das Maennchen einer Fliegenart, *Dolichopus plumipes*, besitzt an dem ersten Tarsengliede der Mittelbeine eine huebsche, regelmaessige Befiederung. Den Zweck derselben kann man sich zunaechst nicht erklaeren, da die breiten Fiederhaare unmoeglich zum Festhalten der Weibchen dienen koennen. Ich beobachtete nun die Paarung dieser Thiere, und dabei wurde mir sofort klar, dass es sich um einen wirklichen Schmuck des Maennchens handelt, ebenso wie bei den stark entwickelten Schwanzfedern, u. s. w. der maennlichen Voegel. Das Maennchen kam heran geflogen, schwebte eine Zeit lang ruettelnd so nahe ueber dem ruhig dasitzenden Weibchen, dass das Gefieder der lang herunterhaengenden Mitteltarsen sich unmittelbar neben den Augen desselben befanden. Nach einiger Zeit wurde die Begattung versucht, allein zunaechst zeigte sich das Weibchen noch abgeneigt. Erst nach einigen wiederholten Versuchen kam es wirklich zur Begattung."

More remarkable than any courting habits yet observed among insects are the mating scenes of spiders as described by Prof. G. W. and Mrs. E. G. Peckham, in the Occasional Papers of the Wisconsin Natural History Society, Vol. I, 1889. These investigators, besides adducing very weighty evidence in favor of the theory of sexual selection as maintained by Darwin, have opened up new and rich fields for observation in the habits of the Arthropoda.

The observations of Dahl and myself make it highly probable that all insects provided with marked secondary sexual characters will be found to have modes of courtship more or less similar to those exhibited by the Araneina.

TWO CASES OF INSECT MIMICRY.

WM. M. WHEELER.

While studying the prairie insect fauna of Southeastern Nebraska early in the summer of 1888 I happened on two cases of mimicry, which I believe have not yet been noted.

The first case relates to *Mantispa brunnea*, Say., and *Polistes variatus*, Cress. I had for several days observed individuals of the *Polistes* resting on the petioles in the terminal leaf-clusters of the golden rods so luxuriant in the damp spots, or "draws" between the gently rising hills of the prairies. The wasps were evidently lying in wait for prey, and their yellow, black and brown markings made them look like insect tigers hiding among the leaves. More careful observation showed that some of these leaf clusters half concealed specimens of *Mantispa brunnea*, crouching in the same manner. Their coloring so closely resembled the wasp's that I was at first quite deceived and was ridiculously careful in extricating specimens from my net, fearing to be stung. The coloring of the *Polistes* is carefully copied; the body is banded with yellow, brown and black, the wings are smoky brown and the legs yellow. While lying in wait the *Mantispæ* closely appose their large raptorial fore legs to the lateral faces of the prothorax, which, when these appendages are extended, is so narrow as to resemble but slightly the wasp's thorax. The wings are carried in the same manner by both insects. Several times during the course of a week I found these two insects, which I soon learned to distinguish at a glance, notwithstanding the similarity of their movements and coloring, resting in the same position, both intent upon the slaughter

of the many insects, notably Coleoptera and Trypetid and Ortalid Diptera, which swarmed about the rank vegetation.

Is is easy to see how the *Mantispa*, borrowing the bright warning colors of the wasp, may escape destruction by birds, spiders and possibly also by the large robber flies (*Laphriæ*), which were flying about in great numbers looking for insect food, and which I sometimes saw carrying off insects as large as a female *Lachnosterna lanceolata*.

The other case of mimiery relates to the Chrysomelid beetle. *Disonycha caroliniana*, Fab. (*D punctigera*, Lec.) and the Carabid beetle *Lebia furcata*, Lec. These two insects, so widely separated in our systematic collections, are in life close companions.

On the 18th of June, while examining the foliage of the long-leaved willow (*Salix longifolia*), one of the few species of willow one meets in the damp spots of the Nebraskan prairie, I found numbers of the *Disonycha* hopping about and *in copula* among the leaves. The insect is brick-red beneath and the head and thorax are brick-red above, the latter ornamented with black dots, two of which, near the median line, are very distinct. The antennæ are black with red basal joints. Eaeh of the cream-colored elytra is edged with black externally and along the suture, and has a median longitudinal black band. When closed, the elytra thus present three longitudinal black bands, the black edges of the suture forming the median. I captured a number of specimens and on examining them subsequently found that I had taken at the same time another beetle, a *Lebia furcata*, which from its striking resemblance in eoloring to the Chrysomelid, had completely escaped my attention during the excitement of collecting. The *Lebia* is brick-red beneath, with black legs and feet. The head and throat are briek-red above, the antennæ

black with red basal joints. The elytra are cream-colored, each with a median longitudinal black stripe, and on the edge of the suture, a black band, which, leaving its median course, passes obliquely outward over the anterior inner angle of each elytron. When the elytra are closed there are thus three longitudinal stripes, two lateral and one median which bifurcates anteriorly. A comparison of the rough descriptions of the two beetles shows the striking color resemblance.

A few days later I again found these two species of Coleoptera together on willow bushes several miles from the spot where I had first seen them. The females of *Disonycha* were gravid with eggs, which I found to be mature in the lower follicles of the ovaries, as they dropped from the epithelial compartments with the slightest touch of the dissecting needles. Very probably many of the insects had begun to oviposit on the foliage.

As *Lebia grandis* feeds on the eggs of the potato-beetle (*Doryphora 10-lineata*), and the European *Lebia chlorocephala* is known to frequent the foliage of certain species of *Hypericum* for the purpose of feeding on the larvæ of *Chrysomela varians*, I feel justified in concluding that *Lebia furcata* probably feeds on the eggs or young larvæ of *Disonycha coroliniana*. If true this would explain why the Carabid should so closely resemble in coloring the Chrysomelid, the former being merely a wolf in sheep's clothing. The *Disonycha* evidently mistakes it for one of its own species and oviposits on bushes where it would otherwise not, as it is capable of flying and leaping considerable distances.

The species of the genus *Lebia* are usually brightly and elegantly colored, their hues and patterns not infrequently resembling those of various species of Chrysomelidæ, but, so far as I know, no other cases of mimicry have as yet been observed in the two groups. *Lebia grandis* is eer-

tainly very different from its victim, *Doryphora*. It seems probable that a striped *Lebia*, at first only remotely resembling *Disonycha*, may have become associated with this Chrysomelid, and by natural selection have gradually had its coloring perfected along a line of increasing resemblance to its victim. This seems more probable than that a unicolorous or unstriped form like *Lebia viridis*, or *tricolor*, or *atriventris*, should have been the original form from which this close resemblance was evolved.

The specimens of *Lebia furcata* were about a tenth as numerous as the specimens of *Disonycha*. I believe that the law will hold good that all carnivorous mimetic forms which prey on the forms they mimick are much less abundant than their victims. They are doomed to be represented by a few individuals, as any great increase in their number would be immediately checked by the falling off in the food supply.

Mimicry is not common among our native Coleoptera. I have fancied that some species of Clytus-like longicorns might be mimetic of certain black and yellow wasps, and that the Elaterid *Campylus denticornis*, Kirby, copied some species of *Telephorus*, but the close resemblances of the specimens of our cabinets cannot be relied upon as indicative of mimicry. Only field study can be of any service in deciding whether a particular insect is mimetic.

Drummond, who has given considerable attention to the wonderful cases of insect mimicry so numerous in Southern and Eastern Africa, is undoubtedly correct when he says that "no study in natural history depends more upon observation in the field; for while in the case of a few mimetic forms—the *Heliconidæ*, for example—the imitated form is also an insect, and the two specimens may be laid side by side in the cabinet at home, the great majority of mimetic insects are imitations of objects in the environment which cannot be brought into compari-

son with them in the drawers of a museum. Besides this, it is not only the form but the behavior of the mimetic insect, its whole habit and habitat, that have to be considered; so that mere museum contributions to mimicry are almost useless without the amplest supplement from the field naturalist."

COLEOPTERA OF WISCONSIN.

F. RAUTERBERG.

(CONTINUED FROM PAGE 153.)

THROSCIDÆ.

Wis. No.	Amer. No.	
		DRAPETIS, Redt.
800.	4542.	geminatus, Say.....In sweepings. Very rare.
		THROSCUS, Lat.
801.	4547.	punctatus, Bonv.....In sweepings. Very rare.
802.	4553.	Chevrolati, Bonv.....Same as preceding.

BUPRESTIDÆ.

		CHALCOPHORA, Sol.
803.	4572.	fortis Lec.....Along the streets of the city. Rare.
		DICERCA, Esch.
804.	4576.	prolongata, Lec.....On Crataegi. Common.
805.	4577.	divaricata, Say.....Same as last.
806.	4578.	pugionata, Germ.....On willows.
807.	4579.	obscura, Fab.....In sweepings. Very rare.
808.	4580.	lepida, Lec.....On beech-trees. Rare.
809.	4582.	asperata, Lap. & Gory.....From the pineries.
810.	4588.	punctulata, Sch.....In sweepings. Rare.
		POECILONOTA, Esch.
811.	4594.	cyanipes, Say.....On willows. Common.
		BUPRESTIS, L.
812.	4601.	lineata, Fab.....In sweepings. Rare.
813.	4602.	consularis, Gory.....On pines. Common.
814.	4606.	maculiventris, Say...In the pineries. Common.
815.	4607.	fasciata, Fab.....Same as the last.
816.	4607.*a*	Langii, Mann.....In the pineries. Rare.
817.	4609.	striata, Fab.....In the city. Very rare.
		CINYRA, Lap. and Gory.
818.	4615.	gracilipes, Melsh.....In sweepings Rare.

MELANOPHILA, Esch.

819. 4619. longipes, Say.....Captured on fresh pitch in the bright sunlight, in the city. Quite common.

820. 4621. Drummondi, Kirby...In pineries. Common.

821. 4622. fulvoguttata, Harr..Same as last.

ANTHAXIA, Esch.

822. 4628. aeneogaster, Lap.....In sweepings. Rare.

823. 4631. viridicornis, Say.....In sweepings. Common.

824. 4632. cyanella, Gory.....In sweepings. Commoner than the last.

825. 4633. quercata, Fab.....Same as the last.

CHRYSOBOTHRIS, Esch.

826. 4639. femorata, Fab.....On apple trees. Common.

827. 4639.*a* alabamæ, Gory .....On trees. Rare.

828. 4639.*b* 4-impressa, Lap. & Gory.....On trees. Rather rare.

829. 4639.*e* obscura, Lec.....Same as the last.

830. 4647. dentipes, Germ.....On trees. Rare.

831. 4652. pusilla, Lap. & Gory. With the sweep-net. Rare.

832. 4657. 6-signata, Say.....Same as last. Rare.

ACMAEODERA, Esch.

833. 4699. pulchella, Hbst .....On the blossoms of Compositæ. Common near Racine, Wis.

PTOSIMA, Sol.

834. 4714. Walshii, Lec.....In sweepings. Very rare.

AGRILUS, Steph.

835. 4720. arcuatus, Say.....In sweepings. Rare.

836. 4721. ruficollis, Fab.....In sweepings. Common.

837. 4722. torquatus, Lec .....Same as last.

838. 4723. fulgens, Lec .....In sweepings. Rather common.

839. 4724. otiosus, Say.....Same as last.

840. 4727. bilineatus, Web .....Captured flying about newly-hewn oak stumps.

841. 4728. vittaticollis, Rand...In sweepings. Rare.

842. 4729. granulatus, Say .....Same as last.

843. 4731. fallax, Say.....In sweepings. Common.

844. 4740. torpidus, Lec.....In sweepings. Rare.

845. 4741. plumbeus, Lec .....Same as last.

846. 4742. politus, Say .....In sweepings. Common.

847. 4746.*a* cephalicus, Lec.....In sweepings. Rare.

BRACHYS, Sol.

848. 4758. ovata, Web.....In sweepings. Rare.
849. 4758.*b* tessellata, Fab.....In sweepings. Common.
850. 4761. aerosa, Melsh.....In sweepings. Very common.
851. 4762. aeruginosa, Gory.....In sweepings. Rare.

PACHYSCELUS, Sol.

852. 4763. carbonatus, Lec.....In sweepings. Very rare.
853. 4764. purpureus, Say.....Same as last.

LAMPYRIDÆ.

LYCOSTOMUS, Mots.

854. 4770. lateralis, Melsh.....In sweepings. Rare.

CALOPTERON, Guir.

855. 4776. reticulatum, Fab.....On shrubbery. Rather common.

CELETES, Newm.

856. 4779. basalis, Lec.....On shrubbery. Common.

CAENIA, Newm.

857. 4780. dimidiata, Fab.....In sweepings. Very rare.

EROS, Newm.

858. 4787. aurora, Hbst.....In sweepings. Very rare.

PLATEROS, Bourg.

859. 4794. modestus, Say.....In sweepings. Common.
860. 4795. canaliculatus, Say....In sweepings. Very rare.
861. 4797. lictor, Newm.....In sweepings. Common.
862. 4798. floralis, Melsh.....In sweepings. Rare.

POLYCLASIS, Newm.

863. 4809. bifaria, Say.....In sweepings. Very rare.

LUCIDOTA, Lap.

864. 4810. atra, Fab.....In sweepings. Common.

ELLYCHNIA, Lec.

865. 4815. corrusca, L.....In sweepings. Common.

PYROPYGA, Mots.

866. 4817. fenestralis, Melsh. ....In sweepings. Rare.
867. 4818. nigricans, Say.....Same as the last.
868. 4820. decipiens, Harr.....In sweepings. Very rare.
869. 4821. minuta, Lec.....In sweepings. Very common.

PYROACTOMENA, Lec.

870. 4823. angulata, Say.....In sweepings. Common.
871. 4824. borealis, Rand.....Same as last.

PHOTINUS, Lap.

872.	4829.	ardens, Lec.....In sweepings.	Rare.
873.	4832.	punctulatus, Lec.....In sweepings.	Common.
874.	4835.	pyralis, Linn.....In sweepings.	Rare.
875.	4836.	marginellus, Lec.....Same as last.	
876.	4837.	scintillans, Say.....In sweepings.	Common.

PHOTURIS, Lec.

877.	4847.	pennsylvanica, DeG..In sweepings.	Common.
878.	4848.	frontalis, Lec.....In sweepings.	Rare.

CHAULIOGNATHUS, Hentz.

879.	4875.	pennsylvanicus, DeG.	Common on golden-rods.

PODABRUS, Westw.

880.	4878.	nothoides, Lec.....In sweepings.	Abundant.
881.	4879.	tricostatus, Say.....In sweepings.	Rare.
882.	4882.	basilaris, Say.....In sweepings.	Common.
883.	4885.	diadema, Fab.....Same as the last.	
884.	4886.	modestus, Say.....Same as the last.	
885.	4901.	piniphilus, Esch.....In sweepings.	Rather rare.

SILIS, Lat.

886.	4920.	percomis, Say.....In sweepings.	Common.

TELEPHORUS, Schaeff.

887.	4926.	dentiger, Lec.....In sweepings.	Common.
888.	4927.	excavatus, Lec.....Same as last.	
889.	4931.	fraxini, Say.....Same as last.	
890.	4932.	carolinus, Fab.....Same as last.	
891.	4933.	lineola, Fab.....In sweepings.	Rare.
892.	4936.	rectus, Melsh.....In sweepings.	Common.
893.	4938.	cruralis, Lec.....In sweepings.	Rare.
894.	4939.	flavipes, Lec.....In sweepings.	Rare.
895.	4940.	scitulus, Say.....Very common on oaks.	
896.	4942.	luteicollis, Germ.....In sweepings.	Rare.
897.	4947.	rotundicollis, Say.....Same as last.	
898.	4953.	tuberculatus, Lec.....Same as last.	
899.	4955.	bilineatus, Say.....In sweepings.	Very common.

POLEMIUS, Lec.

900.	4966.	laticornis, Say.....In sweepings.	Common.

DITEMNUS, Lec.

901.	4969.	bidentatus, Say.....In sweepings.	Rare.

MALTHINUS, Lat.

902.	4975.	occipitalis, Lec.....In sweepings.	Rare.

MALTHODES, Kies.

903. 4979. coneavus, Lec.....In sweepings. Common.

MALACHIDÆ.

COLLOPS, Er.

904. 4994. tricolor, Say.....In sweepings. Rare.

TANAOPS, Lec.

905. 5033. longiceps, Lec.....In sweepings. Rare.

ANTHOCOMUS, Er.

906. 5038. Erichsoni, Lec.....In sweepings. Common.
907. 5039. flavilabris, Say.....In sweepings. Rare.

PSEUDEBAEUS, Horn.

908. 5041. apicalis, Say.....In sweepings. Rare.
909. 5045. oblitus, Lec.....Same as last.

CLERIDÆ.

CYMATODERA, Gray.

910. 5136. bicolor, Say.....In sweepings. Rare.
911. 5137. inornata, Say.....In sweepings. Rarer than the last.

TRICHODES, Hbst.

912. 5159. Nuttalli, Kirby.....On flowers. Very common.

CLERUS, Geoff.

913. 5167. 4–guttatus, Oliv.....In sweepings. Rare.

HYDNOCERA, Newm.

914. 5201. bicolor, Lec.....In sweepings. Rare.
915. 5205. tabida, Lec..... .....Same as the last.

PHYLLOBAENUS, Spin.

916. 5210. dislocatus, Say.....In sweepings. Rare.

CHARIESSA, Perty.

917. 5215. pilosa, Forst.....In sweepings. Very rare.

NECROBIA, Lat.

918. 5230. rufipes, Fab.....In sweepings. Common.
919. 5231. ruficollis, Fab.....In sweepings. Rare.

PTINIDÆ.

PTINUS, Linn.

920. 5239. fur, Linn.....On the walls of houses, barns, etc. Common.
921. 5240. brunneus, Duft.....In same places as the last, but rarer.

EUCRADA, Lec.

922. 5245. humeralis, Melsh.. ...In sweepings. Very rare.

HADROBREGMUS, Thom.

923. 5270. erraus, Melsh.....In sweepings. Common.
924. 5271. carinatus, Say.....Same as the last.

NICOBIUM, Lec.

925. 5278. hirtum, Ill.. .....In sweepings. Rare.

ANOBIUM, Fab.

926. 5279. notatum, Say.....In sweepings. Rare.

TRYPOPITYS, Redt.

927. 5281. sericeus, Say.....About old dwellings, etc. Common.

PETALIUM, Lec.

928. 5283. bistriatum, Say.....In sweepings. Rare.

XYLETINUS, Lat.

929. 5295. fueatus, Lec.....In sweepings. Rare.

HEMIPTYCHUS, Lec.

930. 5309. gravis, Lec.....In sweepings. Rare.

PROTHECA, Lec.

931. 5319. puberula, Lec.....In sweepings. Rare.

DORCATOMA, Hbst.

932. 5321. setulosum, Lec.....In sweepings. Rare.

CAENOCARA, Thom.

933. 5326. oculata, Say.....In sweepings. Common.

PTILINUS, Geoff.

934. 5332. rufieornis, Say.....In sweepings. Rare.
935. 5334. thoracicus, Rand.....Same as the last.

ENDECATOMUS, Mellié.

936. 5337. rugosus, Rand.....In sweepings. Rare.

SINOXYLON, Duft.

937. 5339. basilare, Say.....On dead twigs. Very rare.

BOSTRYCHUS, Geoff.

938. 5350. bicornis, Web.....On wild grape-vines. Common.
939. 5352. truncaticollis, Lec.....Same as last.

LYCTUS, Fab.

940. 5374. striatus, Melsh.....On dead willows. Rare.
941. 5375. opaculus, Lec.....On dead shrubs. Rare.

CUPESIDÆ.

CUPES, Fab.

942. 5382. concolor, Westw.....In sweepings. Very rare.
943. 5383. capitata, Fab.....Same as the last.

CIOIDÆ.

CIS, Lat.

944. 5389. fuscipes, Mellié.....On old walls, etc. Rare.

CERACIS, Mellié.

945. 5406. Sallei, Mellié. In sweepings. Rare.

RHIPIDANDRUS, Lec.

946. 5107. paradoxus, Beauv....In sweepings. Rare.

SPHINDIDÆ.

SPHINDUS, Chev.

947. 5409. Americanus, Lec.....In sweepings. Very rare.

LUCANIDÆ.

LUCANUS, Linn.

948. 5412, dama, Thumb.....Common in woods, under stumps, etc.; in the cities about electric lights.

949. 5414. placidus, Say.....Common in many parts of Wisconsin, but not in Milwaukee Co.

DORCUS, MacL.

950. 5415. parallelus, Say.....In logs and stumps. Common.

PLATYCERUS, Geoff.

951. 5416. quercus, Web.....In oak-logs. Common.

952. 5419. depressus, Lec.....In oak-logs. Rare.

CERUCHUS, MacL.

953. 5422. piceus, Web.....In oak-logs. Very common.

PASSALUS, Fab.

954. 5424. cornutus, Fab.....In logs. Very rare.

(TO BE CONTINUED.)

FLORA OF MILWAUKEE COUNTY.

(FIRST SUPPLEMENT.)

W. M. WHEELER.

The list published in the proceedings of the society for 1888, though embracing all the species of Phanerogams and Vascular Cryptogams at that time known to occur within the limits of Milwaukee County, was necessarily incomplete.

As new forms are being introdueed eonstantly, and new species found, especially of those groups in which the specific characters are much blended and consequently of difficult determation, it has become necessary to publish from time to time supplements to the original florula. In compiling this first supplement I have had to rely almost entirely on the assistance of Mr. A. Conrath and Mr. F. Runge.

Mr. Conrath has very kindly allowed me to look through his entire herbarium, many of the speeimens of which were collected in the county.

An examination of his collection has furnished the following numbers of the list: 694, 695, 697, 698, 700 to 713, 715 to 717, 719 to 721, 723 to 726, 728, 730, 731, 734, 736 to 741, 747 to 749.

Mr. Runge has been indefatigable in scouring the county in search of species not in my first list and has suceeeded in adding the following numbers: 692, 693, 696, 699, 714, 718, 727, 729, 732, 733, 740, 741, 743, 745. Numbers 722, 735, 742, 744, 746 were observed by myself.

Under the list of literature, given on pages 158–159 of my florula, the following was omitted:

Hale, T. J. and Lapham, I. A.

Additions to the Flora of Wisconsin. (In Transactions of Wiconsin Agricultural Society, Vol. V., 1858-59.)

LIST OF SPECIES.

692. Amarantus paniculatus, L. In the Menomonee Valley.
693. Ambrosia psilostachya, D. C. In the Menomonee Valley.
694. Amorpha canescens, Nutt. Wauwatosa, 1880.
695. Arabis perfoliata, Lam. In the city.
696. Artemisia Ludoviciana, Nutt. In the Menomonee Valley.
697. Aster miser, Ait. Common in various parts of the county.
698. A. simplex, Wild. In Larkin's Tamarack Swamp.
699. Betula glandulosa, Michx. Lincoln Ave. Swamps.
700. Bidens cernua, L. Milwaukee County.
701. Blephilia ciliata, Raf. Wauwatosa.
702. *Brassica campestris, L. Escaped from cultivation in Wauwatosa.
703. Calystegia spithamæa, Pursh. Wauwatosa.
704. Carex stellulata, L. var. angustata. Black's woods, south of National Ave.
705. C. aurea, Nutt. Wauwatosa.
706. C. conoidea, Schk. Wauwatosa.
707. C. Deweyana, Schw. In Black's woods, south of National Ave.
708. C. Novæ-Angliæ, Schw. In the woods with the preceding.
709. C. rosea, Schk. Same woods as preceding.
710. C. scirpoidea, Michx. In Larkin's Tamarack Swamp.
711. C. trichocarpa, Muhl. Same swamp as the preceding.
712. Coreopsis palmata, Nutt. Wauwatosa.
713. Cornus alternifolia, L. Wauwatosa marshes.
714 C. circinata, L'Her. In Schweichart's woods, near Wauwatosa village.
715. Crataegus tomentosa, L. var. punctata, Gray. Northern portions of the county.
716. Dentaria maxima, Nutt. Wauwatosa.
717. Desmodium paniculatum, D. C, Wauwatosa.
718. Erechtites hieracifolia, Raf. White Fish Bay.
719. Eleocharis acicularis, R. Br. Black's woods, south of National Ave.
720. Erigeron strigosus, Muhl. Wauwatosa.
721. Eriophorum gracile, Koch. In Larkin's Tamarack Swamp.
722. *Fumaria officinalis, L. Along a road near the Forest Home Cemetery.
723. Galium circaezans, Michx. In Black's woods, south of National Ave.

724. G. trifidum, L. In Larkin's Tamarack Swamp.
725. Hieracium scabrum, Michx. Grand Ave. road, west of Calvary Cemetery.
726. Hypericum Canadense, L. Wauwatosa.
727. Liatris pycnostachya, Michx. Near Story's Quarry.
728. Menyanthes trifoliata, L. In Larkin's Tamarack Swamp. Now probably exterminated.
729. Polygonatum giganteum, Dietr. North of the Cement Works.
730. Polygonum Careyi, Olney. Swamps south of the city.
731. P. incarnatum, Ell. Same place as preceding.
732. Polygonum Virginianum, L. Spring Meadow.
733. Pyrola secunda, L. White Fish Bay.
734. *Rumex conglomeratus, Murray. Wauwatosa.
735. Salix lucida, Muhl. Along the Milwaukee River near Krohn's summer resort.
736. Scirpus pungens, Vahl. Wauwatosa.
737. Solidago Ohioensis, Riddell. Near Story's Quary.
738. S. speciosa, Nutt. Bay View.
739. Sparganium simplex, Hudson. Along the Kinnikinnic River.
740. Spiranthes latifolia, Torr. Near the Cement Works.
741. Streptopus roseus, Michx. Wauwatosa.
742. *Tragopogon pratensis, L. Escaped from gardens in several places.
743. Ulmus fulva, Michx. In Schweichart's woods.
744. U. racemosa, Thomas. In the same woods and along some of the streets of the city.
745. Valeriana edulis, Nutt. Story's Quarry.
746. Verbena bracteosa, Michx. In the Menomonee Valley, recently introduced from the counties further west.
747. Vernonia fasciculata, Michx. Menomonee Valley.
748. Virburnum dentatum, L. Southern and western parts of the county.
749. Vicia Cracca, L. White Fish Bay.