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OF THE

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VOLUME VI.

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TABLE OF CONTENTS

VOLUME VI

Each number paged separately

No. 1

No. 2

No. 3

No. 4

BULLETIN OF THE STATE UNIVERSITY OF IOWA

NEW SERIES No. 28 MAY 13, 1911

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VOLUME VI NUMBER 1

THE HYDROIDS

of the

WEST COAST OF NORTH AMERICA

With special reference to those of the Vancouver Island region

with a map and eight plates

C. McLEAN FRASER

PUBLISHED BY THE UNIVERSITY

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THE HYDROIDS OF THE WEST COAST OF NORTH AMERICA

INTRODUCTION

The new material examined in connection with the preparation of this paper has been collected from various localities in the Vancouver Island Region. In the summer of 1903 I spent some time at the Minnesota Seaside Station at Port Renfrew on the West Coast of Vancouver Island at the entrance of the Strait of Juan de Fuca. There was no provision made for dredging, consequently all the specimens obtained were shore forms. In 1908 and again in 1909 I spent some time at the Dominion Biological Station at Departure Bay, five miles from the City of Nanaimo on the East Coast of the Island. Here I collected shore specimens and obtained others by dredging, seldom in water more than 25 fathoms deep. The best locality for dredging was in Northumberland Strait, between Gabriola Island and other smaller Islands, at the mouth of Dodd's Narrows, a narrow channel between two small islands, about ten miles southeast of the Station. Besides the specimens that I collected while there, several others were handed over to me by Rev. G. W. Taylor, the curator of the Station. These were obtained at various times from various points along the coast from Rose Spit on Graham Island in the Queen Charlotte Archipelago, southward as far as Victoria, and many of these were very fine specimens. In 1909 Prof. John Macoun, Curator of the Dominion Museum at Ottawa, with two assistants, Messrs. Spreadborough and Young, spent four months collecting off Amphitrite Point at the entrance to the Alberni Canal on the West Coast, making the village of Ucluelet their working base. Through the kindness of Prof. Macoun, I received the Hydroids of the Collection for examination. During that same season, Dr. A. G. Huntsman went over to Ucluelet from Departure Bay, to collect for the University of Toronto. He brought back some Hydroids that helped to supplement the material from Prof. Macoun's collection. The specimens from Ucluelet were collected along the shore and from dredging in shallow water up to 30 fathoms.

When I came to the University of Iowa last September, Prof. C. C. Nutting placed at my disposal two collections from San Juan Archipelago, not previously examined, the one made by Mr. H. Moon, a graduate of the University of Iowa, and the other by Prof. T. Kincaid of the University of Washington, Seattle. The collection belonging to the University and Prof. Nutting's own collection, both extensive, have been available for reference and comparison. A collection made at Canso, Nova Scotia, under the supervision of Prof. R. Ramsay Wright, while connected with the University of Toronto, was also of value in comparing the West Coast forms with those on the Atlantic Coast. These collections, then, form the basis for the work set forth in this paper.

As so many contributions to Hydroid Literature were at hand, on the advice of Prof. Nutting, I decided to extend the work to include all the references to Hydroid distribution on the West Coast up to the present time. The paper, therefore, is intended to serve two purposes, (1) To give a list of all the species found in the new material from the Vancouver Island Region, with the description of any new species found or any new points of interest observed in connection with forms already described. (2) To give a full list of species known to exist on the West Coast of North America, with the full recorded distribution of each species along this coast.

The Hydroid history of the Coast as far as collecting is concerned, up until 1901, has been given by Prof. Nutting in his paper on the Harriman Hydroids. Since that time he has extended the list of Sertularians in his monographic work of 1904. Dr. Torrey reported several new species and extended the range of many others, chiefly along the California Coast, by his paper on Pacific Hydroids in 1902, and that on San Diego Hydroids in 1904. In 1907, E. Jäderholm in his paper "Zur Kenntnis der Hydroiden-fauna des Beringsmeeres", reported several other species from the Bering Sea, two of which, *Halecium telescopicum* and *Stegopoma plicatile,* had not previously been reported from the West Coast.

Although I have added but seven new species and ten more that had not been reported from the Coast previously, the closer connection made between the Alaskan and Californian forms by the identification of species new to the Vancouver Island Region, serves as a slight addition to our too scant knowledge of the fauna of the Pacific.

That no doubt may exist as to the exact location of the points most commonly mentioned, I have appended an outline map of the Vancouver Island Region, extending far enough north to include all the localities mentioned in the paper in connection with the new material examined.

It might be well to say a few words with regard to the nature of the coast at the various localities. In general it may be said that the whole West Coast is rocky, tending in many places to be precipitous. The sandy reaches are comparatively few and pebbly beaches just as rare. At Port Renfrew the Station is situated on a projecting point between San Juan Harbor and the open Pacific. The rock is a slate formation with an extensive dip, covered with sandstone and conglomerate. On the ocean side the swell rolls in with the strata and the covering is well worn off with the force of the waves so there is little chance for attachment to the smooth rocks. On the harbor side, the swell strikes against the strata so that the slate breaks off with ragged edges. In many cases the underlying strata may be worn out more than those above and the latter are left overhanging, making perfect feeding ground for numerous animal forms. The sandstone above becomes worn into potholes and as the water in them is replenished with each flow of the tide they make excellent salt water aquaria. At Ucluelet the conditions are much different, as Amphitrite Point is low-lying, much of it covered at high tide, and the depth of the water increases more gradually than usually on this coast, but here also there is an exposed and a sheltered side. At Departure Bay, the bay itself is almost land-locked so that little wave action is noticeable though the variation in the tide is greater than usual. Eel grass and seaweed are plentiful but they are covered so much with diatoms and other similar forms that the Hydroids found on them are not very readily examined. On the lee side of some of the islands at the entrance, where there are overhanging rocks, the conditions are more favorable. Most of the bay is less than 25 fathoms in depth but several species were obtained by dredging, among them the interesting new forms, *Crypta huntsmani* and *Hydractinia aggregata*. In Northumberland Strait at the mouth of Dodd's Narrows there is a powerful tide-rip at the change of the tide, which cannot fail to bring a good food supply to the animals that are near enough to reap the benefit. In the San Juan Archipelago the conditions are very much as those already described. The shores of the various islands are in general not very well adapted to collecting, though there are some favored spots. The numerous channels between the islands give a variety of current and plenty of interchange to make good feeding grounds for such forms as Hydroids. As the Archipelago is in the direct path of the current through the Strait of Juan de Fuca, these conditions are accentuated. The base for work in this vicinity is at Friday Harbor, on the Eastern or sheltered side of San Juan Island, at which there is now a regular Biological Station under the direction of Prof. T. Kincaid of the University of Washington.

My thanks are especially due to Prof. C. C. Nutting, who has given so much advice and assistance and supplied so many conveniences for advancing the work. The list of papers available for consultation has been extended through the kindness of the Librarian of the John Crerar Library, Chicago, who, through Mr. M. G. Wyer, the University Librarian, loaned some rare and important papers. I wish also to express my obligation to Rev. G. W. Taylor, Prof. John Macoun and Dr. A. G. Huntsman for collections of material, to Prof. Josephine E. Tilden and Prof. Conway MacMillan for their courtesy and assistance at the Minnesota Seaside Station, and to my wife who has contributed to the work by making the pen drawings for the plates from camera-lucida drawings supplied.

GEOGRAPHIC DISTRIBUTION

In 1876 Dr. S. F. Clark reported 24 species of Hydroids from the Pacific Coast, south of Vancouver Island and later in the same year 42 species from Alaskan waters. Taking these reports as a basis he concluded that since he found only one species, *Lafœa dumosa,* in the two regions, there must be a distinct break in distribution between the two regions. Investigations since that time have shown that no such generalization should be made on so small an amount of data. The more the group is studied and the greater the number of locations for examination included, the more reason there is for believing that there are no sudden, nor even comparatively sudden, breaks in distribution along the entire West Coast, though naturally certain species gradually disappear and others as gradually come in. At the present time, out of a total of 196 species, there is record of 155 species from the Vancouver Island Region and north of it, and 88 south of that region. No less than 47 or 24% of the whole number are common to the two, these being divided up as follows: Gymnoblastic forms 9, Campanularians (here used in the broad sense of all hydrothecate forms except Sertularians and Plumularians) 20, Sertularians 11 and Plumularians 7. Furthermore, 22 species that are found north of Vancouver Island, are found in the Vancouver Island Region as well as in the Region south of it.

Referring again to Dr. Clark's paper[1], he says "There is little doubt that when the fauna has been more thoroughly investigated, the number of Hydroids may be at least doubled. Such a variety as exists on the New England Coast can hardly be expected from our Pacific shores south of Vancouver Island, for the waters there do not afford the same diversity of temperature." The basis for this latter conclusion was rather insufficient also. Since that time, the work that has been done south of Cape Flattery, has been limited almost entirely to the work of Dr. Torrey, which, however excellent it has been, has been largely confined to the vicinity of San Francisco and San Diego with some intermediate points, and a little dredging by the "Albatross", reported as yet only so far as the Sertularians and Plumularians are concerned, yet the number of species has increased from 24 to 88, and as far as I can see, if the waters off shore from Cape Flattery to San Francisco are carefully worked, there is no reason to suppose that the latter number might not be doubled, or that it might not favorably compare with an equal amount of Coast-line on the Atlantic side of the continent.

However that may be with regard to the coast south of Cape Flattery, there is no stretch of the Atlantic Coast equal in extent to that of the Pacific Coast to the north of Cape Flattery that can offer such variety of favorable conditions for Hydroid growth as there is to be found in that region. The broken nature of the outline, the presence of innumerable islands, large and small, throughout the entire length, in many cases separated by great depths of water, making a variety of currents and tide-waves, and a wide range of temperature, though the cold, which the Hydroid usually prefers, is predominant. The profusion of plant life everywhere evident, is a good indication of the variety in

[1] Hydroids of the Pacific Coast, 1876, p. 251.

animal life that may be found along the shores and in the depths and among the forms of animal life there is every reason to believe that the Hydroid is well represented. When the little collecting that has been done, has brought to light 111 species in the Vancouver Island Region and 101 species north of the Island, what may we expect when the whole coast has been carefully examined?

In examining the distribution of the species along the Coast, I have prepared two tables: one, a table of distribution showing the number of species in various areas along the Coast, as well as to some extent, their general distribution, though this is not intended to be exhaustive, the other, a table of comparisons in number of species in various areas. An analysis of these tables shows several interesting points.

Before going into the general discussion, it might be well to note that Dr. Clark was hardly justified in making the statement that there is a distinct break at Shumagin Islands any more than at any other point along the Coast. Of 57 species that have been reported from Bering Sea and the Aleutian Islands, distributed as follows: Gym. 5, Camp. 11, Sert. 39 and Plum. 2, 38 or 67%, Gym. 3, Camp. 8, Sert. 26, Plum. 1, have been found farther East and South along the Coast, the various groups supplying proportionate numbers. It is also interesting that, in proportion to the number of species obtained in the two cases, the species found on the West Coast of Vancouver Island bear a quite similar relation to those north and south of the Island, as do those on the East Coast. Of the 36 species found on the West Coast of Vancouver Island, 21 have been found north of the Island, i. e. 58% and 22 south of the Island or 61%. This may be tabulated as follows:

	Total	Gym.	Camp.	Sert.	Plum.
WEST.	36	4	14	14	4
Common to North,..	21	2	8	10	1
Common to South,..	22	3	7	8	4
EAST.	101	8	55	31	7
Common to North,..	52	1	25	25	1
Common to South,..	38	4	20	9	5

Of the 101 species on the East Coast 52 or 51% are also found to the North and 38 or 38% are also found to the South. The affinities of the species on the East side of the Island show a tendency towards the North rather than the South, somewhat more so than those on the West side. It is rather gratifying to find that only four species are found common to the north and the south of Vancouver Island that are not found in the Vancouver Island Region, because this indicates that however scanty the collection is, it must be fairly representative of the whole coast.

Since the number of species has become more extensive, the conclusions of some earlier authors that for a great number of species, the distribution occurs along meridional lines from a circumpolar centre, seem to be more fully corroborated. Of the 45 species common to the East and West Coasts of North America, no less than 40 or 89% are also found either in Europe or in the Arctic Regions generally, distributed as follows: Total 45, Gym. 7, Camp. 23, Sert. 13, Plum. 2; Common 40, Gym. 6, Camp. 21, Sert. 12, Plum. 1, while the total number of species common to the West Coast and the South Pacific is inconsiderable.

Taking up a more particular comparison of forms along the Coast itself, though there is a fairly general distribution in the different groups, the centre of distribution for the coast varies to a large extent.

Of the Gymnoblastic forms 31 have been found along the whole coast, but the distribution is much scattered. This may be accounted for by the fact that most of the collecting has been done by men that are not hydroid systematists and the soft yielding nature of the Gymnoblastic forms makes them less noticeable to such collectors, than the more rigid, and in general more conspicuous, Calyptoblastic forms. Corroboration is given to this from the number of Gymnoblastic forms reported by Dr. Torrey from the California Coast. He, being familiar with such forms, was able to find a relatively large number. No one species has been found over a large area, although some are quite abundant in certain localities. Cape Flattery divides the group quite accurately into two equal parts. 20 species have been found north of that point and 20 south of it. 11 are restricted to the north and 11 to the south. Those to the north are evenly divided between the Vancouver Island Region and north of it. 9 are found in the Vancouver Island Region and not north of it and 8 are found north of that Region that are not found in it. 3 are common to the two regions. 12 species are circumpolar but none are found common to the South Pacific.

Among the Campanularian forms, in the Family *Campanular-*

idæ itself, *Campanularia verticillata* and *Obelia dichotoma* appear at the greatest number of points in quantity. Next to *Obelia geniculata,* they have the widest general distribution of any species found on the West Coast, but *Obelia geniculata* has been reported only from the California Coast on the West, up to the present time. *Campanularia volubilis* is also quite common. Among the *Campanulinidæ,* a family represented by very few species, *Calycella pygmæa* and *Calycella syringa* are the only widely-distributed forms. No equal area so little investigated as far as I have been able to find out, possesses so great a variety in the Family *Halecidæ,* which with the exception of Dr. Torrey's one species, *Campalecium medusiferum,* is restricted to one genus. 18 species are reported, 11 of which are found in the Vancouver Island Region. Only 6 have been reported elsewhere and strangely enough 3 of these are from the Australian Region. In the *Lafœidæ* 3 species of *Lafœa, dumosa, gracillima,* and *fruticosa* are particularly abundant, but they are all cosmopolitan forms. As far as mass of material is concerned, these three species supply a greater amount than any other three species on the Coast.

The number of Campanularians is quite extensive. The colonies of many of them are large and much branched so that they are easily detected. More of them are very small, even microscopic, but they use the other larger colonies of Hydroids for their hosts and thus are collected with them. The distribution of the group differs from the Gymnoblastic group, the centre of distribution being moved to the northward. Of the 78 species found along the Coast, 68 or 87% are found in the Vancouver Island Region or north of it, while only 38 or 48% have been reported to the south. 48 species are restricted to Vancouver Island Region and the north, 13 of these to the north of Vancouver Island alone, and only 10 are restricted to the south. 55 are found in the Vancouver Island Region, 70% of the whole number. 36 or 46% are circumpolar.

In the *Sertularidæ, Abietinaria abietina* and *Sertularella tricuspidata,* here as in general distribution, cannot be approached for number by any other species. *Abietinaria variabilis, Abietinaria amphora, Abietinaria anguina* and *Abietinaria traski,* the last three being restricted to the Coast, have a wide range. *Selaginopsis cylindrica, Selaginopsis mirabilis, Thuiaria dalli* and

Thuiaria similis are very plentiful in the Vancouver Island Region and the north. In this group the centre of distribution is still farther to the northward. Out of a total of 68 species, 57 or 83% are found north of Cape Flattery, 49 or 72% being found north of Vancouver Island, and only 22 or 32% to the south. 46 are restricted to the north and only 11 to the south. 36 or 53% are found in the Vancouver Island Region and 26 or 38% are circumpolar.

In the *Plumularidæ* only two, *Aglaophenia struthionides* and *Plumularia lagenifera,* are at all wide-spread, but these two are very abundant. Many species are reported only from a single locality. The centre of distribution for the family, if one can speak of such when the distribution is so scattered, is south of Cape Flattery. This is natural as the family is especially a tropical one. Out of a total of 19 species only 10 or 53% are found in the north, while 16 or 84% are found in the south. Only 3 are found north of Vancouver Island. One of these, the only representative of a genus, is reported only from the Aleutian Islands. 12 species or 63% are restricted to the West Coast. The 7 that are found elsewhere have practically nothing in common in their distribution. *Aglaophenia latirostris,* reported from Brazil, was found off the Oregon Coast and in the San Juan Archipelago. *Aglaophenia pluma,* reported from Great Britain, Southern Europe and South Africa, was found off the California Coast. *Diplocheilus allmani,* reported from the Japan Coast, was found off the Coast of California. *Plumularia corrugata,* reported from Brazil and the Hawaiian Islands, was found in the San Juan Archipelago. *Plumularia echinulata,* reported from the British Coast, was found in Puget Sound. *Plumularia megalocephala,* reported off Georgia, was found off the California Coast. *Plumularia setacea,* reported from Europe and Florida, was found off the California Coast. From such an incongruous list it is impossible to generalize as to distribution. It would seem either, that these species represent the ragged ends of lines of distribution from a centre not yet discovered, or that the connections are made along lines in deep water, where up to the present they have not been reached.

I have very little accurate information concerning bathymetrical distribution and still less concerning temperature, not enough in either case to form a basis for general discussion.

Geographical Distribution of the Hydroids found off the West Coast of North America

	Bering Sea	Aleutian Islands	East of Aleutian Is. to Sitka	From Sitka to Vancouver I.	East Coast of Vancouver I.	San Juan Archipelago	Puget Sound Region	West Coast of Vancouver I.	From C. Flattery to San Francisco	South of San Francisco	South Pacific	East Coast of North America	Europe	Arctic Regions
Clava leptostyla									+			+	+	
Crypta huntsmani						+								
Coryne brachiata			+											
Syncoryne eximia			+							+			+	
Syncoryne mirabilis					+	+	+		+	+		+		+
Garveia annulata			+					+	+	+				
Garveia formosa										+				
Garveia nutans			+										+	
Bimeria franciscana									+					
Bimeria gracilis										+				
Bimeria robusta						+				+				
Bougainvillia glorietta										+				
Bougainvillia mertensi	+				+				+					
Perigonimus repens	+		+		+								+	
Eudendrium californicum				+	+	+								
Eudendrium capillare		+										+	+	+
Eudendrium rameum										+		+	+	+
Eudendrium ramosum										+			+	
Eudendrium vaginatum		+	+										+	
Hydractinia aggregata					+	+								
Hydractinia californica										+				
Hydractinia milleri								+	+	+				
Corymorpha carnea	+													
Corymorpha palma										+				
Tubularia borealis	+													
Tubularia crocea				+					+	+		+		
Tubularia harrimani			+					+						
Tubularia indivisa	+											+	+	+
Tubularia larynx							+					+	+	+
Tubularia marina									+	+				
Tubularia tubularoides									+					
Campanularia denticulata			+		+	+				+				
Campanularia exigua					+		+	+					+	
Campanularia fusiformis					+					+				
Campanularia grœnlandica			+				+	+					+	+
Campanularia hesperia						+				+				
Campanularia hincksi										+		+	+	+
Campanularia integra	+		+			+	+				+	+	+	+
Campanularia kincaidi					+		+							
Campanularia occidentalis										+				
Campanularia pacifica					+	+			+					
Campanularia raridenta				+	+								+	
Campanularia regia			+											
Campanularia rigida									+					
Campanularia ritteri			+											

	Bering Sea	Aleutian Islands	East of Aleutian Is. to Sitka	From Sitka to Vancouver I.	East Coast of Vancouver I.	San Juan Archipelago	Puget Sound Region	West Coast of Vancouver I.	From C. Flattery to San Francisco	South of San Francisco	South Pacific	East Coast of North America	Europe	Arctic Regions
Campanularia speciosa			+			+								+
Campanularia urceolata			+		+	+		+	+	+				
Campanularia verticillata	+		+	+	+	+	+			+		+	+	+
Campanularia volubilis				+	+	+		+		+		+	+	+
Clytia attenuata						+	+							
Clytia bakeri										+				
Clytia edwardsi						+	+	+		+		+		
Clytia hendersoni										+				
Clytia johnstoni			+				+		+			+	+	
Clytia universitatis										+				
Eucopella caliculata			+			+	+				+	+	+	+
Eucopella compressa			+							+	+			
Eucopella everta					+			+		+				
Gonothyræa clarki			+		+	+				+				+
Gonothyræa inornata			+											
Obelia borealis			+			+		+						
Obelia commissuralis									+			+		
Obelia corona										+				
Obelia dichotoma			+		+	+	+			+	+	+	+	+
Obelia dubia			+		+	+		+						
Obelia fragilis							+							
Obelia gelatinosa							+					+	+	
Obelia geniculata									+	+	+	+	+	+
Obelia gracilis						+	+							
Obelia griffini					+		+							
Obelia longissima		+		+	+	+					+	+	+	+
Obelia plicata			+		+	+	+						+	
Obelia surcularis							+							
Thaumantias inconspicua					+	+	+						+	
Calycella pygmæa					+	+	+						+	
Calycella syringa			+	+	+	+	+			+		+	+	+
Campanulina forskalea						+								
Campanulina rugosa			+				+							
Cuspidella humilis					+	+						+	+	+
Lovenella producta					+	+						+	+	+
Stegopoma plicatile	+												+	+
Campalecium medusiferum										+				
Halecium annulatum					+			+		+				
Halecium balei						+					+			
Halecium corrugatum							+							
Halecium densum						+	+	+						
Halecium halecinum			+				+	+				+	+	+
Halecium kofoidi						+				+				
Halecium muricatum		+	+									+	+	+
Halecium ornatum			+											
Halecium pygmæum						+								
Halecium reversum			+											
Halecium robustum			+											
Halecium scutum		+	+			+								
Halecium speciosum			+											

	Bering Sea	Aleutian Islands	East of Aleutian Is. to Sitka	From Sitka to Vancouver I.	East Coast of Vancouver I.	San Juan Archipelago	Puget Sound Region	West Coast of Vancouver I.	From C. Flattery to San Francisco	South of San Francisco	South Pacific	East Coast of North America	Europe	Arctic Regions
Halecium telescopicum	+										+			
Halecium tenellum						+				+	+	+	+	+
Halecium washingtoni					+	+	+			+				
Halecium wilsoni					+	+	+	+						
Filellum expansum						+							+	+
Filellum serpens			+			+					+	+	+	+
Grammaria immersa	+		+			+								+
Hebella pocillum	+		+									+	+	+
Lafœa adhærens			+											
Lafœa dumosa		+	+	+	+	+	+	+	+	+	+	+	+	+
Lafœa fruticosa	+	+	+			+	+					+	+	+
Lafœa gracillima			+		+	+	+	+		+	+	+	+	+
Lafœa grandis						+							+	+
Lictorella carolina						+								
Abietinaria abietina	+	+	+	+	+	+	+	+	+	+		+	+	+
Abietinaria alexanderi		+												
Abietinaria amphora		+			+	+	+	+	+					
Abietinaria anguina			+	+	+	+		+	+	+				
Abietinaria annulata		+												
Abietinaria costata			+											
Abietinaria filicula			+		+	+	+					+	+	+
Abietinaria gigantea	+	+	+			+								
Abietinaria gracilis		+						+						
Abietinaria greenei					+	+		+	+	+				
Abietinaria inconstans		+												
Abietinaria rigida						+								
Abietinaria traski				+	+	+		+	+	+				
Abietinaria turgida	+	+	+											+
Abietinaria variabilis	+	+	+			+	+		+	+				+
Dictyocladium flabellum		+						+						
Diphasia claræ				+		+								
Diphasia corniculata									+					
Diphasia kincaidi			+											
Diphasia pulchra						+								+
Hydrallmania distans				+	+	+	+	+						
Hydrallmania franciscana									+					
Selaginopsis cedrina	+													
Selaginopsis cylindrica	+	+	+	+		+	+							
Selaginopsis hartlaubi	+					+								+
Selaginopsis mirabilis	+	+	+		+	+	+					+	+	+
Selaginopsis obsoleta	+													+
Selaginopsis ornata		+												
Selaginopsis pinaster	+													
Selaginopsis pinnata	+			+		+								
Selaginopsis plumiformis	+													
Selaginopsis triserialis										+				
Sertularella albida	+		+											
Sertularella clarki		+												
Sertularella complexa		+	+											
Sertularella conica						+	+	+				+		

	Bering Sea	Aleutian Islands	East of Aleutian Is. to Sitka	From Sitka to Vancouver I.	East Coast of Vancouver I.	San Juan Archipelago	Puget Sound Region	West Coast of Vancouver I.	From C. Flattery to San Francisco	South of San Francisco	South Pacific	East Coast of North America	Europe	Arctic Regions
Sertularella dentifera										+				
Sertularella elegans		+												
Sertularella fusiformis									+		+	+	+	
Sertularella levinseni		+												
Sertularella magna	+	+												
Sertularella minuta		+												
Sertularella pinnata		+	+			+								
Sertularella polyzonias	+		+			+					+	+	+	+
Sertularella rugosa			+				+					+	+	+
Sertularella tanneri								+						
Sertularella tenella						+	+		+		+	+	+	+
Sertularella tricuspidata	+	+	+		+	+	+		+	+	+	+	+	+
Sertularella turgida				+	+	+	+	+	+	+				
Sertularia cornicina										+	+	+		
Sertularia desmoides										+				
Sertularia furcata								+	+	+			+	
Sertularia gracilis										+		+	+	
Sertularia pedrensis										+				
Sertularia pumila										+		+	+	+
Synthecium cylindricum										+	+			
Thuiaria alba						+								
Thuiaria argentea	+	+	+			+						+	+	+
Thuiaria dalli	+	+			+	+		+						
Thuiaria elegans	+													
Thuiaria fabricii			+		+	+	+						+	+
Thuiaria kurilæ		+												
Thuiaria plumosa	+													+
Thuiaria robusta	+							+	+					+
Thuiaria similis	+	+	+		+	+	+							
Thuiaria tenera	+		+				+						+	+
Thuiaria thuiarioides	+		+				+							
Thuiaria thuja	+	+		+		+						+	+	+
Aglaophenia diegensis										+				
Aglaophenia inconspicua										+				
Aglaophenia latirostris							+			+				
Aglaophenia octocarpa										+				
Aglaophenia pluma										+				
Aglaophenia struthionides					+	+	+	+	+	+				
Antenella avalonia										+				
Diplocheilus allmani										+				
Nuditheca dalli		+												
Plumularia alicia										+				
Plumularia corrugata						+								
Plumularia echinulata							+						+	
Plumularia goodei								+		+				
Plumularia lagenifera			+	+	+	+	+	+	+	+				
Plumularia megalocephala										+		+		
Plumularia palmeri					+			+		+				
Plumularia plumularoides	+									+				
Plumularia setacea					+	+			+	+		+	+	
Plumularia virginiæ										+				

A COMPARATIVE DISTRIBUTION TABLE

	Total	Gymno-blastea	Campan-u'arian forms	Sertu-larians	Plumu-larians
Number of species from the entire Coast	196	31	78	68	19
Number of new species	7	2	2	3	0
Number of species new to the Coast	17	3	9	3	2
Number of species north of Vancouver Is.	101	11	38	49	3
Number in V. I. Region and north of it	155	20	68	57	10
Number south of Vancouver Island Region	88	20	30	22	16
Number common to these two divisions	47	9	20	11	7
Number restricted to Northern Division	108	11	48	46	3
Number restricted to Southern Division	41	11	10	11	9
Number in the Vancouver Island Region	111	12	55	36	8
Number north of V. I. not in V. I. Region	44	8	13	21	2
Number in V. I. Region and not north of it	54	9	30	8	7
Number common to V. I. Region and north of it	57	3	25	28	1
Number in V. I. Region and south of it	156	25	66	47	18
Number in V. I. Region and not south of it	68	5	36	25	2
Number south and not in V. I. Region	45	13	11	11	10
Number common to V. I. Region and to the south of it	43	7	19	11	6
Number not in V. I. Region but common to north and south	4	2	1	0	1
Number common to East and West Coasts of North America	45	7	23	13	2
Number common to Europe and West Coast of North America	59	10	31	15	3
Number common to Arctic Regions and West Coast	52	5	27	21	0
Number common to South Pacific and West Coast of North America	18	0	12	6	0
Number restricted to West Coast of N. A.	111	19	39	41	12

SOUTHERN PORTION
OF
VANCOUVER ISLAND REGION

SYSTEMATIC DISCUSSION

In the nomenclature used in this paper no new departures have been made from that in most general use by other authors. Other things being equal, that used by authors who have done the greatest amount of work in the field, has been followed. 'Tis true that sometimes there is no little disagreement among these on certain points, but in all cases a position has been adopted such that anyone who is familiar with Hydroid Literature, will be able to trace with case the relation of any species, and that is the chief use for nomenclature.

In case any particular author is followed in any family or group, it is indicated in the special discussion at the point where the family or group is taken up. Where no author is followed in entirety, the characteristics of the family or group are given as used. Except in special cases no authors' names are given except in connection with the species.

I have made no endeavor to indicate all the changes in synonymy, as that is necessary only in monographic work. I have tried in every case to give the original binomial designation with its reference and at least the majority of references made by authors who have dealt with the Hydroids of the West Coast. Further references can readily be obtained from the works of such authors as Nutting, Broch and Jäderholm.

GYMNOBLASTEA

In taking up the gymnoblastic hydroids, I have followed Allman's classification[2] almost entirely, at least as far as the Families are concerned. For that reason I shall not give the characters of each family, simply taking these given by Allman as the basis. I do this because, while I think it makes very little difference how the classification is made as long as the species referred to, is made evident, there certainly is nothing gained in clearness by grouping as much as some authors do, even where intergrading takes place, as it is always liable to do. Allman has not gone so far in the other direction as to make confusion by division into smaller groups. In any case his classification

[2] Monograph of Gymnoblastic Hydroids, Ray Society, 1871.

will answer the purpose in this paper, and it is unnecessary to discuss it further.

The shore and shallow water forms have been carefully investigated in only a few localities on the West Coast, and for that reason the number of representatives of the Gymnoblastea reported, is not very large, but those obtained show sufficient variety to have several families represented.

CLAVIDÆ

Genus CLAVA

Trophosome.—Hydrocaulus rudimental; hydrorhiza of creeping tubes; both invested with perisarc. Hydranths club-shaped.

Gonosome.—Sporosacs on the body of the hydranth, proximal to the tentacles.

CLAVA LEPTOSTYLA Agassiz

Clava leptostyla Agassiz, Cont. Nat. Hist. U. S., 1862, p. 218.
Clava leptostyla Torrey, Hydroida of the Pacific Coast, 1902, p. 30.

Distribution.—San Francisco Bay, Cal. (Torrey).

TURRIDÆ

Genus CRYPTA new genus

Trophosome.—Hydrorhiza of small fibres or almost entirely degenerated. Hydrocaulus not strongly developed. The perisarc which envelopes the hydrocaulus also unites one with the others, this connection being in the nature of a very thin encrustation. Hydranths claviform.

Gonosome.—Gonophores producing free medusæ.

CRYPTA HUNTSMANI new species

Pl. I, Figs. 1-5

Trophosome.—Hydrocaulus tubular, up to 8 mm. in height in adult forms. Perisarc so thin as to be a mere pellicle. That which forms the basal expansion is also very thin and transparent. The hydrorhiza consists, in the young colony, of a network of fine fibrils, but these appear to degenerate in the older forms, so that when a single animal is separated from the colony it pulls out like a fungus with a portion of the mycelium attached. The hydranth appears much darker than the hydrocaulus. It is usually club-shaped but seems to have much mobility, so that its appearance differs much at different times. In some cases the tentacles, which appear to be made up of a series of joints, seem to be arranged in fairly definite rows, but more commonly there seems to be no regularity in their arrangement; they are simply scattered over the hydranth surface. In the young forms they may be very few in number but as development proceeds the number is increased, until as many as 24 may be present.

Gonosome.—Gonophores, from 1 to 3, are developed a short distance below the tentacles. From each of these a single medusa with 4 marginal tentacles is developed.

Distribution.—Departure Bay.

I am indebted to Dr. A. G. Huntsman for the pleasure of studying this rather unique species. It is found in the branchial basket of several species of simple Ascidians, dredged from 5 to 20 fathoms and if it had not been that Dr. Huntsman was dissecting one of these Ascidians while I was studying hydroids near him, I should never have come across the species. After he handed over the first specimens I was able to procure a good supply, as the Ascidians were common and many of them were hydroid hosts. Though it is a common occurrence to find hydroids growing on the surface of ascidians, ordinarily one would scarce think of looking for specimens inside. It is evident that such a position is not accidental when the majority of the ascidians possess at least a few hydranths. The hydroids must thrive well in such a habitation, as presumably they get their food from the water current in the branchial basket without receiving any detrimental effect from their position. In two or three cases, instead of these hydroids, I found free-swimming copepods, females with egg-sacs turgid with eggs. It may be that these copepods were in the same locality for the purpose of using the hydroids as food, but there was no direct evidence that such was the case.

It seemed a very easy matter to find all the developmental stages of the hydroid until the period was reached for the formation of the gonophores but there were not many specimens with these present. As I saw no free medusæ I can only surmise that the radial canals are as those in other genera of the Family. There is no doubt as to the four marginal tentacles as in some cases these were plainly visible. In its generic characters there are rather distinct differences from other genera of the Family, yet the resemblances seem sufficient to retain the genus in the Family Turridæ.

CORYNIDÆ

Genus CORYNE

Trophosome.—Hydrocaulus simple or branching. Hydrorhiza of creeping filiform tubes. Both invested with perisarc. Hydranths club-shaped with scattered capitate tentacles.

Gonosome.—Sporosacs developed from the body of the hydranth among, or just proximal to, the tentacles.

CORYNE BRACHIATA Nutting

Coryne brachiata NUTTING, Hydroids of the Harriman Ex. 1901, p. 165.
Coryne brachiata TORREY, Hydroida of the Pacific Coast, 1902, p. 8.

Distribution.—Yakutat Bay, Alaska (Nutting).

SYNCORYNIDÆ

Genus SYNCORYNE

Trophosome.—Hydrocaulus branched or unbranched; hydrorhiza of filiform tubes; both invested with perisarc. Hydranths club-shaped with scattered capitate tentacles.

Gonosome.—Gonophores bearing free medusæ, arising from the body of the hydranth. Medusæ with four marginal tentacles which are bulbous and ocellate at the base.

SYNCORYNE EXIMIA (Allman)

Coryne eximia ALLMAN, Ann. and Mag. N. H., 3rd. Ser. 4, 1859, p. 141.
Syncoryne eximia NUTTING, Hydroids of the Harriman Ex., 1901, p. 166.
Syncoryne eximia TORREY, Hydroida of the Pacific Coast, 1902, p. 31.

Distribution.—Juneau, Alaska (Nutting); Pacific Grove, Cal. (Torrey).

SYNCORYNE MIRABILIS (Agassiz)

Coryne mirabilis AGASSIZ, Cont. Nat. Hist. U. S. IV, 1862, p. 185.
Coryne rosaria A. AGASSIZ, Ill. Cat. 1865, p. 176.
Syncoryne rosaria CLARK, Hydroids of the Pacific Coast, 1876. p. 250.
Syncoryne rosaria FEWKES, New Invert. from Cal. Coast, 1889, p. 4.
Syncoryne mirabilis NUTTING, Hydroids from Alaska and Puget Sound. 1899, p. 741.
Coryne mirabilis CALKINS, Some Hydroids from Puget Sound, 1899, p. 336.
Syncoryne mirabilis HARTLAUB, Hydroiden aus dem Stillen Ocean, 1901, p. 356.
Syncoryne mirabilis TORREY, Hydroida of the Pacific Coast, 1902, p. 31.

Distribution.—San Francisco, Gulf of Georgia (A. Agassiz); Santa Barbara (Fewkes); Puget Sound (Calkins); Bare Island (Hartlaub); San Francisco Bay (Torrey); San Juan Archipelago.

BIMERIDÆ

ATRACTYLOIDES FORMOSA Fewkes

Atractyloides formosa FEWKES, New Invert. from Cal. Coast, 1889, p. 5.

This species, when it was described by Fewkes, was given a new generic as well as a new specific name. As he did not give the generic characters separately, I have referred to it among the species only.

Genus BIMERIA

Trophosome.—Colony branched, invested with a conspicuous perisarc. Hydranth fusiform, hypostome conical. Perisarc covering the base of the tentacles.

Gonosome.—Sporosacs, covered with perisarc, arising from the stem or branches.

BIMERIA FRANCISCANA Torrey

Bimeria franciscana TORREY, Hydroida of the Pacific Coast, 1902, p. 28.

Distribution.—San Francisco Bay (Torrey).

BIMERIA GRACILIS Clark

Bimeria gracilis CLARK, Hydroids of the Pacific Coast, 1876, p. 252.
Bimeria gracilis TORREY, Hydroida of the Pacific Coast, 1902, p. 8.

Distribution.—San Diego (Clark).

BIMERIA ROBUSTA Torrey

Bimeria robusta TORREY, Hydroida of the Pacific Coast, 1902, p. 29.

Distribution.—San Pedro, Cal. (Torrey); San Juan Archipelago.

Some fragments in the San Juan material answer to the description given by Dr. Torrey, but as in his material, there were no gonosomes present. The perisarc extended well up on the base of the tentacles in all cases.

Genus GARVEIA

Trophosome.—Colony branched. Perisarc conspicuous. Hydranths fusiform.

Gonosome.—Sporosacs borne on distinct branchlets, more or less invested with perisarc, which regularly is confined to the branchlets only.

GARVEIA ANNULATA Nutting

Garveia annulata NUTTING, Hydroids of the Harriman Ex., 1901, p. 166.
Bimeria annulata TORREY, Hydroida of the Pacific Coast, 1902, p. 28.

Distribution.—Yakutat and Sitka, Alaska (Nutting); Santa Catalina Island, San Francisco, Cal. (Torrey); Port Renfrew, Ucluelet.

In this case, as in many other cases later in the work, I have followed the principle that because two species or two genera intergrade, it does not follow that the two should be combined under one name. Dr. Torrey has often taken the opposite view, and has here combined *Garveia* and *Bimeria,* both genera instituted by Wright and used by most authors since that time, under the name *Bimeria.* Even if some of the sporosacs of this species are entirely covered with chitin, it does not necessarily follow, that hence the whole genus *Garveia* should be combined with the genus *Bimeria.*

? GARVEIA FORMOSA (Fewkes)

Perigonimus formosus FEWKES, New Invert. of Cal. Coast, 1889, p. 6.
Bimeria formosa TORREY, Hydroida of the Pacific Coast, 1902, p. 8.

Distribution.—Santa Cruz, Cal. (Fewkes).

Fewkes' description of this is not sufficiently clear to decide very definitely as to the genus to which it belongs. It is evidently not a *Perigonimus.* Torrey in his list has placed it with *Bimeria,* but he includes *Garveia* with *Bimeria* in any case. It seems to me that it is probably a *Garveia,* and I have so placed it.

GARVEIA NUTANS Wright

Garveia nutans WRIGHT, Edin. New Phil. Jour., 1859, p. 109.
Garveia nutans NUTTING, Hydroids of the Harriman Ex., 1901, p. 166.

Distribution.—Berg Inlet, Glacier Bay, Alaska (Nutting).

BOUGAINVILLIDÆ

Genus BOUGAINVILLIA

Trophosome.—Colony branching. Hydranths fusiform, hypostome conical.

Gonosome.—Gonophores arising from the stem or branches, producing free medusæ. Medusæ when liberated bell-shaped with four radial canals and eight tentacles, each with an ocellus at the base.

BOUGAINVILLIA GLORIETTA Torrey

Bougainvillia glorietta TORREY, Hydroids of San Diego, 1904, p. 7.

Distribution.—San Diego, Cal. (Torrey).

BOUGAINVILLIA MERTENSI Agassiz

Bougainvillia mertensii AGASSIZ, Cont. Nat. Hist. U. S., IV, 1862, p. 344.
Bougainvillia mertensii A. AGASSIZ, N. A. Acalephæ, 1865, p. 152.
Bougainvillia mertensi TORREY, Hydroida of the Pacific Coast, 1902, p. 1.

Distribution.—Bering Sea, Gulf of Georgia, San Francisco (A. Agassiz); Oakland (Torrey).

Genus PERIGONIMUS

Trophosome.—Colony branched or unbranched. Hydranths fusiform with conical proboscis.

Gonosome.—Gonophores arising from the hydrorhiza, bearing medusæ that when liberated have 2 to 4 marginal tentacles but no ocelli.

PERIGONIMUS REPENS (Wright)

Eudendrium pusillum WRIGHT, Proc. Roy. Phys. Soc. Edin., 1857, p. 231.
Atractylis repens WRIGHT, Proc. Roy. Phys. Soc. Edin., 1858, p. 450.
Perigonimus repens ALLMAN, Ann. and Mag. N. H., 3rd Ser. 13, 1864, p. 365.
Perigonimus repens CALKINS, Some Hydroids of Puget Sound, 1899, p. 339.
Perigonimus repens TORREY, Hydroida of the Pacific Coast, 1902, p. 29.

Distribution.—Townshend Harbor (Calkins); Sausalito, Cal. (Torrey); Departure Bay.

EUDENDRIDÆ

Genus EUDENDRIUM

Trophosome.—Colony branching. Hydranths with hypostomes somewhat trumpet-shaped.

Gonosome.—Sporosacs developed from the hydranth just below the tentacles.

EUDENDRIUM CALIFORNICUM Torrey

Eudendrium californicum TORREY, Hydroida of the Pacific Coast, 1902, p. 32.

Distribution.—San Francisco Bay, Tomales Bay, Pacific Grove, Cal. (Torrey); Santa Cruz, Monterey Bay, Cal. (Clark); Port Renfrew, Ucluelet.

EUDENDRIUM CAPILLARE Alder

Eudendrium capillare ALDER, Trans. Tyne. F. C. III, 1857, p. 105.
Eudendrium capillare HINCKS, British Hydroid Zoophytes, 1868, p. 84.

Distribution.—San Juan Archipelago.

There were only two or three specimens of this *Eudendrium*, but these had gonophores present that are similar to those of *Eudendrium capillare* as is the trophosome as well. Though the species has not hitherto been reported from this coast, I have no doubt that the specimens belong to the species.

EUDENDRIUM RAMEUM (Pallas)

Tubularia ramea PALLAS, Elench. Zooph., 1766, p. 83.
Eudendrium rameum TORREY, Hydroida of the Pacific Coast, 1902, p. 33.
Eudendrium rameum TORREY, Hydroids of San Diego, 1904, p. 8.

Distribution.—San Pedro, Cal. (Torrey).

EUDENDRIUM RAMOSUM (Linnæus)

Tubularia ramosa LINNÆUS, Systema Naturæ, 1767, p. 1302.
Eudendrium ramosum TORREY, Hydroida of the Pacific Coast, 1902, p. 34.
Eudendrium ramosum TORREY, Hydroids of San Diego, 1904, p. 8.

Distribution.—Pacific Grove, San Diego, Cal. (Torrey).

EUDENDRIUM VAGINATUM Allman

Eudendrium vaginatum ALLMAN, Ann. and Mag. N. H., 3rd Ser. 11, 1863, p. 10.
Eudendrium pygmæum CLARK, Alaskan Hydroids, 1876, p. 232.
Eudendrium vaginatum NUTTING, Hydroids of the Harriman Ex., 1901, p. 167.

Distribution.—Akutan Pass, Alaska (Clark); Sitka Harbor and Yakutat, Alaska (Nutting).

HYDRACTINIDÆ

Genus HYDRACTINIA

Trophosome.—Hydranths club-shaped, developed from a basal cœnosarc. Proboscis conical.

Gonosome.—Sporosacs developed on special zooids with few or no tentacles, often provided with thread-cells.

HYDRACTINIA AGGREGATA new species

Pl. II, Figs. 1-4

Trophosome.—The nutritive zooid of this species appears much stouter near the distal end than *Hydractinia polyclina*. Part of this stoutness may be due to contraction in the preserved specimen, but in comparing with preserved specimens of *H. polyclina* the difference is still evident. As in other species, the number of tentacles increases during development, the number in the adult being 20-24.

Gonosome.—The generative zooids develop sporosacs while still very young. In the early stages there may be as many as 10 or

12 tentacles, but these tend to degenerate. Though I found no specimen entirely without them, the number in some cases was reduced to 3 or 4. A mouth appears to be present in all cases. The female sporosacs become of large size and remain quite globular. Each contains a large number of ova. The male sporosacs are not nearly so large as the female and are oval in shape. In some cases at least nematocysts are present, but instead of being definitely grouped, they are somewhat irregularly scattered over the surface both distal and proximal to the tentacles. I did not find any of these on the young forms with the numerous tentacles, and it may be that they are not developed until the tentacles are to some extent degenerated.

Distribution.—Departure Bay, San Juan Archipelago.

The generative and nutritive zooids are not scattered promiscuously. Each kind has its own definite locality with no intermixing except at or near the limit where the areas meet. All specimens were found on gastropod shells, inhabited by hermit crabs. The nutritive zooids are restricted to an area extending some distance from the inner border of the lip, while the generative zooids occupy the remainder of the surface of the shell, and hence are many times as numerous as the nutritive zooids. The conical spines arising from the common basal expansion have a very extensive development. They may appear with the regular conical shape, common to *Hydractinia polyclina,* they may retain their diameter throughout to form columns or they may appear as a ridge continuous for some distance. These ridges may even join to form a network over a large portion of the surface of the shell. The ridges instead of being simply jagged, are in the majority of cases provided with small sharp-pointed spines. When a network of ridges is formed, it provides a very efficient protection for the developing zooids that are packed so closely together that one can scarcely see through to the cœnosarc at any point. This is especially noticeable when the sporosacs are developing on the generative zooids. Though I have examined a large amount of material, I have seen no indication of dactylozooids. It may be possible that as Bergh says in regard to *H. carica*[3] that none are present in any case. This might account for the strong development of the protective spines.

[3] Goplepolyper fra Kara Havet, 1887, p. 331.

HYDRACTINIA CALIFORNICA Torrey

Hydractinia californica TORREY, Hydroids of San Diego, 1904, p. 9.

Distribution.—San Diego, Cal. (Torrey).

HYDRACTINIA MILLERI Torrey

Hydractinia milleri TORREY, Hydroida of the Pacific Coast, 1902, p. 34.

Distribution.—San Francisco, Tomales Bay, Cal. (Torrey); Port Renfrew.

CORYMORPHIDÆ

Genus CORYMORPHA

Trophosome.—Hydranths solitary, flask-shaped. Proximal tentacles long, in one whorl, distal shorter, in several whorls. Hypostome conical. Perisarc very thin.

Gonosome.—Gonophores borne on body of hydranth, between proximal and distal tentacles. Medusæ deep bell-shaped with one or more tentacles which may be rudimentary.

CORYMORPHA CARNEA (Clark)

Rhizonema carnea CLARK, Alaskan Hydroids, 1876, p. 233.
Corymorpha carnea TORREY, Hydroida of the Pacific Coast, 1902, p. 9.

Distribution.—Norton Sound, Alaska (Clark).

CORYMORPHA PALMA Torrey

Corymorpha palma TORREY, Hydroida of the Pacific Coast, 1902, p. 37.
Corymorpha palma TORREY, Hydroids of San Diego, 1904, p. 9.

Distribution.—San Pedro, San Diego, Cal. (Torrey).

TUBULARIDÆ

Genus TUBULARIA

Trophosome.—Large hydranths usually unbranched. Proximal set of tentacles longer than distal set. Proboscis conical.

Gonosome.—Gonophores borne in clusters from the hydranths, distal to the proximal tentacles. These produce actinulæ.

TUBULARIA BOREALIS Clark

Tubularia borealis CLARK, Alaskan Hydroids, 1876, p. 231.
Tubularia borealis TORREY, Hydroida of the Pacific Coast, 1902, p. 9.

Distribution.—Hagmeister Island, Alaska (Clark).

TUBULARIA CROCEA (Agassiz)

Parypha crocea AGASSIZ, Cont. Nat. Hist. U. S., IV, 1862, p. 249.
Parypha crocea A. AGASSIZ, Ill. Cat., 1865, p. 195.

Parypha macrocephala A. AGASSIZ, Ill. Cat., 1865, p. 195.
Tubularia elegans CLARK, Hydroids of the Pacific Coast, 1876, p. 253.
Tubularia crocea TORREY, Hydroida of the Pacific Coast, 1902, p. 43.
Tubularia crocea TORREY, Hydroids of San Diego, 1904, p. 10.

Distribution.—San Francisco (A. Agassiz); San Francisco Bay, San Pedro, San Diego, Cal. (Torrey); Port Simpson, B. C.

I believe that Dr. Torrey is correct in considering *Tubularia elegans* Clark as synonymous with *T. crocea.* I examined several specimens of *T. crocea* from the Atlantic Coast. In many instances the tentacles on the gonophore are so reduced as to be not much more than nodules. If Clark's specimen was in poor condition the reduction would be all the more pronounced. The number of tentacles in the distal row is a usual number and in the proximal row the number is not so much too great that "about" would not cover the discrepancy.

TUBULARIA INDIVISA Linnæus

Tubularia indivisa LINNÆUS, Systema Naturæ, 1767, p. 1301.
Tubularia indivisa CLARK, Alaskan Hydroids, 1876, p. 232.

Distribution.—St. Michael's, Norton Sound, Alaska (Clark).

TUBULARIA LARYNX Ellis & Solander

Tubularia larynx ELLIS & SOLANDER, Nat. Hist. Zooph., 1786, p. 31.
Tubularia larynx CALKINS, Some Hydroids of Puget Sound, 1899, p. 335.
Tubularia larynx TORREY, Hydroida of the Pacific Coast, 1902, p. 9.

Distribution.—Port Townshend (Calkins).

TUBULARIA HARRIMANI Nutting

Tubularia harrimani NUTTING, Hydroids of the Harriman Ex. 1901, p. 168.

Distribution.—Orca, Prince William Sound, Alaska (Nutting); Port Renfrew.

TUBULARIA MARINA Torrey

Tubularia marina TORREY, Hydroida of the Pacific Coast, 1902, p. 46.

Distribution.—Trinidad, San Francisco, Pacific Grove, Cal. (Torrey).

TUBULARIA TUBULAROIDES (A. Agassiz)

Thamnocnidia tubularoides A. AGASSIZ, Ill. Cat. 1865, p. 196.
Tubularia tubularoides TORREY, Hydroida of the Pacific Coast, 1902, p. 9.

Distribution.—San Francisco (A. Agassiz).

CALYPTOBLASTEA

In taking up the Calyptoblastea I shall not undertake any definite discussion, except a limited one in the cases of the Sertularidæ and Plumularidæ, chiefly because there has been no monographic work of recent date except for these families, and in fact as far as American forms are concerned, there has never been such a work. Since this is the case there has been much diversity in classification, though the majority of authors have followed more or less closely, the classification used by Hincks in his classic work on hydroids[4]. This I shall do also, though in doing so, I must of necessity differ with some authors in some respects, since there is this diversity.

In the Sertularidæ and Plumularidæ, as later stated, I have used as a basis Prof. Nutting's classification as given in his Monograph of American Hydroids, Volumes I and II. We must look forward to the time when the third volume, at which he is now working, will help to clear up some of the difficulties in the Campanularian species, as well.

The constant features of the Calyptoblastea are these:

Hydroids in which the hydranths are protected by hydrothecæ and the gonophores by gonothecæ.

CAMPANULARIDÆ

Trophosome.—Hydrothecæ campanulate, pedicellate, non-operculate. A septum, which partly shuts off the hydrothecal cavity from the cavity of the stem, is present in each. Hydranth with a long trumpet-shaped proboscis, and a single row of filiform tentacles.

Gonosome.—Gonophores producing planulæ or free medusæ.

In this family the trophosome affords no features of much taxonomic value, thus the gonosome is the main basis for classification into genera. Specific differences appear in both trophosome and gonosome.

Genus CAMPANULARIA

Trophosome.—Colony unbranched or regularly branched; stem simple or fascicled; hydrotheca campanulate.

Gonosome.—Gonophores containing fixed sporosacs from which planulæ are produced.

CAMPANULARIA DENTICULATA Clark

Campanularia denticulata CLARK, Alaskan Hydroids, 1876, p. 213.

Campanularia denticulata NUTTING, Hydroids of the Harriman Ex. 1901, p. 171.

[4] British Hydroid Zoophytes. 1868.

Campanularia denticulata TORREY, Hydroida of the Pacific Coast, 1902, p. 51.

Distribution.—Port Etches, Alaska (Clark); Orca, Alaska (Nutting); San Pedro, Cal. (Torrey); Departure Bay, San Juan Archipelago.

This species bears much resemblance to the unbranched form of *Clytia edwardsi* (Nutting). The hydrotheca of *C. edwardsi* is, in general larger than that of *C. denticulata,* but judging from Clark's figures there is much variation in the latter, as there is in the former. Clark found no gonosome, nor did Nutting, who later identified this species. Laura R. Thornely has reported a species from the Red Sea[5], on specimens of which she found gonosomes. This she takes to be the same as *C. denticulata* Clark, basing her opinion on Torrey's description of this species[6], but later Torrey observed that what he took to be *C. denticulata,* was a fragment of a large much-fascicled form which he name *Clytia universitatis*[7], a form very distinct from *C. denticulata.* If *C. denticulata* is characteristically an unbranched form, the Red Sea specimens cannot belong to that species. If it is synonymous with *Clytia edwardsi,* they might do so. There is resemblance in the mode of branching and to a certain extent in the shape of the hydrotheca, but the gonosome is different to that which I have found in *C. edwardsi.* As I have not sufficient proof to state definitely that the two species *Campanularia denticulata* and *Clytia edwardsi* are synonymous, I retain both of them in this work.

CAMPANULARIA EXIGUA (Sars)

Laomedea exigua SARS, Middelhavet's Littoral Fauna, 1857, p. 50.

Campanularia exigua HINCKS, British Hydroid Zoophytes, 1868, p. 172.

Campanularia exigua CALKINS, Some Hydroids of Puget Sound, 1899, p. 353.

Distribution.—Pt. Townshend (Calkins); Ucluelet.

CAMPANULARIA FUSIFORMIS Clark

Campanularia fusiformis CLARK, Hydroids of the Pacific Coast, 1876, p. 254.

Campanularia fusiformis TORREY, Hydroida of the Pacific Coast, 1904, p. 52.

[5] Reports of Marine Biol. of the Sudanese Red Sea, Jour. Linn. Soc., 1908, p. 82.

[6] Hydroida of the Pacific Coast, 1902, p. 51.

[7] Hydroids of San Diego, 1904, p. 19.

Distribution.—Vancouver Island (Clark); Point Reyes Peninsula and Dillon's, Cal. (Torrey).

CAMPANULARIA GRŒNLANDICA Levinsen

Campanularia grœnlandica LEVINSEN, Meduser, Ctenopher og Hydroider fra Grœnland's Vestkyst, 1893, p. 26.

Campanularia lineata NUTTING, Hydroids from Alaska and Puget Sound, 1899, p. 744.

Campanularia lineata NUTTING, Hydroids from the Harriman Ex., 1901, p. 171.

Distribution.—Puget Sound (Nutting); Berg Inlet, Glacier Bay, Alaska (Nutting); Port Renfrew.

I found but one specimen of this species, growing on *Lafœa gracillima.*

CAMPANULARIA HESPERIA Torrey

Campanularia hesperia TORREY, Hydroids of San Diego, 1904, p. 12.

Distribution.—La Jolla, Cal. (Torrey).

CAMPANULARIA HINCKSI Alder

Campanularia hincksii ALDER, Trans. Tynes. Field Club, 1857, p. 37.

Campanularia hincksii HINCKS, British Hydroid Zoophtyes, 1868, p. 162.

Campanularia hincksi TORREY, Hydroida of the Pacific Coast, 1902, p. 53.

Campanularia hincksi TORREY, Hydroids of San Diego, 1904, p. 13.

Distribution.—San Diego, Cal. (Torrey).

CAMPANULARIA INTEGRA MacGillivray

Campanularia integra MACGILLIVRAY, Ann. and Mag., 2nd Ser. 9, 1842, p. 465.

Campanularia integra CLARK, Alaskan Hydroids, 1876, p. 215.

Campanularia integra CALKINS, Some Hydroids of Puget Sound, 1899, p. 352.

Distribution.—Lituya Bay and Shumagin Islands, Alaska (Clark); Pt. Wilson, Pt. Townshend and Bremerton, Wash. (Calkins); Bering Sea (Jäderholm); San Juan Archipelago.

CAMPANULARIA KINCAIDI Nutting

Campanularia kincaidi NUTTING, Hydroids from Alaska and Puget Sound, 1899, p. 743.

Distribution.—Puget Sound (Nutting); Dodd's Narrows.

The single specimen of this species that has come under my notice, was making use of a rather unusual support. It was attached to the side of a hydrotheca of *Lovenella producta.*

CAMPANULARIA OCCIDENTALIS Fewkes

Campanularia occidentalis FEWKES, New Invert. from the Coast of Cal., 1899, p. 4.

Distribution.—Santa Barbara, Cal. (Fewkes).

The description of this species is so very meagre, that no one unless the author himself, can tell if it has been described under some other name since he found it. I simply put it in the list for the sake of completeness.

CAMPANULARIA PACIFICA (A. Agassiz)

Laomedea pacifica A. AGASSIZ, Ill. Cat. Mus. Comp. Zool., II, 1865, p. 94.
Campanularia pacifica TORREY, Hydroida from the Pacific Coast, 1902, p. 53.

Distribution.—Gulf of Georgia and San Franeisco (A. Agassiz) ; San Francisco Bay (Torrey) ; San Juan Archipelago.

This species was found quite plentifully in the material from San Juan Archipelago. The trophosome bears much resemblance to that of *Obclia gclatinosa* (Pallas), but the hydrothecæ are relatively much longer than those of *O. gclatinosa.* I did not find any gonosomes but Torrey, who has found these, shows conclusively that the species does not belong to the genus *Obelia.*

CAMPANULARIA RARIDENTATA Alder

Campanularia raridentata ALDER, Ann. and Mag. 3rd Ser. 9, 1862, p. 315.
Campanularia raridentata HINCKS, British Hydroid Zoophytes, 1868, p. 176.

Distribution.—Departure Bay, Queen Charlotte Islands.

This species, of which several colonies were found appears to be quite distinct from *Thaumantias inconspicua* Forbes. Further reference is made to it in connection with that species.

CAMPANULARIA REGIA Nutting

Cmpanularia regia NUTTING, Hydroids from the Harriman Ex., 1901, p. 172.

Distribution.—Orca, Prince William Sound, Alaska (Nutting).

CAMPANULARIA RIGIDA (A. Agassiz)

Laomedea rigida A. AGASSIZ, Ill. Cat. Mus. Comp. Zool., II, 1865, p. 93.
Laomedea rigida CLARK, Hydroids of the Pacific Coast, 1876, p. 251.
Campanularia rigida TORREY, Hydroida of the Pacific Coast, 1902, p. 11.

Distribution.—San Francisco (A. Agassiz).

A. Agassiz reported this species but his description contains so little detail, that it might apply to several forms. As he gives no figures there is no means of deciding even to what genus it belongs. Torrey has placed it with *Campanularia* and that seems to be the most probable position for it. As the San Francisco region has been explored to some extent since, this may correspond to some of the later species.

CAMPANULARIA RITTERI Nutting

Campanularia ritteri NUTTING, Hydroids of the Harriman Ex. 1901, p. 171.

Distribution.—Juneau, Alaska (Nutting).

CAMPANULARIA SPECIOSA Clark

Campanularia speciosa CLARK, Alaskan Hydroids, 1876, p. 214.

Campanularia speciosa NUTTING, Hydroids of the Harriman Ex. 1901, p. 171.

Distribution.—Shumagin Islands, Alaska (Clark); Orca, Alaska (Nutting); Friday Harbor, San Juan Island.

I found but one specimen of this species, but it was in excellent condition. It was growing on a stem of *Abictinaria amphora.*

CAMPANULARIA URCEOLATA Clark

Campanularia urceolata CLARK, Alaskan Hydroids, 1876, p. 215.

Campanularia cylindrica CLARK, Hydroids of the Pacific Coast, 1876, p. 254.

Campanularia turgida CLARK, Alaskan Hydroids, 1876, p. 213.

Campanularia urceolata NUTTING, Hydroids of the Harriman Ex. 1901, p. 172.

Campanularia reduplicata NUTTING, Hydroids of the Harriman Ex. 1901, p. 172.

Campanularia turgida HARTLAUB, Hydroiden aus dem Stillen Ocean, 1901, p. 350.

Campanularia urceolata TORREY, Hydroida of the Pacific Coast, 1902, p. 54.

Distribution.—Port Etches, Lituya Bay, Alaska (Clark); Santa Cruz, Cal. (Clark); Yakutat (Nutting); Bare Island (Hartlaub); San Francisco, Tomales Bay, Pacific Grove, Cal. (Torrey); Queen Charlotte Islands, Dodd's Narrows, San Juan Archipelago.

This rather ubiquitous form has been mentioned under many specific names. In examining material where it appears abundantly one can readily conclude that one species is represented. In any case Dr. Torrey's many figures are quite convincing.

CAMPANULARIA VERTICILLATA (Linnæus)

Sertularia verticillata LINNÆUS, Systema Naturæ, 1758, p. 811.

Campanularia circula CLARK, Alaskan Hydroids, 1876, p. 213.

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Campanularia verticillata NUTTING, Hydroids of the Harriman Ex. 1901, p. 171.

Campanularia fascia TORREY, Hydroida of the Pacific Coast, 1902, p. 52.

Distribution.—Port Etches, Alaska (Clark); Puget Sound (Nutting); Kadiak, Alaska (Nutting); San Diego (Torrey); Bering Strait and Bering Island (Jäderholm); Queen Charlotte Islands, Dodd's Narrows, San Juan Archipelago.

CAMPANULARIA VOLUBILIS (Linnæus)

Sertularia volubilis LINNÆUS, Systema Naturæ, 1767, p. 1311.

Campanularia volubilis HARTLAUB, Hydroiden aus dem Stillen Ocean, 1901, p. 350.

Campanularia volubilis TORREY, Hydroida of the Pacific Coast, 1902, p. 54.

Campanularia volubilis TORREY, Hydroids of San Diego, 1904, p. 13.

Distribution.—Bare Island (Hartlaub); San Pedro, Tomales Bay, San Diego, Cal. (Torrey); Banks Island, Ucluelet, San Juan Archipelago.

Genus CLYTIA

Trophosome.—Stems unbranched or irregularly branched; hydrothecæ of the usual campanulate form.

Gonosome.—Reproduction with free medusæ, these with four tentacles and four radial canals at time of liberation.

CLYTIA ATTENUATA (Calkins)

Campanularia attenuata CALKINS, Some Hydroids of Puget Sound, 1899, p. 350.

Distribution.—Port Townshend (Calkins); San Juan Archipelago.

CLYTIA BAKERI Torrey

Clytia bakeri TORREY, Hydroids of San Diego, 1904, p. 16.

Distribution.—Pacific Beach, San Diego, Cal. (Torrey).

CLYTIA EDWARDSI (Nutting)

Pl. III, Figs. 1-2.

Campanularia gracilis CALKINS, Some Hydroids of Puget Sound, 1899, p. 350.

Campanularia edwardsi NUTTING, Hydroids of Wood's Hole, 1901, p. 346.

Campanulari edwardsi TORREY, Hydroids of San Diego, 1904, p. 11.

Distribution.—Port Townshend (Calkins); San Diego (Torrey); San Juan Archipelago, Departure Bay.

This species, found very abundantly at Departure Bay, shows a great variation in mode of growth. While commonly it is found unbranched or but slightly branched, in some cases the branching is quite extensive though irregular, and the whole colony may reach the height of an inch. In the former case the stolon is spread widely over the surface of Fucus and is much anastomosed. When the stem is unbranched the pedicels vary in length, are generally annulated for some distance at the base and below the calyx, or they may be annulated throughout the greater part of their length. When forms appear with only one branch, this branch is usually much longer than the remainder of the main stem, is annulated similarly and has a distinct flexure near its origin, so that it passes out often closely applied to the main stem as shown in Nutting's figure.[8] The hydrothecæ vary much in size but in all cases the typical shape is fairly well retained. Torrey refers to this difference in size[9] and gives measurements to verify.

The simple forms resemble *Clytia johnstoni* Alder, but the teeth in the hydrothecæ are relatively longer and much more slender than in that species. The resemblance is carried farther than the trophosome as the gonosomes are quite similar. In both they have their origin either from the stolon or from the pedicel and they are strongly annulated. In the branched forms the calyces are usually much larger, but apart from this each branch corresponds to a simple form. The gonangia appear in the axils, or they may appear anywhere along the stem. They vary much in size and the number of their rings, which may be as few as five or as many as twelve. These branched forms correspond to those found by Torrey and Nutting but as they found no gonosome the species was supposed to belong to the genus *Campanularia*.

Apparently this is the form which Calkins has described as *Campanularia gracilis*, supposing it to be the same as *Gonothyræa gracilis* Allman. The trophosomes of the two are much alike, but the extra-capsular gonosome of *Gonothyræa gracilis* is very different from that figured by him,[10] this evidently being a *Clytia*.

CLYTIA HENDERSONI Torrey

Clytia hendersoni TORREY, Hydroids of San Diego, 1904, p. 16.

[8] Hydroids of the Wood's Hole Region, 1901, p. 346.

[9] Hydroids of San Diego, 1904, p. 11.

[10] Some Hydroids of Puget Sound, 1899, p. 350, Pl. 2, Fig. 10.

Distribution.—San Diego, Cal. (Torrey).

CLYTIA JOHNSTONI (Alder)

Campanularia johnstoni ALDER, Trans. Tynes. F. C., 1857, p. 36.

Clytia johnstoni CLARK, Alaskan Hydroids, 1876, p. 212.

Campanularia johnstoni CALKINS, Some Hydroids of Puget Sound, 1899, p. 348.

Clytia bicophora TORREY, Hydroida of the Pacific Coast, 1902, p. 1.

Distribution.—Port Etches, Alaska (Clark); Puget Sound (Calkins); Oakland Creek, Cal. (Torrey).

Both Clark and Calkins, in reporting this species, do so with doubt as to their identification. Clark's figures would serve very well for one of the varieties of *Campanularia urceolata,* and Calkins' are not unlike the unbranched forms of *Clytia edwardsi.* Torrey's reference to it is very meagre, as it occurs only in a foot-note.

CLYTIA UNIVERSITATIS Torrey

Campanularia denticulata TORREY, Hydroida of the Pacific Coast, 1902, p. 51.

Clytia universitatis TORREY, Hydroids of San Diego, 1904, p. 19.

Distribution.—San Diego, San Pedro, Cal. (Torrey).

Genus EUCOPELLA

Trophosome.—Stem unbranched arising from an anastomosing stolon; hydrothecæ with very thick walls and smooth margins.

Gonosome.—Gonophores produce large medusoid structures, never more than two, one large and one very small in a gonangium at the same time. They are of an elongated dome shape. They differ from ordinary medusæ in not being provided with mouth or digestive cavity.

EUCOPELLA CALICULATA (Hincks)

Campanularia caliculata HINCKS, Ann. and Mag. N. H., 3rd Ser. XI, 1863, p. 178.

Campanularia caliculata CALKINS, Some Hydroids of Puget Sound, 1899, p. 351.

Clytia caliculata NUTTING, Hydroids of the Harriman Ex. 1901, p. 170.

Distribution.—Pt. Wilson, Pt. Townshend, Bremerton (Calkins); Yakutat, Alaska (Nutting); San Juan Archipelago.

Specimens of this species show very well the typical *Eucopella* gonosome, but as these gonosomes have been figured by Calkins to bring out the features in an excellent manner, it is not necessary to refer to them further.

EUCOPELLA COMPRESSA (Clark)

Campanularia compressa CLARK, Alaskan Hydroids, 1876, p. 214.
Clytia compressa NUTTING, Hydroids of the Harriman Ex. 1901, p. 170.
Clytia compressa TORREY, Hydroida of the Pacific Coast, 1902, p. 58.
Clytia compressa TORREY, Hydroids of San Diego, 1904, p. 17.

Distribution.—Shumagin Islands, Alaska (Clark); Orca, Alaska (Nutting); San Diego, San Pedro, Cal. (Torrey).

EUCOPELLA EVERTA (Clark)

Campanularia everta CLARK, Hydroids of the Pacific Coast, 1876, p. 253.
Campanularia everta TORREY, Hydroida of the Pacific Coast, 1902, p. 51.
Campanularia everta TORREY, Hydroids of San Diego, 1904, p. 12.

Distribution.—San Diego, Cal., Vancouver Island (Clark); Catalina Island, San Diego, Pacific Grove, Cal. (Torrey); Port Renfrew, Departure Bay.

Genus GONOTHYRÆA

Trophosome.—Stem branched; hydrothecæ campanulate with thin walls.

Gonosome.—Reproduction by fixed medusiform sporosacs furnished with tentacles, that at maturity become extra-capsular, remaining attached until their contents are discharged.

GONOTHYRÆA CLARKI (Marktanner-Turneretscher)

Gonothyræa hyalina CLARK, Alaskan Hydroids, 1876, p. 215.
Laomedea (Gonothyræa) clarkii MARKTANNER-TURNERETSCHER, Hydroiden von Ostspitzbergen, 1895, p. 408.
Gonothyræa hyalina HARTLAUB, Hydroiden aus dem Stillen Ocean, 1901, p. 350.
Gonothyræa clarki TORREY, Hydroida of the Pacific Coast, 1902, p. 55.

Distribution.—Semidi Islands to Nunivak Island (Clark); Bare Island (Hartlaub); Oakland, Cal. (Torrey); Departure Bay, San Juan Archipelago.

Marktanner-Turneretscher in 1895, believing that *Gonothyræa hyalina* Clark was not the same as *G. hyalina* Hincks, renamed it after Clark. Torrey in 1902, on examining specimens of apparently the same species, without having seen Marktanner's paper, came to similar conclusions, and also renamed it after Clark, considering he was giving it a new name.

GONOTHYRÆA INORNATA Nutting

Gonothyræa inornata NUTTING, Hydroids of the Harriman Ex. 1901, p. 175.

Distribution.—Yakutat, Alaska (Nutting).

Genus OBELIA

Trophosome.—Stem branched, simple or fascicled; hydrothecæ with thin walls.

Gonosome.—Reproduction by means of free medusæ, that when liberated, possess more than eight marginal tentacles but no mouth tentacles. Eight interradial lithocysts are present.

OBELIA BOREALIS Nutting

Obelia borealis NUTTING, Hydroids of the Harriman Ex. 1901, p. 174.

Distribution.—Yakutat, Alaska (Nutting); Ucluelet, San Juan Archipelago.

OBELIA COMMISSURALIS McCready

Obelia commissuralis McCREADY, Gymno. Charleston Har., 1858, p. 95.
Obelia commissuralis TORREY, Hydroida of the Pacific Coast, 1902, p. 56.

Distribution.—San Francisco Bay (Torrey).

OBELIA CORONA Torrey

Obelia corona TORREY, Hydroids of San Diego, 1904, p. 14.

Distribution.—San Diego (Torrey); San Juan Archipelago.

OBELIA DICHOTOMA (Linnæus)

Sertularia dichotoma LINNÆUS, Systema Naturæ, 1756, p. 812.
Obelia dichotoma CALKINS, Some Hydroids of Puget Sound, 1899, p. 741.
Obelia dichotoma NUTTING, Hydroids of the Harriman Ex. 1901, p. 173.
Obelia dichotoma TORREY, Hydroida of the Pacific Coast, 1902, p. 57.
Obelia dichotoma TORREY, Hydroids of San Diego, 1904, p. 15.

Distribution.—Bremerton (Calkins); Sitka, Berg Inlet, Orca, Alaska (Nutting); San Pedro to Coronado Islands, San Diego, Cal. (Torrey); Departure Bay, San Juan Archipelago.

OBELIA DUBIA Nutting

Pl. III, Figs. 3-4

Obelia dubia NUTTING, Hydroids of the Harriman Ex. 1901, p. 174.

Distribution.—Orca, Alaska (Nutting); Departure Bay, Dodd's Narrows, Ucluelet, San Juan Archipelago.

The gonosome of this species has not, hitherto, been described. In the majority of specimens examined there were no gonosomes present, but where they were present, there was one in the axil of each of the lower pedicels or branches. The pedicels which supported them are annulated throughout, varying in length but never very long. The gonangium is pear-shaped and is provided with from one to five rings. The rim of the opening is raised on a distinct collar, with diameter very much less than that of the part of the gonangium that supports it.

OBELIA FRAGILIS Calkins

Obelia fragilis CALKINS, Some Hydroids of Puget Sound, 1899, p. 355,

Distribution.—Port Townshend (Calkins).

OBELIA GELATINOSA (Pallas)

Sertularia gelatinosa PALLAS, Elenchus Zoophytorum, 1766, p. 116.
Obelia gelatinosa HINCKS, British Hydroid Zoophytes, 1868, p. 151.
Obelia gelatinosa CALKINS, Some Hydroids of Puget Sound, 1899, p. 357.

Distribution.—Discovery Bay, Wash. (Calkins).

OBELIA GENICULATA (Linnæus)

Sertularia geniculata LINNÆUS, Systema Naturæ, 1767, p. 1312.
Obelia geniculata TORREY, Hydroida of the Pacific Coast, 1902, p. 58.
Obelia geniculata TORREY, Hydroids of San Diego, 1904, p. 15.

Distribution.—San Francisco, Catalina Island, Coronado Island (Torrey).

OBELIA GRACILIS Calkins

Obelia gracilis CALKINS, Some Hydroids of Puget Sound, 1899, p. 353.

Distribution.—Scow Bay, Port Townshend, Wash. (Calkins); San Juan Archipelago.

OBELIA GRIFFINI Calkins

Obelia griffini CALKINS, Some Hydroids of Puget Sound, 1899, p. 357.

Distribution.—Puget Sound (Calkins); Departure Bay.

OBELIA LONGISSIMA (Pallas)

Sertularia longissima PALLAS, Elenchus Zoophytorum, 1766, p. 119.
Obelia longissima CLARK, Alaskan Hydroids, 1876, p. 212.

Distribution.—Unalaska (Clark); Banks Island, Departure Bay, Dodd's Narrows, San Juan Archipelago.

OBELIA PLICATA Hincks

Obelia plicata HINCKS, British Hydroid Zoophytes, 1868, p. 159.
Obelia plicata NUTTING, Hydroids from Alaska and Puget Sound, 1899, p. 741.
Obelia plicata CALKINS, Some Hydroids of Puget Sound, 1899, p. 357.
Obelia plicata NUTTING, Hydroids of the Harriman Ex. 1901, p. 173.

Distribution.—Puget Sound (Nutting); Puget Sound (Calkins); Orca, Alaska (Nutting); Departure Bay, San Juan Archipelago.

OBELIA SURCULARIS Calkins

Obelia surcularis CALKINS, Some Hydroids of Puget Sound. 1899, p. 355.

Distribution.—Scow Bay, Port Townshend, Wash. (Calkins).

Genus THAUMANTIAS

Trophosome.—Stem unbranched, arising from a much branched stolon.

Gonosome.—"Reproduction by free medusæ. Umbrella hemispheric; manubrium 4-lipped; radiating canals 4; marginal tentacles numerous; sporosacs in the course of the radiating canals; lithocysts wanting." (Hincks).

THAUMANTIAS INCONSPICUA Forbes

Thaumantias inconspicua FORBES, Monograph of the British Naked-eyed Medusæ, 1848, p. 52.

Thaumantias inconspicua WRIGHT, Quarterly Jour. Micr. Sc., 1862, p. 221.

Campanularia inconspicua CALKINS, Some Hydroids of Puget Sound, 1899, p. 349.

Distribution.—Puget Sound (Calkins); San Juan Archipelago.

Dr. J. Strethill Wright, in experimenting with *Thaumantias inconspicua* Forbes, managed to grow some hydroids which he describes[11] but unfortunately does not figure. A form which corresponds perfectly to his description was found by Calkins in Puget Sound, though he named it *Campanularia inconspicua.* I have found specimens from the San Juan Archipelago in both Prof. Kincaid's and Mr. Moon's Collections. What serves to substantiate the opinion that it is the same as that described by Wright is that it has the medusæ of the regular *Thaumantias* type as is shown by Calkins' figure,[12] quite different from that found in other Campanularian forms. It has been considered by some investigators to be synonymous with *Campanularia raridentata* Hincks, but I have found several specimens of a species which bears an exact resemblance to Hincks' figure[13] of this species, very different indeed from Calkins' type, as can readily be seen from the figures.

CAMPANULINIDÆ

Trophosome.—Colonies branched or unbranched; hydrothecæ pedicellate or sessile, always operculate, the operculum being

[11] Quarterly Jour. Micr. Sc., 1862, p. 221.

[12] Some Hydroids of Puget Sound, 1899, Pl. 2, Fig. 8c.

[13] British Hydroid Zoophytes, Pl. XXVI, Figs. 2 and 2a.

formed of converging segments. Hydranths with a conical proboscis.

Gonosome.—Gonophores producing planulæ or free medusæ.

Genus CALYCELLA

Trophosome.—Stem a creeping rootstock; hydrothecæ tubular, borne on ringed pedicels. A distinct margin appears where the segmented operculum joins the hydrotheca proper.

Gonosome.—Gonangia oval, borne on the rootstock, producing acrocysts.

CALYCELLA PYGMÆA Hincks

Pl. III, Fig. 5

Lafœa pygmæa HINCKS. British Hydroid Zoophytes, 1868, p. 205.
Calycella pygmæa HINCKS, Ann. and Mag. N. H., 4th Ser. 13, 1874, p. 149.
Calycella syringa CLARK, Alaskan Hydroids, 1876, p. 217.
Calycella syringa CALKINS, Some Hydroids of Puget Sound, 1899, p. 358.

Distribution.—Coal Harbor, Shumagin Islands, Alaska (Clark); Port Townshend (Calkins); Departure Bay, Dodd's Narrows, San Juan Archipelago.

Hincks ascribed this species to Alder, but as Alder described it only in manuscript, he can scarcely be credited with it. There seems to be much confusion in relation to this species. Hincks in his first description places it with *Lafœa,* but mentions the evidence of an operculum. Later he figures what he considers to be the same species under the name *Calycella pygmæa,* showing a distinct segmented operculum. Since that time some authors have found the operculate form and retained the name *Calycella pygmæa,* while others have found non-operculate forms similar in shape which they have either called *Lafœa pygmæa* or have substituted the generic name *Hebella* instituted by Allman,[14] though in this genus one of the characters is the presence of a septum, separating the hydrothecal cavity from the cavity of the pedicel. In colonies of *Calycella pygmæa* one often comes across individuals in which the operculum has disappeared, so that the rim of the hydrotheca looks that of a *Lafœa* and it is just possible that specimens supposed to be *Lafœa pygmæa* are such as these. If the hydrothecal partition or septum has really been seen in specimens of such a form it would be a good indication that a *Hebella* has been found. It would be a hard matter to de-

[14] Challenger Hydroids Part II, 1883, p. 29.

cide if there are the three species very much alike, one in each genus, unless one had samples of the three so described. In any case there appears to be but the one on the West coast, consequently, the matter does not need to be settled here. Confusion arises in a very different way as well. Many authors have made no distinction between *Calycella syringa* and *Calycella pygmæa* but have called every *Calycella* that would answer to either type, *Calycella syringa*. It seems to me that there are two distinct types, as shown by Hincks' figures,[15] though as in the case of many other closely allied species there may be intergradations. Of the west coast investigators, Clark and Calkins only have shown drawings to scale. These drawings indicate the smaller form, and it may be that the other cases reported are similar, though there is no means of knowing. It is quite possible, therefore, that *Calycella pygmæa* and not *Calycella syringa,* is the common species on the Pacific Coast.

CALYCELLA SYRINGA (Linnæus)

Pl. III, Fig. 6

Sertularia syringa LINNÆUS, Systema Naturæ, 1867, p. 1311.
Calycella syringa HINCKS, British Hydroid Zoophytes, 1868, p. 206.
Calycella syringa NUTTING, Hydroids from Alaska and Puget Sound, 1899, p. 741.
Calycella syringa NUTTING, Hydroids of the Harriman Ex., 1901, p. 177.
Calycella syringa TORREY, Hydroida of the Pacific Coast, 1902, p. 59.

Distribution.—Puget Sound (Nutting); Bare Island (Hartlaub); Berg Inlet, Kadiak, Alaska (Nutting); San Diego (Torrey); Queen Charlotte Islands, Banks Island, San Juan Archipelago.

Genus CAMPANULINA

Trophosome.—Colony branched or unbranched, Hydrothecæ oval or ovate; margin indistinct; teeth of operculum long and slender.

Gonosome.—"Gonangia producing bell-shaped medusæ, with four radial canals, two to four marginal tentacles, and eight lithocysts." (Nutting).

[15] Ann. and Mag. N. H., 4th Ser. 13, 1874, Pl. VII, fig. 15 and Pl. VIII, fig. 24.

? CAMPANULINA FORSKALEA Peron et Lesueur

Pl. III, Figs. 11-13.

Æquorea forskalea PERON ET LESUEUR, Ann. Mus. Nat. Hist., Tome 14, 1809, p. 336.

Æquorea vitrina WRIGHT, Jour. Micr. Sc., Vol. III, New Series, p. 45.

Zygodactyla vitrina HINCKS, British Hydroid Zoophytes, 1868, p. 192.

Trophosome.—Stem unbranched or slightly branched. Hydrothecæ oval or oblong, contracting abruptly at the base, so that the base forms almost a right angle with the side, terminating above in about 12 converging segments. Hydranths with 12 tentacles.

Gonosome unknown.

Distribution.—San Juan Archipelago.

Dr. T. S. Wright, having secured specimens of the medusa *Æquorea vitrina* Gosse, succeeded in hatching the ova, and continuing the development until hydroids were produced, these corresponding in character to a species of *Campanulina*. Hincks refers to this but calls the species *Zygodactyla vitrina*. Neither before nor since, as far as I can make out, has this hydroid been reported as appearing in its own habitat, though the medusa is found widely distributed, at least we must believe so if we are to credit Mayer who has recently produced a large two volume monograph on the Hydromedusæ, as under the common name *Æquorea forskalea* Peron et Lesueur, he includes those that have been named *Æquorea vitrina* as well as *Æquorea cærulescens* of the Pacific Coast and many others.[16] An *Æquorea*, which in all likelihood is this same species, is very abundant in the Vancouver Island Region and consequently I have very little doubt but that the hydroid I have obtained is of the same species as that reared by Wright from this *Æquorea*. As such investigators as Nutting and Mayer have given up the idea of an entire coincidence of nomenclature between the hydroids and the hydromedusæ in the present state of knowledge, I think it better to use the hydroid generic name *Campanulina*, than the medusa name *Æquorea*.

All the specimens examined with one exception are unbranched; that one had one hydrotheca growing by means of a pedicel from what might be called the main stem and on the opposite side one seemed to have been broken off. The pedicels were wavy or annulated throughout. They arise from a quite

[16] A. G. Mayer, The Hydromedusæ, 1910, p. 325.

regular net-work of tubes that form the stolon. Their minuteness corresponds very well with Wright's description, as even the branched specimen was less than 1 mm. long and the unbranched ones were little more than half that.

CAMPANULINA RUGOSA Nutting

Campanulina rugosa NUTTING, Hydroids of the Harriman Ex., 1901, p. 176.

Distribution.—Juneau Alaska (Nutting); West Seattle, in Prof. Kincaid's Collection.

Genus CUSPIDELLA

Trophosome.—Hydrothecæ tubular, sessile on a creeping root-stock.

Gonosome.—Unknown.

CUSPIDELLA HUMILIS (Alder)

Campanularia humilis ALDER, Trans. Tyne. F. C. V., 1862, p. 239.
Cuspidella humilis HINCKS, Ann. and Mag. N. H., 3rd Ser. 18, 1866, p. 298.
Cuspidella humilis HINCKS, British Hydroid Zoophytes, 1868, p. 209.

Distribution.—Departure Bay, San Juan Archipelago.

This species has generally been credited to Hincks, who seems to have used it in manuscript before Alder did in a published work. As manuscript is not generally recognized, I have used Alder's name instead of Hincks'.

Genus LOVENELLA

Trophosome.—Colony unbranched or slightly branched. Hydrothecæ turbinate. Margin more distinct than in any other genus of the family.

Gonosome.—Gonophores producing bell-shaped medusæ with eight tentacles and four lithocysts.

LOVENELLA PRODUCTA (Sars)

Pl. III, Figs. 7-10

Calycella producta SARS, Norges Hydroider, 1873, p. 30.
Calycella producta HINCKS, Ann. and Mag. N. H., 4th Ser. 13, 1874, p. 134.
Lovenella producta JADERHOLM, Northern and Arctic Invert., 1909, p. 73.

Distribution.—Dodd's Narrows, San Juan Archipelago.

Although this species has been reported by Hincks, Verrill, Bonnevie, Broch and Jäderholm since it was first described by Sars, no very definite description has been given. On that account, and because it has not been reported previous to this time from the Pacific Coast, it might be well to give here the substance of Sars' general description from the type specimen.

Polyps always growing from an irregularly branched stolon, which firmly adheres to some foreign support. From this support the numerous pedicellate hydrothecæ radiate in all directions, often quite densely aggregated. The sub-erect pedicels, slightly annulated at the base, vary much in length, some of them being quite long. They pass almost imperceptibly into the tubular somewhat obconic hydrothecæ, the apertures of which are circular. The operculum consists of about twelve converging segments, which may be extended above the rim of the hydrotheca, or be retracted within it. The portion of the hydrotheca near the margin may be slightly ribbed longitudinally.

Gonosome unknown. Color, grayish-white. Height of the hydrotheca with pedicel up to 6 mm. Found attached to the stems of *Tubularia indivisa* and to calcareous serpulid tubes.

The specimens I have examined answer to this description very well, except that the pedicels are not so long. According to Sars' figures, in his specimens the variation is from 2 mm. to 6 mm. In specimens from Dodd's Narrows the longest is not more than 2 mm., and in the San Juan material many of them are little more than 1 mm., but as they agree in every other respect, I do not hesitate to put them with this species.

Genus STEGOPOMA

Trophosome.—Hydrotheca with an operculum formed of two membranes, folded lengthwise, and which, roof-like, come together with their long edges. Each of these is separated from the remainder of the hydrotheca by a curved line. At each side, the hydrothecal wall forms a triangular gable-like structure between the two opercular membranes.

I have not seen specimens of this genus. Levinsen in instituting the genus gives no characters of the gonosome.[17] Later authors who have used the genus, have described the gonangia in some species but have not described the contents thereof.

STEGOPOMA PLICATILE (Sars)

Lafœa plicatile SARS, Vidensk. Selsk. Forhandl., 1862, p. 31.

Stegopoma plicatile LEVINSEN, Meduser, Ctenophorer og Hydroider, 1893, p. 36.

[17] Meduser, Ctenophorer og Hydroider fra Grœnlands Vestkyst, 1893, p. 34.

Stegopoma plicatile JADERHOLM, Der Hydroidenfauna des Beringsmeeres, 1907, p. 2.

Distribution.—Bering Sea (Jäderholm).

HALECIDÆ

Trophosome.—Hydrothecæ arranged alternately; shallow saucer-shaped, not deep enough to contain the contracted hydranths; margins even, often duplicated. Hydranths with conical proboscis, surrounded by a single whorl of filiform tentacles.

Gonosome.—Gonophores producing planulæ, (or medusoids, if we are to include Dr. Torrey's genus Campalecium) usually different in the two sexes.

Genus CAMPALECIUM

"*Trophosome.*—As in Halecium.

"*Gonosome.*—Gonothecæ, each with a blastostyle bearing several medusoid gonophores". (Torrey).

I have seen no type of this genus that Dr. Torrey has instituted, nor has any other so far as I know. Dr. Torrey himself, has given no more recent reference to it, but if his conclusions are correct, it would seem that the characters are sufficient to make a new genus.

CAMPALECIUM MEDUSIFERUM Torrey

Campalecium medusiferum TORREY, Hydroida of the Pacific Coast, 1902, p. 43.

Distribution.—Long Beach, Cal. (Torrey).

Genus HALECIUM

Characteristics as given for the family.

HALECIUM ANNULATUM Torrey

Halecium annulatum TORREY, Hydroida of the Pacific Coast, 1902, p. 49.
Halecium annulatum TORREY, Hydroids of San Diego, 1904, p. 10.

Distribution.—Coronado, Cal. (Torrey); Coronado Island, Mexico (Torrey); Port Renfrew, Ucluelet, Dodd's Narrows.

HALECIUM BALEI new name

Halecium gracile BALE, Proc. Linn. Soc. N. S. W., 1888, p. 759.
Halecium parvulum BALE, Proc. Linn. Soc. N. S. W, 1888, p. 760.
Halecium gracile CLARK, Bull. Mus. Comp. Zool. Harvard, Vol. XXV, No. 6, 1894, p. 74.

Distribution.—San Juan Archipelago.

Bale described this species in 1888 under the name, *Halecium gracile.* This name has later been used for the same species by Clark, Jäderholm[18] and Billard,[19] but the name was preoccupied by Verrill[20] in 1874, and later used by Fewkes[21] and Nutting.[22] In consequence I have taken the liberty of using Bale's name in the substitution.

HALECIUM CORRUGATUM Nutting

Halecium corrugatum NUTTING, Hydroids from Alaska and Puget Sound, 1899, p. 745.

Distribution.—Puget Sound (Nutting).

HALECIUM DENSUM Calkins

Halecium densum CALKINS, Some Hydroids of Puget Sound, 1899, p. 343.

Distribution.—Bremerton (Calkins) ; Port Renfrew, Ucluelet, San Juan Archipelago.

HALECIUM HALECINUM (Linnæus)

Sertularia halecina LINNÆUS, Systema Naturæ, 1767, p. 1308.

Halecium halecinum NUTTING, Hydroids of Alaska and Puget Sound, 1899, p. 741.

Halecium halecinum NUTTING, Hydroids of the Harriman Ex. 1901, p. 179.

Distribution.—Puget Sound (Nutting) ; Kadiak, Alaska (Nutting) ; Ucluelet.

HALECIUM KOFOIDI Torrey

Halecium kofoidi TORREY, Hydroida of the Pacific Coast, 1902, p. 49.

Halecium kofoidi TORREY, Hydroids of San Diego, 1904, p. 11.

Distribution.—San Diego, Catalina Island, Cal. (Torrey) ; Coronado Island, Mexico (Torrey) ; San Juan Archipelago.

HALECIUM MURICATUM (Ellis & Solander)

Sertularia muricata ELLIS & SOLANDER, Nat. Hist. Zooph., 1786, p. 59.

Halecium muricatum CLARK, Alaskan Hydroids, 1876, p. 217.

Halecium muricatum NUTTING, Hydroids of the Harriman Ex. 1901, p. 180.

Distribution.—Unalaska (Clark) ; Orca, Alaska (Nutting).

18 Aussereuropäische Hydroiden, 1903, p. 266.

19 Ex. du Travailleur et du Talisman, 1907, p. 163.

20 Invertebrated Animals of Vineyard Sound, 1874, p. 729.

21 Guide to a Collector, 1891, p. 36.

22 Hydroids of Wood's Hole, 1901, p. 358.

HALECIUM ORNATUM Nutting

Halecium ornatum NUTTING, Hydroids of the Harriman Ex. 1901, p. 181.

Distribution.—Berg Inlet, Glacier Bay, Alaska (Nutting).

HALECIUM PYGMÆUM new species

Pl. IV, Figs. 1-2

Trophosome.—Colony minute, largest specimen reaching a height of 2.5 mm. The stolon, creeping on kelp, anastomoses to such an extent that a dense net-work is produced. The stem most commonly consists of but one pedicel about .5 mm. long, but may consist of a series of these pedicels, each giving origin to another pedicel just below its hydrophore. Not more than five were found in any one series. In rare instances, branches consisting of one or two of these pedicels, were also given off. The pedicels thus take the place of stem joints bending alternately to one side and the other, but as they are not all in the same plane, the trophosome seems somewhat spirally twisted. The annulations are not very well marked; there may be one or two near the base of each pedicel. The hydrophores are large with expanded margins, either not everted or but slightly so.

Gonosome.—Only the female gonosomes were found. In these the gonangia are borne on short pedicels, attached immediately below the hydrophore. In a case where a trophosome consists of a single pedicel, the gonangium extends beyond and overtops the hydrotheca. There is only one gonangium on each of the stems, with one or more than one pedicel. The shape is obovate with a projection on one side near the top immediately over the opening which is shaped like a half-moon. The ova are of large size, six to eight in each gonangium.

Distribution.—San Juan Archipelago in Prof. Kincaid's collection.

HALECIUM REVERSUM Nutting

Halecium reversum NUTTING, Hydroids of the Harriman Ex., 1901, p. 180.

Distribution.—Juneau, Alaska (Nutting).

HALECIUM ROBUSTUM Nutting

Halecium robustum NUTTING, Hydroids of the Harriman Ex., 1901, p. 182.

Distribution.—Berg Inlet, Glacier Bay, Alaska (Nutting).

HALECIUM SCUTUM Clark

Halecium scutum CLARK, Alaskan Hydroids, 1876, p. 218.
Halecium scutum NUTTING, Hydroids of the Harriman Ex. 1901, p. 180.

Distribution.—Semidi Islands to Unalaska (Clark); Berg Inlet and Yakutat (Nutting); San Juan Archipelago.

HALECIUM SPECIOSUM Nutting

Halecium speciosum NUTTING, Hydroids of the Harriman Ex., 1901, p. 181.

Distribution.—Yakutat, Alaska (Nutting).

HALECIUM TELESCOPICUM Allman

Halecium telescopicum ALLMAN, Challenger Report, Part II, 1888, p. 10.
Halecium telescopicum JADERHOLM, Hydroidenfauna der Beringsmeeres, 1907, p. 4.

Distribution.—Bering Sea (Jäderholm).

HALECIUM TENELLUM Hincks

Halecium tenellum HINCKS, Ann. and Mag. N. H., 3rd Ser. 8, 1861, p. 252.
Halecium tenellum CLARK, Hydroids of the Pacific Coast, 1876, p. 225.

Distribution.—San Diego, Cal. (Clark); San Juan Archipelago.

HALECIUM WILSONI Calkins

Halecium wilsoni CALKINS, Some Hydroids of Puget Sound, 1899, p. 343.
Halecium wilsoni HARTLAUB, Hydroiden aus dem Stillen Ocean, 1901, p. 350.

Distribution.—Bremerton (Calkins); Bare Island (Hartlaub); Ucluelet, San Juan Archipelago.

Besides finding specimens of this species with the male gonosome similar to that described and figured by Calkins, I found others to which the same description of the trophosome applies but with female gonosomes. The gonangia of these are shaped like the male gonangia of the species and have the openings similar and similarly placed. When the ova are within the gonangia, they appear to be very irregularly arranged, but when they are extruded into the globular acrocyst, the cause is evident. There is the same irregular branching from the spadix as in the male. giving the whole gonosome a fantastic appearance when viewed from the exterior. The fact that this female gonosome is smaller than the male, though unusual, will scarcely make it doubtful that it belongs to the same species.

HALECIUM WASHINGTONI Nutting

Halecium geniculatum NUTTING, Hydroids of Alaska and Puget Sound, 1899, p. 744.

Halecium nuttingi TORREY, Hydroida of the Pacific Coast, 1902, p. 50.

Halecium washingtoni NUTTING, Am. Nat., XXXV, 1901, p. 789.

Halecium washingtoni TORREY, Hydroids of San Diego, 1904, p. 11.

Distribution.—Puget Sound (Nutting); San Diego (Torrey); Dodd's Narrows, San Juan Archipelago.

LAFŒIDÆ

Trophosome.—Hydrothecæ tubular, margins even, opercula absent. The hydrothecal cavity is not divided from the stem cavity by a partial septum, except in the genus Hebella. Hydranth with a conical hypostome.

Gonosome.—"Gonangia forming a 'Coppinia' mass." (Nutting).

Genus FILELLUM

Trophosome.—Stem a slender rootstock, parasitic on other hydroids. Hydrothecæ partly adherent, curved outward at the point of separation.

Gonosome.—A 'Coppinia' mass.

FILELLUM EXPANSUM Levinsen

Filellum expansum LEVINSEN, Hydroider fra Grönland's Vestkyst, 1893, p. 30.

Distribution.—Deer Harbor, San Juan, in Prof. Kincaid's Collection.

FILELLUM SERPENS (Hassell)

Campanularia serpens HASSELL, Trans. Micro. Soc., III, 1852, p. 163.

Filellum serpens NUTTING, Hydroids of the Harriman Ex. 1901, p. 179.

Distribution.—Juneau, Alaska (Nutting); San Juan Archipelago.

Genus GRAMMARIA

Trophosome.—Stem fascicled, consisting of a hydrothecate axial tube surrounded by a certain number of peripheral, non-hydrothecate tubes. The hydrothecæ are partly adherent.

Gonosome.—A 'Coppinia' mass.

GRAMMARIA IMMERSA Nutting

Grammaria immersa NUTTING, Hydroids of the Harriman Ex. 1901, p. 178.

Distribution.—St. Paul's Harbor, Kadiak, Alaska (Nutting);

Bering Sea, N. W. of St. Lawrence Island (Jäderholm); Dodd's Narrows.

Genus HEBELLA

"*Trophosome.*—Pedicels arising from a creeping rootstock, very short. Hydrothecæ tubular, with entire margins, without opercula, and having their cavities separated from those of the stem by a partial septum. Hydranths with a conical proboscis." (Nutting).

This genus has been moved around from one family to another and really does not properly belong to any of the families described up to the present. On account of its hydrothecal septum, it has been placed with the *Campanularidæ,* but the tubular hydrotheca and more especially the conical hypostome makes it very unsuitable for such a home. The only difficulty there is in putting it in the *Lafœidæ* arises from the presence of the hydrothecal septum. As this paper is intended to be largely a work on distribution, I do not feel justified in making a new family for the genus. As it seems to have the closest affinities to the *Lafœidæ* I have placed it with, rather than in, that family.

HEBELLA POCILLUM (Hincks)

Lafœa pocillum Hincks, British Hydroid Zoophytes, 1868, p. 204.
Lafœa pocillum Clark, Alaskan Hydroids, 1876, p. 215.
Hebella pocillum Nutting, Hydroids of the Harriman Ex. 1901, p. 175.

Distribution.—Nunivak Island, Alaska (Clark); Kadiak, Alaska (Nutting).

Genus LAFŒA

Trophosome.—Stem fascicled throughout the greater part of its length in a mature form. Hydrothecæ generally free from the stem, though sometimes slightly immersed in it.

Gonosome.—A 'Coppinia' mass.

LAFŒA ADHÆRENS Nutting

Lafœa adhærens Nutting, Hydroids of the Harriman Ex. 1901, p. 178.

Distribution.—Kadiak, Alaska (Nutting).

LAFŒA DUMOSA (Fleming)

Sertularia dumosa Fleming, Edin. Phil. Jour. II, 1828, p. 83.
Lafœa dumosa Clark, Alaskan Hydroids, 1876, p. 210.
Lafœa dumosa Nutting, Hydroids from Alaska and Puget Sound, 1899, p. 741.

Lafœa dumosa NUTTING, Hydroids of the Harriman Ex., 1901, p. 177.
Lafœa dumosa TORREY, Hydroida of the Pacific Coast, 1902, p. 59.

Distribution.—Port Etches, Alaska (Clark); Puget Sound (Nutting); Juneau, Berg Inlet, Orca, Alaska (Nutting); Port Orchard, Puget Sound (Torrey); Banks Island, Departure Bay, Dodd's Narrows, Ucluelet, Port Renfrew, San Juan Archipelago.

LAFŒA FRUTICOSA Sars

Lafœa fruticosa SARS, Norske Hydroider, Vid. Selsk. Forh., 1862, p. 30.
Lafœa fruticosa CLARK, Alaskan Hydroids, 1876, p. 216.
Lafœa fruticosa NUTTING, Hydroids of the Harriman Ex. 1901, p. 178.

Distribution.—Shumagin Island to Kyska Island, Alaska (Clark); Puget Sound (Nutting); Juneau, Berg Inlet, Orca, Alaska (Nutting); Bering Sea (Jäderholm); San Juan Archipelago.

LAFŒA GRACILLIMA (Alder)

Campanularia gracillima ALDER, Trans. Tynes. Field Club, 1857, p. 39.
Lafœa gracillima CLARK, Alaskan Hydroids, 1876, p. 216.
Lafœa gracillima NUTTING, Hydroids of Alaska and Puget Sound, 1899, p. 741.
Lafœa gracillima NUTTING, Hydroids of the Harriman Ex., 1901, p. 177.
Lafœa gracillima TORREY, Hydroida of the Pacific Coast, 1902, p. 60.

Distribution.—Sitka Harbor to Shumagin Islands, Alaska (Clark); Bare Island (Hartlaub); Puget Sound (Nutting); Juneau, Berg Inlet, Orca, Alaska (Nutting); San Pedro, Cal., Puget Sound (Torrey); Departure Bay, Dodd's Narrows, Ucluelet, Port Renfrew, San Juan Archipelago.

LAFŒA GRANDIS Hincks

Lafœa grandis HINCKS, Ann. and Mag. N. H., 4th Ser. XIII, 1874, p. 148.

Distribution.—San Juan Archipelago.

Only a fragment of this species appeared in the San Juan material but it was in very good condition.

LICTORELLA

Trophosome.—Stem polysiphonic, with ultimate branches monosiphonic and bilateral. Hydrothecæ never sessile. Thin diaphragm present. Nematophores may be present, usually on the branch at the base of the hydrothecæ.

Gonosome.—"Gonangia aggregated, with curious protuberant 'shoulders' on one or two sides of the distal end. These are horn-like processes which may curve upward, or downward, or be directed straight outward, according to the species'' (Nutting).

As nematocysts are found in many species of the *Lafœidæ* group, I do not see any necessity of the genus *Zygophylax* that Quelch has instituted. Even in *Lictorella pinnata* (Sars), they are commonly present, though they seem to have been generally overlooked, probably because they are so easily broken off. E. T. Browne, in describing *L. pinnata*,[23] is the only one who has called attention to them directly, as far as I know, without putting the species in another genus, while Broch[24] in calling attention to this reference, remarks that if the species has nematocysts, it must belong to the genus *Zygophylax*. Nutting in his Hawaiian Island paper,[25] when defining the genus *Lictorella*, mentions the frequency with which nematocysts are found in this genus.

LICTORELLA CAROLINA new species

Pl. IV, Figs. 3-5

Trophosome.—The only specimen of this species, 2.5 cm. in length, was found detached, so that it may or may not have been a complete specimen. The main stem is polysiphonic, with comparatively few hydrothecæ, and was probably erect. The branches coming off from the main stem are also polysiphonic, but the tubes are much reduced in number, gradually disappearing until in the secondary branches there is but a single tube. An appearance of dichotomy is produced in most cases by a hydrotheca from one tube originating in such a way that it seems to come from the axil formed by the branching of another tube. The ultimate branches are divided into internodes of almost equal length by deep constrictions. From each internode, nearly midway between the nodes a single hydrotheca is given off. These hydrothecæ alternate on successive internodes but are all in the same plane. At the origin of each of these there is a distinct shoulder on the branch, which is divided by a deep constriction from the base of the hydrotheca. On this shoulder there are two nematocysts present, which are deeply cup-shaped and supported by a two-ringed pedicel. Evidently they are very easily broken off, as I could find very few perfect ones, but the

23 Hydroids collected by the ''Huxley'', 1906, p. 27.

24 Hydroiduntersuchungen II, 1909, p. 201.

25 Hydroids of the Hawaiian Islands, 1905, p. 945.

holes in the shoulder indicate the places where they had been. The hydrotheca widens gradually and symmetrically until it reaches the diaphragm. From this point the under surface passes out almost in a straight line, while the upper surface is convex for some distance, after which it passes out parallel to the lower side. The margin is but slightly flaring. It is commonly duplicated.

Gonosome.—Unknown.

Distribution.—San Juan Archipelago in Prof. Kincaid's Collection.

In some respects this species resembles *Lictorella pinnata* (Sars), or *Lictorella halecioides* Allman, which I presume is the same thing. The hydrotheca especially resembles that figured by Sars,[26] so much so that if I had not had the opportunity of examining some fine specimens of *L. pinnata* from the Hawaiian Islands, identified by Prof. Nutting,[27] I should have hesitated in placing the Puget Sound specimen in a new species. One of the most marked differences is shown in the pronounced and regular division into internodes, which is not present in the Hawaiian Island forms, nor is it shown in any figures of *L. pinnata* that I have seen. The tendency towards dichotomy in the arrangement of the branches, and the presence of secondary branches, make the appearance of the specimen quite different from the somewhat stiffly-pinnate arrangement found in *L. pinnata.*

This species also resembles *Zygophylax biarmata* Billard, as described and figured by Billard,[28] differing from it in much the same way as from *L. pinnata.* Whether this species of Billard's is the same as *L. pinnata* or not, it is not necessary to discuss.

SERTULARIDÆ

In taking up this family of Hydroids, I have followed the example of the majority of those who have written since 1904 in using as a basis, the classification given by Prof. C. C. Nutting in his monograph of that year.

Of his 12 genera I have found only 7 represented in the new material I have examined, viz., *Abietinaria, Diphasia, Hydrallmania, Selaginopsis, Sertularella, Sertularia* and *Thuiaria.* To

26 Bidrag til Kundskaben om Norges Hydroider, 1873, Tab. IV, figs. 27, 28.

27 Hydroids of the Hawaiian Islands, 1905, p. 946.

28 Expeditions du Travailleur et du Talisman, 1907, p. 180.

these 7 there has been little objection made. Hartlaub,[29] Warren,[30] Billard[31] and Ritchie,[32] who have made large contributions, and others who have made smaller contributions, have used this classification as it is, for these genera. Jäderholm[33] has included *Abietinaria* with *Diphasia*, but otherwise has not departed from the classification. In each of these the operculum consists of a single adcauline flap, but the shape of the hydrothecæ and the mode of growth are different. In species of *Diphasia*, where the gonosome has been found, it is widely different from that which is found in species of *Abietinaria*.

Broch and Torrey are the only notable exceptions whose papers I have seen. Broch[34] has cut down the 7 genera to 5, but has introduced a number of sub-genera, so that the main divisions are more numerous than in Nutting's classification. Very little can be gained by combining *Diphasia* and *Abietinaria* into the one genus *Diphasia*, and then dividing the genus into the sub-genera, *Diphasia* and *Abietinaria*. It would seem to be more satisfactory to combine them and leave them that way, as Jäderholm has done, than to separate them thus. His treatment of *Selaginopsis* is rather unfortunate, when two forms that have as much resemblance to each other as *S. mirabilis* and *S. obsoleta*, are put in two genera, while at the same time, such unlike forms as *S. mirabilis* and *Sertularia pumila* are placed in the same genus. He has placed much emphasis on the trophosome as far as its individual components go, and none whatever on the general appearance, mode of growth and the features of the gonosome.

Torrey prefers to follow the grouping method of Schneider,[35] but no other systematist since his last paper appeared, seems to take this method of classification into serious account. He gives

29 Die Hydroiden der Magalhaenischen Region, 1905.

30 On a Collection of Hydroids mostly from the Natal Coast, 1908.

31 Hydroides du "Travailleur" et du "Talisman", 1907 and Hydroides du British Museum, 1910.

32 Hydroids of the Scottish Antarctic Expedition, 1907 and its Supplement, 1909.

33 Northern and Arctic Invertebrata in the Swedish Museum, Sect. IV, Hydroiden, 1909.

34 Die Hydroiden der Arktischen Meere, 1909.

35 Hydropolypen from Rovigno, 1897.

as his reason for adopting this method, that these groups "discourage the growth of synonyms, offer no awkward bars to the free passage of any species from one group to nearer relatives". He evidently is consistent with this statement, as he uses the same generic name, *Sertularia,* in two different groups, while in the same paper,[36] he uses the two generic names, *Dynamena* and *Sertularia,* for two species almost as much allied as it is possible to find.

It seems to me that it is a fair test of classification into genera, if one who has examined a good supply of material, which has included species of the allied genera of a group, can take a typical form that he has not already seen and without hesitation, place it in the genus in which it belongs, without necessarily going over all the points of distinction. This test will apply to these 7 genera of the *Sertularidæ,* consequently, they may be accepted as satisfactory. This by no means excludes the possibility of intergrading forms, as these are found here as well as elsewhere. This is particularly true among the lower marine forms.

Of the other 5 genera, *Dictyocladium, Pasythea, Staurotheca, Synthecium* and *Thecocladium,* only two, *Dictyocladium* and *Synthecium,* are reported from this Coast. As far as the genus *Dictyocladium* is concerned, I have seen no exception to it except from Billard,[37] who would place it with *Selaginopsis,* but as he gives no indication that he has seen any specimen that would be included under this genus, the features of the genus which Allman[38] and Nutting[39] point out would, necessarily, not come under his observation.

To the genus *Synthecium* Torrey takes great exception, in both Hydroid papers, but especially the latter. He claims that the species[40] described by Nutting as *Synthecium cylindricum,* should be considered a *Sertularella,* which he calls *S. halecina.* His argument is this. In his material he has found specimens, some of which have gonangia springing from the hydrothecæ, as is required for *Synthecium,* but he has also found them extra-

36 Hydroids of San Diego, 1904.

37 Hydroides du Travailleur et du Talisman, 1907, p. 183.

38 Challenger Report, The Hydroida, Part II, 1888, p. 76.

39 American Hydroids, Part II, 1904, p. 105.

40 Hydroids of San Diego, 1904, p. 21.

thecal, viz. on the stolon. In some cases he finds branches springing from the hydrothecæ, which would qualify the species for the genus *Thecocladium.* Hartlaub[41] in referring to this discussion, cites an interesting laboratory experiment, where, in a colony of *Obelia,* the hydranths disappeared from the calyces, and gonophores later appeared to take their place, though they were attenuated, and otherwise differed from the type. He concludes that the entire nourishment is used in this case to produce the gonosome, that the species may be perpetuated. In his discussion, however, he offers no opinion on the merits of the two sides of the question, but in the same paper, he later uses the genus *Synthecium,* showing that he is not satisfied that the genus should be eliminated.

It does not follow that because Torrey has found these variations in this species, that on this alone the genus *Synthecium* should be discarded. As I have already stated, there are and must be intergradations between any two allied genera, as well as between two nearly allied species, and evidently this is a good case in point, but that does not signify that the genus must on that account be left out. This is evidently the stand that most authors, who have met with species of this genus since Allman instituted it, have taken, as it has been used by them without hesitation. With regard to this particular species, there must remain some doubt as to where to place it, until a large amount of material has been examined, so that the typical form may be decided upon. As the only specimens I have seen are Prof. Nutting's type specimens, and as I have followed his classification throughout in this group, I shall continue to do so in this case, though I am perfectly free to admit that my opinion might be changed if I had the opportunity to examine a large amount of material.

Genus ABIETINARIA

ABIETINARIA ABIETINA (Linnæus)

Sertularia abietina Linnæus, Systema Naturæ. 1758, p. 808.

Sertularia anguina var. robusta Clark, Hydroids of Pacific Coast, 1876, p. 255.

Abietinaria abietina Nutting, American Hydroids, Part II, 1904, p. 114.

Abietinaria anguina Nutting, American Hydroids, Part II, 1904, p. 119.

Distribution.—Alaska, Bering Sea, Albatross collections off

[41] Die Hydroiden der Magalhaenischen Region, 1905, pp. 615-627.

Washington; Albatross Station, 2864, N. 48° 22′, W. 122° 51′, 48 fathoms; Station 3159, N. 37° 47′ 20″, W. 123° 10′, 27 fathoms; Station 3443, N. 48° 13′ 30″, W. 123° 11′ 20″, 97 fathoms; Station 3546, N. 54° 12′, W. 165° 42′, 36 fathoms; Station 3552, N. 56° 28′, W. 169° 28′, 54 fathoms; Station 2842, N. 54° 15′, W. 166° 03′, 72 fathoms; Station 3230, N. 58° 31′ 30″, W. 157° 13′ 30″, 30 fathoms; Station 3599, N. 52° 05′, E. 177° 40′, 55 fathoms (Nutting); San Juan Archipelago, Ucluelet, Departure Bay, Dodd's Narrows, Banks Island.

ABIETINARIA ALEXANDERI Nutting

Abietinaria alexanderi NUTTING, American Hydroids, Part II, 1904, p. 120.

Distribution.—Albatross Station 2841, N. 54° 18′, W. 165° 55′ 56″, 56 fathoms; Station 3599, N. 52° 05′, E. 177° 40′, 55 fathoms (Nutting).

ABIETINARIA AMPHORA Nutting

Abietinaria amphora NUTTING, American Hydroids, Part II, 1904, p. 119.

Distribution.—Albatross Station 2841, N. 54° 18′, W. 165° 55′ 56″, 56 fathoms; Station 2866, N. 48° 09′, W. 125° 03′, 171 fathoms; Whidley Island, Puget Sound (Nutting); Port Renfrew, Ucluelet, Dodd's Narrows.

ABIETINARIA ANGUINA (Trask)

Sertularia anguina TRASK, Proc. Cal. Acad. Sc., Vol. I, 1857, p. 112.
Sertularia labrata MURRAY, Ann. and Mag., 3rd Series, V, 1860, p. 250.
Sertularia anguina CLARK, Hydroids of Pacific Coast, 1876, p. 255.
Abietinaria labiata KIRCHENPAUER, Nordische Gattungen, 1884, p. 34.
Thuiara coei NUTTING, Hydroids of the Harriman Ex., 1901, p. 185.
Abietinaria coei NUTTING, American Hydroids, Part II, 1904, p. 117.

Distribution.—San Diego, Cal. (Hemphill); Monterey Bay (Anderson); Vancouver Island (Dawson); San Francisco (Trask); Dutch Harbor, Alaska, Tledis Village near Susk, B. C. (Nutting); Port Renfrew, Ucluelet.

The species *Abietinaria anguina* (Trask), described by Prof. Nutting,[42] which evidently is the same as *S. anguina var. robusta* Clark, appears to me to be identical with *A. abietina* (Linnæus). I have examined a large amount of material and have found all phases of gradation in the size of the hydrotheca, from those that

[42] American Hydroids, Part II, 1904, p. 119.

are almost half immersed, to those even longer than the figures would indicate. I have compared these specimens with others from the Atlantic Coast and can see no reason for considering this a separate species. Moreover, on the same colony there appear gonangia as smooth and as elongated as those figured for *A. anguina,* and others as stout and as much annulated as that figured by Hincks[43] for *A. abietina.* In all of them the border is turned in to form a somewhat funnel-shaped portion, like an inverted collar. The border is ornamented with a ring of sharp teeth.

The name, *Abietinaria anguina,* should be retained for the species originally described as *Sertularia anguina* by Trask. It would have been much easier to trace his species if he had seen any gonangia, but by making a series of comparisons it is possible to trace it to *A. coei* Nutting, as distinct from *Sertularia filicula,* with which Dr. Torrey associates it.

Trask's fig. 1, Pl. V, is evidently the same as that figured by Murray, in fig. 2a, Pl. XI, as *S. labrata.* Fig. 2 showing this in natural size, corresponds with *A. coei* Nutting in its definitely pinnate arrangement, and decidedly geniculate stem above the first pinna, while *A. filicula* is branched many times, so that the pinnate arrangement is obliterated. This latter figure agrees with the natural size fig. 5 in table 14, given by Kirchenpauer for *A. labiata.* The figs. 5a, 5b and 5c in the same table, represent gonangia similar to those figured in plate XXXIII, for *A. coei* Nutting, these being quite different from those of *A. filicula,* which are well figured by Hincks,[44] in fig. 3b, Pl. LIII, and by Ellis and Solander,[45] in fig. C, Pl. 6.

It is probable that it is on account of its mode of growth that Trask speaks of its resemblance to *S. fallax* Johnston, because in its definitely pinnate arrangement, it more nearly resembles *S. fallax* that Johnston has figured in Pl. XI,[46] than it does the loose arrangement of *S. filicula* as figured in Pl. XIV of the same work.

Clark in one of his papers[47] describes *S. anguina* and mentions

[43] British Hydroid Zoophytes, 1868, Pl. LV.

[44] British Hydroid Zoophytes, 1868.

[45] Natural History of Zoophytes, 1786.

[46] British Zoophytes, 1847.

[47] Hydroids of the Pacific Coast, 1876, p. 255.

its resemblance to *A. filicula,* while in another paper published in the same year,[48] he includes *S. filicula.* Therefore, though he states that their trophosomes are quite similar, he evidently considers that there are the two separate species.

ABIETINARIA ANNULATA (Kirchenpauer)

Thuiaria annulata KIRCHENPAUER, Nordische Gattungen, 1884, p. 26.
Abietinaria annulata NUTTING, American Hydroids, Part II, 1904, p. 122.

Distribution.—Albatross Station 3546, N. 54° 12′, W. 165° 42′, 36 fathoms (Nutting).

ABIETINARIA COSTATA (Nutting)

Thuiaria costata NUTTING, Hydroids of the Harriman Ex., 1901, p. 187.
Abietinaria costata NUTTING, American Hydroids, Part II, 1904, p. 122.

Distribution.—Yakutat, Alaska (Nutting).

ABIETINARIA FILICULA (Ellis and Solander)

Sertularia filicula E. & S., Nat. Hist. Zoophytes, 1786, p. 57.
Sertularia filicula CLARK, Alaskan Hydroids, 1876, p. 219.
Sertularia filicula TORREY, Hydroida of the Pacific Coast, 1902, p. 68.
Abietinaria filicula NUTTING, American Hydroids, Part II, 1904, p. 117.

Distribution.—Alaska, Albatross Station 2865, N. 48° 12′, W. 122° 49′, 40 fathoms (Nutting); San Juan Archipelago, Victoria, Dodd's Narrows.

The specimen described by Dr. Torrey, evidently belongs to this species, if one is to judge from his drawing of the gonangia, but that it is the same species as *S. anguina* Trask, is an opinion with which I cannot agree, as explained in connection with the note on *A. anguina.*

ABIETINARIA GIGANTEA (Clark)

Thuiaria gigantea CLARK, Alaskan Hydroids, 1876, p. 230.
Thuiaria gigantea NUTTING, Hydroids from Alaska and Puget Sound, 1899, p. 741.
Thuiaria gigantea NUTTING, Hydroids of the Harriman Ex., 1901, p. 186.
Abietinaria gigantea NUTTING, American Hydroids, Part II, 1904, p. 123.

Distribution.—Alaskan Shores and Aleutian Islands, Bering Sea, Hagmeister Island, Akutan Pass, Kyska Harbor, Orca, Kadiak, Belkoffsky, Albatross Station 3464, N. 48° 14′, W. 123° 20′ 40″, 40 fathoms; Station 3546, N. 54° 12′, W. 162° 42′, 36 fathoms; Station 3557, N. 57° 04′, W. 170° 24′, 26 fathoms (Nutting); Bering Sea (Jäderholm).

[48] Alaskan Hydroids, 1876, p. 219.

ABIETINARIA GRACILIS Nutting

Abietinaria gracilis NUTTING, American Hydroids, Part II, 1904, p. 120.

Distribution.—Albatross Station 2873, N. 48° 30′, W. 124° 57′, 40 fathoms; Station 3480, N. 52° 06′, W. 171° 45′, 283 fathoms; Station 3599, N. 52° 05′, E. 177° 40′, 55 fathoms (Nutting).

ABIETINARIA GREENEI (Murray)

Sertularia greenei MURRAY, Ann. and Mag. 3rd Ser. V, 1860, p. 504.
Sertularia greenei CLARK, Hydroids of the Pacific Coast, 1876, p. 257.
Sertularia greenei TORREY, Hydroida of the Pacific Coast, 1902, p. 69.
Abietinaria greenei NUTTING, American Hydroids, Part II, 1904, p. 121.

Distribution.—Tomales Point, Monterey, Punta Reyes, San Francisco, Port Renfrew, Vancouver Island (Nutting); San Juan Archipelago, Dodd's Narrows, Departure Bay, Port Renfrew, Ucluelet.

ABIETINARIA INCONSTANS (Clark)

Sertularia inconstans CLARK, Alaskan Hydroids, 1876, p. 222.
Abietinaria inconstans NUTTING, American Hydroids, Part II, 1904, p. 116.

Distribution.—Unalaska (Nutting).

ABIETINARIA RIGIDA, new species

Pl. V, Figs. 1-3

Trophosome.—Largest colony obtained reaches a height of 4 inches. The main stem is coarse, rigid and but slightly flexuose, with annulations at the base, but with little indication of being regularly divided into internodes. Some specimens over 2 inches in length are entirely unbranched. When the branches are present they have usually a regular alternate arrangement, each branch making a wide angle with the stem. As the branches also, are rigid, the whole colony has a coarse stiff appearance. The number of hydrothecæ between two successive branches on the same side of the main stem is by no means constant, but is commonly three. At the junction with the main stem, the branch is much constricted, so that it readily breaks off at that point. The branches have at most one or two nodal rings, in many cases there appears to be none present. The hydrothecæ on the main stem and on the branches have a regular arrangement, but on the branches they are somewhat more closely placed. They are stout, narrowing gradually but slightly, towards the circular opening, the margin of which is perfectly smooth, lying parallel to the axis of the stem or branch. In some cases there is a slight indication of flaring, but this is seldom noticeable. The hydrothecæ are immersed to a large extent, less than one-fourth being free. The operculum consists of a single adcauline flap.

Gonosome.—The gonangia are borne on the upper surface of the branches. The shape is an elongated oval, with a distinctly narrowed pedicel. At the distal end it narrows suddenly to form a narrow collar which is double, on account of the margin being turned in. A finely-toothed ornamentation appears on the collar. The gonangia are very similar to some of those found on *A. abietina.*

Distribution.—Albatross Station 2865, N. 48° 12′, W. 122° 51′, 48 fathoms (in collection of the State University of Iowa); San Juan Archipelago.

This species resembles to some extent, one of the varieties that Clark includes under *Sertularia variabilis,*[49] but in this species he has included forms resembling such greatly differing species as *Abietinaria traski* and *Abietinaria abietina.* It seems to me that even if there are intergrading forms, such distinct typical forms should be treated as specifically distinct. It is a common experience in examining a large amount of material, to find many specimens showing such intergradation between two allied species, that it is difficult to decide to which they belong. As such is the case, distinct types must be treated as specifically distinct, no matter how much intergradation there may be, if we are going to have any classification. The indications are that if it were possible to get even a fairly complete collection of hydroids, or of any of the lower marine groups, the whole group would be a series of gradations, and not only that, but the groups themselves would scarcely be delimited. Even in the higher land forms, where isolation has had the best chance to produce distinct species, disagreement among systematists as to the position of a specimen, often occurs.

This type is plentiful in the San Juan Archipelago, and is so characteristic, that it can readily be picked out from a hydroid mass, without the aid of a lens. Since this is the case, even if intergradations may be or have been found between it and other forms, it seems best to distinguish it specifically.

[49] Alaskan Hydroids, 1876, p. 221.

ABIETINARIA TRASKI (Torrey)

Sertularia traski TORREY, Hydroida of the Pacific Coast, 1902, p. 69.
Abietinaria traski NUTTING, American Hydroids, Part II, 1904, p. 118.

Distribution.—San Pedro, Cal. (Torrey); Albatross Station, 2861, N. 51° 14′, W. 129° 50′, 204 fathoms; Station 2873, N. 48° 30′, W. 124° 57′, 40 fathoms; Station 2886, N. 43° 59′, W. 124° 56′ 30″, 50 fathoms; Station 3192, N. 35° 33′ 40″, W. 121° 15′, 101 fathoms (Nutting); San Juan Archipelago, Dodd's Narrows, Departure Bay.

ABIETINARIA TURGIDA (Clark)

Thuiaria turgida CLARK, Alaskan Hydroids, 1876, p. 229.
Thuiaria turgida NUTTING, Hydroids from Alaska and Puget Sound, 1899, p. 741.
Thuiaria turgida NUTTING, Hydroids of the Harriman Ex., 1901, p. 186.
Abietinaria turgida NUTTING, American Hydroids, Part II, 1904, p. 123.

Distribution.—Alaskan Coasts, Aleutian Islands and Bering Sea (Nutting); Orca, Alaska, Collection of H. Moon.

ABIETINARIA VARIABILIS (Clark)

Sertularia variabilis CLARK, Alaskan Hydroids, 1876, p. 221.
Sertularia variabilis NUTTING, Hydroids of Alaska and Puget Sound, 1899, p. 741.
Thuiaria variabilis NUTTING, Hydroids of the Harriman Expedition, 1901, p. 185.
Abietinaria variabilis NUTTING, American Hydroids, Part II, 1904, p. 115.

Distribution.—Alaskan Coasts, Aleutian Islands, Bering Sea, San Miguel Island, California; Albatross Station 2857, N. 58° 05′, W. 150° 46′, 51 fathoms; Station 2864, N. 48° 22′, W. 122° 51′, 48 fathoms; Station 2866, N. 48° 09′, W. 125° 03′, 171 fathoms; Station 2886, N. 43° 59′, W. 124° 56′ 30″, 50 fathoms; Station 3231, N. 58° 35′, W. 157° 28′ 50″, 12 fathoms; Station 3465, N. 48° 21′, W. 123° 14′, 48 fathoms; Station 3599, N. 52° 05′, E. 177° 40′, 55 fathoms; Puget Sound (Nutting); Bering Sea (Jäderholm); Queen Charlotte Islands.

Genus DICTYOCLADIUM

DICTYOCLADIUM FLABELLUM Nutting

Dictyocladium flabellum NUTTING, American Hydroids, Part II, 1904, p. 105.

Distribution.—Albatross Station 2842, N. 54° 15′, W. 166° 03′, 72 fathoms; Station 2874, N. 48° 30′, W. 124° 57′, 27 fathoms (Nutting).

Genus DIPHASIA

DIPHASIA CLARÆ, new species

Pl. VI, Fig. 1

Trophosome.—The colony is small and delicate, not half an inch in length, parasitic on *Abietinaria abietina* and other coarse forms. It is dichotomously branched, with a hydrotheca in the angle in each case. A quite regular division into internodes takes place, with rarely more than one hydrotheca to an internode. The hydrothecæ are alternately arranged, the two in succession being quite distant from each other. Each has the regular *Diphasia* form, with but a slight narrowing from the base to the aperture. The margin of the aperture is also typical, being shaped like the rim of a pitcher, with the adcauline operculum of a single flap, shaped to fit. The hydrotheca is less than half immersed.

Gonosome.—Unknown.

Distribution.—On *Abietinaria abietina* and other large hydroid colonies, San Juan Archipelago; Queen Charlotte Islands.

DIPHASIA CORNICULATA (Murray)

Sertularia corniculata Murray, Ann. and Mag., 3rd Ser., V, 1860, p. 251.
Sertularia corniculata Clark, Hydroids of the Pacific Coast, 1876, p. 251.
Diphasia corniculata Nutting, American Hydroids, Part II, 1904, p. 112.

Distribution.—Bay of San Francisco (Murray).

DIPHASIA KINCAIDI (Nutting)

Thuiara elegans Nutting, Hydroids of the Harriman Ex., 1901, p. 187.
Thuiaria kincaidi Nutting, American Naturalist, Sept., 1901, p. 789.
Thuiaria elegans Torrey, Hydroida of the Pacific Coast, 1902, p. 14.
Diphasia kincaidi Nutting, American Hydroids, Part II, 1904, p. 112.

Distribution.—Berg Inlet and Dutch Harbor, Alaska (Nutting).

? DIPHASIA PULCHRA Nutting

Diphasia pulchra Nutting, American Hydroids, Part II, 1904, p. 111.

Distribution.—Albatross Station 2863, N. 48° 58′, W. 123° 10′, 67 fathoms (Nutting).

I have seen no specimens of this species except Prof. Nutting's types, and no description except the one that he gives, consequently, I can only place it in this genus provisionally, as he has done.

Genus HYDRALLMANIA

HYDRALLMANIA DISTANS Nutting

Hydrallmania falcata CALKINS, Hydroids from Puget Sound, 1899, p. 362.

Hydrallmania distans NUTTING, Hydroids from Alaska and Puget Sound, 1899, p. 746.

Hydrallmania distans NUTTING, American Hydroids, Part II, 1904, p. 126.

Distribution.—Puget Sound (Calkins); Puget Sound (Nutting); San Juan Archipelago, Ucluelet, Dodd's Narrows, Queen Charlotte Islands.

Calkins' type slides show that what he named *H. falcata* is the same as *H. distans* Nutting. Consequently there is at present no indication that *H. falcata* has been found on the Pacific Coast of North America.

HYDRALLMANIA FRANCISCANA (Trask)

Plumularia franciscana TRASK, Proc. Cal. Acad. Sc., Vol. I. 1857, p. 113.

Hydrallmania franciscana CLARK, Hydroids of the Pacific Coast, 1876, p. 260.

Hydrallmania franciscana TORREY, Hydroida of the Pacific Coast, 1902, p. 13.

Hydrallmania franciscana NUTTING, American Hydroids, Part II, 1904, p. 126.

Distribution.—San Francisco Bay (Trask and Murray).

Genus SELAGINOPSIS

SELAGINOPSIS CEDRINA (Linnæus)

Sertularia cedrina LINNÆUS, Systema Naturæ, 1758, p. 814.

Selaginopsis pacifica MERESCHKOWSKY, Ann. and Mag., 5th Ser., II, 1878, p. 438.

Selaginopsis cedrina KIRCHENPAUER, Nordische Gattungen, 1884, p. 8.

Selaginopsis cedrina NUTTING, American Hydroids, Part II, 1904, p. 130.

Distribution.—Bering Sea (Kirchenpauer).

SELAGINOPSIS CLYINDRICA (Clark)

Thuiaria cylindrica, CLARK, Alaskan Hydroids, 1876, p. 226.

Selaginopsis cylindrica CALKINS, Some Hydroids from Puget Sound, 1899, p. 362.

Selaginopsis cylindrica NUTTING, American Hydroids, Part II, 1904, p. 131.

Distribution.—Port Moller, Alaska, Hagmeister Island, Bering Sea, Chirikoff Island, Chiachi Islands (Clark); Puget Sound (Calkins); Bristol Bay, Alaska (Nutting); St. Lawrence Island, lotte Islands.
Bering Sea (Jäderholm); San Juan Archipelago, Queen Char-

SELAGINOPSIS HARTLAUBI Nutting

Selaginopsis hartlaubi NUTTING, American Hydroids, Part II, 1904, p. 133.

Distribution.—Albatross Station 3560, N. 56° 40′, W. 169° 20′, 43 fathoms (Nutting); San Juan Archipelago.

SELAGINOPSIS MIRABILIS (Verrill)

Diphasia mirabilis VERRILL, Amer. Jour. Science, 3rd Ser., V, 1872, p. 9.
Diphasia mirabilis CLARK, Alaskan Hydroids, 1876, p. 219.
Selaginopsis mirabilis NUTTING, Hydroids of Alaska and Puget Sound, 1899, p. 741.
Selaginopsis mirabilis TORREY, Hydroida of the Pacific Coast, 1902, p. 70.
Selaginopsis mirabilis NUTTING, American Hydroids, Part II, 1904, p. 128.

Distribution.—Hagmeister Island, Bering Sea, Popoff Strait, Shumagin Islands (Clark); Puget Sound, Albatross Station 2865, N. 48° 12′, W. 122° 49′, 40 fathoms (Nutting); San Juan Archipelago, Dodd's Narrows.

SELAGINOPSIS OBSOLETA (Lepechin)

Sertularia obsoleta LEPECHIN, Acta Acad. Petropol. II, 1778, Pt. 2, p. 137.
Selaginopsis hincksii MERESCHOWSKY, Ann. and Mag., 5th Ser., II, 1878, p. 444.
Selaginopsis obseleta KIRCHENPAUER, Nordische Gattungen, 1884, p. 10.
Selaginopsis obsoleta NUTTING, American Hydroids, Part II, 1904, p. 132.

Distribution.—St. Paul's Island, Bering Sea (A. and A. Krause). Albatross Station 3508, N. 58° 33′, W. 164° 49′, 23 fathoms (Nutting).

SELAGINOPSIS ORNATA Nutting

Selaginopsis ornata NUTTING, American Hydroids Part II, 1904, p. 131.

Distribution.—Albatross Station 2843, N. 53° 56′, W. 165° 56′, 45 fathoms (Nutting).

SELAGINOPSIS PINASTER (Lepechin)

Sertularia pinaster LEPECHIN, Acta Acad. Petropol., 1783, p. 223.
Sertularia pinus KIRCHENPAUER, Nordische Gattungen, 1884, p. 11.
Selaginopsis pinaster NUTTING, American Hydroids, Part II, 1904, p. 128.

Distribution.—St. Paul's Island (A. and A. Krause).

SELAGINOPSIS PINNATA Mereschkowsky

Selaginopsis pinnata MERESCHOWSKY, Ann. and Mag., 5th Ser., II, 1878, p. 436.
Selaginopsis pinnata KIRCHENPAUER, Nordische Gattungen, 1884, p. 14.
Selaginopsis pinnata NUTTING, American Hydroids, Part II, 1904, p. 130.

Distribution.—Port Ajan (M. Wosnessensky); St. Paul's Island, 23 fathoms (Kirchenpauer); Albatross Station 3558, N. 56° 58′, W. 170° 09′, 25 fathoms (Nutting); San Juan Archipelago, Queen Charlotte Islands.

SELAGINOPSIS PLUMIFORMIS Nutting

Selaginopsis plumiformis NUTTING, American Hydroids, Part II, 1904, p. 129.

?*Selaginopsis cylindrica* CLARK, Alaskan Hydroids, 1876, p. 226.

Distribution.—N. 60° 22′, W. 168° 45′ (Nutting).

I have not been able to satisfy myself that this species is distinct from *S. cylindrica* Clark, as I have found a number of specimens of what I take to be *S. cylindrica,* with a woody main stem and large primary branches, with secondary branches, similar to Prof. Nutting's type specimen. It appears that the reason that they are not often found in this way is, that the primary branches break off from the main stem, taking the annulated portion with the branch. Consequently what appears as a main stem in an ordinary specimen, is really a primary branch, and what appears as a primary branch is really a secondary branch. This would explain what Clark says, "occasionally a large branch occurs which resembles the main stem in every particular".[50] With regard to the branching he says, "branches, cylindrical or polygonal, arranged alternately, bearing from one to three branchlets near the base, which are of equal size and of nearly equal length with the branches, or unbranched". I have found that this accurately describes the specimens that I have examined. This branching of the branches gives a close resemblance to Mereschkowsky's figure of *S. pacifica,*[51] corresponding to the agreement Prof. Nutting finds between *S. plumiformis* and *S. pacifica.*

SELAGINOPSIS TRISERIALIS Mereschkowsky

Selaginopsis triserialis MERESCHKOWSKY, Ann. and Mag., 5th Ser., II, 1878, p. 435.

Selaginopsis triserialis KIRCHENPAUER, Nordische Gattungen, 1884, p. 14

Sertularia incongrua TORREY, Hydroida of the Pacific Coast, 1902, p. 69.

Selaginopsis triserialis NUTTING, American Hydroids, Part II, 1904, p. 129.

Distribution.—San Pedro, Cal. (Torrey); Albatross Station 2908, N. 34° 25′ 25″, W. 120° 20′, 31 fathoms (Nutting).

[50] Alaskan Hydroids, 1876, p. 227.

[51] Ann. and Mag., Vol. 2, 5th Ser., 1878, Pl. 16, fig. 5.

Genus SERTULARELLA

SERTULARELLA ALBIDA Kirchenpauer

Sertularella robusta CLARK, Alaskan Hydroids, 1876, p. 225.
Sertularella albida KIRCHENPAUER, Nordische Gattungen, 1884, p. 42.
Sertularella albida NUTTING, American Hydroids, Part II, 1904, p. 86.

Distribution.—Yukon Harbor, Big Koniushi, Shumagin Islands, 6 to 20 fathoms (Clark).

SERTULARELLA CLARKII Mereschkowsky

Sertularella clarkii MERESCHKOWSKY, Ann. and Mag., 5th Ser., II, 1878. p. 447.
Sertularella clarkii NUTTING, American Hydroids, Part II, 1904, p. 102.

Distribution.—Unalaska (M. Petelin), 1847.

SERTULARELLA COMPLEXA Nutting

Sertularella complexa NUTTING, American Hydroids, Part II, 1904, p. 94.

Distribution.—Albatross Station 2843, N. 53° 56′, W. 165° 56′, 45 fathoms; Station 2853, N. 56°, W. 154° 20′, 159 fathoms; Station 2858, N. 58° 17′, W. 148° 36′, 230 fathoms; Station 3500, N. 56° 02′, W. 169° 30′, 121 fathoms (Nutting).

SERTULARELLA CONICA Allman

Pl. VI, Figs. 2-4

Sertularella conica ALLMAN, Hydroids of the Gulf Stream, 1877, p. 21.
Sertularella conica CALKINS, Some Hydroids of Puget Sound, 1899, p. 359.
Sertularella conica NUTTING, American Hydroids, Part II, 1904, p. 79.

Distribution.—Townshend Harbor (Calkins); San Juan Archipelago, Port Renfrew, Ucluelet.

Prof. Nutting is doubtful if *S. conica* Calkins, is really the same as *S. conica* Allman. I have found many specimens in the Puget Sound material as well as in the material from Port Renfrew and Ucluelet that have the four-flapped operculum, and seemingly all the other characteristics of *S. conica* Allman, consequently, I believe that the diagnosis was correct. In the Port Renfrew material I found gonangia, which as far as I know, have not yet been described. They resemble the gonangia of *S. polyzonias,* but they are not nearly so large. They are peculiar in that they have their origin directly from the stolon, from which the unbranched stems arise. Sometimes they appear singly, but sometimes several of them are grouped together. They are formed, evidently, while the colony is very young, as in the same specimens in which they were present, there were stems with only one hydrotheca, some with two, and none with more than three or four. The figures showing the development, were obtained from the same specimen as that showing the gonangium.

? SERTULARELLA DENTIFERA Torrey

Sertularella dentifera TORREY, Hydroida of the Pacific Coast, 1902, p. 61.
Sertularella dentifera NUTTING, American Hydroids, Part II, 1904, p. 100.

Distribution.—San Pedro, Cal. (Torrey).

I have found specimens of *S. tricuspidata* with reduplications in the margin of the hydrothecæ, in some cases even more marked than Dr. Torrey shows in his figure, and at the same time they resemble his figure in every other respect except that I have not found any in which the branches arise from the lumen of the hydrothecæ. In the figure one branch is shown to have its origin in that way, while the other has not. If the former is the normal condition, the species, as he says, should belong to the genus *Thecocladium;* if the latter it is a *Sertularella,* and would more likely be an abnormal specimen of *S. tricuspidata,* than of *S. tropica* as Prof. Nutting suggests, because *S. tricuspidata* is very common along the whole Pacific Coast, and *S. tropica* has not been reported. In a later paper[52] Prof. Nutting recognizes the species, but his figure of the gonangium gives the further evidence that was needed to show that it is really *S. tricuspidata.*

SERTULARELLA ELEGANS Nutting

Sertularella elegans NUTTING, American Hydroids, Part II, 1904, p. 98.

Distribution.—Albatross Station 2842, N. 54° 15′, W. 166° 03′, 72 fathoms (Nutting).

SERTULARELLA FUSIFORMIS (Hincks)

Sertularia fusiformis HINCKS, Ann. and Mag., 3rd Ser., VIII, 1861, p. 253.
Sertularella fusiformis TORREY, Hydroida of the Pacific Coast, 1902, p. 61.
Sertularella fusiformis NUTTING, American Hydroids, Part II, 1904, p. 89.

Distribution.—San Francisco, Cal. (Torrey).

SERTULARELLA LEVINSENI Nutting

Sertularella levinseni NUTTING, American Hydroids, Part II, 1904, p. 100.

Distribution.—Albatross Station 2842, N. 54° 15′, W. 166° 03′, 72 fathoms (Nutting).

[52] Hydroids of the Hawaiian Islands, 1905, p. 948.

SERTULARELLA MAGNA Nutting

Sertularella magna NUTTING, American Hydroids, Part II, 1904, p. 103.

Distribution.—Albatross Station 3480, N. 52° 06′, W. 171° 45′, 283 fathoms (Nutting).

SERTULARELLA MINUTA Nutting

Sertularella minuta NUTTING, American Hydroids, Part II, 1904, p. 99.

Distribution.—Albatross Station 3480, N. 52° 06′, W. 171° 45′, 283 fathoms (Nutting).

SERTULARELLA PEDRENSIS Torrey

Sertularella pedrensis TORREY, Hydroids of San Diego, 1904, p. 27.

Distribution.—San Pedro, Cal. (Torrey) ; Santa Barbara, Cal., in collection of the State University of Iowa (collected by Mrs. V. B. Gibbs).

SERTULARELLA PINNATA Clark

Sertularella pinnata CLARK, Alaskan Hydroids, 1876, p. 226.
Sertularella pinnata NUTTING, American Hydroids, Part II, 1904, p. 94.

Distribution.—Unalaska, Coal Harbor, Shumagin Islands, Lituya Bay, 112 fathoms (Clark) ; San Juan Archipelago.

SERTULARELLA POLYZONIAS (Linnæus)

Sertularia polyzonias LINNÆUS, Systema Naturæ, 1758, p. 813.
Sertularella polyzonias CLARK, Alaskan Hydroids, 1876, p. 224.
Sertularella polyzonias NUTTING, Hydroids of the Harriman Ex., 1901, p. 183.
Sertularella polyzonias NUTTING, American Hydroids, Part II, 1904, p. 90.

Distribution.—Alaska (Clark) ; Albatross Station 3294, N. 57° 16′ 45″, W. 159° 03′ 30″, 30 fathoms; Station 3505, N. 57° 09′, W. 168° 17′, 44 fathoms; Station 3511, N. 57° 32′, W. 169° 38′, 39 fathoms (Nutting) ; San Juan Archipelago.

SERTULARELLA RUGOSA (Linnæus)

Sertularia rugosa LINNÆUS, Systema Naturæ, 1758, p. 809.
Sertularella rugosa CLARK, Alaskan Hydroids, 1876, p. 224.
Sertularella saceata NUTTING, Hydroids of the Harriman Ex., 1901, p. 183.
Sertularella rugosa NUTTING, American Hydroids, Part II, 1904, p. 82.

Distribution.—Alaska (Clark) ; Puget Sound (Nutting) ; Popoff Island and Yakutat, Alaska, in H. Moon's Collection.

SERTULARELLA TANNERI Nutting

Sertularella tanneri NUTTING, American Hydroids, Part II, 1904, p. 81.

Distribution.—Albatross Station 2873, N. 48° 30′, W. 124° 57′, 40 fathoms (Nutting).

SERTULARELLA TENELLA (Alder)

Sertularia rugosa (var.) JOHNSTON, British Zoophytes, 1847, p. 64.
Sertularia tenella ALDER, Cat. Zooph. Northumberland, 1857, p. 23.
Sertularella tenella TORREY, Hydroida of the Pacific Coast, 1902, p. 64.
Sertularella tenella NUTTING, American Hydroids, Part II, 1904, p. 83

Distribution.—Albatross Station 2865, N. 48° 12′, W. 122° 49′, 40 fathoms (Nutting); Puget Sound (Hartlaub); California (Torrey); San Juan Archipelago.

SERTULARELLA TRICUSPIDATA (Alder)

Sertularia tricuspidata ALDER, Ann. and Mag., 2nd Ser., XVIII, 1856, p. 356.
Sertularella tricuspidata CLARK, Alaskan Hydroids, 1876, p. 224.
Sertularella tricuspidata NUTTING, Hydroids from Alaska and Puget Sound, 1899, p. 741.
Sertularella tricuspidata CALKINS, Some Hydroids from Puget Sound, 1899, p. 360.
Sertularella tricuspidata NUTTING, Hydroids of the Harriman Ex., 1901, p. 183.
Sertularella hesperia TORREY, Hydroida of the Pacific Coast, 1902, p. 63.
Sertularella tricuspidata NUTTING, American Hydroids, Part II, 1904, p. 100.

Distribution.—Alaska, Aleutian Islands, St. Paul's Island (Clark); Puget Sound (Nutting); Port Townshend (Calkins); San Diego Harbor (Torrey); Albatross Station 2850, N. 54° 52′, W. 159° 46′, 21 fathoms; Station 2857, N. 58° 05′, W. 150° 46′, 51 fathoms; Station 2858, N. 58° 17′, W. 148° 36′, 230 fathoms; Station 2865, N. 48° 12′, W. 122° 49′, 40 fathoms; Station 2866, N. 48° 09′, W. 125° 03′, 171 fathoms; Station 3225, N. 54° 48′ 30″, W. 165° 49′, 85 fathoms (Nutting); St. Lawrence Island, Bering Sea (Jäderholm); San Juan Archipelago, Dodd's Narrows, Departure Bay.

SERTULARELLA TURGIDA (Trask)

Sertularia turgida TRASK, Proc. Cal. Acad. Sc., 1857, p. 113.
Sertularella turgida CLARK, Hydroids of the Pacific Coast, 1876, p. 259.
Sertularella nodulosa CALKINS, Some Hydroids from Puget Sound, 1899, p. 360.
Sertularella turgida TORREY, Hydroida of the Pacific Coast, 1902, p. 64.
Sertularella turgida NUTTING, American Hydroids, Part II, 1904, p. 95.

Distribution.—Bay of San Francisco, Monterey, Tomales

Point, Cal. (Trask); San Diego, Cal., Vancouver Island (Clark); Townshend Harbor (Calkins); Oregon (Nutting); Albatross Station 2861, N. 54° 14′, W. 129° 50′, 204 fathoms (Nutting); San Juan Archipelago, Victoria, Port Renfrew, Ucluelet, Dodd's Narrows, Departure Bay.

Genus SERTULARIA

SERTULARIA CORNICINA (McCready)

Dynamena cornicina McCready, Gmynophthalmata of Charleston Harbor, 1858, p. 204.

Sertularia cornicina Nutting, Hydroids of Wood's Hole, 1901, p. 359.

Sertularia complexa Nutting, Hydroids of Wood's Hole, 1901, p. 360.

Sertularia cornicina Nutting, American Hydroids, Part II, 1904, p. 58.

Dynamena cornicina Torrey, Hydroids of San Diego, 1904, p. 30.

Distribution.—Coronado Islands, Cal. (Torrey).

SERTULARIA DESMOIDES Torrey

Sertularia desmoides Torrey, Hydroida of the Pacific Coast, 1902, p. 65.

Sertularia desmoides Nutting, American Hydroids, Part II, 1904, p. 56.

Distribution.—San Diego, San Clemente Island, San Pedro, Cal., 1-42 fathoms (Torrey); Albatross Station 2939, N. 33° 36′, W. 118° 09′ 30″, 27 fathoms (Nutting).

SERTULARIA FURCATA Trask

Pl. VI, Fig. 5

Sertularia furcata Trask, Proc. Cal. Acad. Sc., 1857, p. 112.

Sertularia furcata Clark, Hydroids of the Pacific Coast, 1876, p. 258.

Sertularia furcata Torrey, Hydroida of the Pacific Coast, 1902, p. 66.

Sertularia pulchella Nutting, American Hydroids, Part II, 1904, p. 55.

Sertularia furcata Torrey, Hydroids of San Diego, 1904, p. 31.

Distribution.—Bay of San Francisco and Farallone Islands (Trask); Santa Cruz, Monterey, San Diego, Santa Barbara (Clark); San Pedro, Coronado Island, shore to 24 fathoms (Torrey); Ucluelet.

Prof. Nutting, in his American Hydroids, basing his opinion on Clark's description and figure of *Sertularia furcata* Trask, places this species along with *Dynamena pulchella* d'Orbigny, and calls it *Sertularia pulchella.* Jäderholm[53] follows him in this, and also follows Hincks,[54] in taking *S. pulchella* and *S.*

[53] Northern and Arctic Invertebrata in the Swedish State Museum, Section IV, Hydroiden, 1909, p. 97.

[54] British Hydroid Zoophytes, 1868, p. 263.

operculata together, giving the latter name to the three species. Hartlaub[55] goes a step farther, by including as well, *Dynamena bispinosa* Gray, with these three species, all under the name *S. operculata.* Evidently none of these investigators have seen a specimen of *S. furcata,* and unfortunately Clark's drawings do not bring out many of the characteristic features. His description too, is rather meagre, though in it certain features distinguishing this from these other forms are mentioned. Torrey, particularly in his 1904 paper, makes note of some of these differences, but as he had not seen d'Orbigny's drawings, only one of which was copied by Nutting, he was not in a position to appreciate all the differences that exist.

The mode of growth in the two cases is markedly different. *D. pulchella,* according to d'Orbigny,[56] may be a quarter of a meter long, is much and irregularly branched, and is attached in the usual way to the surface of a shell. None of the specimens of *S. furcata* are more than three-quarters of an inch in length, unbranched; each stem is attached to a stolon "by a short, slender, twisted process, about the length of an internode". The stolon which may be quite long, is not very sinuous, and in all specimens to hand, is growing attached to the surface of eel-grass. The pairs of hydrothecæ with the exception of the first two or three towards the base, are in contact on the one side of the stem, which Trask calls the back and Torrey the face. There is no indication in any of d'Orbigny's figures, that they come together, but rather they are shown to be noticeably apart. I see no sign of the double annulation at the nodes that d'Orbigny mentions, and the annulations are not so regular as he figures them. The gonangia appear to be similar in the two species. In *S. furcata* they are restricted to an area near the base of the stem, whereas in *D. pulchella,* on account of the extensive branching, they have a wide range. In both cases they have their origin just below the bases of the hydrothecæ.

Trask's description agrees very well with Clark's except that he speaks of the stolon as the main stem or rachis, which is "adnate to the various marine algæ on which it grows, and often quite embedded in the fronds of marine plants". His descrip-

55 Die Hydroiden der Magalhaenischen Region, 1905, p. 664.

56 Voyage dans L'Amerique Meridionale, 1839, p. 26.

tion of the pedicel which supports the "pinna", scarcely corresponds. He says "This (the pedicel) is attached to the rachis by a strong base, is sub-pyriform and cylindrical, is free for about three-fourths of its length, terminating in a rather bluntly rounded, rostrate process on the outer and superior aspect". In his drawings he shows this "rostrate process", but I can see no indication of it in the specimens examined. These show the pedicel to be "a short, slender, twisted process, about the length of an internode", as Clark describes. Trask's other drawings though somewhat indistinct, bear out several of the points mentioned.

SERTULARIA GRACILIS Hincks

Sertularia pumila var. JOHNSTON, British Zoophytes, 1848, p. 469.
Sertularia gracilis HINCKS, British Hydroid Zoophytes, 1868, p. 262.
Sertularia gracilis NUTTING, American Hydroids, Part II, 1904, p. 57.

Prof. Nutting gives this species in the table of Geographical distribution on p. 46, but does not mention any such distribution in his description of the species on p. 57.

SERTULARIA PUMILA Linnæus

Serularia pumila LINNÆUS, Systema Naturæ, 1758, p. 807.
Sertularia pumila CLARK, Hydroids of the Pacific Coast, 1876, p. 251.
Sertularia pumila NUTTING, American Hydroids, Part II, 1904, p. 51.

Distribution.—Coast of California (Clark).

SYNTHECIUM CYLINDRICUM (Bale)

Sertularella cylindricum BALE, Proc. Linn. Soc., N. S. W., 2nd Ser., III, 1888, p. 765.
Sertularella halecina TORREY, Hydroida of the Pacific Coast, 1902, p. 61.
Synthecium cylindrica NUTTING, American Hydroids, Part II, 1904, p. 136.

Distribution.—San Diego Bay, Cal., 5-12 fathoms (Torrey).

Reference is made to this species in the general discussion of the *Sertularidæ.*

Genus THUIARIA

THUIARIA ALBA new species

Pl. VII, Figs. 1-2

Trophosome.—The colony reaches a height of about two inches. The main stem is coarse, rigid and but slightly flexuose, provided with several annulations near the base, nodes irregular but quite distinct. The branching is regular, alternate and pinnate, with commonly three hydrothecæ between two successive branches, but often only two. The branches are not nearly so coarse as the main stem, they are silvery white in appearance, while the stem is much darker. Only occasionally is there any division into internodes. The hydrothecæ are closely crowded, especially on the branches, so much so that in many instances the upper point where the one hydrotheca leaves the branch is on a level with the next hydrotheca in order. Those on opposite sides alternate quite regularly. Both borders of the hydrotheca are regularly curved, but the inner, upper border is much longer than the outer lower one, so that the even margin of the nearly circular aperture is placed parallel to the axis of the branch, an exception to the general rule among Thuiarian forms. The hydrotheca is largely immersed, seldom more than one-fourth being free. The operculum consists of a single abcauline flap.

Gonosome.—Unknown.

Distribution.—San Juan Archipelago, in both Prof. Kincaid's and Mr. H. Moon's collection.

Jäderholm[57] has described and figured a species, *Thuiaria kolaënsis,* which bears a great resemblance to this species. In *T. kolaënsis,* however, the branches are turned with the flat side upward, a condition which is sufficiently unusual to be of specific value, and they are usually dichotomously branched near the tip. The branches of *T. alba* lie in the same plane as the stem and show no indication of any tendency to dichotomous branching near the tip. Apart from these features, the same description seems to apply to the two.

THUIARIA ARGENTEA (Linnæus)

Sertularia argentea LINNÆUS, Systema Naturæ, 1758, p. 809.
Sertularia argentea CLARK, Hydroids of the Pacific Coast, 1876, p. 257.
Thuiaria argentea NUTTING, Hydroids from Alaska and Puget Sound, 1899, p. 741.
Thuiaria argenta NUTTING, Hydroids of the Harriman Ex., 1901, p. 184.
Sertularia argentea TORREY, Hydroida of the Pacific Coast, 1902, p. 67.
Thuiaria argentea NUTTING, American Hydroids, Part II, 1904, p. 71.

Distribution.—One of the commonest species in shallow water off the Alaskan Coast (Nutting) ; San Juan Achipelago.

THUIARIA DALLI Nutting

Sertularia cupressoides CLARK, Alaskan Hydroids, 1876, p. 220.

[57] Northern and Arctic Invertebrates, Part IV, 1909, p. 88, Figs. 17-18. Taf. VIII.

Thuiaria cupressoides NUTTING, Hydroids of the Harriman Ex., 1901, p. 185.

Thuiaria dalli NUTTING, American Hydroids, Part II, 1904, p. 68.

Distribution.—Shumagin Islands and Port Moller, Alaska (Clark); Yakutat, Alaska (Nutting); San Juan Archipelago, Dodd's Narrows, Departure Bay, Ucluelet.

THUIARIA ELEGANS Kirchenpauer

Thuiaria elegans KIRCHENPAUER, Nordische Gattungen, 1884, p. 21.

Thuiaria elegans NUTTING, American Hydroids, Part II, 1904, p. 64.

Distribution.—Plover Bay, Bering Sea (Krause).

THUIARIA FABRICII Levinsen

Sertularia fastigiata FABRICIUS, Fauna Grœnlandica, 1780, p. 458.

Sertularia fabricii LEVINSEN, Vid. Middel. Naturh. Foren., 1892, p. 48.

Sertularia fabricii CALKINS, Some Hydroids of Puget Sound, 1899, p. 361.

Thuiaria fabricii NUTTING, Hydroids of the Harriman Ex., 1901, p. 185.

Thuiaria fabricii NUTTING, American Hydroids, Part II, 1904, p. 71.

Distribution.—Puget Sound (Calkins); Dutch Harbor and Orca, Alaska (Nutting); San Juan Archipelago, Dodd's Narrows.

THUIARIA KURILÆ Nutting

Sertularia kurilæ PŒPPIG, Manuscript.

Thuiaria kurilæ NUTTING, American Hydroids Part II, 1904, p. 65.

Distribution.—Unalaska (Nutting).

THUIARIA PLUMOSA Clark

Thuiaria plumosa CLARK, Alaskan Hydroids, 1876, p. 228.

Thuiaria plumosa KIRCHENPAUER, Nordische Gattungen, 1884, p. 21.

Thuiaria plumosa NUTTING, American Hydroids, Part II, 1904, p. 74.

Distribution.—Nunivak Island, Bering Sea, 30 fathoms (Clark); Bering Strait (Jäderholm).

THUIARIA ROBUSTA Clark

Thuiaria robusta CLARK, Alaskan Hydroids, 1876, p. 227.

Thuiaria robusta KIRCHENPAUER, Nordische Gattungen, 1884, p. 81.

Thuiaria robusta NUTTING, American Hydroids, Part II, 1904, p. 64.

Distribution.—Hagmeister Island, King's Island, Bering Sea (Clark); Albatross Station 2875, N. 48° 30′, W. 124° 57′, 40 fathoms; Station 3153, N. 57° 37′ 10″, W. 122° 56′ 20″, 32 fathoms; Station 3504, N. 56° 57′, W. 169° 27′, 34 fathoms; Station 3505, N. 59° 09′, W. 168° 17′, 44 fathoms; Station 3511, N. 57° 32′, W. 169° 38′, 39 fathoms; Station 3515, N. 59° 59′,

W. 167° 53′, 13 fathoms; Station 3540, N. 56° 27′, W. 166° 08′, 51 fathoms (Nutting).

THUIARIA SIMILIS (Clark)

Pl. VIII, Figs. 1-6

Sertularia similis CLARK, Alaskan Hydroids, 1876, p. 219.

Sertularia similis HARTLAUB, Hydroiden aus dem Stillen Ocean, 1891, p. 362.

Sertularella nana HARTLAUB, Hydroiden aus dem Stillen Ocean, 1891, p. 361.

Sertularia similis NUTTING, Hydroids of the Harriman Ex., 1901, p. 185.

Sertularella nana NUTTING, American Hydroids, Part II, 1904, p. 105.

Thuiaria similis NUTTING, American Hydroids, Part II, 1904, p. 69.

Distribution.—Hagmeister Island (Clark): Berg Inlet, Glacier Bay, Puget Sound, Albatross Station 2842, N. 54° 15′, W. 166° 03′, 72 fathoms; Station 2865, N. 48° 12′, W. 122° 49′, 40 fathoms; Station 3465, N. 48° 21′, W. 123° 14′, 48 fathoms; Station 3515, N. 59° 59′, W. 167° 53′, 13 fathoms; Station 3557, N. 57° 04′, W. 170° 24′, 26 fathoms (Nutting); San Juan Archipelago, Dodd's Narrows, Departure Bay.

This species is very common in the Puget Sound and the Vancouver Island region, where it shows a very great degree of variability in the arrangement of the hydrothecæ, and in the shape of these as well. In the typical arrangement on the branches, the hydrothecæ are in nearly opposite pairs, being quite close together, but in some cases there is a long interval in each case, while the arrangement may be still opposite or in extreme cases it may become distinctly alternate, so much so that if it were not for the intergrading specimens, one might take it as a distinct species as Hartlaub has evidently done when he describes it as *Sertularella nana*. This has been copied by Prof. Nutting, though he indicates that he does not think it can belong to the genus *Sertularella*. The entire range may be found in the same colony, consequently, it is scarcely possible to apply both names satisfactorily. The shape of the hydrothecæ themselves, is as variable as the arrangement, principally in the extent of their elongation. Some of them are so much lengthened as to become twice the normal length or more, so that they appear as long regularly bent tubes. These elongations occur in what appear to be old colonies, generally those acting as hosts to other hydroids. It may possibly be a diseased condition.

Gonosome.—I have seen no description of the gonangia. They were very scarce in the material I examined, but I found several arranged singly, near the extremity of the upper branches, each of the gonangia having its origin at the base of a hydrotheca. The gonangia are oval in shape, narrowing to the attachment and not so much towards the circular opening, a narrow collar being formed. The surface is entirely free from spines and annulations. Its length is almost the same as that of the hydrotheca, the breadth being about two-thirds the length.

THUIARIA TENERA (Sars)

Sertularia tenera SARS, Bidrag til Kundskaben om Norges Hydroider, 1873, p. 20.

Sertularia tenera NUTTING, Hydroids from Alaska and Puget Sound, 1899, p. 83.

Thuiaria tenera NUTTING, American Hydroids, Part II, 1904, p. 70.

Distribution.—Kadiak Island and Bering Strait; Albatross Station, 2865, N. 48° 12′, W. 122° 49′, 40 fathoms; St. Paul's Island (Nutting).

THUIARIA THUIARIOIDES (Clark)

Sertularia thuiarioides CLARK, Alaskan Hydroids, 1876, p. 223.

Thuiaria thuiarioides CALKINS, Some Hydroids of Puget Sound, 1899, p. 361.

Thuiaria thuiarioides NUTTING, Hydroids of the Harriman Ex., 1901, p. 186.

Thuiaria thuiarioides HARTLAUB, Hydroiden aus dem Stillen Ocean, 1901, p. 354.

Thuiaria thuiariodes NUTTING, American Hydroids, Part II, 1904, p. 64.

Distribution.—Bering Sea, West of Nunivak Island, 24 fathoms, Chignik Bay, Alaska (Clark); Puget Sound (Calkins); Yakutat, Alaska; N. 62° 15′, W. 167° 48′ (Nutting).

THUIARIA THUJA (Linnæus)

Sertularia thuja LINNÆUS, Systema Naturæ, 1758, p. 809.

Thuiaria thuja KIRCHENPAUER, Nordische Gattungen, 1884, p. 18.

Thuiaria thuja NUTTING, American Hydroids, Part II, 1904, p. 62.

Distribution.—Bering Sea (Stimpson); Albatross Station 2843, N. 53° 56′, W. 165° 56′ 45″, 45 fathoms; Station 3558, N. 56° 58′, W. 170° 09′, 25 fathoms (Nutting); San Juan Archipelago, Banks Island.

PLUMULARIDÆ

Few species of this family have been reported except from tropical and sub-tropical regions. Though the family is rich in genera and species, representatives of only five genera, *Aglaophenia, Antenella, Diplocheilus, Nuditheca* and *Plumularia,* have been found off the Pacific Coast of North America, and three of these are represented by a single species. In the new material examined, I have found only two of these, *Aglaophenia* and *Plumularia.* The limitations of these genera have been so generally agreed upon, that it is not necessary to discuss them. The genus *Antenella* Allman, of which Dr. Torrey reports a species from Catalina Island, Cal.,[58] has also been generally accepted. The genus *Nuditheca* has been used by Prof. Nutting[59] to include a species collected off the Unalaska Coast by Dall, and named by Clark,[60] *Macrorhynchia dalli. Macrorhynchia* was used by Kirchenpauer[61] as a name for one of the four sub-genera into which he divided the genus *Aglaophenia,* but he did not use it as a generic name. This sub-genus has not been generally recognized, and at any rate the species collected by Dall does not answer the description for the sub-genus. Prof. Nutting evidently considered the differences great enough to be of generic value and they are certainly quite marked. The genus *Diplocheilus* Allman has received general acceptance, though Bale does not find it suitable. In the first instance he used the generic name *Azygoplon* for a species of the same genus,[62] but later he placed Allman's species, *Diplocheilus mirabilis* with his own *Azygoplon productum,* in the genus *Kirchenpaueria* Jickeli.[63] Judging from Jickeli's figures[64] one must agree with Torrey[65] and Stechow,[66] that such arrangement is not justified. Though

[58] Hydroida of the Pacific Coast, 1902, p. 74.

[59] American Hydroids, Part I, 1900, p. 128.

[60] Alaskan Hydroids, 1876, p. 230.

[61] Ueber die Hydroiden Familie Plumularidæ, Part I, Aglaophenia, 1872, p. 25.

[62] Proc. Linn. Soc., N. S. W., 1888, p. 773.

[63] Proc. Linn. Soc., Victoria, 1893, p. 107.

[64] Der Bau der Hydroidpolypen, II, 1883, Pl. 28, fig. 27.

[65] Hydroids of San Diego, 1904, p. 35.

[66] Hydroidpolpyen der Japanischen Ostküste, I Teil, 1909, p. 88.

Bale has shown that the characteristic on which the name was based is a misconception, the name has become established, and is likely to remain.

Genus AGLAOPHENIA

AGLAOPHENIA DIEGENSIS Torrey

Aglaophenia diegensis TORREY, Hydroida of the Pacific Coast, 1902, p. 71.
Aglaophenia diegensis TORREY, Hydroids of San Diego, 1904, p. 33.

Distribution.—San Diego and False Bay, Cal., 1 to 7 fathoms (Torrey).

AGLAOPHENIA INCONSPICUA Torrey

Aglaophenia inconspicua TORREY, Hydroida of the Pacific Coast, 1902, p. 72.
Aglaophenia inconspicua TORREY, Hydroids of San Diego, 1902, p. 34.

Distribution.—San Diego, 5 fathoms (Torrey).

AGLAOPHENIA LATIROSTRIS Nutting

Aglaophenia latirostris NUTTING, American Hydroids, Part I, 1900, p. 101.

Distribution.—Santa Barbara, collected by Mrs. V. B. Gibbs; Off the Oregon Coast; Puget Sound.

AGLAOPHENIA OCTOCARPA Nutting

Aglaophenia octocarpa NUTTING, American Hydroids, Part I, 1900, p. 103.

Distribution.—C. San Lucas, Lower California (Nutting).

AGLAOPHENIA PLUMA (Linnæus)

Sertularia pluma LINNÆUS, Systema Naturæ, 1767, p. 1309.
Aglaophenia pluma TORREY, Hydroida of the Pacific Coast, 1902, p. 73.
Aglaophenia pluma TORREY, Hydroids of San Diego, 1904, p. 34.

Distribution.—Off Coronado, Cal. (Torrey).

AGLAOPHENIA STRUTHIONIDES (Murray)

Plumularia struthionides MURRAY, Ann. and Mag., 3rd Ser. V, 1860, p. 251.
Aglaophenia struthionides CLARK, Hydroids of the Pacific Coast, 1876, p. 272.
Aglaophenia struthionides CALKINS, Some Hydroids of Puget Sound, 1899, p. 363.
Aglaophenia struthionides NUTTING, American Hydroids, Part I, 1900, p. 102.
Aglaophenia struthionides TORREY, Hydroida of the Pacific Coast, 1902, p. 73.
Aglaophenia struthionides TORREY, Hydroids of San Diego, 1904, p. 35.

Distribution.—Santa Cruz (Nutting); San Diego (Palmer); San Francisco (A. Agassiz); Puget Sound (Dr. Steindachner);

Townshend Bay (Calkins); Puget Sound to San Diego (Torrey); San Juan Archipelago, Victoria, Port Renfrew, Ucluelet.

This is one of the commonest species of hydroids in the Vancouver Island and Puget Sound Region. All phases of growth may be found easily, and at no time is there much indication of variation from the type. Corbulæ have been present on almost all of the colonies examined, and these show the same constancy of type as is found in the various parts of the trophosome.

Genus ANTENELLA

ANTENELLA AVALONIA Torrey

Antenella avalonia TORREY, Hydroida of the Pacific Coast. 1902, p. 74.

Distribution.—Avalon, Catalina Island, Cal. (Torrey).

Genus DIPLOCHEILUS

DIPLOCHEILUS ALLMANI Torrey

Halicornia producta TORREY, Hydroida of the Pacific Coast. 1902, p. 75.
Diplocheilus allmani TORREY, Hydroids of San Diego, 1904, p. 36.

Distribution.—San Diego and Pt. Loma, Cal. (Torrey).

The points of distinction between this species and *Diplocheilus mirabilis* Allman, as given by Dr. Torrey, do not seem to be of very great specific value, particularly as he says that "The immaturity and paucity of my material makes it impossible to determine the real value of these differences".[67] Stechow[68] reports a species from the Japanese East Coast, which he considers is the same as Torrey's. He retains Torrey's name for it, though in his discussion he states definitely that he thinks there is not enough distinction between *D. mirabilis* and *D. allmani* to warrant it. As neither he nor Torrey found any gonangia, each prefers to speak of two distinct species until the presence of these decide the question.

Genus NUDITHECA

NUDITHECA DALLI (Clark)

Macrorhynchia dalli CLARK, Alaskan Hydroids, 1876, p. 230.
Nuditheca dalli NUTTING, American Hydroids, Part I, 1900, p. 129.

Distribution.—Unalaska and Akutan Pass, Alaska, on the beach (Clark).

[67] Hydroids of San Diego, 1904, p. 36.

[68] Hydroidpolypen der Japanischen Ostküste, I Teil, 1909, p. 88.

Genus PLUMULARIA

PLUMULARIA ALICIA Torrey

Plumularia alicia TORREY, Hydroida of the Pacific Coast, 1902, p. 75.
Plumularia alicia TORREY, Hydroids of San Diego, 1904, p. 37.

Distribution.—San Diego and Long Beach, Cal. (Torrey).

PLUMULARIA CORRUGATA Nutting

Plumularia corrugata NUTTING, American Hydroids, Part I, 1900, p. 64.

Distribution.—San Juan Archipelago.

Only two specimens of this species were found, in the material dredged by Prof. Kincaid, but these answer definitely to the original description of the species. The distribution is somewhat unusual, if we may speak of unusual distribution among the hydroids, as, since it was first reported from the Coast of Brazil, it has been found only once, so far as I know, and that was off the Hawaiian Islands, by the Albatross in 1903, and reported by Prof. Nutting.[69]

PLUMULARIA ECHINULATA (Lamarck)

Plumularia echinulata LAMARCK, Hist. Nat. des An. sans Vert., 1836, p. 162.
Plumularia echinulata HINCKS, British Hydroid Zoophytes, 1868, p. 302.
Plumularia echinulata var. CALKINS, Some Hydroids of Puget Sound, 1899, p. 363.

Distribution.—Port Townshend (Calkins).

PLUMULARIA GOODEI Nutting

Plumularia goodei NUTTING, American Hydroids, Part I, 1900, p. 64.
Plumularia goodei TORREY, Hydroida of the Pacific Coast, 1902, p. 76

Distribution.—Santa Barbara (Nutting); Pacific Grove, Cal. (Torrey); Port Renfrew.

PLUMULARIA LAGENIFERA Allman

Plumularia lagenifera ALLMAN, Proc. Linn. Soc., London, 1885, p. 157.
Plumularia californica MARKTANNER-TURNERETSCHER, Ann. des K. K. Nat. Hof., 1890, p. 255.
Plumularia lagenifera NUTTING, American Hydroids, Part I, 1900, p. 65.
Plumularia lagenifera TORREY, Hydroida of the Pacific Coast, 1902, p. 77.
Plumularia lagenifera var. septifera TORREY, Hydroida of the Pacific Coast, 1902, p. 78.

Distribution.—Puget Sound (Dr. Steindachner); Coast of

69 Hydroids of the Hawaiian Islands, 1905, p. 951.

California (Clark); Vancouver Island (Allman); Berg Inlet, Popoff Islands (Nutting); San Pedro and Santa Cruz, Cal. (Torrey); Catalina Island (Torrey); San Juan Archipelago, Port Renfrew, Ucluelet, Dodd's Narrows, Hope Island.

This species seems as widely distributed in the Vancouver Island and Puget Sound region as *Aglaophenia struthionides,* but as it grows in masses that are much less conspicuous, it may not be so often found as that species is. The majority of the colonies correspond to Allman's type, but many of them are somewhat similar to Torrey's variety *septifera,* but more nearly to that type with the variations described by Ritchie.[70] I find as he does, that though many of the intermediate internodes have but one intrathecal ridge, some of them have two. Certain specimens have two or even three athecate internodes at the base of the hydrocladium, between the process that supports the hydrocladium and the first thecate internode, each having a single intrathecal ridge. Occasionally there is more than one intermediate internode between two thecate internodes on the hydrocladium. Torrey states that in his specimens the hydrocladia coming out on the opposite sides of the stem, are in the same plane. I do not find this the case in any specimen. In all cases they come out at an angle of from 100° to 120°, as they do in the regular *lagenifera* type. Ritchie makes no reference to this and his drawing does not make the matter clear. If this characteristic is constant in Torrey's specimens and the other points that he mentions are always as definite as he says, they would seem to be of specific value. Since I have not found them constant, even in the same specimen, I have included all of them under *P. lagenifera.* These short forms, however, are worthy of reference on account of the sharp definition of the intrathecal ridges. Marktanner-Turneretscher has shown this very well in his drawing of *P. californica,* as he calls it. In the larger specimens the ridges are not nearly so distinct. These short forms have gonangia present, but they are more like the gonangia of *P. setacea,* quite small in cross-section as compared with the type.

PLUMULARIA MEGALOCEPHALA Allman

Plumularia megalocephala ALLMAN, Mem. Mus. Comp. Zool., V, No. 2, 1877, p. 31.

[70] Supplementary report on the Hydroids of the Scottish National Antarctic Expedition, 1909, p. 87.

Plumularia megalocephala NUTTING, American Hydroids, Part I, 1900, p. 57.

Plumularia megalocephala TORREY, Hydroids of San Diego, 1904, p. 37.

Distribution.—Off San Diego (Torrey).

PLUMULARIA PALMERI Nutting

Pl. VII, Figs. 3-4

Plumularia palmeri NUTTING, American Hydroids, Part I, 1900, p. 65.

Distribution.—San Diego, Cal., Victoria, B. C. (Nutting); Ucluelet.

The gonosome of this species has not been hitherto described. Many of the Ucluelet specimens have gonangia arranged along the greater portion of the length of the stem, while others are less plentifully supplied. These gonangia, as is the case with a good many species of this genus, have their origin by a short pedicel, from the basal process of the hydrocladium. They are irregularly oval in shape, with the distal end usually larger than the proximal. Though in some cases there is a slight narrowing in the nature of a neck at the distal end, this end is usually club-shaped. They are closely applied to the stem for at least a portion of their length, and this may account for some of the irregularity of shape. They are but little like the gonangia of *P. setacea,* consequently, the gonosomes show that these two species are not synonymous, as Torrey says[71] I can not see much resemblance in the trophosomes of the two either. In my material, *P. palmeri* bears a much greater resemblance to *P. lagenifera,* so much so that there seems to be almost a complete series of intergradations between the two.

PLUMULARIA PLUMULAROIDES (Clark)

Halecium plumularoides CLARK, Alaskan Hydroids, 1876, p. 217.

Plumularia plumularoides NUTTING, American Hydroids, Part I, 1900, p. 62.

Plumularia plumularoides TORREY, Hydroida of the Pacific Coast, 1902, p. 78.

Plumularia plumularoides TORREY, Hydroids of San Diego, 1904, p. 38.

Distribution.—Cape Etolin, 8-10 fathoms, Nunivak Island, Alaska (Clark); San Diego, Cal, 15-25 fathoms (Torrey).

PLUMULARIA SETACEA (Ellis)

Corallina setacea ELLIS, Nat. Hist. Cor., 1755, p. 19.

Plumularia setacea LAMARCK, Anim. sans Vert., 1836, p. 165.

[71] Hydroida of the Pacific Coast, 1902, p. 79.

Plumularia setacea CLARK, Hydroids of the Pacific Coast, 1876, p. 261.
Plumularia setacea CALKINS, Some Hydroids of Puget Sound, 1899, p. 362.
Plumularia setacea NUTTING, American Hydroids, Part I, 1900, p. 56.
Plumularia setacea TORREY, Hydroida of the Pacific Coast, 1902, p. 79.
Plumularia setacea TORREY, Hydroids of San Diego, 1904, p. 39.

Distribution.—Santa Barbara (Nutting); San Diego, Avalon, San Pedro, and San Francisco, Cal., Victoria, B. C., Pt. Loma, La Jolla, Catalina Island, San Pedro, Monterey, Cal. (Torrey); Point Wilson (Calkins); San Juan Archipelago.

PLUMULARIA VIRGINIÆ Nutting

Plumularia virginiæ NUTTING, American Hydroids, Part I, 1900, p. 66.

Distribution.—Santa Barbara, Cal. (Nutting).

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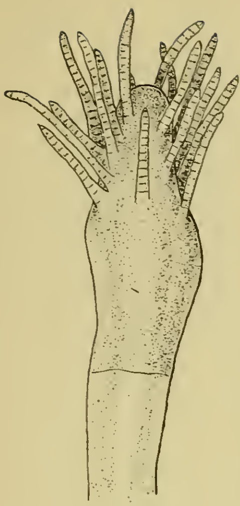
PLATE I.

Fig. 1. *Crypta huntsmani.* Hydranth of an adult zooid showing distribution of tentacles.

2. Hydranth with gonophores present.
3. Group of young zooids showing attachment to the mycelium-like base.
4. Side view of a gonophore.
5. End view of a gonophore.

Note.— In these as in all the other drawings the magnification is 30 diameters so that direct comparison can be made for size in any case.



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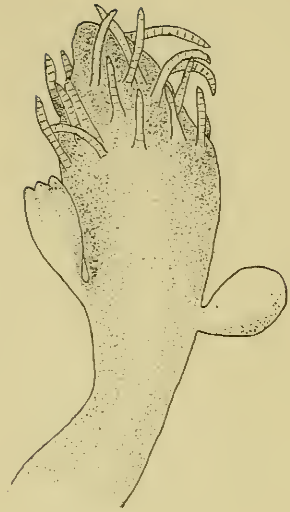

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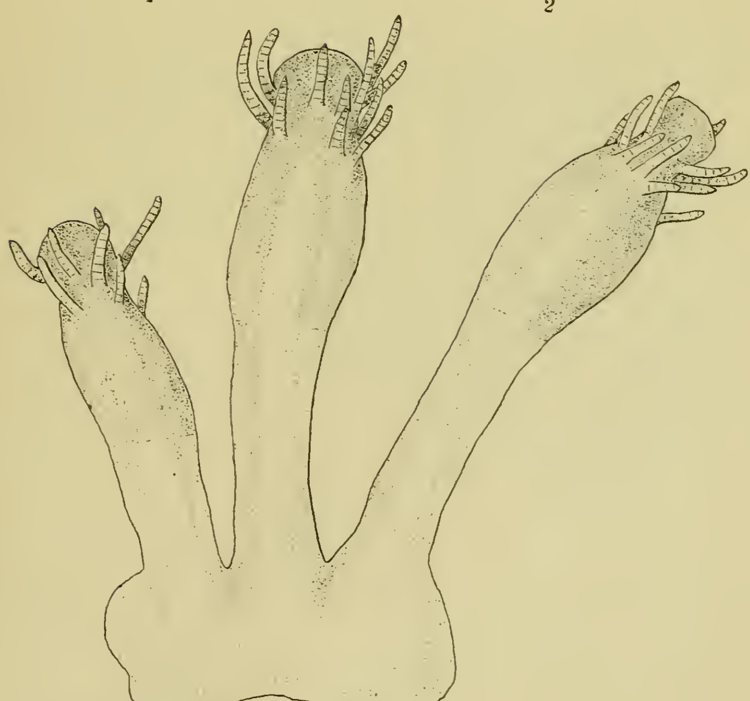


CLARA A. FRASER, DEL.
AFTER C. M. F.

3

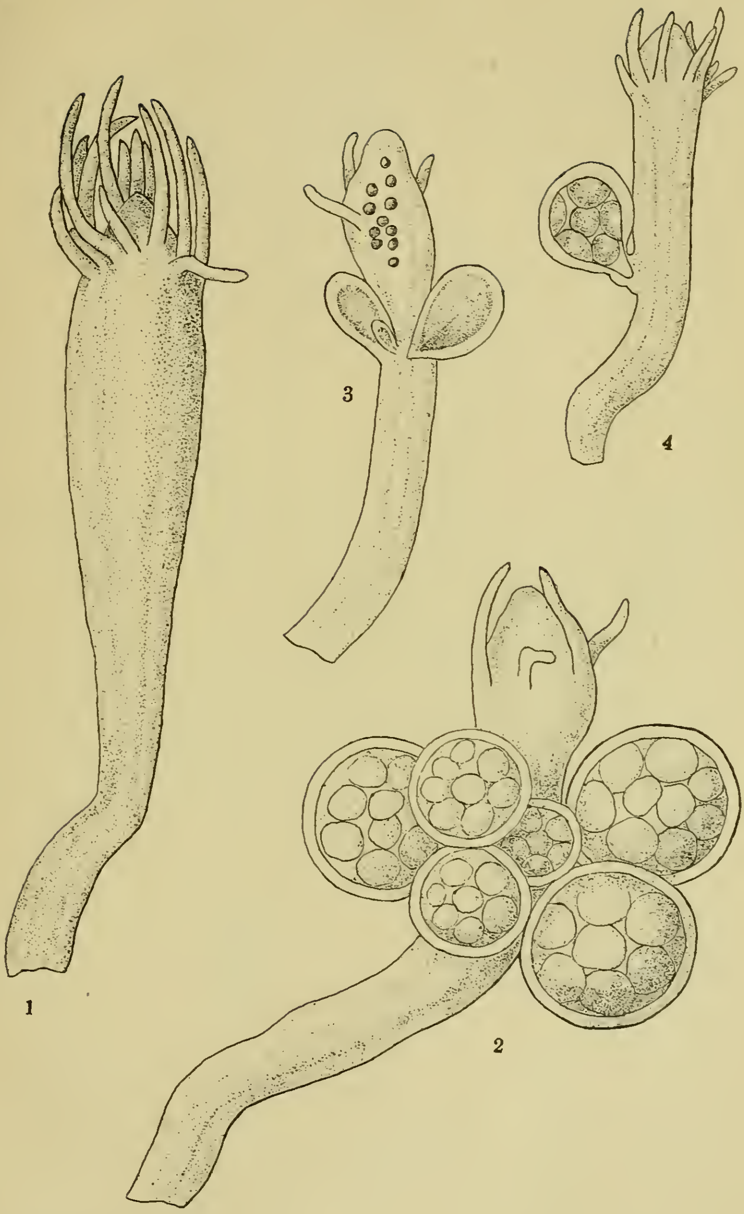
WEST COAST HYDROIDS

PLATE II.

Fig. 1. *Hydractinia aggregata.* Mature nutritive zooid.

2. Mature generative zooid showing large size of the female gonophores.
3. Young generative zooid showing male gonophores and scattered thread cells.
4. Young generative zooid with female gonophores.

PLATE 2



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WEST COAST HYDROIDS

PLATE III.

Fig. 1. *Clytia edwardsi.* Part of a branched colony showing gonophores.

2. Single gonangium attached to the stolon.

3 and 4. *Obelia dubia.* Gonangia.

5. *Calycella pygmæa.* Single hydrotheca.

6. *Calycella syringa.* Single hydrotheca.

5 and 6 show the relative size of the two species.

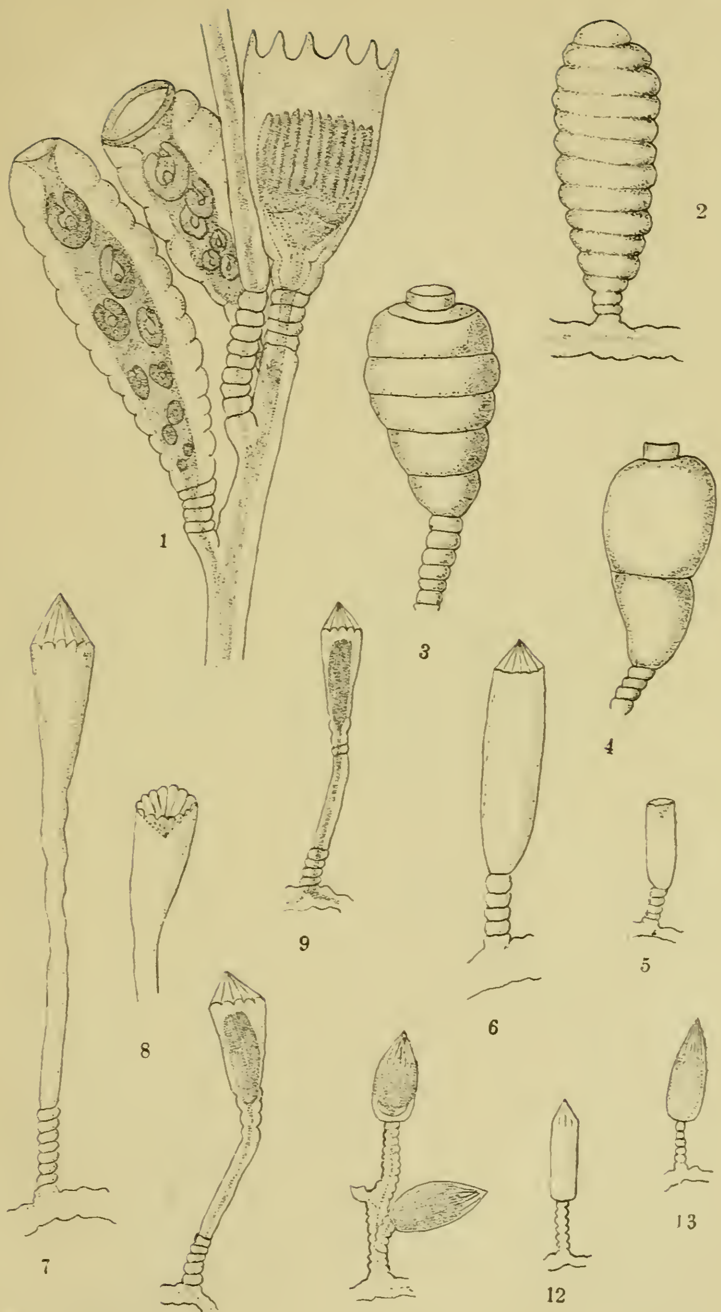
7 and 8. *Lovenella producta.* Specimens from Dodd's Narrows.

9 and 10. Specimens from San Juan Archipelago.

Difference in size in the two localities is shown.

11. Campanulina forskalea. The only branched specimen.

12 and 13. Single hydrothecæ growing directly from the stolon.



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AFTER C. M. F. 10

WEST COAST HYDROIDS

PLATE IV.

Fig. 1. *Halecium pygmæum.* Colony made up of several stem joints showing position of gonangium.

2. Colony consisting of a single joint showing large female gonophore.
3. *Lictorella carolina.* Part of a branch showing hydrothecæ and nematophores.
4. Terminus of one part of the polysiphonic stem.
5. Portion of a polysiphonic stem.

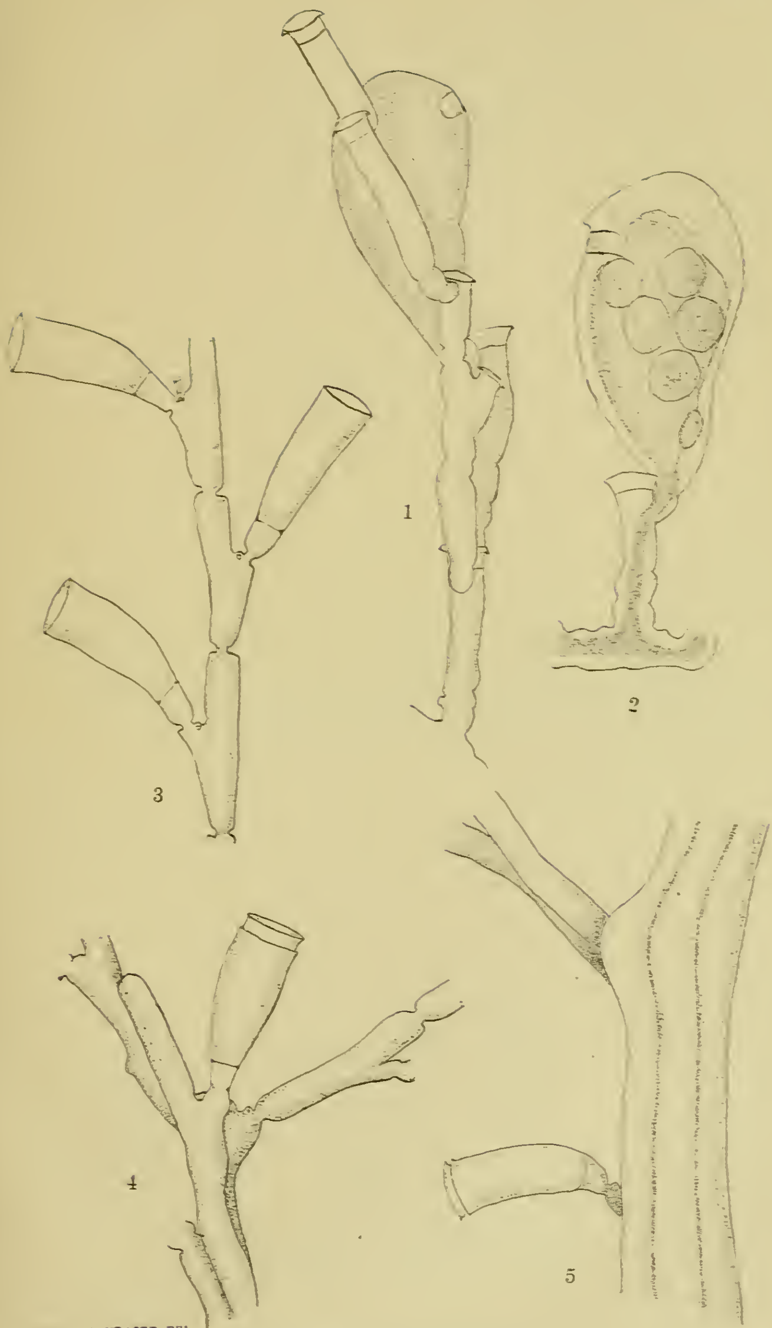

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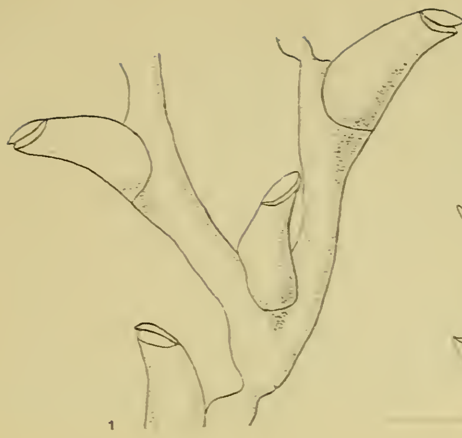
PLATE V.

Fig. 1. *Abietinaria rigida.* Portion of a colony to show node and origin of branch.

2. Portion of branch showing typical arrangement of hydrothecæ.

3. Gonangium.

PLATE 5



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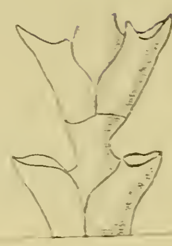

ERRATA

The explanation facing Plate 5 is to be read with Plate 6 and that facing Plate 6 with Plate 5.

5

2

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PLATE 5

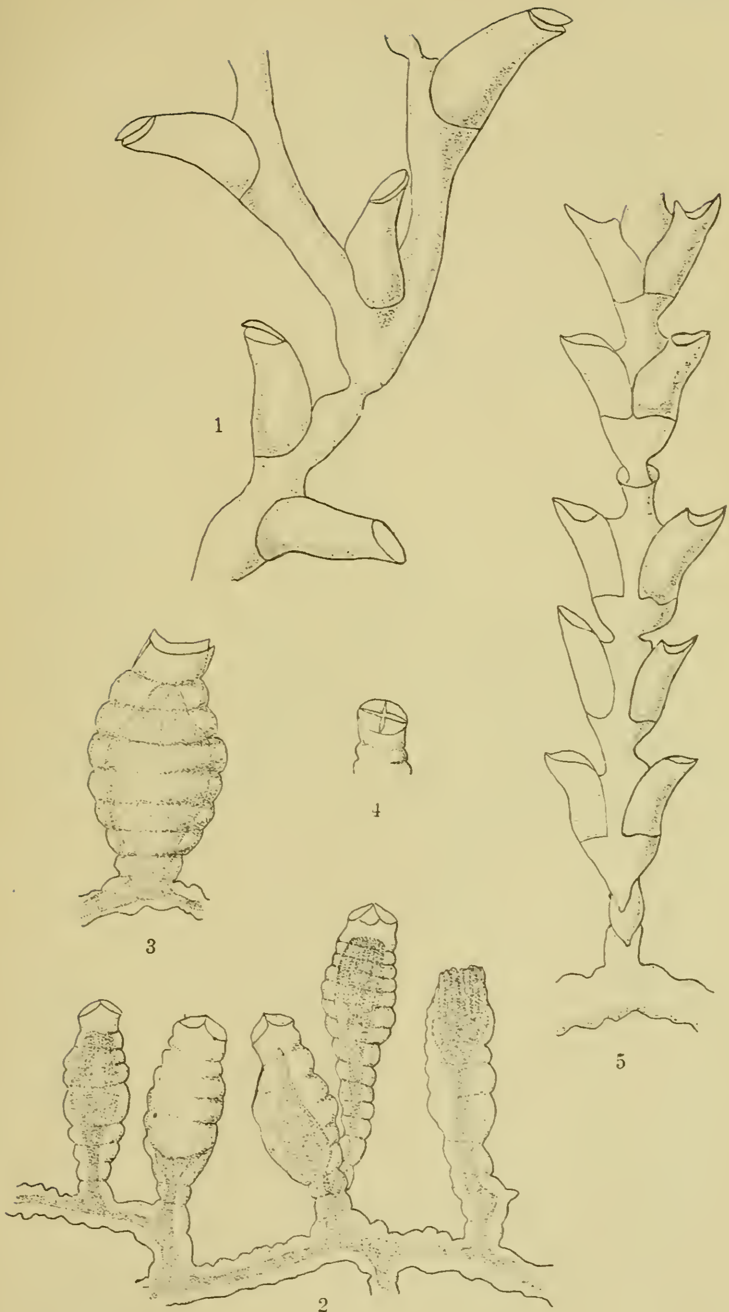

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PLATE VI.

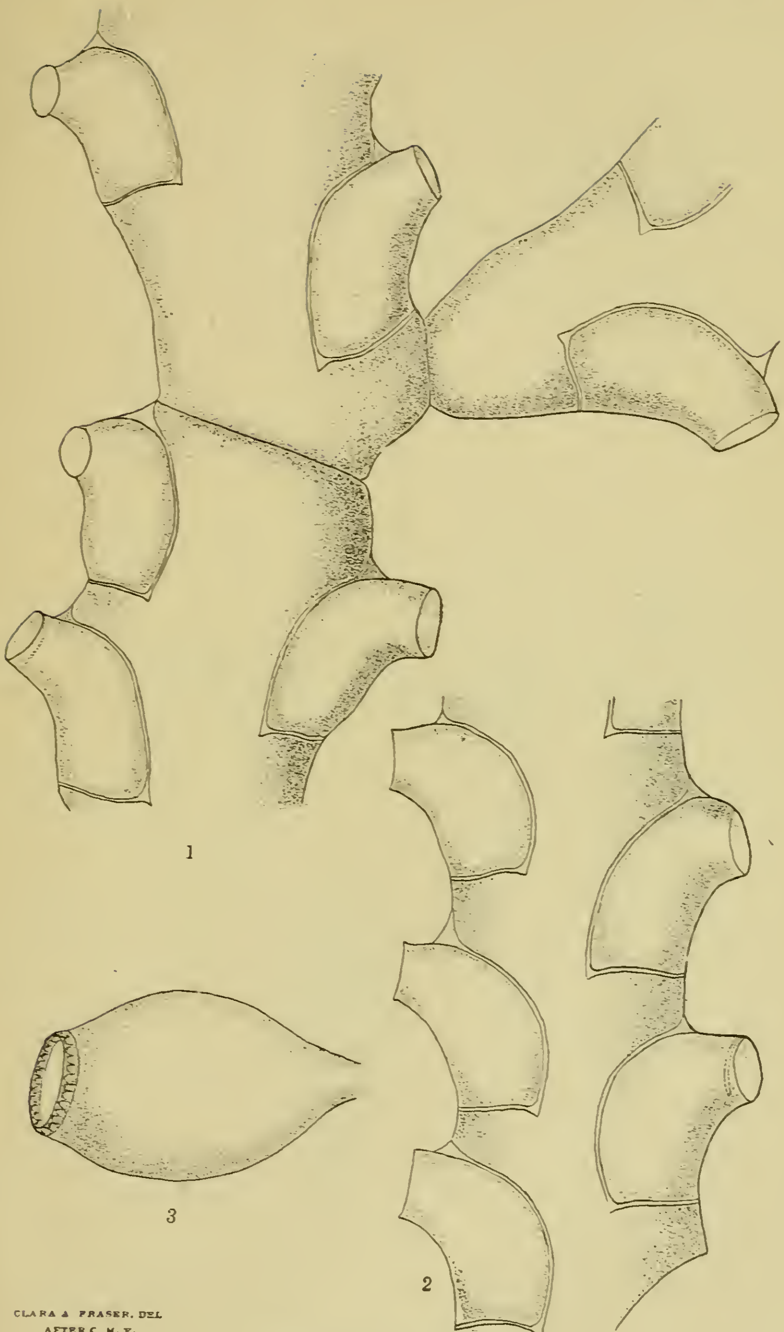
Fig. 1. *Diphasia claræ.* Portion of colony showing branching and hydrothecal arrangement.

2. *Sertularella conica.* Number of colonies showing earliest stages of development.

3. Single gonophore growing from the stolon.

4. Portion of hydrotheca to show four-parted operculum.

5. *Sertularia furcata.* Portion of colony to show mode of attachment to the stolon and the arrangement of the hydrothecæ.



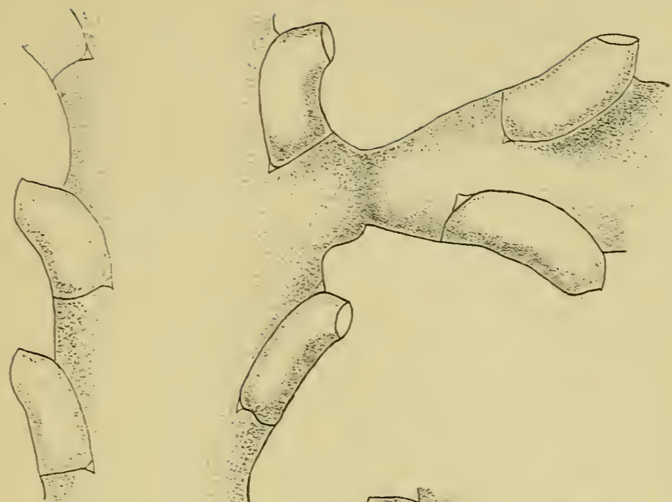
WEST COAST HYDROIDS

PLATE VII.

Fig. 1. *Thuiaria alba.* Part of colony showing origin of branch.

2. Portion of branch to show arrangement of hydrothecæ.

3 and 4. *Plumularia palmeri.* Gonangia.



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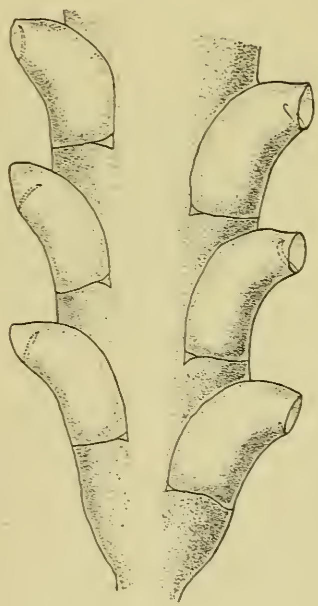
4



2

3

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PLATE VIII.

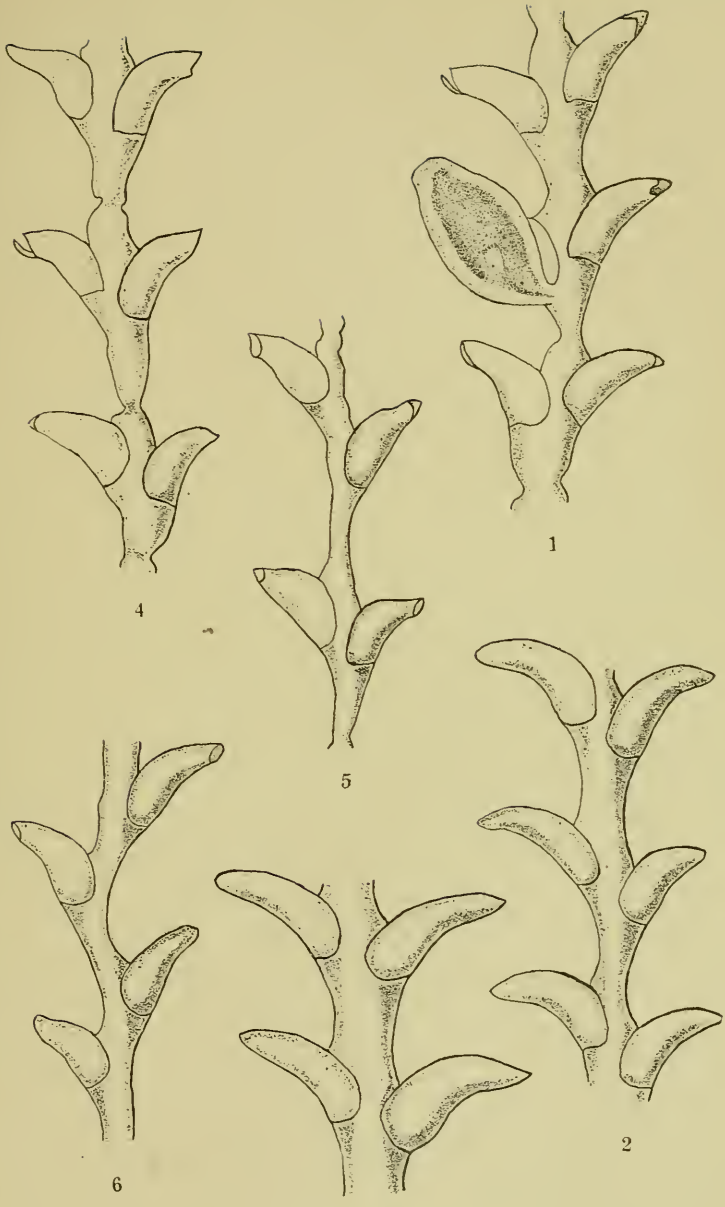
Fig. 1. *Thuiaria similis.* Part of colony with gonophore and hydrothecæ showing tendency to elongation.

2 and 3. Portions of colony showing further elongation of hydrothecæ.

4. Portion of colony with usual arrangement of hydrothecæ.

5. Portion showing a more alternate arrangement.

6. Portion with hydrothecæ so alternate as to be similar to that described by Hartlaub as *Sertularella nana.*



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AFTER C. M. F.

West Coast Hydroids

BULLETIN OF THE STATE UNIVERSITY OF IOWA
NEW SERIES No. 35 OCTOBER, 1911

BULLETIN

FROM THE

LABORATORIES OF NATURAL HISTORY

OF

THE STATE UNIVERSITY OF IOWA

VOLUME VI NO. 2

PUBLISHED BY THE UNIVERSITY
IOWA CITY, IOWA

ISSUED TWENTY-ONE TIMES DURING THE ACADEMIC YEAR; MONTHLY FROM OCTOBER TO JANUARY, WEEKLY FROM FEBRUARY TO JUNE. ENTERED AT THE POST OFFICE AS SECOND CLASS MAIL MATTER

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IN THE SERIES OF RESEARCH BULLETINS OF THE UNIVERSITY

CONTRIBUTIONS

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A LIST OF THE COLEOPTERA OF IOWA

BY H. F. WICKHAM.

This catalogue has been prepared as a necessary preliminary to a projected survey of the beetles of the state. As matters now stand, no one can identify even a reasonable proportion of his captures in this order without the expenditure of a sum of money altogether disproportionate to the results attained. The writer hopes to render conditions somewhat easier by the preparation of a series of memoirs upon Iowa beetles with the idea of assisting students of our local fauna to name their specimens properly. Unfortunately our knowledge of certain groups is insufficient for complete treatment, since collections from the northern and western parts of the state are but few. However, a beginning has to be made somewhere and it is hoped that this list will serve to show what parts need attention as well as to indicate what is already known.

Several lists of our beetles have been printed in local publications and numerous records exist in the current literature of North American entomology. The first serious attempt in this direction was made by J. Duncan Putnam[1] in three papers on the Coleoptera of Davenport, Monticello and Frederic, but the number of species is not large. This was followed by a "List of the Coleoptera of Iowa City and Vicinity" by the present writer[2] in which 871 names were given. Soon after appeared a "Partial Catalogue of the Animals of Iowa" by Herbert Osborn,[3] comprising the species of the preceding lists reinforced by several hundred records from Ames and a few from other points. To this the present writer[4] printed additions numbering

1 Proc. Davenport Acad. Sci., Vol. I., 1876, 169-173.

2 Bulletin Lab. Nat. Hist., State Univ. of Iowa, Vol. I, 1888, 81-92.

3 Published by the Iowa Agricultural College, Ames, 1892.

4 Report of the Committee on State Fauna, Proc. Ia. Acad. Sci., Vol. II, 1894, 45-51.

about 234, and later[5] a supplement to his Iowa City list, making a total of some 1121 names from this vicinity. Meanwhile numerous other insects have been detected and the time seems opportune for the presentation of a revised catalogue which shall show the state of our knowledge today. Nevertheless much remains to be done before our acquaintance with the fauna of Iowa can be considered in any sense complete, the southeastern part alone having furnished any really considerable number of records. Particular attention should be given the counties along our northern border, especially those lying in the driftless area in the northeast corner. The diversified surface of this last named region furnishes conditions not met with elsewhere within our limits, while the beetles thereof are almost unknown. All collectors of Iowa beetles are invited to communicate with the writer concerning new records and doubtful identifications in order that the systematic papers which are to follow this list may be made as complete as possible.

For the benefit of students of distribution who may wish to compare the characters of our fauna with those of other regions, a few words may be said regarding the physical features of the state. Iowa is essentially a prairie, it offers comparatively little variation in altitude, the lowest portion, near Keokuk, lying about 477 feet above sea level while the highest point, Ocheyedan Mound, reaches 1650 feet. With the exception of a narrow strip along the eastern edge of the upper half, the entire state has been extensively glaciated and is buried under the drift sheets left by the retreating ice. Western and southern Iowa lie under the Kansan drift, while most of the northeastern quarter is covered by the Iowan. To the westward of this last named sheet, a great tongue of the Wisconsin drift, the main lake region in which the surface topography shows scarcely any trace of water carving, reaches south as far as Des Moines. Its further edge curves north and west until it reaches our northern boundary in Lyon County. All of the foregoing sheets came from the Kewatin center, but on our eastern border, from just above Davenport to a point below Burlington is to be seen an invasion of the Illinoian

[5] Bulletin Lab. Nat. Hist. State Univ. of Iowa, Vol. III, No. 3, 1895, 36-40.

drift from the Labrador center. Each of these areas shows some difference in topography and consequently in fauna.

In forests, the state is poor, the principal timber follows the course of the streams and is rapidly being cut off. Practically the whole consists of deciduous trees, though some conifers are found in the northeastern portion. This lack of coniferous forests explains the absence of many species of insects common in adjacent states. Many of our records of pinicolous beetles are due to their importation from other districts in sawed lumber.

On the whole, our beetle fauna is quite homogeneous, and is that of the central prairies. Some western types of plants and insects invade our counties along that side, in some instances extending nearly across the state — Eleodes and Nothopus being good examples. The marshes of the Wisconsin drift support some northern types, while the lower reaches of the Mississippi River yield forms which are more characteristic of the Ohio Valley.

This catalogue is based mainly on the collections of the writer. To the data thus afforded have been added the published records of Osborn and Putnam, numerous references to Keokuk and Cedar Rapids from the works of Casey and Brendel, together with a few from the papers of other recent systematists. Much information has been obtained from collections made at Iowa City by R. M. Anderson, C. H. Edmondson, John G. Griffith, M. P. Somes, Dayton Stoner, D. E. Merrill, Mary M. McGuire, Alice Yocom, and Mrs. H. F. Wickham. From other parts of the state, material has been secured through friends whose names appear with the list of abbreviations. Frank Shoemaker of Omaha has sent notes on the occurrence of insects at Council Bluffs, and Frank R. Mason of Philadelphia has kindly furnished data from the H. G. Griffith collection, made mostly at Burlington. Dr. A. Fenyes of Pasadena has given valuable assistance in making up the list of Aleocharinæ.

LOCALITIES AND ABBREVIATIONS.

A. Ames. All records from the Osborn list.

B. Independence. Collections by the writer and Mrs. H. F. Wickham.

Bl. Burlington. The H. G. Griffith collection.

C. Cedar Rapids. Mostly published records of Casey and Brendel, from collections made by the latter. About a hundred records from the writer's collection.

Ch. Cherokee. A. D. Whedon.

Cn. Chariton. B. Shimek.

D. Davenport. Putnam records.

Dm. Des Moines. M. P. Somes.

Dw. De Witt. F. H. Shoemaker.

E. Eddyville. B. Shimek.

Ep. Eastport. B. Shimek.

El. Elma. J. C. Warren.

Fd. Fort Dodge. M. P. Somes.

Fx. Fairfax. Osborn list.

H. Hamburg. B. Shimek.

Hp. Hampton. F. H. Shoemaker.

I. Iowa City.

Ia. Iowa. This signifies that the distribution is general throughout the state, and in every case species thus marked are known to occur at Iowa City as well as at other points.

K. Keokuk. Published records from works of Thos. L. Casey.

L. Lyon Co. B. Shimek.

M. Muscatine. Thos. H. Macbride and Alice Yocom.

Mv. Missouri Valley. B. Shimek.

O. Okoboji. Maud Brown.

Ob. Odebolt. F. H. Shoemaker.

P. Council Bluffs. Frank Shoemaker and the writer.

R. Riverton. B. Shimek.

S. Sioux City. Mrs. Ida Grillet Slemmons.

Sp. Spirit Lake. J. H. Brown.

T. Traer. J. E. Cameron.

U. Unionville. B. Shimek.

W. Waterloo. Mrs. Lucy Brant Meade.

Wi. Williamsburg. P. C. Myers.

Where no symbol follows the name of the insect, it is to be understood that the published citation or collection record of locality is simply "Iowa" but it is not to be inferred that the distribution is necessarily state-wide.

CICINDELIDÆ.

TETRACHA *Hope.*
virginica *Linn.* Southwest Ia.
CICINDELA *Linn.*
formosa generosa *Dej.* I. B. P. El. W.
purpurea *Oliv.* I. A. El.
v. auduboni *Lec.* S.
v. splendida *Hentz.* D. P.
v. amœna *Lec.* P.
v. transversa *Leng.* I.
v. limbalis *Kl.* I. Ch.P. Hp. El.
duodecimguttata *Dej.* I. El. Fx.
repanda *Dej.* Ia.
hirticollis *Say.* I. P. W.
tranquebarica *Hbst.* I.A.P.
scutellaris lecontei *Hald.* I. C. B. Fort Madison. Elkader. P. El. W.
sexguttata *Fabr.* Ia.
v. violacea *Fabr.* Bl.
punctulata *Fabr.* Ia.
celeripes *Lec.* I. P.
cursitans *Lec.* I. P.
unipunctata *Fabr.* Cedar Bluffs.
cuprascens *Lec.* A. Ep. P.
v. macra *Lec.* I. B. W.
lepida *Dej.* I. P.

CARABIDÆ.

OMOPHRON *Lat.*
labiatum *Fabr.*
nitidum *Lec.* El.
americanum *Dej.* I. C. El.
robustum *Horn.*
tessellatum *Say.* A. I. Fx. El.
CYCHRUS *Fabr.*
lecontei *Dej.* I. B. Cedar Bluffs. Bluffton.
elevatus *Fabr.* I. A. Fx. Bl.
NOMARETUS *Lec.*
bilobus *Say.* I. Cedar Bluffs.
cavicollis *Lec.*
CARABUS *Linn.*
sylvosus *Say.* I. A. El.
serratus *Say.* I. A. F. P.
limbatus *Say.* I. Forest City.
vinctus *Web.* A.
CALOSOMA *Web.*
externum *Say.* I.
scrutator *Fabr.* Ia.
willcoxi *Lec.* I. Bl.
calidum *Fabr.* Ia.
ELAPHRUS *Fabr.*
ruscarius *Say.* Ia.
cicatricosus *Lec.* I.
LORICERA *Lat.*
cærulescens *Linn.* Sp. O.
NOTIOPHILUS *Dum.*
æneus *Hbst.* I. El.
semistriatus *Say.* I.
novemstriatus *Lec.* I. O. S.
NEBRIA *Lat.*
pallipes *Say.* B.
PASIMACHUS *Bon.*
elongatus *Lec.* I. B. S. E. C. Ch. El. M.
SCARITES *Fabr.*
subterraneus *Fabr.* Ia.
DYSCHIRIUS *Bon.*
nigripes *Lec.* Bl.
æneolus *Lec.* I. Bl.
globulosus *Say.* A. B. I. L. C.
hæmorrhoidalis *Dej.* I.
sphæricollis *Say.* Bl. I.
truncatus *Lec.* Bl.
erythrocerus *Lec.* Bl.
CLIVINA *Lat.*
dentipes *Dej.* I. Bl.
impressifrons *Lec.* I. Bl.
rufa *Lec.* P.
americana *Dej.* I. Bl.
striatopunctata *Dej.* Cedar Bluffs.
ferrea *Lec.* I. Bl.
bipustulata *Fabr.* I. C. Bl.
ASPIDOGLOSSA *Putz.*
subangulata *Chd.* Bl.

SCHIZOGENIUS *Putz.*
lineolatus *Say.* I. B. El.
amphibius *Hald.* I.
ARDISTOMIS *Putz.*
puncticollis *Putz.* Bl.
PANAGÆUS *Lat.*
fasciatus *Say.* I.
BEMBIDIUM *Lat.*
lævigatum *Say.* A. I. Bl. P.
nitidum *Kby.* El.
inæquale *Say.* I. Bl. Dw. Hp.
littorale *Oliv.* I. P. Dw.
robusticolle *Hayw.* I.
punctatostriatum *Say.* P.
æuulum *Hayw.* Cedar Co.
coxendix *Say.* A. I. P.
confusum *Hayw.* I. Bl. Dw. C. W.
bifossulatum *Lec.* Elkader. Sp. Bl.
americanum *Dej.* I. Dw.
honestum *Say.*
chalceum *Dej.* I.
nigrum *Say.*
postremum *Say.*
ustulatum *Linn.* W.
lucidum *Lec.* I. P.
picipes *Kby.* I. Bl. Wi.
texanum *Chd.* I.
versutum *Lec.* P.
cordatum *Lec.* I.
graciliforme *Hayw.* I. El.
dorsale *Say.* I.
postfasciatum *Hamilton.* I. Bl.
oberthuri *Hayw.* Hp. C.
variegatum *Say.* Ia.
intermedium *Kby.* I. O. El.
versicolor *Lec.* Ia.
quadrimaculatum *Linn.* Ia.
affine *Say.* I. E. Bl.
sulcatum *Lec.* El.
assimile *Gyll.* I. Bl.
TACHYS *Schaum.*
nanus *Gyll.* Ia.
flavicauda *Say.* Ia.
granarius *Dej.*
incurvus *Say.* Ia.
dolosus *Lec.*
capax *Lec.* I.
vivax *Lec.* M. I.
tripunctatus *Say.*
ferrugineus *Dej.* I.
lævus *Say.* A. I.
proximus *Say.* I. Bl.
scitulus *Lec.* I.
corruscus *Lec.* I. Bl.
PATROBUS *Dej.*
longicornis *Say.* I.D. M. B. Bl. Dw. W.
PTEROSTICHUS *Bon.*
adoxus *Say.* A.
constrictus *Say.* I. El.
incisus *Lec.* I. El.
coracinus *Newm.* I. A. Dw.
stygicus *Say.* D. I. B. Bluffton. Cn.
permundus *Say.* Ia.
sayi *Brullé.* I. D. El. P.
lucublandus *Say.* Ia.
caudicalis *Say.* I. T. El.
corvinus *Dej.* I.
haldemanni *Lec.* I.
scrutator *Lec.* I. El.
purpuratus *Lec.* I.
mutus *Say.* I. A. C. Ch. Armstrong. T.
pennsylvanicus *Lec.* B. El.
erythropus *Dej.* A. I. C. M.
patruelis *Dej.* Ob.
femoralis *Kby.* Ia.
EVARTHRUS *Lec.*
seximpressus *Lec.* I. P. B. Dm.
orbatus *Newm.*
colossus *Lec.* I. P. A. Cn. T. Fd. Dm.
sodalis *Lec.* Foster. I. Dw.
AMARA *Bon.*
rufimana *Kby.* Sp.
pennsylvanica *Hayw.* I.
avida *Say.* I. A. B. P.
exarata *Dej.* I. C.
angustata *Say.* A. I. B.
pallipes *Kby.* I. C.
impuncticollis *Say.* O. I. Monona Co.
fallax *Lec.* I. D. El. W.
cupreolata *Putz.* I. O.
polita *Lec.* I. C. B.
interstitialis *Dej.* I. C. A. El.

obesa *Say*. I. Decorah. Ob.
chalcea *Dej*. B. El.
remotestriata *Dej*. I.
musculus *Say*.

LOXANDRUS *Lec.*

brevicollis *Lec*. I.

DIPLOCHILA *Lec.*

laticollis *Lec*. I. A. Fd. Dm.
major *Lec*. I. A. B. Dm.
impressicollis *Dej*. A.
alternans *Csy*. O.
obtusa *Lec*. I.

DICÆLUS *Bon.*

splendidus *Say*. C. D. A. I. B. Bl.
purpuratus *Bon*. D.
sculptilis *Say*. I. A. Colfax. Fd. El.
furvus *Dej*. C.
elongatus *Bon*. I. A. Decorah.

BADISTER *Clairv.*

notatus *Hald*. I.
pulchellus *Lec*. I. A. O.
bipustulatus *Fabr*. I.
flavipes *Lec*.
reflexus *Lec*. I.

CALATHUS *Bon.*

gregarius *Say*. Ia.
impunctatus *Say*. I.

PLATYNUS *Bon.*

decens *Say*. I. El.
sinuatus *Dej*. Ia.
cincticollis v. deplanatus *Chd*. I.
extensicollis *Say*. Ia.
v. viridis *Lec*. El.
decorus *Say*. Ia.
pusillus *Lec*. I. C.
errans *Say*. Sp.
tenuis *Lec*. El. Hp.
atratus *Lec*. Ob.
melanarius *Dej*. Ia.
deceptivus *Lec*. Bl.
cupripennis *Say*. Ia.
excavatus *Dej*. Cedar Co.
basalis *Lec*. Ia.
nutans *Say*. A. I. C. Sedan.
picticornis *Newm*.
octopunctatus *Fabr*. A. I.
placidus *Say*. A. I. C. O. B. El. W.
obsoletus *Say*. A. I. Oskaloosa.
æruginosus *Dej*. I. D. El.
crenistriatus *Lec*. I. C. W.
ruficornis *Lec*. I. A. El.
picipennis *Kby*. I. B. C. Fd. Bl.
lutulentus *Lec*. I. A. Bl.

OLISTHOPUS *Dej.*

parmatus *Say*. I.
micans *Lec*. I.

PERIGONA *Lap.*

pallipennis *Lec*. I.

LEPTOTRACHELUS *Lat.*

dorsalis *Fabr*. A. I. P.

CASNONIA *Lat.*

pennsylvanica *Linn*. Ia.

GALERITA *Fabr.*

atripes *Lec*. I.
janus *Fabr*. Ia.
bicolor v. intermedia *Csy*.

TETRAGONODERUS *Dej.*

fasciatus *Hald*. Bl.

LEBIA *Lat.*

grandis *Hentz*. A. I. C. Bl.
atriventris *Say*. I. C. W.
tricolor *Say*. A.
viridis *Say*. Ia.
pumila *Dej*. I.
viridipennis *Dej*. I.
ornata *Say*. A. I.
fuscata *Dej*. Bl.
scapularis *Dej*. A. I.
furcata *Lec*. Bl.
bivittata *Fabr*. I. Bl.

DROMIUS *Bon.*

piceus *Dej*. I.

BLECHRUS *Mots.*

nigrinus *Mann*. A. El.

METABLETUS *Schm.-Goeb.*

americanus *Dej*. I. O. El. Cn.

CALLIDA *Dej.*

punctata *Lec*. I.
purpurea *Say*. Sp.

PLOCHIONUS *Dej.*

timidus *Hald*. El.

PINACODERA *Schaum.*
limbata *Dej.* I. El.
CYMINDIS *Lat.*
americana *Dej.* A. I.
cribrata *Lec.* El.
pilosa *Say.* I. Grand River.
APENES *Lec.*
sinuata *Say.* I.
PENTAGONICA *Schm.-Goeb.*
flavipes *Lec.* I.
HELLUOMORPHA *Lap.*
bicolor *Harr.* I. C.
BRACHYNUS *Web.*
americanus *Lec.* D. I. Foster.
minutus *Harr.* A.
perplexus *Dej.* I. A.
medius *Harr.* I. B. O. Cedar Co. Bl.
conformis *Dej.* I. Woodbury Co. Sp.
fumans *Fabr.* I. A. Sp.
ballistarius *Lec.* I.
CHLÆNIUS *Bon.*
erythropus *Germ.* I. A. Ch. B.
sericeus *Forst.* Ia.
laticollis *Say.* D.
diffinis *Chd.* I. B. C. Masonville. P. Dw. Ob. W.
platyderus *Chd.* A.
prasinus *Dej.* D. I. B. Ch.
solitarius *Say.* A. I. P. W.
nemoralis *Say.* I. P.
tricolor *Dej.* Ia.
brevilabris *Lec.*
pennsylvanicus *Say.* Ia.
impunctifrons *Say.* I. D. W.
niger *Rand.* I.
purpuricollis *Rand.* I.
tomentosus *Say.* A. I. C. Dw.
ANOMOGLOSSUS *Chd.*
emarginatus *Say.* A. I. D. Ob.
pusillus *Say.* A. I. D. Bl. El.
BRACHYLOBUS *Chd.*
lithophilus *Say.* Ia.
LACHNOCREPIS *Lec.*
parallelus *Say.* A.
GEOPINUS *Lec.*
incrassatus *Dej.* I. Fx. A. C. P.

NOTHOPUS *Lec.*
zabroides *Lec.* I. B. P.
CRATACANTHUS *Dej.*
dubius *Beauv.* B. I. A. El.
AGONODERUS *Dej.*
lineola *Fabr.* D.
pallipes *Fabr.* Ia.
partiarius *Say.* A. I.
indistinctus *Dej.* A.
DISCODERUS *Lec.*
parallelus *Hald.* I.
HARPALUS *Lat.*
autumnalis *Say.* El. U.
erraticus *Say.* I. A. Ch. B. M. S. Decorah. P. Hp.
caliginosus *Fabr.* Ia.
faunus *Say.* A. D.
pennsylvanicus *DeG.* Ia.
v. compar *Lec.* I. A. Ch. Bl.
v. erythropus *Dej.* D.
herbivagus *Say.* Ia.
rufimanus *Lec.* I. El.
basilaris *Kby.* El. I.
testaceus *Lec.* I. W.
SELENOPHORUS *Dej.*
pedicularius *Dej.* I. B. El.
opalinus *Lec.* I.
STENOLOPHUS *Dej.*
fuliginosus *Dej.* A. I. El.
conjunctus *Say.* Ia.
ochropezus *Say.* I. A. D. B. O. Bl.P.El.
ACUPALPUS *Lat.*
carus *Lec.* I. LeMars.
BRADYCELLUS *Er.*
cognatus *Gyll.* A.
rupestris *Say.* A. I. C. B. L. El.
nigriceps *Lec.* I.
TACHYCELLUS *Moraw.*
atrimedius *Say.* I.
badiipennis *Hald.* C.
ANISODACTYLUS *Dej.*
rusticus *Say.* Ia.
carbonarius *Say.* A. I.
nigerrimus *Dej.* I. El. Bl.
harrisii *Lec.* I. Bl.
discoideus *Dej.* A. D. I. Bl.

baltimorensis *Say.* Ia.
verticalis *Lec.* I. B. Foster. Cedar Co. Bl. Hp.
terminatus *Say.* Bl. I. P.
lugubris *Dej.* D. I. Bl. Armstrong.
sericeus *Harr.* I. D. Bl. P.
interstitialis *Say.* D. I. B. P. Bl.

HALIPLIDÆ.

HALIPLUS *Lat.*
triopsis *Say.* A. I.
borealis *Lec.* I.
ruficollis *DeG.* A. I.

CNEMIDOTUS *Er.*
duodecimpunctatus *Say.* A. D. I.
edentulus *Lec.* I.

DYTISCIDÆ.

HYDROCANTHUS *Say.*
iricolor *Say.* D.

LACCOPHILUS *Leach.*
maculosus *Germ.* Ia.
proximus *Say.* Sibley. I.
fasciatus *Aubé.* Ia.

DESMOPACHRIA *Bab.*
convexa *Aubé.* I. A.

BIDESSUS *Shp.*
affinis *Say.* Ia.
lacustris *Say.* A.
granarius *Aubé.* I.

CŒLAMBUS *Thoms.*
inæqualis *Fabr.* D.
acaroides *Lec.* I.
nubilus *Lec.* I.
dissimilis *Harr.* A. I.

DERONECTES *Shp.*
catascopium *Say.* I.

HYDROPORUS *Clairv.*
undulatus *Say.* I. A. Cn.
proximus *Aubé.* D.
hybridus *Aubé.* D.
striatopunctatus *Melsh.* I.
modestus *Aubé.* D. I.
stagnalis *G. & H.* A. I.

ILYBIUS *Er.*
pleuriticus *Lec.* A. I. Mv.
biguttulus *Germ.* A. I.

COPTOTOMUS *Say.*
interrogatus *Fabr.* Ia.

ILYBIOSOMA *Cr.*
bifaria *Kby.* A.

COPELATUS *Er.*
glyphicus *Say.* I. P.

MATUS *Aubé.*
bicarinatus *Say.* I. A. D.

AGABUS *Leach.*
obtusatus *Say.* I.
punctatus *Melsh.* A.
æruginosus *Aubé.* I.
disintegratus *Cr.* P.
occidens *Shp.* I.

RHANTUS *Esch.*
bistriatus *Bergst.* I.

COLYMBETES *Clairv.*
sculptilis *Harr.* I. A. Ch. P.

HYDATICUS *Leach.*
piceus *Lec.* I. A.

DYTISCUS *Linn.*
fasciventris *Say.* Ia.
hybridus *Aubé.* I. P.
sublimbatus *Lec.* Ch.

ACILIUS *Leach.*
semisulcatus *Aubé.* Ia.
mediatus *Say.* I.

THERMONECTES *Esch.*
ornaticollis *Aubé.* I.

GRAPHODERES *Esch.*
liberus *Say.* A. I.
cinereus *Linn.* I.

CYBISTER *Curt.*
fimbriolatus *Say.* Ia.

GYRINIDÆ.

Gyrinus *Linn.*
minutus *Fabr.* I. W.
dichrous *Lec.* I.
ventralis *Kby.* I.
maculiventris *Lec.* I. M. C.
affinis *Aubé.* I. Cedar Bluffs.
analis *Say.* Ia.
lugens *Lec.* El.
Dineutes *MacL.*
discolor *Aubé.* I.
assimilis *Aubé.* Ia.

HYDROPHILIDÆ.

Helophorus *Fabr.*
obscurus *Lec.* A. I. O.
lineatus *Say.* A. I.
Hydrochus *Leach.*
scabratus *Melsh.* I.
excavatus *Lec.* I.
variolatus *Lec.*
squamifer *Lec.* I. A. Forest City.
Ochthebius *Leach.*
foveicollis *Lec.* I.
Hydrophilus *Geoff.*
ovatus *G. & H.* I.
triangularis *Say.* Ia.
Tropisternus *Sol.*
dorsalis *Brullé.* Ia.
glaber *Hbst.* Ia.
Hydrocharis *Lat.*
obtusatus *Say.* Ia.
Berosus *Leach.*
pantherinus *Lec.* I.
peregrinus *Hbst.* I.
striatus *Say.* Ia.
Chætarthria *Steph.*
pallida *Lec.* I.
Laccobius *Er.*
agilis *Rand.* Ia.
Philydrus *Sol.*
nebulosus *Say.* Ia.
cinctus *Say.* I.
perplexus *Lec.* I.
hamiltoni *Horn.* O.
diffusus *Lec.* El.
Cymbiodyta *Bedel.*
fimbriata *Melsh.* D. A.
Helocombus *Horn.*
bifidus *Lec.* El.
Hydrobius *Leach.*
fuscipes *Linn.* Ia.
Creniphilus *Motsch.*
subcupreus *Say.* Ia.
Sphæridium *Fabr.*
scarabæoides *Fabr.* I. Hp.
Cercyon *Leach.*
unipunctatus *Linn.* I.
ocellatus *Say.* I.
prætextatus *Say.* A. I. O. P.
analis *Payk.* A.
melanocephalus *Linn.* I. C. B.
pygmæus *Ill.* I.
navicularis *Zimm.* I.
tristis *Ill.*
Cryptopleurum *Muls.*
minutum *Fabr.* Ia.
americanum *Horn.* I.

LEPTINIDÆ.

Leptinus *Müll.*
testaceus *Müll.* I. K.

SILPHIDÆ.

Necrophorus *Fabr.*
americanus *Oliv.* Ia.
sayi *Lap.* I.
orbicollis *Say.* Ia.
marginatus *Fabr.* Ia.
obscurus *Kby.* Norwich. Sp.

pustulatus *Hersch.* A. I.
v. melsheimeri *Kby.* I.
tomentosus *Web.* Ia.

SILPHA *Linn.*
surinamensis *Fabr.* Ia.
lapponica *Hbst.* A. F. C. Sp. I.
inæqualis *Fabr.* Ia.
noveboracensis *Forst.* Ia.
americana *Linn.* Ia.
ramosa *Say.* Waverly.

CHOLEVA *Lat.*
clavicornis *Lec.* I.

PRIONOCHÆTA *Horn.*
opaca *Say.* I. B.

PTOMAPHAGUS *Ill.*
consobrinus *Lec.* I.
parasitus *Lec.* I.
pusio *Lec.* I.

COLENIS *Er.*
impunctata *Lec.* I.

LIODES *Lat.*
discolor *Melsh.* I. Wi.
basalis *Lec.* I.

AGATHIDIUM *Ill.*
oniscoides *Beauv.* I.
exiguum *Melsh.* I.
politum *Lec.* I.

SCYDMÆNIDÆ.

EUCONNUS *Thoms.*
bicolor *Lec.* I.
occultus *Csy.* I.
affinis *Csy.* I.
gratus *Csy.* I.
salinator *Lec.* I.

PYCNOPHUS *Csy.*
rasus *Lec.* I.

CONNOPHRON *Csy.*
longipenne *Csy.* I. K.
formale *Csy.* I.
flavitarse *Lec.* I.
dentiger *Csy.* I.
ludificans *Csy.* I.
nigripenne *Csy.* I.
fossiger *Lec.* I.
femorale *Csy.* I.
clavicorne *Csy.* I.
pallidum *Csy.* I.
integrum *Csy.* I.
decorum *Csy.* I.
testaceipes *Csy.* I.
castaneum *Csy.* I.
triviale *Csy.* I.
trinifer *Csy.* I.
trifidum *Csy.* I.
fulvum *Lec.* I.
capillosulum *Lec.* I.
illustre *Csy.* I.
basale *Lec.* I.
lacunosum *Csy.* I.
pumilum *Csy.* I.

SMICROPHUS *Csy.*
leviceps *Csy.* I.

SCYDMÆNUS *Lat.*
perforatus *Schm.* C. I.
conjux *Csy.* I.

OPRESUS *Csy.*
minimus *Brend.* C.

ASCYDMUS *Csy.*
tener *Csy.* I.

EUTHIODES *Brend.*
lata *Brend.*

EUMICRUS *Lap.*
motschulskii *Lec.* I.
ochreatus *Csy.* I.
saginatus *Csy.* I.

PSELAPHIDÆ.

ADRANES *Lec.*
lecontei *Brend.* I.

CEDIUS *Lec.*
spinosus *Lec.* Southern Iowa.
ziegleri *Lec.* Southern Iowa.

TMESIPHORUS *Lec.*
carinatus *Say.* I.
costalis *Lec.* I.

CEOPHYLLUS *Lec.*
monilis *Lec.* I.
PILOPIUS *Csy.*
consobrinus *Lec.* I.
piceus *Lec.*
zimmermanni *Lec.* I.
lacustris *Csy.* I.
iowensis *Csy.* K.
PSELAPHUS *Hbst.*
erichsoni *Lec.* I.
longiclavus *Lec.*
TYCHUS *Leach.*
minor *Lec.* I.
CYLINDRARCTUS *Schf.*
longipalpus *Lec.* I.
crinifer *Csy.* I.
ANCHYLARTHRON *Brend.*
cornutum *Brend.* I.
curtipenne *Csy.*
REICHENBACHIA *Leach.*
divergens *Lec.* I.
trigona *Lec.* C.
subsimilis *Csy.* I. B.
congener *Brend.* I.
facilis *Csy.* I.
cribricollis *Brend.* I.
rubicunda *Aubé.* I.
gracilis *Csy.*
sodalis *Csy.* I.
peregrinator *Csy.* I. K.
puncticollis *Lec.* I.
procera *Csy.*
bicolor *Brend.* I.
propinqua *Lec.* I.
BRYAXIS *Leach.*
illinoiensis *Brend.*
terebrata *Csy.*
arguta *Csy.* I.
RYBAXIS *Saulcy.*
truncaticornis *Brend.*
DECARTHRON *Brend.*
abnorme *Lec.* I.
exsectum *Brend.* I.
scarificatum *Brend.* C.
BATRISUS *Aubé.*
scabriceps *Lec.* I.
lineaticollis *Aubé.* I.
fossicauda *Csy.* I.
declivis *Csy.* I.
harringtoni *Csy.* I.
frontalis *Lec.* I.
globosus *Lec.* I.
spretus *Lec.* I.
foveicornis *Csy.* I.
furcatus *Brend.* I.
denticollis *Csy.* I.
striatus *Lec.* I.
TRIMIOPLECTUS *Brend.*
obsoletus *Brend.* C.
MELBA *Csy.*
parvula *Lec.* I.
sulcatula *Csy.* I.
thoracica *Brend.* I.
maja *Brend.*
THESIUM *Csy.*
cavifrons *Lec.*
laticolle *Csy.*
BIBLIOPLECTUS *Reitt.*
ruficeps *Lec.*
THESIASTES *Csy.*
fossulatus *Brend.* I.
EUPLECTUS *Leach.*
interruptus *Lec.* I.
confluens *Lec.* I.
elongatus *Brend.* I.
iowensis *Csy.* I.
pertenuis *Csy.* I.
planipennis *Brend.* C.
rotundicollis *Brend.* C.
RAMECIA *Csy.*
crinita *Brend.*
RHEXIDIUS *Csy.*
canaliculatus *Lec.* I. C.
RHEXIUS *Lec.*
insculptus *Lec.* I.

STAPHYLINIDÆ.

DINOPSIS *Matth.*
americana *Kr.* I.
OLIGOTA *Mann.*
parva *Kr.*

pusillima *Grav.*
claviger *Csy.* K.

GYROPHÆNA *Mann.*
affinis *Sahlb.* I.
lacustris *Csy.* I.
corruscula *Er.* I.
vinula *Er.* I.
dissimilis *Er.* I.

THECTUROTA *Csy.*
exigua *Csy.* C.

HOMALOTA *Mann.*
plana *Gyll.* I.

SILUSA *Er.*
cribratula *Csy.* I.

LEPTUSA *Kr.*
caseyi *Fenyes.* C. I.

BOLITOCHARA *Mann.*
picta *Csy.*
blanchardi *Csy.* I.
lætula *Csy.*

FALAGRIA *Mann.*
dissecta *Er.* D. I.
iowana *Csy.* C.
cingulata *Lec.*
tenuicornis *Csy.*
bilimbata *Csy.*

MERONERA *Shp.*
venustula *Er.* I.

CHITALIA *Shp.*
nigrescens *Csy.*

TACHYUSA *Er.*
americana *Csy.*

ATHETA *Thoms.*
palustris *Kies.* I.
festinans *Er.* I.
euryptera *Steph.* I.
sordida *Melsh.* I.
luteola *Er.* I.
analis *Grav.* I.
limatula *Csy.* I.

EURYPRONOTA *Csy.*
discreta *Csy.* C. I.

HOPLANDRIA *Kr.*
lateralis *Melsh.* I.

TRICHIUSA *Csy.*
robustula *Csy.* C.

ZYRAS *Steph.*
caliginosus *Csy.* I.

XENODUSA *Wasm.*
cava *Lec.* I. Dw.

PHLŒOPORA *Er.*
sublævis *Csy.*

PACHYCEROTA *Csy.*
duryi *Csy.* I.

BLEPHARRYMENUS *Sol.*
brendeli *Csy.* C.

NASIREMA *Csy.*
humilis *Csy.* I.
inquilina *Csy.* I.

OCYUSA *Kr.*
asperula *Csy.*

OXYPODA *Mann.*
minuta *Sachse.* I., in doubt.
sagulata *Er.* I.
perexilis *Csy.* I.
amica *Csy.* I.
iowensis *Csy.* I.

STICHOGLOSSA *Kr.*
corticina *Er.* I.

THIASOPHILA *Kr.*
angustiventris *Csy.*
laticollis *Csy.* I.

CRATARIA *Thoms.*
suturalis *Mann.* I.

DECUSA *Csy.*
expansa *Lec.* I.

MYRMOBIOTA *Csy.*
crassicornis *Csy.* I.

ALEOCHARA *Grav.*
lata *Grav.* Ia.
bimaculata *Grav.* I.
minuta *Csy.*

ACYLOPHORUS *Nordm.*
pronus *Er.* I.

HETEROTHOPS *Steph.*
fumigatus *Lec.* I.

QUEDIUS *Steph.*
explanatus *Lec.* El.
fulgidus *Fabr.* I. A.
peregrinus *Grav.* I. El.
capucinus *Grav.* I. El.

LISTOTROPHUS *Perty.*
cingulatus *Grav.* Ia.
CREOPHILUS *Kby.*
villosus *Grav.* Ia.
STAPHYLINUS *Linn.*
badipes *Lec.* El.
vulpinus *Nordm.* Ia.
maculosus *Grav.* Ia.
mysticus *Er.* I.
tomentosus *Grav.* B. I.
fossator *Grav.* C.
cinnamopterus *Grav.* Ia.
violaceus *Grav.* A. I. P.
OCYPUS *Kby.*
ater *Grav.* A. I. C. Hp.
PHILONTHUS *Curt.*
politus *Linn.* Ia.
hepaticus *Er.* A. El.
quisquiliarius *Gyll.* I.
debilis *Grav.* I.
thoracicus *Grav.* I.
fusiformis *Melsh.* I.
fulvipes *Fabr.* E.
micans *Grav.* I.
lomatus *Er.* Ia.
cyanipennis *Fabr.* I.
blandus *Grav.* I.
sordidus *Grav.* Ia.
cephalotes *Grav.* I.
microphthalmus *Horn.* I. B.
apicalis *Say.* I.
confertus *Lec.* Bl.
ACTOBIUS *Steph.*
sobrinus *Er.* I.
pæderoides *Lec.* I. B.
GYROHYPNUS *Steph.*
obsidianus *Melsh.* Ia.
emmesus *Grav.* I. B.
fusciceps *Lec.*
vernicatus *Csy.* I.
hamatus *Say.* Ia.
pusillus *Sachse.* I.
LEPTACINODES *Csy.*
flavipes *Lec.*
nigritulus *Lec.*
STICTOLINUS *Csy.*
scolopacea *Csy.*
NEMATOLINUS *Csy.*
longicollis *Csy.*
LEPTOLINUS *Kr.*
rubripennis *Lec.*
DIOCHUS *Er.*
schaumii *Kr.* I.
STENUS *Lat.*
colon *Say.* I.
juno *Fabr.* I.
femoratus *Say.* I.
strangulatus *Csy.* I.
erythropus *Melsh.* I.
vicinus *Csy.* I.
inornatus *Csy.* I.
colonus *Er.* I.
stygicus *Say.* I.
egenus *Er.* I.
gratiosus *Csy.* B.
flavicornis *Er.* I. B. El.
annularis *Er.* I.
reconditus *Csy.* I.
EUÆSTHETUS *Grav.*
brevipennis *Csy.* I.
GASTROLOBIUM *Csy.*
lecontei *Horn.*
bicolor *Grav.* Ia.
strenuum *Csy.*
HESPEROBIUM *Csy.*
pallipes *Grav.* Ia.
capito *Csy.*
cinctum *Say.* I.
sellatum *Lec.* I.
CRYPTOBIELLA *Csy.*
pusilla *Lec.* A.
PÆDERILLUS *Csy.*
palustris *Aust.* I.
iowensis *Csy.*
littorarius *Grav.* Ia.
APTERALIUM *Csy.*
brevipenne *Lec.* I. C.
LATHROBIUM *Grav.*
armatum *Say.* I.
simile *Lec.* A. I.
LITOLATHRA *Csy.*
convictor *Csy.* I.
amputans *Csy.*

LATHROBIOMA *Csy.*
othoides *Lec.* I.
LATHROLEPTA *Csy.*
debilis *Lec.*
TETARTOPEUS *Czwl.*
punctulatus *Lec.* A. I.
rubripennis *Csy.*
semiruber *Csy.*
angularis *Lec.* I.
EULATHROBIUM *Csy.*
grande *Lec.* M.
LATHROTAXIS *Csy.*
longiuscula *Grav.* D. I. E.
PSEUDOLATHRA *Csy.*
analis *Lec.*
LATHROBIELLA *Csy.*
ventralis *Lec.* I. B.
gracilicornis *Csy.*
collaris *Er.* I.
famelica *Csy.*
ambigua *Lec.*
ADEROCHARIS *Shp.*
corticina *Grav.*
LITHOCHARIS *Lac.*
ochracea *Grav.* Ia.
TRACHYSECTUS *Csy.*
confluens *Say.* A. I.
PLATYMEDON *Csy.*
laticolle *Csy.* I.
LEUCORUS *Csy.*
rubens *Csy.*
PYCNORUS *Csy.*
iowanus *Csy.*
SCOPÆUS *Er.*
notangulus *Csy.*
exiguus *Er.* I.
brachypterus *Csy.* I.
STILICUS *Lat.*
angularis *Lec.* I.
lacustrinus *Csy.*
dentatus *Say.* I.
MEGASTILICUS *Csy.*
formicarius *Csy.* I.
SUNIUS *Er.*
prolixus *Er.* I.
binotatus *Say.* I.
cinctus *Say.* I.
simulans *Csy.*
brevipennis *Aust.* I.
discopunctatus *Say.*
PALAMINUS *Er.*
larvalis *Lec.* I.
TACHINUS *Grav.*
memnonius *Grav.* I. El.
flavipennis *Dej.* I.
pallipes *Grav.* I.
fimbriatus *Grav.* I.
limbatus *Melsh.* B. I.
TACHYPORUS *Grav.*
chrysomelinus *Linn.* Ia.
v. maculipennis *Lec.* Ia.
jocosus *Say.* Ia.
nitidulus *Fabr.* Ia.
ERCHOMUS *Mots.*
ventriculus *Say.* Ia.
CONOSOMA *Kr.*
crassum *Grav.* I. El.
pubescens *Payk.* I.
basale *Er.* I. B. C.
limuloides *Csy.*
scriptum *Horn.* I.
MYCETOPORUS *Mann.*
americanus *Er.* I. Cedar Co.
flavicollis *Lec.* I.
splendidus *Grav.* I. B.
BOLETOBIUS *Leach.*
intrusus *Horn.* I. B.
cincticollis *Say.* I. M.
trinotatus *Er.* I.
cinctus *Grav.* I.
OXYPORUS *Fabr.*
rufipennis *Lec.* A.
stygicus *Say.* I. Hesper.
vittatus *Grav.* I.
lepidus *Lec.* I.
OSORIUS *Latr.*
latipes *Grav.* A. I.
BLEDIUS *Leach.*
semiferrugineus *Lec.* I. B.
fumatus *Lec.* I.
analis *Lec.* I.
assimilis *Csy.* I.

opacus *Block.* I.
nebulosus *Csy.*
annularis *Lec.* I.
tau *Lec.* I. C. B.
emarginatus *Say.* I.

PLATYSTETHUS *Mann.*
americanus *Er.* Ia.

OXYTELUS *Grav.*
sculptus *Grav.* I.
pennsylvanicus *Er.* I.
nitidulus *Grav.* I.
placusinus *Lec.* I.
suspectus *Csy.* I.
exiguus *Er.* I.

TROGOPHLŒUS *Mann.*
4-punctatus *Say.* I.
imbellis *Csy.* C.
lepidus *Csy.* I.
phlœoporinus *Lec.* C.
detractus *Csy.* C.
ingens *Csy.* C.

APOCELLUS *Er.*
sphæricollis *Say.* Ia.

GEODROMICUS *Redt.*
cæsus *Er.* I.
brunneus *Say.* I. B.

LESTEVA *Lat.*
pallipes *Lec.* I.

ARPEDIUM *Er.*
cribratum *Fvl.* I.
tenue *Lec.* I.

LATHRIMÆUM *Er.*
sordidum *Er.* D.

OLOPHRUM *Er.*
rotundicolle *Sahlb.* I.

ANTHOBIUM *Leach.*
hornii *Fvl.* I.

GLYPTOMA *Er.*
costale *Er.* Ia.

TRIGA *Fauv.*
picipennis *Lec.* I.

ELEUSIS *Lec.*
pallidus *Lec.* I.

MICROPEPLUS *Lat.*
cribratus *Lec.* I.

TRICHOPTERYGIDÆ.

LIMULODES *Matth.*
paradoxus *Matth.* I.

TRICHOPTERYX *Kby.*
atomaria *DeG.* I.

SCAPHIDIIDÆ.

SCAPHIDIUM *Oliv.*
quadriguttatum *Say.* I. P. Bl.
v. piceum *Melsh.* A. I. Dw.

BÆOCERA *Er.*
concolor *Fabr.*
congener *Csy.*
speculifer *Csy.* K.
apicalis *Lec.* I. B.

SCAPHISOMA *Leach.*
repanda *Csy.*
convexum *Say.* I. D. W.
suturale *Lec.* I. B.
evanescens *Csy.*

SCAPHIOMICRUS *Csy.*
nugator *Csy.* K.

PHALACRIDÆ.

PHALACRUS *Payk.*
simplex *Lec.* I.
politus *Melsh.* I. P. B.

ACYLOMUS *Shp.*
ergoti *Csy.* I.

STILBUS *Seid.*
apicalis *Melsh.* I. A. B. El. W.
nitidus *Melsh.* Ia.
obscurus *Csy.* I.

CORYLOPHIDÆ.

GRONEVUS *Csy.*
sticticus *Csy.*
truncatus *Lec.* I.
hesperus *Csy.* K.
SERICODERUS *Steph.*
flavidus *Lec.* I.

MOLAMBA *Csy.*
lunata *Lec.*
ornata *Csy.*
fasciata *Say.* I. B.
ARTHROLIPS *Er.*
decolor *Lec.*

COCCINELLIDÆ.

ANISOSTICTA *Duponchel.*
strigata *Thunb.* A. O.
MEGILLA *Muls.*
maculata v. fuscilabris *Muls.* Ia.
HIPPODAMIA *Chev.*
13-punctata *Linn.* Ia.
glacialis *Fabr.* I. A.
convergens *Guér.* Ia.
15-maculata *Muls.* I. P.
parenthesis *Say.* Ia.
HARMONIA *Muls.*
picta *Rand.* Bl.
ADALIA *Muls.*
bipunctata *Linn.* I. C. Dm. W.
humeralis *Say.* I.
COCCINELLA *Linn.*
novemnotata *Hbst.* Ia.
transversoguttata *Fald.* A.
CYCLONEDA *Cr.*
sanguinea v. munda *Say.* Ia.
OLLA *Csy.*
oculata *Fabr.* I. A.
abdominalis *Say.* A. I.
ANATIS *Muls.*
15-punctata *Oliv.* Ia.
PSYLLOBORA *Chev.*
20-maculata *Say.* Ia.
v. obsoleta *Csy.* K.

CHILOCORUS *Leach.*
bivulnerus *Muls.* Ia.
DELPHASTUS *Csy.*
pusillus *Lec.* C. I.
BRACHYACANTHA *Chev.*
ursina *Fabr.* Ia.
10-pustulata *Melsh.* Ia.
4-punctata *Melsh.* I. A.
HYPERASPIS *Chev.*
proba *Say.* I. B. El.
binotata *Say.* I. B. El.
pratensis *Lec.* I.
lugubris *Rand.* I. El.
undulata *Say.* Ia.
SMILIA *Weise.*
marginata *Lec.* A.
misella *Lec.* I.
STETHORUS *Weise.*
punctum *Lec.* I.
SCYMNUS *Kug.*
hæmorrhous *Lec.* I.
cervicalis *Muls.* I.
iowensis *Csy.* K..
brullei *Muls.* (Horn). I.
collaris *Melsh.*
americanus *Muls.* I. Bl.
flavifrons *Melsh.* I.

ENDOMYCHIDÆ.

SYMBIOTES *Redt.*
ulkei *Cr.* C. I.
minor *Cr.* Bl.
RHANIS *Lec.*
unicolor *Zieg.* I.
PHYMAPHORA *Newm.*
pulchella *Newm.* C.

LYCOPERDINA *Lat.*
ferruginea *Lec.* Ia.
APHORISTA *Gorh.*
vittata *Fabr.* A. I.
STENOTARSUS *Perty.*
hispidus *Hbst.* El.
ENDOMYCHUS *Panz.*
biguttatus *Say.* Ia.

EROTYLIDÆ.

LANGURIA *Lat.*
bicolor *Fabr.* A.
mozardi *Lat.* Ia.
trifasciata *Say.* A. I. P.
gracilis *Newm.* I. A. Dm.
PLŒOSOMA *Woll.*
punctata *Lec.* I.
MEGALODACNE *Cr.*
fasciata *Fabr.* A. I.
heros *Say.* Ia. In doubt, Osborn List.
ISCHYRUS *Lac.*
4-punctatus *Oliv.* A. I. W. P.
MYCOTRETUS *Lac.*
sanguinipennis *Say.* I. Foster.
pulchra *Say.* Bluffton.
TRITOMA *Fabr.*
biguttata *Say.* I.
humeralis *Fabr.* I.
v. ruficeps *Lec.* I. C. B.
erythrocephala *Lac.* A.
angulata *Say.* I. Bl.
unicolor *Say.* I.
thoracica *Say.* Ia.
flavicollis *Lec.* Ia.

COLYDIIDÆ.

SYNCHITA *Hellw.*
fuliginosa *Melsh.* I.
DITOMA *Ill.*
quadriguttata *Say.* I.
COLYDIUM *Fabr.*
lineola *Say.* I.
BOTHRIDERES *Er.*
geminatus *Say.* I.
CERYLON *Lat.*
castaneum *Say.* Ia.
sticticum *Csy.* I.
clypeale *Csy.* I.
PHILOTHERMUS *Aubé.*
glabriculus *Lec.* I.
MURMIDIUS *Leach.*
ovalis *Beck.* I.

RHYSSODIDÆ.

RHYSSODES *Dalm.*
exaratus *Ill.* I.

CUCUJIDÆ.

SILVANUS *Lat.*
surinamensis *Linn.* Ia.
bidentatus *Fabr.* Ia.
planatus *Germ.* Ia.
imbellis *Lec.* I. P.
advena *Waltl.* I.
CATOGENUS *Westw.*
rufus *Fabr.* Ia.
PEDIACUS *Shuck.*
depressus *Hbst.* I.
CUCUJUS *Fabr.*
clavipes *Fabr.* Ia.
LÆMOPHLŒUS *Lap.*
biguttatus *Say.* A. I. Bl.
fasciatus *Melsh.* A. I.
convexulus *Lec.* I.
adustus *Lec.* I.
testaceus *Fabr.* I. W.
BRONTES *Fabr.*
dubius *Fabr.* I. A.
TELEPHANUS *Er.*
velox *Hald.* Ia.

CRYPTOPHAGIDÆ.

TELMATOPHILUS *Heer.*
americanus *Lec.* C.
LOBERUS *Lec.*
impressus *Lec.* I.
TOMARUS *Lec.*
pulchellus *Lec.* I.
ANTHEROPHAGUS *Lat.*
ochraceus *Melsh.* I. B.

CROSIMUS *Csy.*
hirtus *Csy.* I.
CRYPTOPHAGUS *Hbst.*
cellaris *Scop.* I.
croceus *Zimm.* I.
laticlavus *Csy.* I.
fungicola *Zimm.* I.
CÆNOSCELIS *Thoms.*
testacea *Zimm.* I.
AGATHENGIS *Gozis.*
pumilio *Csy.*
ATOMARIA *Steph.*
ephippiata *Zimm.* Ia.
divisa *Csy.* B.
curtula v. pumilio *Csy.*
crypta *Csy.*
ovalis *Csy.*

MYCETOPHAGIDÆ.

MYCETOPHAGUS *Hellw.*
punctatus *Say.* Ia.
flexuosus *Say.* Ia.
pluripunctatus *Lec.* I. Bl.
bipustulatus *Melsh.* I.
TYPHŒA *Curt.*
fumata *Linn.* Ia.
LITARGUS *Er.*
tetraspilotus *Lec.* I.
sexpunctatus *Say.* I. B.
didesmus *Say.* I.

DERMESTIDÆ.

BYTURUS *Lat.*
unicolor *Say.* I.
DERMESTES *Linn.*
marmoratus *Say.* A.
caninus v. nubipennis *Csy.* Ia.
fasciatus *Lec.* I. El.
vulpinus *Fabr.* A.
frischii *Kug.* K. I.
elongatus *Lec.* El.
lardarius *Linn.* Ia.
ATTAGENUS *Lat.*
piceus *Oliv.* Ia.
extricatus *Csy.* I. B.
cylindricornis *Say.* K. I. B.
bicolor *G. & H.* K.
schaefferi *Hbst.* B.
TROGODERMA *Lat.*
ornata *Say.* I. K.
tarsale *Melsh.* I.
ANTHRENUS *Geoff.*
scrophulariæ *Linn.* Ia.
verbasci *Linn.* Ia.
v. destructor *Melsh.* K. B.
ORPHILUS *Er.*
ater *Er.* I. B.

HISTERIDÆ.

HOLOLEPTA *Payk.*
fossularis *Say.* A. I. P.
HISTER *Linn.*
subopacus *Lec.* W.
biplagiatus *Lec.* I.
harrisii *Kby.* I.
felipæ *Lew.* El. I.
merdarius *Hoffm.* I. El.
immunis *Er.* I. El.
cognatus *Lec.* I. El.
fœdatus *Lec.* I.
abbreviatus *Fabr.* Ia.
depurator *Say.* I.
furtivus *Lec.* I. Bl.
incertus *Mars.* A.
bimaculatus *Linn.* I. A.
sedecimstriatus *Say.* A. I. Bl.
americanus *Payk.* B. El. I. P.
perplexus *Lec.* I.
exaratus *Lec.* A. I. Bl.
subrotundus *Say.* Ia.
carolinus *Payk.* Ia.
lecontei *Mars.* Ia.
TRIBALUS *Er.*
americanus *Lec.* I.

EPIERUS *Er.*
pulicarius *Er.* I.
HETÆRIUS *Er.*
brunnipennis *Rand.* I.
DENDROPHILUS *Leach.*
punctulatus *Say.* I. P.
PAROMALUS *Er.*
æqualis *Say.* I.
estriatus *Lec.* I.
bistriatus *Er.* A. I. El.
SAPRINUS *Er.*
rotundatus *Kug.* A.
pennsylvanicus *Payk.* Ia.
assimilis *Payk.* Ia.
conformis *Lec.* A. I.
sphæroides *Lec.* I.
mancus *Say.* El. W.
fraternus *Say.* C. E. L. W.
fitchii *Mars.* I. El.
patruelis *Lec.* W.
BACANIUS *Lec.*
punctiformis *Lec.* C.
ACRITUS *Lec.*
exiguus *Er.* I.
ÆLETES *Horn.*
politus *Lec.* I.

NITIDULIDÆ.

BRACHYPTERUS *Er.*
urticæ *Fabr.* I.
CERCUS *Lat.*
abdominalis *Er.* I.
CARPOPHILUS *Steph.*
brachypterus *Say.* Ia.
hemipterus *Linn.* B.
COLASTUS *Er.*
semitectus *Say.* I.
unicolor *Say.* I.
truncatus *Rand.* I.
CONOTELUS *Er.*
obscurus *Er.* Ia.
EPURÆA *Er.*
helvola *Er.* A. I.
rufa *Say.* I.
erichsonii *Reitt.* I.
ovata *Horn.* I.
labilis *Er.* I.
NITIDULA *Linn.*
bipustulata *Linn.* Ia.
rufipes *Linn.* Ia.
ziczac *Say.* Ia.
STELIDOTA *Er.*
geminata *Say.* I.
octomaculata *Say.* I.
PROMETOPIA *Er.*
sexmaculata *Say.* I.
PHENOLIA *Er.*
grossa *Fabr.* Ia.
OMOSITA *Er.*
colon *Linn.* Ia.
AMPHICROSSUS *Er.*
ciliatus *Oliv.* I.
CYCHRAMUS *Kug.*
adustus *Er.* I.
CYBOCEPHALUS *Er.*
nigritulus *Lec.* El.
CRYPTARCHA *Shuck.*
ampla *Er.* Ia.
concinna *Melsh.* I.
IPS *Fabr.*
sanguinolentus *Oliv.* I.
fasciatus *Oliv.* Ia.

LATHRIDIIDÆ.

LATHRIDIUS *Hbst.*
liratus *Lec.* I.
CONINOMUS *Thoms.*
constrictus *Gyll.*
ENICMUS *Thoms.*
minutus *Linn.* I.
CARTODERE *Thoms.*
costulata *Reitt.* I.
CORTICARIA *Marsh.*
pubescens *Gyll.* I.
elongata *Gyll.* I.
ferruginea *Marsh.* I.
serrata *Payk.* I.

Melanophthalma *Mots.*
picta *Lec.* Ia.
villosa *Zimm.* I.
distinguenda *Com.* Ia.
pumila *Lec.* I.
gibbosa *Hbst.* I.
longipennis *Lec.* I.
americana *Mann.* I.
cavicollis *Mann.*

TROGOSITIDÆ.

Alindria *Er.*
cylindrica *Serv.* I.
Tenebrioides *Pall.*
mauritanica *Linn.* I. A.
corticalis *Melsh.* I. El.
dubia *Melsh.* I.
marginata *Beauv.* I.
castanea *Melsh.* I. A.
Grynocharis *Thoms.*
quadrilineata *Melsh.* A. El.
Thymalus *Duft.*
fulgidus *Er.* I.
Monotoma *Hbst.*
fulvipes *Melsh.* I.
Bactridium *Lec.*
ephippigerum *Guér.* I.

DERODONTIDÆ.

Derodontus *Lec.*
maculatus *Melsh.* I.

BYRRHIDÆ.

Cytilus *Er.*
sericeus *Forst.* I.
Byrrhus *Linn.*
murinus *Fabr.* I.
americanus *Lec.* Sp.
Limnichus *Lat.*
punctatus *Lec.* I.

PARNIDÆ.

Dryops *Oliv.*
lithophilus *Germ.* I.
fastigiatus *Say.* I.
striatus *Lec.* I.
Elmis *Lat.*
vittatus *Melsh.* I.
4-notatus *Say.* I.
Stenelmis *Dup.*
crenatus *Say.* I.
vittipennis *Zimm.* I. B.
Macronychus *Müll.*
glabratus *Say.* I.

HETEROCERIDÆ.

Heterocerus *Fabr.*
pallidus *Say.* Mv.
undatus *Melsh.* I. C.
v. substriatus *Kies.* I.
brunneus *Melsh.* Mv.
collaris *Kies.* I.
tristis *Mann.* O.
auromicans *Kies.* A. C. Hp.

DASCYLLIDÆ.

Ptilodactyla *Lat.*
serricollis *Say.* I. A.
Eucinetus *Germ.*
terminalis *Lec.* I. El. W.
strigosus *Lec.* I.
Prionocyphon *Redt.*
discoideus *Say.* A.
Helodes *Lat.*
fuscipennis *Guér.* I. B. Waverly
Scirtes *Ill.*
tibialis *Guér.* A. I.

CYPHON *Payk.*
ruficollis *Say.* I.
obscurus *Guér.* I.
variabilis *Thunb.* A. I.

RHIPICERIDÆ.

SANDALUS *Knoch.*
niger *Knoch.* A.

ELATERIDÆ.

THAROPS *Lap.*
ruficornis *Say.* A. I.
STETHON *Lec.*
pectorosus *Lec.* Wapello.
DELTOMETOPUS *Beauv.*
amœnicornis *Say.* I. W.
DROMÆOLUS *Kies.*
cylindricollis *Say.* I.
striatus *Lec.* I.
FORNAX *Lap.*
badius *Melsh.* I.
calceatus *Say.* I.
hornii *Bonv.* I.
orchesides *Newm.* I.
MICRORHAGUS *Esch.*
triangularis *Say.* I.
NEMATODES *Lat.*
penetrans *Lec.* I.
ANELASTES *Kby.*
drurii *Kby.* Oskaloosa.
ADELOCERA *Lat.*
impressicollis *Say.* I.
discoidea *Web.* A. I.
aurorata *Say.* A.
LACON *Lap.*
rectangularis *Say.* I. S.
ALAUS Esch.
oculatus *Linn.* Ia.
CARDIOPHORUS *Esch.*
cardisce *Say.* I. P.
ESTHESOPUS *Esch.*
claricollis *Say.* I.
CRYPTOHYPNUS *Esch.*
choris *Say.* I.
exiguus *Rand.* I. A.
æstivus *Horn.* I.
obliquatulus *Melsh.* I. Bl.
pectoralis *Say.* I.
ŒDOSTETHUS *Lec.*
femoralis *Lec.* I.
MONOCREPIDIUS *Esch.*
lividus *DeG.* P.
vespertinus *Fabr.* Ia.
auritus *Hbst.* Ia.
bellus *Say.* A.
ELATER *Linn.*
manipularis *Cand.* I.
pedalis *Germ.* I.
v. deletus *Lec.* B.
nigricollis *Hbst.* A. I. Bl.
linteus *Say.* A. I.
rubricollis *Hbst.* I.
semicinctus *Rand.* A.
luctuosus *Lec.* I.
rubricus *Say.* I.
sanguinipennis *Say.* I. Bl.
apicatus *Say.* El.
obliquus *Say.* Fx. I. B.
DRASTERIUS *Esch.*
elegans *Fabr.* Ia.
amabilis *Lec.* I.
LUDIUS *Lat.*
attenuatus *Say.* A. I. W.
abruptus *Say.* I.
AGRIOTES *Esch.*
mancus *Say.* I. Fd.
fucosus *Lec.* El.
pubescens *Melsh.* I. El. Bl.
oblongicollis *Melsh.* Fx. I.
DOLOPIUS *Esch.*
lateralis *Esch.* Ia.
GLYPHONYX *Cand.*
testaceus *Melsh.* A. P.
recticollis *Say.* Bl.
MELANOTUS *Esch.*
depressus *Melsh.* A.

fissilis *Say*. Ia.
communis *Gyll*. Ia.
parumpunctatus *Melsh*. A. El.
cribulosus *Lec*. B. I.
pertinax *Say*. A. Fx.
americanus *Hbst*. I.
opacicollis *Lec*. I.
paradoxus *Melsh*. El.

LIMONIUS *Esch*.
auripilis *Say*. A. I. Sp.
griseus *Beauv*. A. Fx. I. Bl.
interstitialis *Melsh*. I.
confusus *Lec*. Bl.
quercinus *Say*. El.
basillaris *Say*. I. A. El.
nimbatus *Say*. I.

ATHOUS *Esch*.
brightwelli *Kby*. I.
acanthus *Say*. Fx. I. W.
cucullatus *Say*. I.

CORYMBITES *Lat*.
sjælandicus *Müll*. I. Bl.
cylindriformis *Hbst*. I.
spinosus *Lec*. A.
hieroglyphicus *Say*. A. I. El.
inflatus *Say*. I. El. Bl.
rotundicollis *Say*. A. I. El.

OXYGONUS *Lec*.
obesus *Say*. I. El.

HEMICREPIDIUS *Germ*.
decoloratus *Say*. I. El. Bl.
memnonius *Hbst*. Ia.
bilobatus *Say*. I.

MELANACTES *Lec*.
piceus *DeG*. A. I.

PEROTHOPS *Er*.
mucida *Gyll*. A.

THROSCIDÆ.

DRAPETES *Redt*.
geminatus *Say*. I.

THROSCUS *Lat*.
validus *Lec*. I.
punctatus *Bonv*. I.
chevrolati *Bonv*. I.

BUPRESTIDÆ.

DICERCA *Esch*.
prolongata *Lec*. I.
divaricata *Say*. A. I.
obscura *Fabr*. A. I. B. Bl.
lurida *Fabr*. A. I.
asperata *Lap. & Gory*. I.

CINYRA *Lap. & Gory*.
gracilipes *Melsh*. I.

PŒCILONOTA *Esch*.
cyanipes *Say*. El.

BUPRESTIS *Linn*.
confluens *Say*. A.

MELANOPHILA *Esch*.
acuminata *DeG*. B. Forest City. El.

ANTHAXIA *Esch*.
viridifrons *Lap*. Fx. I.
viridicornis *Say*. I.
cyanella *Gory*. A. El.

CHRYSOBOTHRIS *Esch*.
femorata *Fabr*. Fx. A. I. C. El.
dentipes *Germ*. A. I.
sexsignata *Say*. A. I.

ACMÆODERA *Esch*.
pulchella *Hbst*. Ia.
tubulus *Fabr*. I.

AGRILUS *Steph*.
ruficollis *Fabr*. Fx. I. El.
otiosus *Say*. A. I. El.
arcuatus *Say*. I. Fx.
bilineatus *Web*. I. Fx. El.
acutipennis *Mann*. El.
anxius *Gory*. I.
politus *Say*. Fx. I. Ep.
fallax *Say*. I. El. W.
obsoleteguttatus *Gory*. I. Fx. El.
pusillus *Say*. I.

TAPHROCERUS *Sol*.
gracilis *Say*. A. I. Bl.

BRACHYS *Sol*.
ovata *Web*. A. I. El.
ærosa *Melsh*. Fx.

PACHYSCELUS *Sol*.
purpureus *Say*. I. W.

LAMPYRIDÆ.

LYCOSTOMUS *Mots.*
lateralis *Melsh.* I.
CALOPTERON *Guér.*
terminale *Say.* A. I. P. El.
reticulatum *Fabr.* A. I.
v. affine *Lec.* I. C. Decorah.
LOPHEROS *Lec.*
fraternus *Rand.* El.
EROS *Newm.*
thoracicus *Rand.* I.
aurora *Hbst.* I. A.
PLATEROS *Bourg.*
canaliculatus *Say.* I.
modestus *Say.* I.
floralis *Melsh.* Bl.
LUCIDOTA *Lap.*
atra *Fabr.* Ia.
ELLYCHNIA *Lec.*
corrusca *Linn.* Ia.
PYROPYGA *Mots.*
nigricans *Say.* I.
PYRACTOMENA *Lec.*
angulata *Say.* A. I. El.
lucifera *Melsh.* O.
PHOTINUS *Lap.*
pyralis *Linn.* A. I. C. El.
punctulatus *Lec.* I. El.
marginellus *Lec.* Dm.
scintillans *Say.* A. I.
PHOTURIS *Lec.*
pennsylvanica *DeG.* Ia.
PHENGODES *Ill.*
plumosa *Oliv.* . Manchester.

CHAULIOGNATHUS *Hentz.*
pennsylvanicus *DeG.* Ia.
marginatus *Fabr.* Ep. P.
PODABRUS *Westw.*
rugulosus *Lec.* A. Fx. I. B.
basillaris *Say.* A. I. Ep.
diadema *Fabr.* I.
modestus *Say.* A. Fx. I. El.
tomentosus *Say.* Ia.
brunnicollis *Lec.* A.
puncticollis *Kby.*
lævicollis *Kby.* I.
SILIS *Lat.*
percomis *Say.* A. I.
TELEPHORUS *Schäff.*
dentiger *Lec.* A. I.
excavatus *Lec.* B.
carolinus *Fabr.* Ia.
lineola *Fabr.* Ia.
rectus *Melsh.* A. I.
flavipes *Lec.* I. El.
scitulus *Say.* I.
luteicollis *Germ.* A. I.
rotundicollis *Say.* I.
curtisii *Kby.* A.
tuberculatus *Lec.* I.
bilineatus *Say.* Ia.
DITEMNUS *Lec.*
bidentatus *Say.* I.
TRYPHERUS *Lec.*
latipennis *Germ.* A. I. Fx.
MALTHODES *Kies.*
exilis *Melsh.* I.

MALACHIDÆ.

COLLOPS *Er.*
punctatus *Lec.* L.
quadrimaculatus *Fabr.* Ia.
vittatus *Say.* Sp. El.
ANTHOCOMUS *Er.*
erichsoni *Lec.* I.

PSEUDEBÆUS *Horn.*
apicalis *Say.* I. W.
ATTALUS *Er.*
scincetus *Say.* I. B. El.
otiosus *Say.* I.

CLERIDÆ.

CYMATODERA *Gray.*
brunnea *Melsh.* I.
bicolor *Say.* I.

inornata *Say.* I.
undulata *Say.* I.

TRICHODES *Hbst.*
nuttalli *Kby.* Ia.
CLERUS *Geoff.*
quadriguttatus *Oliv.* Ia.
v. nigripes *Say.* I.
rosmarus *Say.* I. A.
thoracicus *Oliv.* I. Bl.
THANEROCLERUS *Spin.*
sanguineus *Say.* A. I. Elkader. Bl.
HYDNOCERA *Newm.*
humeralis *Say.* A. El. I.
v. difficilis *Lec.* El.
pallipennis *Say.* A. I.
verticalis *Say.* I. Bl.
tabida *Lec.* I. A.
PHYLLOBÆNUS *Spin.*
dislocatus *Say.* A. I.
CHARIESSA *Perty.*
pilosa *Forst.* I. Le Claire. El.
ORTHOPLEURA *Spin.*
damicornis *Fabr.* I. Bl.
NECROBIA *Lat.*
rufipes *Fabr.* I.
ruficollis *Fabr.* I. Bl.
violaceus *Linn.* I. El.

PTINIDÆ.

PTINUS *Linn.*
brunneus *Duft.* I. Bl.
fur *Linn.* I. A. Bl.
bicinctus *Sturm.* I.
villiger *Reitt.* I.
EUCRADA *Lec.*
humeralis *Melsh.* I.
OLIGOMERUS *Redt.*
sericans *Melsh.* Fx.
SITODREPA *Thoms.*
panicea *Linn.* Ia.
TRICHODESMA *Lec.*
gibbosa *Say.* I. Bl.
HADROBREGMUS *Thoms.*
carinatus *Say.* Ia.
linearis *Lec.* Fx.
TRYPOPITYS *Redt.*
sericeus *Say.* I. Bl.
EUPACTUS *Lec.*
nitidus *Lec.* I.
LASIODERMA *Steph.*
serricorne *Fabr.* I.
CATORAMA *Guér.*
confusum *Fall.*
PROTHECA *Lec.*
puberula *Lec.* I.
DORCATOMA *Hbst.*
dresdensis *Hbst.* I.
CÆNOCARA *Thoms.*
oculata *Say.* I. Bl. W.
PTILINUS *Geoff.*
ruficornis *Say.* I. Bl.

BOSTRYCHIDÆ.

ENDECATOMUS *Mellié.*
rugosus *Rand.* Bl.
BOSTRYCHUS *Geoff.*
bicornis *Web.* I. C.
armiger *Lec.* I.
AMPHICERUS *Lec.*
bicaudatus *Say.* I. A. Bl.
gracilis *Csy.* I.
XYLOPERTHA *Guér.*
bidentata *Horn.* Bl.
XYLOBIOPS *Csy.*
basillare *Say.* I. C.
DINODERUS *Steph.*
porcatus *Lec.* I. Bl.
pusillus *Fabr.* I.
punctatus *Say.* I. Bl.

LYCTIDÆ.

LYCTUS *Fabr.*
striatus *Melsh.* A. I. El.
opaculus *Lec.* I.
TROGOXYLON *Lec.*
parallelopipedum *Melsh.* I.

CUPESIDÆ.

CUPES *Fabr.*
concolor *Westw.* I. Cedar Co.

CIOIDÆ.

CIS *Lat.*
fuscipes *Mell.* Ia.
XESTOCIS *Csy.*
levettei *Csy.* I.
ENNEARTHRON *Mellié.*
thoracicorne *Ziegl.* Ia.
RHIPIDANDRUS *Lec.*
paradoxus *Beauv.* I.

SPHINDIDÆ.

SPHINDUS *Chev.*
americanus *Lec.* I. O.
trinifer *Csy.* I.

LUCANIDÆ.

LUCANUS *Linn.*
elaphus *Fabr.* Southeastern Iowa.
dama *Thunb.* Ia.
placidus *Say.* A. I. C. B.
DORCUS *MacL.*
parallelus *Say.* A. C. I.
PLATYCERUS *Geoff.*
quercus *Web.* I. Fd.
CERUCHUS *MacL.*
piceus *Web.* A. I.
PASSALUS *Fabr.*
cornutus *Fabr.* M. Morning Sun. I.

SCARABÆIDÆ.

CANTHON *Hoffm.*
lævis *Dru.* Ia.
vigilans *Lec.* Louisa Co.
viridis *Beauv.* A. El.
CHŒRIDIUM *Lep.*
histeroides *Web.* A.
COPRIS *Geoff.*
minutus *Dru.* A. I.
anaglypticus *Say.* Ia.
PHANÆUS *MacL.*
carnifex *Linn.* I. C. Clinton.
ONTHOPHAGUS *Lat.*
hecate *Panz.* Ia.
janus *Panz.* A. I.
pennsylvanicus *Har.* I. El.
ÆGIALIA *Lat.*
conferta *Horn.* B.
PLEUROPHORUS *Muls.*
cæsus *Panz.* I.
RHYSSEMUS *Muls.*
sonatus *Lec.* P.
ATÆNIUS *Har.*
gracilis *Melsh.* I. Atwood.
abditus *Hald.* I. El.
robustus *Horn.* I.
strigatus *Say.* I.
cognatus *Lec.* I. E. O. Mv. B. P. El. Bl. W.
DIALYTES *Har.*
striatulus *Say.* I.
APHODIUS *Ill.*
fossor *Linn.* I.
hamatus *Say.* El.
fimetarius *Linn.* Ia.
ruricola *Melsh.* I.
granarius *Linn.* Ia.
vittatus *Say.* Bl.
inquinatus *Hbst.* Ia.
stercorosus *Melsh.* I. B. Mv. W.
concavus *Say.* I. A. Bl. Sp. P.
bicolor *Say.* I.
femoralis *Say.* Ia.
BOLBOCERAS *Kby.*
lazarus *Oliv.* Ia.
BOLBOCEROSOMA *Schaeff.*
farctum *Fabr.* El.
v. tumefactum *Beauv.* Ia.

ODONTÆUS *Kl.*
filicornis *Say.* I.
cornigerus *Melsh.* I.
GEOTRUPES *Lat.*
splendidus *Fabr.* Ia.
semiopacus *Jek.* I. Fd.
opacus *Hald.* I. P.
CLŒOTUS *Germ.*
aphodioides *Ill.* Ft. Madison.
TROX *Fabr.*
suberosus *Fabr.* I. S. C.
punctatus *Germ.* Bl.
tuberculatus *DeG.* I. Bl.
unistriatus *Beauv.* A. I. Sp. El.
sordidus *Lec.* I. A.
foveicollis *Har.* I. B.
terrestris *Say.* I. Bl.
scaber *Linn.* A. I.
æqualis *Say.* I. Mv. Louisa Co. B.
HOPLIA *Ill.*
trifasciata *Say.* I.
v. tristis *Melsh.* I.
modesta *Hald.* A. I. C. El.
DICHELONYCHA *Kby.*
elongata *Fabr.* A. I. C. El.
subvittata *Lec.* I.
MACRODACTYLUS *Lat.*
subspinosus *Fabr.* B. El.
SERICA *MacL.*
vespertina *Gyll.* Ia.
sericea *Ill.* Ia.
DIPLOTAXIS *Kby.*
liberta *Germ.* A.
harperi *Blanch.* A.
frondicola *Say.* I. L. U.
LACHNOSTERNA *Hope.*
longitarsus *Say.* A. I.
gibbosa *Burm.* A. I.
affinis *Lec.* A.
inversa *Horn.* A. I.
micans *Knoch.* I.
fusca *Fröh.* A. I. C. El.
grandis *Smith.* A. I.
arcuata *Smith.* El.
insperata *Smith.* A.
dubia *Smith.* A.
innominata *Smith.* A.
marginalis *Lec.* I.
spreta *Horn.* I.
fraterna *Harr.* I.
v. forsteri *Burm.*
rugosa *Melsh.* I. C. Ch.
implicita *Horn.* I.
balia *Say.* A. I.
villifrons *Lec.* I.
ilicis *Knoch.* I. A. D.
crenulata *Fröh.* A. I. C. El.
quercus *Knoch.* A.
tristis *Fabr.* I.
POLYPHYLLA *Harr.*
hammondi *Lec.* I.
ANOMALA *Koeppe.*
binotata *Gyll.* A. I. C. Louisa Co. P.
minuta *Burm.* I.
STRIGODERMA *Burm.*
arboricola *Fabr.* Ia.
PELIDNOTA *MacL.*
punctata *Linn.* Ia.
COTALPA *Burm.*
lanigera *Linn.* Ia.
CYCLOCEPHALA *Latr.*
immaculata *Oliv.*
CHALEPUS *MacL.*
trachypygus *Burm.* I. T.
LIGYRUS *Burm.*
gibbosus *DeG.* Ia.
relictus *Say.* Ia.
APHONUS *Lec.*
tridentatus *Say.* I. C. El.
XYLORYCTES *Hope.*
satyrus *Fabr.* I. Franklin Co. Hp.
EUPHORIA *Burm.*
fulgida *Fabr.* A. I. Wi.
inda *Linn.* Ia.
CREMASTOCHILUS *Knoch.*
knochii *Lec.* A. I.
retractus *Lec.*
harrisii *Kby.* I.
OSMODERMA *Lep.*
eremicola *Knoch.* A. I.
scabra *Beauv.* A.
TRICHIUS *Fabr.*
piger *Fabr.* I. B.
affinis *Gory.* A. I. C. Dm. P.

SPONDYLIDÆ.

PARANDRA *Lat.*
brunnea *Fabr.* A. I. C. El.

CERAMBYCIDÆ.

ORTHOSOMA *Serv.*
brunneum *Forst.* A. I. Hp. Bl. Clinton.
PRIONUS *Geoff.*
imbricornis *Linn.* A. I.
fissicornis *Hald.* A.
ASEMUM *Esch.*
mœstum *Hald.* A.
CRIOCEPHALUS *Muls.*
productus *Lec.* A.
agrestis *Kby.* I.
australis *Lec.* A.
SMODICUM *Hald.*
cucujiforme *Say.* I.
PHYSOCNEMUM *Hald.*
brevilineum *Say.* A.
HYLOTRUPES *Serv.*
bajulus *Linn.* A.
ligneus *Fabr.* A. I.
PHYMATODES *Muls.*
amœnus *Say.* I.
dimidiatus *Kby.* A.
varius *Fabr.* A. I. B.
CALLIDIUM *Fabr.*
æreum *Newm.* B.
janthinum *Lec.* I.
CHION *Newm.*
cinctus *Dru.* A. Fx. I. C. B. Dm.
EBURIA *Serv.*
quadrigeminata *Say.* A. I. B.
ROMALEUM *White.*
atomarium *Dru.* I.
rufulum *Hald.* A. I.
ELAPHIDION *Serv.*
mucronatum *Fabr.* A.
incertum *Newm.* I.
villosum *Fabr.* A. I.
parallelum *Fabr.* A. I.
PSYRASSA *Bates.*
unicolor *Rand.* O. D. I. El.
TYLONOTUS *Hald.*
bimaculatus *Hald.* A. R.
OBRIUM *Serv.*
rufulum *Gahan.* A.
MOLORCHUS *Fabr.*
bimaculatus *Say.* I.
CALLIMOXYS *Kr.*
sanguinicollis *Oliv.* D.
RHOPALOPHORA *Serv.*
longipes *Say.* A.
PURPURICENUS *Serv.*
humeralis *Fabr.* A. I.
BATYLE *Thoms.*
suturalis *Say.* A. I. B. Clear Lake. El.
ignicollis *Say.* P.
STENOSPHENUS *Hald.*
notatus *Oliv.* A. I.
CYLLENE *Newm.*
caryæ *Gahan.* Ia.
robiniæ *Forst.* A. I. Ch.
decorus *Oliv.* A. B. I. Clear Lake. Sp. Fd. Hp.
PLAGIONOTUS *Muls.*
speciosus *Say.* A.
CALLOIDES *Lec.*
nobilis *Say.* A. D. I. C. El.
ARHOPALUS *Serv.*
fulminans *Fabr.* A. I. B. R. El.
XYLOTRECHUS *Chev.*
colonus *Fabr.* Ia.
convergens *Lec.*
undulatus *Say.* I.
NEOCLYTUS *Thoms.*
capræa *Say.* I.
erythrocephalus *Fabr.* A. I. C. B.
MICROCLYTUS *Lec.*
gazellula *Hald.* El.
CYRTOPHORUS *Lec.*
verrucosus *Oliv.* A.
EUDERCES *Lec.*
picipes *Fabr.* A. I. B. W.
DESMOCERUS *Serv.*
palliatus *Forst.* A.

TOXOTUS *Serv.*
schaumii *Lec.* I.
ACMÆOPS *Lec.*
bivittata *Say.* A. I. C.
v. nigripennis *Lec.* I.
v. varians *Lec.* I.
GAUROTES *Lec.*
cyanipennis *Say.* A. I.
STRANGALIA *Serv.*
famelica *Newm.* A. D. I. El.
luteicornis *Fabr.* A. I.
strigosa *Newm.* Bl.
TYPOCERUS *Lec.*
badius *Newm.* I.
velutinus *Oliv.* I. El.
lugubris *Say.*
sinuatus *Newm.* A. I.
LEPTURA *Serv.*
americana *Hald.*
nitens *Forst.* A. El.
instabilis v. convexa *Lec.* Bl.
rubrica *Say.* A. I. B. El.
circumdata *Oliv.* El.
proxima *Say.* I.
vittata *Germ.* Ia.
pubera *Say.* I. Bl.
ruficollis *Say.* Bl.
PSENOCERUS *Lec.*
supernotatus *Say.* A. I. B.
MONOHAMMUS *Serv.*
titillator *Fabr.* I.
DORCASCHEMA *Lec.*
alternatum *Say.* Fx. I.
nigrum *Say.* A. I.
HETŒMIS *Hald.*
cinerea *Oliv.* A.
GOES *Lec.*
pulchra *Hald.* Ames, in doubt.
debilis *Lec.* D. I.
tesselata *Hald.*
PLECTRODERA *Lec.*
scalator *Fabr.* I. S. Ep. P.
. ACANTHODERES *Serv.*
decipiens *Hald.* A. I. Sp.
LEPTOSTYLUS *Lec.*
aculiferus *Say.* I. A. C.
macula *Say.* Masonville.
LIOPUS *Serv.*
variegatus *Hald.* A. I.
fascicularis *Harr.* A. I.
alpha *Say.* A. I. B.
cinereus *Lec.* I. B. W.
DECTES *Lec.*
spinosus *Say.* A. I. S. Dm.
LEPTURGES *Bates.*
symmetricus *Hald.* B. Bl.
v. angulatus *Lec.* I.
signatus *Lec.* I.
querci *Fitch.* Fx.
facetus *Say.* I.
HYPERPLATYS *Bates.*
aspersus *Say.* Fx. I.
maculatus *Hald.* D. I.
UROGRAPHIS *Horn.*
fasciatus *DeG.* A. I. B. T. El. Clinton.
ACANTHOCINUS *Steph.*
obsoletus *Oliv.* I.
POGONOCHERUS *Lat.*
mixtus *Hald.* B.
ECYRUS *Lec.*
dasycerus *Say.* I.
EUPOGONIUS *Lec.*
tomentosus *Hald.* A.
vestitus *Say.* I.
subarmatus *Lec.* I.
HIPPOPSIS *Serv.*
lemniscata *Fabr.* I.
SAPERDA *Fabr.*
calcarata *Say.* A. I.
candida *Fabr.* A. I.
cretata *Newm.* I. Charles City, Manchester.
vestita *Say.* A. I. Masonville.
discoidea *Fabr.* A.
tridentata *Oliv.* Ia.
lateralis *Fabr.* I.
puncticollis *Say.* I.
concolor *Lec.* I. Dm.
MECAS *Lec.*
inornata *Say.* A. Fx. I.

OBEREA *Muls.*
schaumii *Lec.* I.
tripunctata *Swed.* I.
v. flavipes *Hald.*
v. mandarina *Fabr.* I.
v. basalis *Lec.* Bl. I.

TETRAOPES *Serv.*
canteriator *Drap.* I.
tetraophthalmus *Forst.* Ia.
femoratus *Lec.* A. D.
v. basalis *Lec.* I.

AMPHIONYCHA *Lec.*
flammata *Newm.* I.

CHRYSOMELIDÆ.

DONACIA *Fabr.*
hirticollis *Kby.* I.
pubescens *Lec.* O.
cincticornis v. proxima *Kby.*
palmata *Oliv.* A.
hypoleuca v. rufescens *Lac.* Clear Lake.
piscatrix *Lac.* Jones Co.
subtilis *Kunze.* A. P.
æqualis *Say.* A. I. Bl.
distincta v. torosa *Lec.* I.
emarginata *Kby.* I. Monticello.
flavipes *Kby.* I.
rufa *Say.* I.

HÆMONIA *Lat.*
nigricornis *Kby.*

ORSODACHNA *Lat.*
atra *Ahr.* El.
v. childreni *Kby.* Bl.
v. trivittata *Lac.* I.
v. vittata *Say.* I.

SYNETA *Esch.*
ferruginea *Germ.* I.

LEMA *Fabr.*
longipennis *Linell.* I.
brunnicollis *Lac.* A. I. Bl. W.
collaris *Say.* B. I.
trilineata *Oliv.* A. I. Fd. P. E. L.

ANOMŒA *Lac.*
laticlavia *Forst.* Ia.

COSCINOPTERA *Lac.*
dominicana *Fabr.* D. Sp. I.

BABIA *Chev.*
quadriguttata *Oliv.* I. El.
v. pulla *Lec.* Monticello.

CHLAMYS *Knoch.*
plicata *Fabr.* A. I.
foveolata *Knoch.* I.

BASSAREUS *Hald.*
congestus *Fabr.* R. P.
mammifer *Newm.* I.
v. sellatus *Suffr.* I. El.
v. pretiosus *Melsh.* I.
v. luteipennis *Melsh.* I.
lituratus v. recurvus *Say.* I.

CRYPTOCEPHALUS *Geoff.*
quadrimaculatus *Say.* A. I.
quadruplex *Newm.* A. I. R.
guttulatus *Oliv.* A. I.
leucomelas *Suffr.* A. I. Ep. P.
venustus *Fabr.* A. I.
v. hamatus *Melsh.* I.
v. cinctipennis *Hald.* I.
v. simplex *Hald.* I.
gibbicollis *Hald.* Bl.
mutabilis *Melsh.* I. A. Fd. Dm.
tinctus *Lec.* A.

PACHYBRACHYS *Chev.*
litigiosus *Suffr.* I.
othonus *Say.* Fx. I. Cn.
viduatus *Fabr.* I. Ep. Sp. P.
intricatus *Suffr.* I.
tridens *Melsh.* A. Fx. I.
cælatus *Lec.* A. I.
carbonarius *Hald.* I.
luridus *Fabr.* A. El.
atomarius *Melsh.* A. I. Ep. R. Cn.
femoratus *Oliv.* E. I. Cn.
infaustus *Hald.* A.

MONACHUS *Chev.*
saponatus *Fabr.* I. W.

DIACHUS *Lec.*
auratus *Fabr.* I.
levis *Hald.* A. I.

ADOXUS *Kby.*
obscurus *Linn.* I.

FIDIA *Baly.*
viticida *Walsh.* I. S. Fd. Dm.
longipes *Melsh.* Ames, in doubt.
XANTHONIA *Baly.*
decemnotata *Say.* Ia.
villosula *Melsh.* I. El.
MYOCHROUS *Er.*
denticollis *Say.* Ep.
GLYPTOSCELIS *Lec.*
pubescens *Fabr.* D.
GRAPHOPS *Lec.*
pubescens *Melsh.* I.
curtipennis *Melsh.* A. I. P. W.
nebulosus *Lec.*
TYPOPHORUS *Er.*
canellus *Fabr.* Ia.
v. quadrinotatus *Say.* I.
v. quadriguttatus *Lec.* I. Ep.
v. sellatus *Horn.* R. Dm.
v. thoracicus *Melsh.* I.
v. gilvipes *Horn.* I. Ob.
v. aterrimus *Oliv.* I.
viridicyanea *Cr.* R.
METACHROMA *Lec.*
angustula *Cr.* E. I.
parallelum *Horn.* C. I. P.
interruptum *Say.* E.
CHRYSOCHUS *Chev.*
auratus *Fabr.* Ia.
COLASPIS *Fabr.*
brunnea *Fabr.* E. El.
v. flavida *Say.* A. I.
v. costipennis *Cr.* I. P.
RHABDOPTERUS *Lef.*
picipes *Oliv.* A. I. B. R. P.
NODONOTA *Lef.*
tristis *Oliv.* Fx. I. El.
convexa *Say.* I. C. Gravity. W.
puncticollis *Say.* Ia.
DORYPHORA *Ill.*
clivicollis *Kby.* A. Fx. I. P.
decemlineata *Say.* Ia.
CHRYSOMELA *Linn.*
exclamationis *Fabr.* A.
suturalis *Fabr.* A. I. B. O. El.
similis *Rog.* A. I. B. El. W.
præcelsis *Rog.* B. I. S. O.
elegans *Oliv.* Ia.
scalaris *Lec.* Ia.
multipunctata *Say.* I.
bigsbyana *Kby.* A. D. I.
pnirsa *Stäl.* Ames, in doubt.
auripennis *Say.* A. I.
PLAGIODERA *Redt.*
viridis *Melsh.* I.
GASTROIDEA *Hope.*
polygoni *Linn.* Ia.
dissimilis *Say.* S.
LINA *Meg.*
lapponica *Linn.* Ia.
scripta *Fabr.* Ia.
PHYLLODECTA *Kby.*
vulgatissima *Linn.* I.
TRIRHABDA *Lec.*
canadensis *Kby.* Ia.
GALERUCELLA *Cr.*
americana *Fabr.* I. B.
cavicollis *Lec.* I. W.
notulata *Fabr.* I.
notata *Fabr.* A. I.
decora *Say.* I.
nymphææ *Linn.* O. Oskaloosa.
DIABROTICA *Chev.*
longicornis *Say.* Ia.
duodecimguttata *Oliv.* Ia.
vittata *Fabr.* Ia.
atripennis *Say.*
v. fossata *Lec.* I. L.
PHYLLOBROTICA *Redt.*
decorata *Say.* A. Fx. D.
limbata *Fabr.* A. I. Fx. Bl.
PHYLLECHTHRUS *Lec.*
gentilis v. nigripennis *Lec.* Bl.
LUPERODES *Mots.*
varicornis *Lec.* Armstrong.
cyanellus *Lec.* I.
GALERUCA *Geoff.*
externa *Say.* A. I.
CEROTOMA *Chev.*
trifurcata *Forst.* I. B. U. P.
BLEPHARIDA *Rog.*
rhois *Forst.* I. Fd. H.

HYPOLAMPSIS *Clark.*
pilosa *Ill.* I.
ŒDIONYCHIS *Lat.*
gibbitarsis *Say.* A. I. S.
thoracica *Fabr.* A. D. I.
vians *Ill.* A. I.
petaurista *Fabr.* I. Bl.
thyamoides *Cr.* Fx. I.
limbalis *Melsh.* I.
sexmaculata *Ill.* A. D.
quercata *Fabr.* A.
DISONYCHA *Chev.*
pennsylvanica *Ill.* I.
v. limbicollis *Lec.* I.
quinquevittata *Say.* Ia.
crenicollis *Say.* I. Bl.
abbreviata *Melsh.* A. I.
triangularis *Say.* A. I. C. P. El.
xanthomelæna *Dalm.* Ia.
HALTICA *Geoff.*
bimarginata *Say.* Ia.
chalybea *Ill.* A. I.
ignita *Ill.* I. E. Foster. Bl.
punctipennis *Lec.* I.
fuscoænea *Melsh.* I.
ORTHALTICA *Cr.*
copalina *Fabr.* I.
CREPIDODERA *Chev.*
rufipes *Linn.*
atriventris *Melsh.* I. B.
helxines *Linn.* Ia.
EPITRIX *Foud.*
fuscula *Cr.* Hamburg.
cucumeris *Harr.* Ia.
LUPERALTICA *Cr.*
fuscula *Lec.* I.
MANTURA *Steph.*
floridana *Cr.* I. B.
CHÆTOCNEMA *Steph.*
subcylindrica *Lec.* I.
denticulata *Ill.* I. L. Bl.
elongatula *Cr.* El.
parcepunctata *Cr.* I.
confinis *Cr.* C. I. B. El.
SYSTENA *Chev.*
hudsonias *Forst.* I. El.
frontalis *Fabr.* A. I. B. Fd.
tæniata *Say.* Armstrong. I.
v. blanda *Melsh.* I.
marginalis *Ill.* A. I.
LONGITARSUS *Lat.*
turbatus *Horn.* I.
testaceus *Melsh.* I.
melanurus *Melsh.* I.
GLYPTINA *Lec.*
spuria *Lec.* I. Bl.
PHYLLOTRETA *Foud.*
armoraciæ *Koch.* B. Guttenberg
sinuata *Steph.* I. B. El.
vittata *Fabr.* Ia.
bipustulata *Fabr.* I. El.
lewisii *Cr.* I.
picta *Say.* I.
DIBOLIA *Chev.*
borealis *Chev.* I. A.
PSYLLIODES *Lat.*
punctulata *Melsh.* A. I.
MICRORHOPALA *Baly.*
vittata *Fabr.* A. Dm.
excavata *Oliv.* A. I.
porcata *Melsh.* I.
ODONTOTA *Chev.*
scapularis *Oliv.* A. I.
dorsalis *Thunb.* P.
rubra *Web.* A. Dm. I.
nervosa *Panz.* Ia.
STENISPA *Baly.*
metallica *Fabr.* A. I. P.
PHYSONOTA *Boh.*
unipunctata *Say.* A. I. Fd.
CASSIDA *Linn.*
nigripes *Oliv.* I.
bivittata *Say.* A. I. El. Bl.
COPTOCYCLA *Chev.*
aurichalcea *Fabr.* A. I. T. P.
signifera *Hbst.* A. I. T. P. El.
purpurata *Boh.* A. I.
clavata *Fabr.* A. I.
CHELYMORPHA *Chev.*
argus *Licht.* A. I. S.

BRUCHIDÆ.

SPERMOPHAGUS *Sch.*
robiniæ *Sch.* A. I. Bl.
BRUCHUS *Linn.*
pisorum *Linn.* Ia.
mimus *Say.* I. Bl.
bivulneratus *Horn.* A. E.
cruentatus *Horn.* I. P. Bl.
fraterculus *Horn.* I.
obtectus *Say.* Ia.
hibisci *Oliv.* Wi.
exiguus *Horn.* I. B. C. P.
seminulum *Horn.* Ames. in doubt.

TENEBRIONIDÆ.

ELEODES *Esch.*
suturalis *Say.* L.
tricostata *Say.* El. A. B. Lyon, Dickinson, Emmet. and Woodbury Cos.
NYCTOBATES *Guér.*
pennsylvanica *DeG.* Ia.
MERINUS *Lec.*
lævis *Oliv.* I.
HAPLANDRUS *Lec.*
femoratus *Lec.* I.
SCOTOBATES *Horn.*
calcaratus *Fabr.* I.
XYLOPINUS *Lec.*
saperdioides *Oliv.* I. W.
TENEBRIO *Linn.*
obscurus *Fabr.* Ia.
molitor *Linn.* Ia.
tenebrioides *Beauv.* Ia.
IDIOBATES *Csy.*
castaneus *Knoch.* E.
BLAPSTINUS *Lat.*
mœstus *Melsh.* A. Ob.
interruptus *Say.* I. A. El.
metallicus *Fabr.* I. B. C. W.
TRIBOLIUM *MacL.*
ferrugineum *Fabr.* I.
confusum *Duv.* I.
DIŒDUS *Lec.*
punctatus *Lec.* I.
ULOMA *Lap.*
impressa *Melsh.* A. I.
mentalis *Horn.* I.
imberbis *Lec.* I.
PARATENETUS *Spin.*
fuscus *Lec.* A. I. B.
DIAPERIS *Geoff.*
hydni *Fabr.* Ia.
ARRHENOPLITA *Kby.*
viridipennis *Fabr.* I. C. P.
bicornis *Oliv.* Ia.
PLATYDEMA *Lap.*
excavatum *Say.* A. I. El.
ruficorne *Sturm.* A. I. U. P. Bl.
americanum *Lap.* D. I.
picilabrum *Melsh.* I.
subcostatum *Lap.* I.
PHYLETHUS *Meg.*
bifasciatus *Say.* I.
BOLETOTHERUS *Cand.*
bifurcus *Fabr.* A. I.
MERACANTHA *Kby.*
contracta *Beauv.* A. I.
STRONGYLIUM *Kby.*
tenuicolle *Say.* I. B.

CISTELIDÆ.

HYMENORUS *Muls.*
pilosus *Melsh.* I.
curticollis *Csy.*
obscurus *Say.* A. I.
MYCETOCHARA *Berth.*
fraterna *Say.* I.
megalops *Csy.* I.
foveata *Lec.*
binotata *Say.* El.
ISOMIRA *Muls.*
iowensis *Csy.*
sericea *Say.* I. El.
ANDROCHIRUS *Lec.*
erythropus *Kby.* A. I.

LAGRIIDÆ.

ARTHROMACRA *Kby.*
ænea *Say.* A. I.

STATIRA *Lat.*
gagatina *Melsh.* I.

MELANDRYIDÆ.

TETRATOMA *Fabr.*
truncorum *Lec.* I.

PENTHE *Newm.*
obliquata *Fabr.* A. I. El.
pimelia *Fabr.* I.

SYNCHROA *Newm.*
punctata *Newm.* I. El.

MELANDRYA *Fabr.*
striata *Say.* I. A.

ENCHODES *Lec.*
sericea *Hald.* C. I.

PHLŒOTRYA *Steph.*
liturata *Lec.* A. I.

SYMPHORA *Lec.*
flavicollis *Hald.* I.

EUSTROPHUS *Ill.*
repandus *Horn.* I.
bicolor *Say.* A. I. P. W.
confinis *Lec.* Ames, in doubt.
tomentosus *Say.* I. Atwood.

HOLOSTROPHUS *Horn.*
bifasciatus *Say.* I.

HALLOMENUS *Panz.*
scapularis *Melsh.* I.
punctulatus *Lec.* B.

ORCHESIA *Lat.*
castanea *Melsh.* I.
gracilis *Melsh.* I.

CANIFA *Lec.*
plagiata *Melsh.* I.

NOTHUS *Oliv.*
varians *Lec.* I.

ŒDEMERIDÆ.

NACERDES *Schm.*
melanura *Linn.* I.

ASCLERA *Schm.*
puncticollis *Say.* I. A.
ruficollis *Say.* A. I.

OXACIS *Lec.*
cana *Lec.* I. A. Ep.

MORDELLIDÆ.

PENTARIA *Muls.*
trifasciata *Melsh.* I.

TOMOXIA *Costa.*
tridentata *Say.* A. I.
lineella *Lec.* I.

MORDELLA *Linn.*
scutellaris *Fabr.* I. R. El.
octopunctata *Fabr.* A. C. I.
marginata *Melsh.* A. I. B.
serval *Say.* A. I.
oculata *Say.* A. H. I. R.
discoidea *Melsh.* A. I.

MORDELLISTENA *Costa.*
trifasciata *Say.* Bl.
lepidula *Lec.* I.
limbalis *Melsh.* A. I.
vapida *Lec.* I.
ornata *Melsh.* A. I.
scapularis *Say.* I. El.
comata *Lec.* A. I.
aspersa *Melsh.* A.
ustulata *Lec.* A.
semiusta *Lec.* I.
nigricans *Melsh.* I. Cn.
splendens *Smith.* A.
unicolor *Lec.* I.
marginalis *Say.* A.
pubescens *Fabr.* I.
æmula *Lec.* D.

ANTHICIDÆ.

STEREOPALPUS *Laf.*
mellyi *Laf.* I.
CORPHYRA *Say.*
elegans *Hentz.* A. El.
fulvipes *Newm.* El.
pulchra *Lec.* I. El.
labiata *Say.* Fx. I.
lugubris *Say.* Fx. I. B.
MACRATRIA *Newm.*
murina *Fabr.* I. Gravity. R.
TOMODERUS *Laf.*
interruptus *Laf.* I.
constrictus *Say.* I.
MALPORUS *Csy.*
formicarius *Laf.* A. I. El.
cinctus *Say.* I.
properus *Csy.* K.
HEMANTUS *Csy.*
floralis *Linn.* Ia.
ANTHICUS *Payk.*
ephippium *Laf.* I.
cervinus *Laf.* A. I. O. P. El.
lutulentus *Csy.* I.
saucius *Csy.* K.
melancholicus *Laf.* I.
SAPINTUS *Csy.*
pubescens *Lec.* I.
rusticus *Csy.* K.
fulvipes *Laf.* I.
festinans *Csy.*
NOTOXUS *Geoff.*
anchora *Hentz.* Ia.
monodon *Fabr.* D. I.
talpa *Laf.* P.
MECYNOTARSUS *Laf.*
candidus *Lec.*
EMELINUS *Csy.*
melsheimeri *Lec.* McGregor.
ZONANTES *Csy.*
tricuspis *Csy.* I.

PYROCHROIDÆ.

PYROCHROA *Geoff.*
flabellata *Fabr.* A. I. C. Bl.
femoralis *Lec.* I. Bl.
DENDROIDES *Lat.*
canadensis *Lat.* I. Bl.

MELOIDÆ.

MELOE *Linn.*
angusticollis *Say.* I. Fd.
americanus *Leach.* A. I.
HENOUS *Hald.*
confertus *Say.* A.
NEMOGNATHA *Ill.*
vittigera *Lec.* A. I.
cribricollis *Lec.* I.
ZONITIS *Fabr.*
bilineata *Say.*
MACROBASIS *Lec.*
unicolor *Kby.* Ia.
EPICAUTA *Redt.*
trichrus *Pall.* Ia.
sericans *Lec.* El.
maculata *Say.* Sp.
vittata *Fabr.* Ia.
cinerea *Forst.* Ia.
pennsylvanica *DeG.* Ia.
PYROTA *Lec.*
terminata *Lec.* H. I.
CANTHARIS *Linn.*
nuttalli *Say.* Fd.

RHIPIPHORIDÆ.

RHIPIPHORUS *Fabr.*
flavipennis *Lec.* I.
dimidiatus *Fabr.* I.
limbatus *Fabr.* A. I. Cn.
MYODITES *Lat.*
fasciatus *Say.* I.
v. stylopides *Newm.* I.

RHYNCHITIDÆ.

EUGNAMPTUS *Sch.*
angustatus *Hbst.* Fx. I.
collaris *Fabr.* I.
RHYNCHITES *Hbst.*
bicolor *Fabr.* Ia.
æneus *Boh.* A. I. P.
PTEROCOLUS *Sch.*
ovatus *Fabr.* I. El.

ATTELABIDÆ.

ATTELABUS *Linn.*
nigripes *Lec.* I.
rhois *Boh.* I.

OTIORHYNCHIDÆ.

EPICÆRUS *Sch.*
imbricatus *Say.* A. I. El.
HORMORUS *Horn.*
undulatus *Uhler.*
ANAMETIS *Horn.*
grisea *Horn.* I. El. P.
NOCHELES *Horn.*
æqualis *Horn.* A. I.
PHYXELIS *Sch.*
rigidus *Say.* I. El.
OTIORHYNCHUS *Germ.*
ovatus *Linn.* I. B.
CERCOPEUS *Sch.*
chrysorhœus *Say.* I.
TANYMECUS *Sch.*
confertus *Gyll.* Ia.
PANDELETEJUS *Sch.*
hilaris *Hbst.* I.
ARAMIGUS *Horn.*
fulleri *Horn.* I.
APHRASTUS *Sch.*
tæniatus *Gyll.* I.

CURCULIONIDÆ.

SITONES *Sch.*
flavescens *Marsh.* A. I. W.
tibialis *Hbst.* A. I.
ITHYCERUS *Sch.*
noveboracensis *Forst.* A. I.
APION *Hbst.*
erraticum *Smith.* I.
impunctistriatum *Smith.* I.
melanarium *Gerst.* B. I.
floridanum *Smith.*
robustum *Smith.* Fx. I.
pennsylvanicum *Boh.* I.
walshii *Smith.* I.
minor *Smith.* I.
griseum *Smith.* I. B.
rostrum *Say.* A.
nigrum *Hbst.* A.
decoloratum *Smith.* I.
PHYTONOMUS *Sch.*
comptus *Say.* A. I. El.
eximius *Lec.* I.
LISTRONOTUS *Jek.*
sordidus *Gyll.* A.
tuberosus *Lec.* I.
callosus *Lec.* A. El.
inæqualipennis *Boh.* Bl.
caudatus *Say.* A. I. Hp.
appendiculatus *Boh.* I.
nebulosus *Lec.* A. Fx.
frontalis *Lec.* A.
latiusculus *Boh.* A. I. Bl.
HYPERODES *Jek.*
soluta *Boh.* I.
indistincta *Dietz.* Fx. I.
delumbis *Gyll.* I. A.
sparsa *Say.* A. I.
vitticollis *Kby.* I.
humilis *Gyll.* A. C.
porcella *Say.* I.
LIXUS *Fabr.*
marginatus *Say.*

musculus *Say*. A. I.
concavus *Say*. A. I. Fd.
mucidus *Lec*. A. I.
macer *Lec*. A. I.
terminalis *Lec*. A. Fx. I. P. El. Bl.

STEPHANOCLEONUS *Mots.*

plumbeus *Lec*.

DORYTOMUS *Steph.*

mucidus *Say*. D. I.
laticollis *Lec*. A. I.
indifferens *Csy*.
fusciceps *Csy*.

GRYPIDIUS *Sch.*

equiseti *Fabr*. I.

NOTARIS *Germ.*

puncticollis *Lec*. Sp.

SMICRONYX *Sch.*

constrictus *Say*.
discoideus *Lec*. A. I.
amœnus *Say*. A. I.
ovipennis *Lec*. I.
sculpticollis *Csy*.
fiducialis *Csy*.
perfidus *Dietz*.

PHYLLOTROX *Sch.*

ferrugineus *Lec*. I.

ONYCHYLIS *Lec.*

nigrirostris *Boh*. I.

ENDALUS *Lap.*

limatulus *Gyll*. A. I.

TANYSPHYRUS *Sch.*

lemnæ *Fabr*. I.

ANCHODEMUS *Lec.*

angustus *Lec*. I.

LISSORHOPTRUS *Lec.*

simplex *Say*. Fx.

BAGOUS *Germ.*

obliquus *Lec*. I.
restrictus *Lec*. I.
bituberosus *Lec*. I.

OTIDOCEPHALUS *Chev.*

myrmex *Hbst*. I.
chevrolatii *Horn*. I. Fx.

OOPTERINUS *Csy.*

perforatus *Horn*. I.

MAGDALIS *Germ.*

perforata *Horn*. A.
olyra *Hbst*. A. I.
pandura *Say*. A. I.
armicollis *Say*. A. I.
pallida *Say*. A. I.

TACHYPTERUS *Dietz.*

quadrigibbus *Say*. A. I.

ANTHONOMUS *Germ.*

scutellatus *Lec*. A. I.
profundus *Lec*. Fx. I.
bolteri *Dietz*. I.
sycophanta *Walsh*. I.
suturalis *Lec*. A. I.
flavicornis *Boh*. Fx.
corvulus *Lec*. I.
subguttatus *Dietz*.
musculus *Say*. Fx. I.
scutellatus *Gyll*. A. I.
squamosus *Lec*. A.
rufipes *Lec*.
nubilus *Lec*. I.
decipiens *Lec*. A. I.

ANTHONOMOPSIS *Dietz.*

mixtus *Lec*. I.

PSEUDANTHONOMUS *Dietz.*

cratægi *Walsh*. Fx. I. El.
facetus *Dietz*.

ELLESCHUS *Steph.*

ephippiatus *Say*. I. P.

ORCHESTES *Ill.*

ephippiatus *Say*. I. P.
pallicornis *Say*. I. P. El.

PIAZORHINUS *Sch.*

scutellaris *Say*. I.

THYSANOCNEMIS *Lec.*

fraxini *Lec*. I.

TYCHIUS *Sch.*

sordidus *Lec*.

GYMNETRON *Sch.*

teter *Fabr*. A. Fx. I.

CONOTRACHELUS *Sch.*

nenuphar *Hbst*. Ia.
seniculus *Lec*. El. I.
nivosus *Lec*. A.

cratægi *Walsh.* A. Fx. I.
posticatus *Boh.* I.
geminatus *Lec.* I.
anaglypticus *Say.* I. A.

RHYSSOMATUS *Chev.*

lineaticollis *Say.* A. I. Fx. C. El. P.
æqualis *Horn.* I.

EURHOPTUS *Lec.*

pyriformis *Lec.* I.

TYLODERMA *Say.*

foveolatum *Say.* A. I. El.
fragariæ *Riley.* I.
æreum *Say.* A. I. El.

CRYPTORHYNCHUS *Ill.*

parochus *Hbst.* A.
bisignatus *Say.* A. I.
obliquus *Say.* I.
tristis *Lec.* I.

LECHRIOPS *Sch.*

oculatus *Say.* I.

CYLINDROCOPTURUS *Heller.*

quercus *Say.* Fx. I.

ACOPTUS *Lec.*

suturalis *Lec.* El.

MONONYCHUS *Germ.*

vulpeculus *Fabr.* I.

AULEUTES *Dietz.*

asper *Lec.*

CEUTHORHYNCHUS *Germ.*

rapæ *Gyll.* I. B. El.
sericans *Lec.*
sulcipennis *Lec.* A.
cyanipennis *Germ.* I. B. El.
squamatus *Lec.*

CEUTHORHYNCHIDIUS *Duv.*

puberulus *Lec.* I.
zimmermanni *Gyll.* I.

PERIGASTER *Dietz.*

cretura *Hbst.* A. I.

PELENOMUS *Thoms.*

sulcicollis *Fabr.*
squamosus *Lec.* I.

MECOPELTUS *Dietz.*

fuliginosus *Dietz.* C.

RHINONCUS *Sch.*

occidentalis *Dietz.* A. I.
pyrrhopus *Lec.* I. P.

BARIS *Germ.*

striata *Say.* Dm. I. Bl.
umbilicata *Lec.* I.
transversa *Say.* A. I.
dolosa *Csy.*
deformis *Csy.* I.
confinis *Lec.* I.

ONYCHOBARIS *Lec.*

pectorosa *Lec.* A. I.

MADARELLUS *Csy.*

undulatus *Say.* A. I.

AULOBARIS *Lec.*

ibis *Lec.* A. I.

PSEUDOBARIS *Lec.*

farcta *Lec.* I.
angusta *Lec.*
nigrina *Say.* Fx. I.

TRICHOBARIS *Lec.*

trinotata *Say.* A. I.

GERÆUS *Pasc.*

lævirostris *Lec.* B.
picumnus *Hbst.* I.
perscitus *Hbst.* I.
penicellus *Hbst.* A.
falsus *Lec.*

ODONTOCORYNUS *Sch.*

scutellumalbum *Say.* A. I.

NICENTRUS *Csy.*

ingenuus *Csy.* I.

LIMNOBARIS *Bedel.*

deplanata *Csy.* K. I.
confinis *Lec.*
rectirostris *Lec.* I.
prolixa *Lec.* I. P.

IDIOSTETHUS *Csy.*

tubulatus *Say.*
ellipsoideus *Csy.*

OOMORPHIDIUS *Csy.*

erasus *Lec.* H.

CATAPASTUS *Csy.*

conspersus *Lec.*

BARINUS *Csy.*

squamolineatus *Csy.* B.

BARILEPTON *Lec.*

cribricolle *Lec.* A.

lineare *Lec.* I.

PLOCAMUS *Lec.*

echidna *Lec.*

BALANINUS *Germ.*

nasicus *Say.* A. I. El.

baculi *Chitt.* O.

rectus *Say.* A. I. El.

BRENTHIDÆ.

EUPSALIS *Lec.*

minuta *Dru.* A. I. C. El.

CALANDRIDÆ.

RHODOBÆNUS *Lec.*

tredecimpunctatus *Ill.* Ia.

SPHENOPHORUS *Sch.*

ochreus *Lec.* A. I. P.

pertinax *Oliv.* A. I. El.

costipennis *Horn.* I.

striatipennis *Chitt.* Sp.

zeæ *Walsh.* A. I.

soltaui *Chitt.* I.

scoparius *Horn.* A.

melanocephalus *Fabr.* El. D. I.

sayi *Gyll.* A.

setiger *Chitt.*

placidus *Say.* A. I.

parvulus *Gyll.* A. I. P. Ob.

retusus *Gyll.* A.

CALANDRA *Clairv.*

oryzæ *Linn.* A. I.

granaria *Linn.* A. I.

DRYOPHTHORUS *Sch.*

corticalis *Say.* I.

COSSONUS *Clairv.*

platalea *Say.* A.

subareatus *Boh.* E.

SCOLYTIDÆ.

MONARTHRUM *Kirsch.*

mali *Fitch.* I.

PITYOPHTHORUS *Eich.*

minutissimus *Zimm.* I.

puberulus *Lec.* Bl.

XYLOTERUS *Er.*

retusus *Lec.* I.

XYLEBORUS *Eich.*

celsus *Eich.* I.

pubescens *Zimm.* I.

TOMICUS *Lat.*

pini *Say.* Iowa City, in doubt.

SCOLYTUS *Geoff.*

quadrispinosus *Say.* I.

CHRAMESUS *Lec.*

icoriæ *Lec.* I.

PHLŒOTRIBUS *Latr.*

liminaris *Harr.* I.

frontalis *Oliv.* Bl.

HYLESINUS *Fabr.*

aculeatus *Say.* A. I. Bl.

opaculus *Lec.* I.

ANTHRIBIDÆ.

HORMISCUS *Waterh.*

saltator *Lec.* I.

PIEZOCORYNUS *Sch.*

mœstus *Lec.* I.

CRATOPARIS *Sch.*

lunatus *Fabr.* Ia.

BRACHYTARSUS *Sch.*

plumbeus *Lec.* I.

variegatus *Say.* I. P. Bl.

The total number of names recorded in this catalogue is 2065, distributed as follows, in 70 families:

Cicindelidæ	22	Throscidæ	4
Carabidæ	271	Buprestidæ	31
Haliplidæ	5	Lampyridæ	47
Dytiscidæ	42	Malachidæ	7
Gyrinidæ	9	Cleridæ	21
Hydrophilidæ	37	Ptinidæ	18
Leptinidæ	1	Bostrychidæ	10
Silphidæ	25	Lyctidæ	3
Scydmænidæ	38	Cupesidæ	1
Pselaphidæ	70	Cioidæ	4
Staphylinidæ	230	Sphindidæ	2
Trichopterygidæ	2	Lucanidæ	7
Scaphidiidæ	11	Scarabæidæ	103
Phalacridæ	6	Spondylidæ	1
Corylophidæ	8	Cerambycidæ	122
Coccinellidæ	38	Chrysomelidæ	193
Endomychidæ	8	Bruchidæ	10
Erotylidæ	18	Tenebrionidæ	33
Colydiidæ	9	Cistelidæ	10
Rhyssodidæ	1	Lagriidæ	2
Cucujidæ	15	Melandryidæ	19
Cryptophagidæ	16	Œdemeridæ	4
Mycetophagidæ	8	Mordellidæ	25
Dermestidæ	19	Anthicidæ	28
Histeridæ	40	Pyrochroidæ	3
Nitidulidæ	28	Meloidæ	15
Lathridiidæ	16	Rhipiphoridæ	5
Trogositidæ	10	Rhynchitidæ	5
Derodontidæ	1	Attelabidæ	2
Byrrhidæ	4	Otiorhynchidæ	11
Parnidæ	8	Curculionidæ	165
Heteroceridæ	7	Brenthidæ	1
Dascyllidæ	9	Calandridæ	19
Rhipiceridæ	1	Scolytidæ	13
Elateridæ	83	Anthribidæ	5

IOWA DISCOMYCETES

BY FRED J. SEAVER

INTRODUCTION

The work of the present paper was begun during the autumn of 1902, under the direction of Professor Thomas H. Macbride, in the State University of Iowa. The work was continued during the four years following this period, the first three of which were spent in Iowa City as a student of the University and the fourth at Mt. Pleasant in charge of the biological work in Iowa Wesleyan University. To Professor Macbride and the various members of the botanical department of the State University I am indebted not only for free access to the material in the collections of that department, but for constant suggestions and aid on the numerous questions which have arisen during the course of the work.

Having since taken up my residence in New York City access to the libraries and collections of the New York Botanical Garden has afforded the opportunity to put the manuscript of the Iowa Discomycetes into better form. The library facilities of this institution have made it possible to confirm the citations of nearly all the species named, and to correct determinations in several cases; to the authorities of this institution I wish to acknowledge my indebtedness for the privilege of completing the work begun in Iowa.

A preliminary paper on the Discomycetes of Eastern Iowa was published in the spring of 1904[1] and the present paper stands in part as a revision of that work with the addition of work done subsequent to the time of that publication. The present work includes, not only the work of the writer but all the information which he has been able to accumulate from other sources on this part of the fungous flora of Iowa.

[1] Bull. Lab. Nat. Hist. State Univ. Ia. V. pp. 335-406.

Since the publication of the Discomycetes of Eastern Iowa, five new species and one variety have been described by various authors based on material collected in connection with this work and this opportunity is taken to bring together all of these facts and publish them as one work. The new species referred to are as follows: *Sphærosoma echinulatum* Seaver, *Schlerotina seaveri* Rehm, *Dermatea olivascens* Rehm, *Gorgoniceps iowensis* Rehm, *Sclerotinia tiliae* Reade, and *Helotium citrinulum seaveri* Rehm. The first of these has since been twice reported from Europe and the second has been collected and studied in New York State.

This work is not intended as a monograph and for this reason no attempt has been made to straighten the many nomenclatural tangles which have arisen, such matters being left to those to whose lot it shall fall to prepare the much-needed monograph of the North American Discomycetes. While an attempt has been made to recognize the first published specific name, where there is a clear case, few new combinations have been made. The question of the validity of several genera has arisen and in some cases noted but it is thought best to leave such matters also to those who may have the time to go into the study of the nomenclature of this group of plants more thoroughly.

The drawings were the most of them made from fresh material and before leaving Iowa. When it became necessary to use dried specimens these were carefully soaked up before using. In the case of large plants the drawing is natural size but when the specimens are very small, both a natural size sketch and an enlarged view have been made to show gross characters. No attempt has been made to draw spores and asci to a common scale throughout. Such drawings are aimed to show the form of the ascus, spore arrangement, spore-form, and internal and external markings. For the relative size of the microscopic characters the reader must depend upon the measurements given with the descriptions.

This article is offered mainly as a guide to local students and while it comprises the sum of the knowledge of the discomycete flora of Iowa so far as I have been able to accumulate it, the subject is a large one and I have reason to believe can scarcely be more than touched upon in an article of this size. It is hoped that other students may take up the work where it is left and carry it on to its completion. To say that there are five hundred species of this group in Iowa would, to my mind, be only a reasonable estimate.

To the various individuals who have contributed to this work acknowledgments are made in the proper place and need not be repeated here. However in addition to the members of the botanical department of the State University of Iowa, I wish to express thanks to Professor L. H. Pammel of Iowa State College for his kindness in loaning to me for study the discomycetes in the Holway collection of that institution.

For characteristics and life-history of the group the reader will consult the Iowa Natural History Bulletin already cited.

CLASSIFICATION.

The classification adopted in this paper is for the most part that offered in *Engler & Prantl, Natürlichen Pflanzen Familien* with some variation and the introduction of several genera not recognized in that work. Only such orders, families, and genera are included in the key as are represented by species described in this paper.

KEY TO THE ORDERS.

Hymenium exposed from the first. . . . I. HELVELLINEÆ.
Hymenium at first closed.
  Hymenium open at an early stage, without firm covering . . . . II. PEZIZINEÆ
  Hymenium enclosed in a firm covering, opening at maturity.
    Opening with astellate or irregular aperture. III. PHACIDIINEÆ.
    Elongate, opening with a slit-like aperture. IV. HYSTERIINEÆ.

KEY TO THE FAMILIES.

Helvellineæ.

Receptacle borne on a stem.
  Pileus clavate or knob-like; asci non-operculate. **1. Geoglossaceae**
  Pileus capitate or pileate; asci operculate. **2. Helvellaceae**
Receptacle sessile. . . . . **3. Rhizinaceae**

PEZIZINEÆ.

Receptacle fleshy or waxy, rarely gelatinous; ends of paraphyses free.
Peridium and hypothecium of nearly the same structure.
Receptacle open from the first, convex, peridium wanting or poorly developed. . **4. Pyronemaceae**
Receptacle at first concave; peridium developed, fleshy.
Asci at maturity forming an even layer. . **5. Pezizaceae**
Asci at maturity emergent. . . . **6. Ascobolaceae**
Peridium forming a more or less well differentiated layer.
Peridium composed of elongate, thin, bright-walled cells, parallel with each other forming the pseudo-parenchyma. . . **7. Helotiaceae**
Peridium composed of roundish or angular, thin, dark-walled cells, forming a pseudo-parenchyma. . . . . . **8. Mollisiaceae**
Receptacle leathery or cartilaginous; ends of paraphyses united to form an epithecium.
Receptacle free from the first, never inclosed in a membrane. . . . . . . **9. Patellariaceae**
Receptacle at first submerged, later breaking through the epidermis, cup- or beaker-shaped often at first inclosed in a membrane. . . . . **10. Cenangiaceae**

PHACIDIINEÆ.

Fleshy, white, bright colored, never black, surrounded by the torn edges of the epidermal covering. . . . . **11. Stictidaceae**

HYSTERIINEÆ.

Apothecia free, carbonaceous, black, round or mostly linear. . . . . **12. Hysteriaceae**

KEY TO THE GENERA.

1. GEOGLOSSACEÆ.

Receptacle globose or pileate, margin free. . . . LEOTIA.
Receptacle spoon-shaped, adnate with the stem. . . SPATHULARIA.

2. HELVELLACEÆ.

Pileus hollow entirely or in the upper part only; cavity of pileus continuous with that of the stem.
Upper surface of the pileus marked by deep pits. MORCHELLA.

Upper surface of pileus spirally folded or convolute. . . . . GYROMITRA.
Pileus membranaceous, bell-shaped or ragged, attached to the stem by the central part only. . . . HELVELLA.

3. RHIZINACEÆ.

Spores globose, root-like processes wanting. . . SPHÆROSOMA

4. PYRONEMACEÆ.

Receptacle seated on a spider-web-like, or felt-like mass of hyphæ, hypothecium well developed, fleshy; peridium poorly developed. . . . . . . PYRONEMA

5. PEZIZACEÆ.

Spores globose.
- Receptacle externally clothed with bristly hairs. SPHÆROSPORA.
- Receptacle externally smooth or nearly so, not bristly.
  - Receptacle large, cup-shaped, brown. . . . DETONIA.
  - Receptacle small, nearly plane or disc-shaped. BARLÆA.

Spores elliptical, blunt, rarely pointed.
- Receptacle externally hairy.
  - At first buried in the ground, margin splitting. SARCOSPHÆRA.
  - Not buried in the ground, margin remaining even. . . . . LACHNEA.
- Receptacle smooth or nearly so externally.
  - Cups or discs regular in outline.
    - Juice colorless.
      - Spores smooth or rough, not reticulate.
        - Plants entirely sessile.
          - Large cup-shaped. . . . . . PEZIZA.
          - Small disc-shaped.
            - Plants bright colored, spores hyaline. HUMARIA.
            - Plants dark colored, spores brown. PHÆOPEZIA.
        - Plants stipitate.
          - Stem stout, short.
            - Stem even, not grooved. . . . GEOPYXIS.
            - Stem uneven, with longitudinal grooves. . . . . . . ACETABULA.
          - Stem long, slender. . . . . . . MACROPODIA.
      - Spores reticulate, with a net work, externally. . . . . ALEURIA.
    - Juice milky. . . . . GALACTINIA.
  - Cups irregular, split on one side. . . . OTIDEA.

6. Ascobolaceæ.

Spores hyaline.
  Asci 8-spored.
    Receptacle smooth or at least not hairy. . . . Ascophanus.
    Receptacle clothed with hairs. . . . . . Lasiobolus.
  Asci 16 to many-spored.
    Plants large, 1 to 2 mm. in diameter, at first conical. . . . . Thecotheus.
    Plants small mostly less than 1 mm. depressed. Rhyparobius.
Spores at first hyaline becoming purple.
  Spores free in the ascus. . . . . Ascobolus.
  Spores united in a ball in the ascus. . . . Saccobolus.

7. Helotiaceæ.

Receptacle between fleshy and waxy, or waxy, thick or membranaceous.
  Receptacle fleshy-waxy, bright colored fragile or dull leathery.
    Plants externally tomentose. . . . . . . Sarcoscypha.
    Plants externally smooth.
      Receptacle not springing from a sclerotium.
        Substratum green. . . . . Chlorosplenium.
        Substratum not colored. . . . . Ciboria.
      Receptacle springing from a sclerotium. . Sclerotinia.
  Receptacle waxy, thick, tough or membranaceous.
    Externally hairy.
      Plants stipitate. . . . . Dasyscypha.
      Plants entirely sessile. . . . . . . Trichopeziza.
    Externally smooth.
      Spores elliptical to fusiform.
        Plants slender stipitate. . . . . . Phialea.
        Plants with stem short, stout or wanting. . Helotium.
      Spores linear or much elongated, many-septate. . . . . Gorgoniceps.
Receptacle cartilaginous; spores becoming several-celled. . . . . Coryne.

8. Mollisiaceæ.

Receptacle fleshy-waxy or rarely membranaceous. . . Mollisia.
Receptacle cartilaginous, horny when dry. . . . Orbilia.

9. Patellariaceæ.

Spores with transverse septa only.
  Plants patellate.
    Spores hyaline 3 to many-septate. . . . Patellaria.

Spores brown 1 to 3-septate.
Spores 1-septate. . . . . KARSCHIA.
Spores 3-septate. . . . . MYCOLECIDEA.
Plants hysteropatelliform. . . . . . HYSTEROPATELLA.
Spores muriform. . . . . BLITRYDIUM.

10. CENANGIACEÆ.

Plants sessile or subsessile.
Receptacle when fresh, leathery, horny or waxy.
Stroma entirely wanting. . . . . . CENANGIUM.
Stroma more or less well developed.
Asci 8-spored. . . . . DERMATEA.
Asci many-spored. . . . . TYMPANIS.
Receptacle when fresh gelatinous.
Spores simple.
Apothecium within watery, shrinking much when dry. . . . . SARCOSOMA.
Apothecium within not watery. . . . BULGARIA.
Spores much elongated, many-septate. . . HOLWAYA.
Plants stipitate, large, urn-shaped. . . . . URNULA.

11. STICTIDACEÆ.

Plants elongated; asci 8-spored; spores simple. . . PROPOLIS.

12. HYSTERIACEÆ.

Spores with transverse septa only.
Spores colored, brown. . . . . HYSTERIUM.
Spores hyaline.
Spores 1-septate. . . . . GLONIUM.
Spores becoming 3-septate. . . . . . GLONIELLA.
Spores muriform (with both transverse and longitudinal septa). . . . . HYSTEROGRAPHIUM.

ORDER I. HELVELLINEÆ.

Receptacle vertical, stipitate, mitrate, pileate, or clavate; hymenium superior, exposed from the first; substance between fleshy and waxy, rarely gelatinous.

FAMILY 1. GEOGLOSSACEÆ.

Receptacle fleshy, waxy, or gelatinous; fructification separated into a sterile stem and fertile receptacle; hymenium on the outside of the receptacle, always exposed; asci clavate, non-operculate.

SPATHULARIA Pers., Tent. Disp. Meth. Fung. 36. 1797.

Receptacle fleshy, stipitate, vertical, compressed laterally, extending down two opposite sides of the stem; spores 8, filiform, hyaline, paraphyses filiform.

One species found in the northeast part of the state.

SPATHULARIA CLAVATA (Schaeff.) Sacc., Michelia 2:77. 1880.
Plate 1, f. I.

Elvela clavata Schæff., Icon. Fung. pl. 149. 1767.

Spathularia flavida Pers., Tent. Disp. Meth. Fung. 3n. 1797.

Receptacle spatulate, compressed, nearly even, yellow; margin often crisped, or undulated, 2 to 5 cm. high; stem light colored, whitish; asci clavate, 8-spored; spores filiform, 50 to 60 by 2 to 3μ, guttulate or granular within; paraphyses filiform, branched, numerous.

On the ground in pine woods, summer; collected by B. Shimek, Winneshiek county.

Plants distinguished by their yellow color. The pileus is flattened laterally so as to be spoon-shaped or spatulate and is often much contorted and twisted.

A note from Mr. Holway after the publication of the Discomycetes of Eastern Iowa states that this species has been found in but one locality in the northeast part of the state, in a piece of pine timber where it grows on the ground among leaves and twigs. This stands as a correction to the statement made in the paper quoted above that these plants are common.

LEOTIA Pers., Tent. Disp. Meth. Fung. 17. 1797.

Receptacle stipitate, gelatinous, pileate, roundish or spreading, revolute, at the margin; hymenium covering the upper surface and margin of the pileus, under surface sterile; hymenium undulated or even; stem cylindrical or laterally compressed; asci clavate, 8-spored; spores fusiform or linear, hyaline.

LEOTIA STIPITATA (Bosc.) Schr., Nat. Pfl. Fam. 1:166. 1897.

Plate 1, f. II.

Tremella (hygromitra) stipitata Bosc., Berl. Mag. 5: 89. 1811.

Plants stipitate, 2 to 4 cm. high by 1 to 2 cm. broad; pileus globose or spreading, smooth, dark æruginous-green; stem long, flattened or twisted, lighter colored than the pileus, yellowish or slightly greenish, covered with minute hair-like structures or nearly smooth; asci clavate, 8-spored; spores guttulate and granular within, 20 by 5μ; paraphyses filiform.

On soil in woods among leaves, summer and fall. Iowa City.

The pileus in this species is very dark green and in some cases so dark as to appear almost black and contrasts strongly with the lighter colored stem. The plants seem to grow for the most part solitary.

LEOTIA LUBRICA (Scop.) Pers., Syn. Fung. 613. 1801.

Plate 2, f. I.

Elvela lubrica Scop., Fl. Carn. 2: 477. 1772.

Plants growing in cespitose clusters, stem and pileus more or less irregular in form and appearing tremulous and rather soft; pileus irregular, convolute, at first golden-yellow becoming brownish to greenish when dry, stem and pileus when fresh of nearly the same color; asci cylindrical, 8-spored; spores elliptical to fusoid, 25 by 8μ; paraphyses filiform.

In woods on soil among leaves, Iowa City.

The specimens described here under this name were decidedly different in color and in general appearance from the preceding species. There was no trace of green in the fresh specimens the color resembling that of *Spathularia clavata*, but as the specimens dried they assumed more or less of a green color and those placed in alcohol became quite decidedly green in color. The stems of pileus of this species are much more irregular than those of the preceding species in the specimens observed by us.

FAMILY 2. HELVELLACEÆ.

Plants fleshy, separated into stem and pileus; stem sharply distinguished from the receptacle, for the most part hollow, fragile; receptacle pileate, covered outside with the hymenium, which is always exposed, composed of asci and well developed paraphyses; asci operculate; spores elliptical, hyaline or faintly yellowish.

MORCHELLA Pers., Tent. Disp. Meth. Fung. 36. 1797.

KEY TO THE SPECIES.

Pileus free half way up. . . . . *M. hybrida.*
Pileus not free.
  Stem much smaller than the head, ribs thick, pits deep.
    Plants large, more than 4 cm. high, usually yellow.
      Pits irregular, head rounded. . . . . . . *M. esculenta.*
      Pits longitudinally inclined, head conical. . . *M. conica.*
    Plants small, usually much less than 4 cm. high, cinereous. . . . . *M. deliciosa.*
  Stem very much enlarged below, ribs very thin, pits shallow. . . . . *M. crassipes.*

*MORCHELLA HYBRIDA (Sow.) Pers., Syn. Fung. 620. 1801. Plate 3, f. II.

Helvella hybrida Sow., Eng. Fungi, 238. 1797.

MORCHELLA ESCULENTA (L.) Pers., Syn. Fung. 618. 1801. Plate 2, f. III.

Phallus esculentus Linn., Fl. Suec. 455. 1755.

Pileus rounded, ovate or oblong, adnate at the base, ribs thick; pits large, deep, irregular; stem even, not much enlarged at the base; asci cylindrical, 8-spored; spores elliptical, 20-22 by 10μ; paraphyses filiform, slightly thickened above.

On the ground in open places among grass, spring, Iowa City and Mt. Pleasant. Probably common throughout the state.

This is much valued on account of its edible qualities and is often gathered in large quantities for this purpose The species is common and the plants very variable in form and size.

*MORCHELLA CONICA Pers., Trait. Champ. 257. 1818. Plate 3, f. I.

MORCHELLA DELICIOSA Fries, Syst Myc. 2:8. 1822. Plate 2, f. II.

Pileus subconical, ribs rather thick, longitudinally inclined, deep, rather dark colored within, grayish, with the edges of the ribs lighter, yellowish; stem short, scarcely as long as the pileus,

*Species are described in the preliminary paper already named.

slender above and a little enlarged below and more or less irregular, nearly smooth; asci cylindrical, 8-spored, spores elliptical, 20 zy 10μ.

On the ground in grassy places, spring, Iowa City.

This and the following species were collected in the same locality and growing together but were so different in size and general appearance that they would at once be recognized as different species. The pits in this species were decidedly grayish within with the edge of the ribs lighter while in *M. crassipes* the pits and ribs are of uniform color. The great difference in size is also a prominent feature.

MORCHELLA CRASSIPES (Vent.) Pers., Syn. Fung. 621. 1801.

Pileus subconical, yellowish to slightly brownish, adnate at the base; ribs very irregular, thin; pits large, irregular, shallow, of the same color as the ribs; stem very large and irregular, enlarged much toward the base, 10-15 cm. high; spores 20 to 23 by 10 to 12μ.

On the ground in open, grassy places, Iowa City, spring.

This species is quite different from any of the preceding forms. The pits are very large and irregular and the ribs are very thin. The large size of the whole stem is a distinguishing character and this is still more enlarged toward the base and often very irregular in form.

GYROMITRA Fries, Summa Veg. Scand. 346. 1849.

Receptacle pileate, stipitate, margin reflexed, covered above by the hymenium; substance fleshy; stem short, slender, even; asci cylindrical, 8-spored; spores elliptical or elongate-elliptical, smooth; paraphyses filiform.

One species found in the state.

GYROMITRA ESCULENTA (Pers.) Fries, Summa Veg. Scand., 346. 1849.

Plate 4, f. 1.

Helvella esculenta Pers., Syn. Fung. 618. 1801.

Pileus inflated, irregularly undulated or convolute, brown, margin adnate with the short stem; asci cylindrical, 8-spored;

spores 20 by 10μ; paraphyses enlarged upwards and containing coloring matter.

On the ground, Iowa City.

Several specimens of this species have been collected by Professors Macbride and Shimek. The plants are very attractive from their large size and peculiar form.

HELVELLA Linn., Sp. Pl. ed. 2, 1649. 1763.

Receptacle pileate, supported by the center, deflected, concave and sterile beneath; upper surface of the pileus covered by the hymenium which is even; stem always present, united by the center to the pileus, hollow or filled with cavities; in mature plants pileus compressed, lobate, substance waxy-membranaceous; asci cylindrical, 8-spored; spores elliptical, smooth; paraphyses linear.

KEY TO THE SPECIES.

Stem slender, even. . . . . *H. elastica.*
Stem stout, with deep furrows.
  Plants entirely white or whitish. . . . . . . *H. crispa.*
  Plants with pileus dark brownish to blackish. . . *M. lacunosa.*

*HELLVELLA ELASTICA Bull., Champ. 299. 1809.
Plate 5, f. II.

*HELVELLA CRISPA (Scop.) Fries, Syst. Myc., 2:14. 1822.
Plate 5, f. I.

Phallus crispus Scop., Fl. Carn. 2: 475. 1772.

HELVELLA LACUNOSA Afzel, Act. Holm., 304. 1785.

Pileus inflated, unequally lobed, cinereous-black; margin of the pileus adnate with the stem; stem rather slender as compared with the preceding, and often more or less twisted, yellowish, lighter than the pileus; asci cylindrical, 8-spored; spores 1-seriate, elliptical, 18 by 10μ; paraphyses filiform, slender.

On the ground in woods, Iowa City and Mt. Pleasant.

Distinguished from the preceding by the darker pileus and more slender stem. The plants of this species vary much in size, specimens collected in Iowa City are from 2 to 6 cm. high while those collected in Mt. Pleasant were much smaller on the average not more than 2 cm. The color of the pileus also varies somewhat but in all the specimens examined is decidedly darker than the stem.

FAMILY 3. RHIZINACEÆ.

Receptacle fleshy-waxy, brittle, sessile. Hymenium exposed from the first, plane or convex. Asci cylindrical, operculate. Paraphyses numerous, free.

SPHÆROSOMA Klotzsch; Dietrich Fl. Boruss 467. 1841.

Receptacle fleshy, sessile, convolute, roundish, outer surface covered entirely by the hymenium, within sterile. Asci cylindrical. Sporidia spherical, verrucose, hyaline.

SPHÆROSOMA ECHINULATUM Seaver., Jour. Myc. 11: 2-5. 1905.
Plate 6, a—g.

Plants gregarious or scattered, occasionally crowded, sessile, 1 to 8 mm. in diameter; at first almost spherical and regular in outline, becoming convolute with age, especially on the upper surface, often umbilicate; lower surface sterile, nearly plane, attached to the soil near the center by delicate hyphæ, very easily detached; at first white or whitish becoming reddish-brown on the exposed surface, then dark brown; the color begins with a brown spot in the center of the upper surface and spreads until it covers all of the exposed surface; at maturity having a brown velvety appearance due to the large, brownish paraphyses which extend far beyond the asci; under surface light colored; hymenium at maturity covering the exposed surface of the plant, composed of very large asci and paraphyses; asci 40 to 50 by 300 to 500μ, clavate, 8-spored; spores globose, at first smooth, filled with numerous guttulæ, and surrounded with a transparent exospore, gradually becoming rough on the outside, at maturity covered with spines which are several times as [illegible] as broad; spines 4 to 5μ in length by 2 to 2.5μ broad at the base, often bent at their apices, at maturity extending to the outer surface of the exospore; spore, excluding exospore 25μ in diameter, including spines or exospore, 35μ in diameter; paraphyses large, clavate, septate, brownish, 12 to 15μ in diameter at the apex; sterile part of the receptacle composed of rather loosely interwoven hyphæ, grading into pseudo-parenchyma; cells large.

Habitat—On the surface of damp soil between the tufts of grass in an open place, in the margins of woods near Iowa City. Plants collected from June to October. Also reported from Europe.

The specific name under which these plants are described is suggested by the character of the markings of the spores, which are distinctly echinulate.

The description and measurements given above were made from fresh material collected at different times. Specimens preserved in alcohol vary somewhat; the most of the color disappears and the plants are a little contracted and the measurements are therefore a little less.

The plants described above were collected during the later part of the month of June in the summer of 1904, in large numbers in a ravine near Iowa City and upon examination were at once referred to this genus. The individuals are at first almost spherical in form, smooth on the outer surface, and of a whitish or lead color. As they mature, a small, brown spot is formed in the center of the supper surface, the brown color gradually spreading until it covers all of the exposed surface. They are at first regular in outline, becoming, at maturity, irregularly convolute and more or less depressed, so that at maturity the plants are roundish but more or less irregular in form, of a deep brown color and with a soft velvety appearance. Examination of sections of young plants shows the brown spot on the upper surface to be the beginning of the development of the hymenial layer and the brown color and velvety appearance to be due to the large paraphyses which contain brown coloring matter.

The writer has not had opportunity to revisit the type locality of this species since the original collection was made in 1904, so that no statement can be made as to its reoccurrence there and so far as noted it has not since been reported from this country. It is interesting to note that one year after the collection of this species in America it was collected in Europe and distributed by Dr. Rehm in his Ascomycetes. It was later collected and distributed the second time. Examination of the foreign material shows it to be identical in every way with that collected in Iowa.

ORDER II. PEZIZINEÆ.

Receptacle well developed, fleshy or more or less leathery, generally regular, at first closed, spherical (except in Pyronemaceae) gradually opening, becoming shallow, cup-shaped or beaker-shaped or disc-like; hymenium forming a covering on the upper, inner surface, composed of asci and paraphyses arranged in the form of a palisade.

FAMILY 4. PYRONEMACEÆ.

Receptacle seated on a mass of thread-like hyphæ; hymenium at length plane or convex; peridium wanting or poorly developed.

PYRONEMA Carus, Nov. Act. Acad. Nat. Cur. 17: 370. 1835.

Receptacle seated on a mass of hyphæ, fleshy, at first spherical, then expanded; peridium very poorly developed or wanting; spores elliptical, hyaline.

KEY TO THE SPECIES.

Plants very small scarcely more than 1 mm. in diameter, pale. . . . . *P. omphalodes.*
Plants 1 to 3 mm. in diameter, dark red. . . . . . *P. melaloma.*

PYRONEMA OMPHALODES (Bull.) Fuckel, Symb. Myc. 319. 1869. Plate 7, f. I.

Peziza omphalodes Bull., Champ. France 264. 1809.

Aleuria omphalodes Gill., Discom. 48. 1888.

Pyronema confluens Tul., Carp. 2: 197. 1865.

Plants fleshy, gregarious or confluent 1 mm. in diameter, forming confluent masses 1 to several cm. in diameter; pale red to salmon-color, surrounding mycelium white; hymenium plane or convex; asci cylindrical, 8-spored; spores elliptical, 10 to 12 by 7μ; 2 to 3 guttulate and granular within; paraphyses enlarged upwards and filled with coloring matter.

On charcoal and ashes where fire has been; Iowa City.

The form described in the Discomycetes of Eastern Iowa as *P. aurantio-rubrum* Fuckel was probably rather a poor specimen of the above. After the publication of that paper the present species was found in abundance on burnt places in wet weather. The beautiful salmon-colored patches on burnt ground were quite attractive.

In the winter of 1906 this species was observed commonly in the propagating house of the New York Botanical Garden where it occurred in abundance on soil which had been sterilized by heating. It grew abundantly for a time and finally disappeared. The gardener reported it to be very common but apparently it did no harm.

Also during the autumn of 1907 the species was observed commonly in North Dakota where it occurred on moist soil along roadsides. It seemed to appear here where no traces of fire were evident but it may have followed prairie fires. Usually it is common only on burnt places.

*PYRONEMA MELALOMA (Fries) Sacc., Syll. Fung. 8:107. 1889.
Plate 7, f. II.

Peziza melaloma Fries., Syst. Myc. 2: 68. 1822.

Saccardo seems to have made a difference between this and *Peziza melaloma* Alb. & Schw. which we have described as *Lachnea melaloma* (Alb. & Schw.) Sacc. The two forms collected by the writer and described under these different names seem to be distinct although both occur on burnt soil and are in other ways similar. Whether they should be placed in different genera is uncertain. The form described here is smaller, of a brighter color and the exterior is not so distinctly hairy.

The plants of this species have been found to be common, and occur in dense crowded masses.

FAMILY 5. PEZIZACEÆ.

Receptacle for the most part borne on the surface, not immersed in the substratum, sessile or stipitate, externally smooth or clothed with hairs, fleshy, at first closed then opening with a small aperture at the top and gradually expanding; peridium and hypothecium composed of loose roundish cells; asci not protruding at maturity, often operculate (opening by a lid-like structure); spores hyaline.

SPHÆROSPORA Sacc., Michelia, 1: 594. 1879.

Receptacle sessile, at first hemispherical, then expanding, externally clother with simple. sharp-pointed, septate hairs; asci cylindrical, 8-spored; spores globose with one large oil-drop; smooth or beset with spines, arranged in one row in the ascus; paraphyses thickened above and filled with colored granules.

In external appearance the plants of this genus resemble those of the genus *Lachnea* but differ in the globose spores. Two forms have been collected by the writer which seem distinct.

KEY TO THE SPECIES

Plants small, mostly 2 to 5 mm. on burnt places. . . *S. confusa.*
Plants large 5 to 10 mm. in diameter, on damp soil
among moss. . . . . *S. scutelloides.*

SPHÆROSPORA (*Sarcoscypha*) SCUTELLOIDES Ellis, Bull. Torrey Cl. 9:18. 1882.

Plate 8, f. 1.

Cups gregarious or scattered, hemispherical, then depressed, 5 to 10 mm. in diameter, dark reddish-brown, clothed externally with numerous, short, septate, brown hairs, which are often enlarged near the base; asci cylindrical, 8-spored, 14 by 150 to 160μ; spores globose, 1-guttulate, 13 to 15μ in diameter; paraphyses filiform, enlarged at their apices.

On damp soil in woods among moss, Iowa City.

The plants described here were at first referred to *Sphaerospora confusa* (Cooke) Sacc. but seem to differ from that species in the size of the plants and also in the habitat with perhaps some difference in spore sizes. The plants described here are of about the size and general appearance of *Lachnea scutellata* except that the color is darker more brown than red. These plants were found by the writer in the same place each year while remaining at Iowa City.

Also specimens of the same form were collected during the fall of 1906 in similar localities in the woods of the New York Botanical Garden.

Sphærospora confusa (Cooke) Sacc., Syll. Fung. 8: 190. 1889.

Peziza confusa Cooke, Mycogr., 69.

On the ground where a pile of wood had been burned, woods, Iowa City.

The plants of this species differ from the preceding mainly in the size of the cups and the habit as well as the habitat. The plants were found in quantity growing in a dense mass on a burnt place. The preceding species occurs on mossy banks in rather sandy places, the cups are more or less scattered, never densely crowded, and much larger. The preceding form has been studied in such localities for several years in succession.

DETONIA Sacc., Syll. Fung., 8:105. 1889.

Cups large, fleshy, expanded, discoid, brown; asci cylindrical, 8-spored; spores globose, hyaline, smooth or rough.

Detonia trachycarpa (Curr.) Sacc., Syll. Fung., 8:105. 1889. Plate 14, f. I.

Peziza trachycarpa Curr., Trans. Linn. Soc., 24: 493. 1864.

Discina trachycarpa Karst., Act. Soc. Fauna Fl. Fenn., 2: 113. 1885.

Plicaria trachycarpa Boud., Bull. Soc. Myc. France, 1: 102. 1885.

Aleuria trachycarpa Gill., Discom., 207.

Plicariella trachycarpa Rehm, Rabenh. Krypt Fl., 1^3 : 996. 1896.

Cups at first closed, soon expanded and nearly plane, umbilicate, scattered, or densely crowded, becoming very irregular with age, often contorted and twisted especially when crowded; hymenium dark brownish-black, more or less uneven; cups externally granular; asci cylindrical, 8-spored; spores globose, about 15μ in diameter becoming very rough with more or less elongated ridges; paraphyses filiform, enlarged upwards and filled with brown coloring matter.

On burnt ground, Iowa City.

The plants of this species were found to be abundant on burnt places during the autumn of 1904 in woods near Iowa City. The plants from which the above description was drawn were collected in woods in which large numbers of trees had been cut and the brush burned in various places. The plants when scattered are nearly plane but when crowded, as they often are they become very irregular with age and the brown mass, often several cm. in diameter, becomes very attractive on account of the peculiar forms which the cups assume. The spores are very rough and close examination shows the roughenings to be in the form of interrupted ridges rather than rounded wart-like elevations.

BARLÆA Sacc., Syll. Fung. 8: 111. 1889.

Plants small, concave or depressed, often becoming convex, not exceeding 1 cm. broad and usually much less, mostly bright colored; asci cylindrical, 8-spored: spores perfectly globose, smooth, reticulate, spinulose or verrucose.

Several species have been collected four of which are described here. The plants of this genus and the genus *Humaria* which differ only in the form of the spores are most beautiful objects for study and the forms which occur in Iowa are numerous but unfortunately on account of the small size of the plants they are often overlooked. The plants of these two genera occur on moist ground often among moss or on entirely naked soil. Mossy banks in, often small, sheltered places by the roadsides furnish a most favorable habitat for these minute plants and scarcely such a place can be found which in the proper season does not furnish some one or many of these delicate forms.

On account of the small size and delicate structure of the plants of this genus they are not easy to preserve in the usual way and for this reason material for comparison is difficult to obtain. Several smooth-spored forms were collected which could not be determined with any degree of certainty and for that reason are not included in this list.

KEY TO THE SPECIES.

Spores with reticulate markings.
 Plants large 2 to 5 mm. in diameter. . . . *B. miniata.*
 Plants small 1 to 2 mm. in diameter. . . . *B. cinnabarina.*
Spores not reticulate.
 Spores spinulose, plants yellow. . . . . *B. crec'hqueraultii.*
 Spores verrucose, plants purplish. . . . . *B. amethystina.*

BARLÆA MINIATA (Crouan) Sacc., Syll. Fung. 8: 111. 1889.
Plate 12, f. I.

Ascobolus miniatus Crouan, Ann. Sci. Nat. IV. 10: 197. 388.

Lamprospora miniata De Notaris, Comm. Critt. It. 1: 388. 1864.

Crouania miniata Fuckel, Symb. Myc. 320. 1869.

Peziza crouani Cooke, Mycogr. 13.

Plants small, 2 to 5 mm. in diameter, at first concave, becoming nearly plane, orange; asci very long, cylindrical to clavate, 150 by 16 to 18μ; 8-spored; spores globose with large central oil-drop, externally delicately reticulated, 15μ in diameter; reticulations regular with the meshes rather small; paraphyses slender, enlarged upwards, filled with orange granules.

On rather sandy soil among moss, Iowa City.

One collection of this species was made in Iowa and the plants are characteristic in every way. The individuals are larger than the other species of the genus here described and the spore-markings are distinct from any of the other forms studied.

BARLÆA CINNABARINA (Fuckel) Sacc., Syll. Fung. 8: 112. 1889.

Plate 12, f. II.

Crouania cinnabarina Fuckel, Symb. Myc. 2: 64. 1873.

Peziza lætirubra Cooke, Mycogr. 14.

Plants small, not to exceed 1 to 2 mm. in diameter, at first slightly concave or plane becoming convex, bright orange; hymenium at maturity more or less rough with minute pits; asci clavate to cylindrical, 8-spored; spores globose, with 1 large, central oil-drop, externally finally reticulated, 15 to 18μ; reticulations more irregular than in preceding and meshes larger;

paraphyses filiform, slender, enlarged upwards and filled with orange granules.

On the ground among moss, Iowa City, common. Also observed and studied in Indiana.

The plants of this species are smaller than in the preceding, the hymenium at maturity always convex and without definite margin. The spore-markings are characteristic on account of their irregularity and the larger size of the meshes. The species is very common and so far has always been found among moss-plants in gardens and open fields.

BARLÆA CREC'HQUERAULTII (Crouan) Sacc., Syll. Fung. 8: 113. 1889.

Ascobolus crec'hqueraultii Crouan, Ann. Sci. Nat. IV. 10: 194. 1858.

Peziza auriflava Cooke, Mycogr. 16.

Plants similar in size and general appearance to the preceding, entirely smooth, pale orange to salmon-colored, growing in thick groups but never crowded; asci cylindrical, 8-spored; spores globose, clothed externally with numerous minute, sharp spines which are often bent in various ways, seldom entirely straight, 15 to 18μ in diameter; paraphyses filiform or a little enlarged.

On naked clay soil among tufts of grass, Iowa City. Common in one locality.

The plants of this species occurred in one locality in great numbers and were studied during the entire season. The habitat and pale yellow color of the plants seems to be quite characteristic and the spore-markings are still more so. The minute spines with which the spore is covered are very sharp and many of them crooked and bent in various ways. The drawings of the forms collected, which were made before leaving Iowa, compare very favorably with those accompanying the original description which has since been examined.

BARLÆA AMETHYSTINA (Quel.) Sacc., Syll. Fung. 8: 116. 1889.
Plate 12, f. III.

Humaria persoonii amethystina Quel., Asc. Franc. Adv. Sci. 14: 451. 1885.

Plants small, 1 to 2 mm. in diameter, purplish, with a delicate whitish margin; hymenium slightly concave of about the same color as the exterior; asci cylindrical, 8-spored; spores globose entirely covered with large wart-like granules appearing very rough; paraphyses slender a little enlarged.

In woods among moss, Iowa City.

The plants of this species are not quite so large as those described by Quelet but the color and the spore-markings are characteristic. The measurements given for the plants of this species in the original description are 3 to 4 mm. in diameter while our specimens scarcely exceed 2 mm. The verrucose markings of the spores of the two specimens are very similar as is also the color of the plants.

SARCOSPHÆRA Auersw., Hedwigia 8: 82. 1869.

Receptacle at first closed and more or less immersed in the ground, gradually opening and often splitting at the margin and becoming subsuperficial; cups externally clothed with flexuose, brown hairs which are more numerous near the base; asci cylindrical, 8-spored; spores elliptical, hyaline, smooth with one oil-drop.

*SARCOSPHÆRA ARENICOLA (Lev.) Lindau; E. & P. Pfl. 1: 182. 1897.

Plate 9, f. II.

Peziza (*Humaria*) *arenicola* Lev., Ann. Sci. Nat. III. 9: 140. 1848.

This species was described and illustrated in the Discomycetes of Eastern Iowa with the note that it had not been found in Iowa but was collected in the adjoining state of Illinois. The species has not yet been collected in Iowa so far as known but is allowed to remain in the list since the illustration occurs on an accompanying plate. This is the only species included in this list which has not been actually collected in the state, this one having been originally included as illustrative of this genus.

LACHNEA Pers., Myc. Eu. 1: 244. 1822.

Plants fleshy or subfleshy, cup-shaped or plane, externally clothed with a covering of sharp, rigid or soft, flexuose hairs which are usually brown but often hyaline; asci cylindrical or clavate, usually 8-spored: spores elliptical to fusiform, hyaline; paraphyses present slender or clavate.

The genus is distinguished from *Peziza* by the presence of the hairs with which the cups are clothed. The forms with hyaline hairs are sometimes placed in a separate genus, *Neotiella*.

Eleven species of the genus are here described one of which has hyaline hairs. Probably many more occur in the state.

KEY TO THE SPECIES.

Hairs hyaline. . . . . *L. lojkoeana.*
Hairs colored, pale to dark brown.
  Hymenium white or whitish.
    Plants large, more than 2 mm. in diameter.
      Plants 2 to 3 cm., spores spinulose. . . . *L. hemispherica.*
      Plants less than 1 cm., spores smooth. . . *L. albo-spadicea.*
    Plants small, less than 2 mm. in diameter.
      Spores tuberculose. . . . . *L. paludosa.*
      Spores smooth. . . . . *L. abundans.*
  Hymenium red or yellow.
    Plants 1 cm. in diameter, hairs short.
      Plants red, hairs rigid.
        Spores smooth or scarcely roughened. . *L. scutellata.*
        Spores spinulose. . . . . *L. hirta.*
      Plants pale yellow, hairs flexuose. . . . *L. aurantiopsis.*
    Plants 1 to 5 mm. in diameter.
      On dung, hairs often stellate. . . . . *L. stercorea.*
      On rotten wood, hairs not stellate. . . *L. setosa.*
      On burnt ground. . . . . *L. melaloma.*

LACHNEA LOJKÆANA Rehm. Rabenh. Krypt. Fl. 13: 1045. 1896.
Plate 8. f. II.

Peziza (Sarcoscypha) luteo-pallens Cooke. Mycogr. 85.

Neottiella luteopallens Sacc., Syll. Fung. 8: 191. 1889.

Cups, sessile, at first hemispherical, then expanded, pale orange, 4 to 5 mm. in diameter, externally clothed with hyaline, septate hairs, which are often more or less rigid; asci cylindrical, operculate, 8-spored; spores elliptical, 15 to 17 to 10μ, granular within; paraphyses stout, thickened at their apices, 5 to 7μ in diameter.

On naked soil in woods, also grown in the laboratory on same material.

Two plants were grown in the laboratory from the soil on which the plants were collected in the field. The hymenium is nearly plane but surrounded with a delicate white fringe. The asci are often found to be only 4 or 6-spored.

*LACHNEA HEMISPHERICA (Schaeff.) Gill., Discom. 73. 1879. Plate 9, f. I.

Elvela hemispherica Schæff., Ic. Fung. 2 pl. 151. 1767.

Peziza hemispherica Hoffm., Veg. Crypt. 2: 28. 1790.

Octospora fasciculata Hedw., Laub-Moose, 2, pl. 4-B.

Sepultaria albida Morgan, Jour. Myc. 8: 188. 1902.

On the ground in woods, common.

The plants are at first small and almost entirely globose becoming expanded and hemispherical with age. The species is easily known by the white hymenium and external covering of brown hairs, the plants being about the size of an acorn-cup.

LACHNEA ALBO-SPADICEA (Grev.) Phill., Brit. Discom. 228. 1887.

Peziza albo-spadicea Grv., Fl. Edin. 420. 1824.

Plants sessile, gregarious, at first subglobose becoming expanded and often nearly plane, about 5 to 8 mm., externally clothed with rather soft brown hairs; hymenium white or whitish; asci cylindrical, 8-spored; spores elliptical, smooth, about 20 by 10μ; paraphyses filiform, slender.

On naked soil in shaded places among weeds, Iowa City.

The specimens referred to this species have been collected often but never in large numbers. They resemble somewhat the preceding but are much smaller and the cups which are at first hemispherical become nearly plane with the margin often slightly split. The hairs are softer and not so prominent as in *L. hemispherica*.

Lachnea paludosa (Boud.) Sacc., Syll. Fung. 11: 400. 1895.
Plate 11, f. I.

Ciliaria (*Trichophæa*) *paludosa* Boud., Bull. Soc. Myc. France 10: 65. 1894.

Plants thickly gregarious, 1 to 2 mm. in diameter, hemispherical, becoming nearly plane, externally thickly clothed with long, bristly, brown hairs; hymenium whitish or bluish-white; hairs straight, rather sharp-pointed, mostly simple, reddish-brown, as long as 500μ; asci cylindrical, 8-spored; spores 1-seriate, elliptical, at first 2-guttulate, becoming tuberculose with very large wart-like markings giving the spore a scalloped appearance; tubercles 2 to 3μ in diameter, entire spore 22 to 25 by 15 to 17μ; paraphyses enlarged at their apices.

On naked soil in moist places, rather common.

The species described here has often been met with in the vicinity of Mt. Pleasant where the small plants grow in dense masses on damp soil in shaded places. The species is an attractive one although probably not very distinct in its external characters. The bluish-white hymenium contrasts quite strongly with the dark brown hairy exterior. The spore characters however are very distinct from any of the discomycetes studied in this locality. The spores are covered with large wart-like markings which give them a decidedly scalloped appearance, the scallops reaching a size of 2 to 3μ, much larger and more distinct than in any of the other species studied. The original drawings of the plants, hairs, and spores of this species correspond as closely with the specimens studied in Iowa as they could have done if drawn from this material, although the original description was drawn from material collected in France.

In addition to the material collected at Mt. Pleasant, one specimen of this species has been sent in by Mr. S. C. Knupp from Garrison, Iowa.

Lachnea abundans (Karst.) Sacc., Syll. Fung. 8: 186. 1889.
Plate 11, f. III.

Peziza abundans Karst., Fauna Fl. Fenn. 10: 124. 1869.

Plants thickly crowded, small 1 to 2 mm. in diameter, externally brownish, clothed with a thick covering of short, rigid, sharp-pointed, pale brown, 1- to 3-septate hairs which reach a length of 200 to 250μ; hymenium dull, pallid, becoming brownish; asci cylindrical, 8-spored, 100 to 125 by 10μ; spores elliptical to ovoid, 1- to 2-guttulate (mostly 2), smooth, 12 to 14 by 7 to 8μ; paraphyses clavate, apex much enlarged, 5 to 7μ in diameter, brownish.

On ground in woods where wood had been burned, Iowa City.

One collection of this species has been made, but the plants occurred in great abundance being closely crowded together on damp soil where a brush-pile had been burned.

*LACHNEA SCUTELLATA (L.) Gill., Discom. 75. 1879.
Plate 10, f. I.

Peziza scutellata Linn., Sp. Pl. 1181. 1753.

Peziza ciliata Hoffm., Veg. Crypt. 2: 25. 1790.

Humaria scutellata Fuckel, Symb. Myc. 321. 1869.

Common on rotten wood.

The species is quite distinct in its scarlet, saucer-shaped plants and still more so in its broadly-elliptical, smooth spores completely filled with oil-drops and granules. The paraphyses also seem to be delicately marked. This is one of the most common species in this locality and is probably widely distributed. Specimens have also been observed by the writer in New York and North Dakota.

LACHNEA HIRTA (Schumach.) Gill., Discom. 75. 1879.

Peziza hirta Schumach., Pl. Saell. 2: 422. 1803.

Cups scattered, sessile, subhemispherical, becoming more or less expanded, externally clothed with septate, brown hairs; hymenium concave or nearly plane, bright red; asci cylindrical, 8-spored; spores elliptical, spinulose, usually 2-guttulate, about 25 by 10μ; paraphyses clavate, filled with colored granules.

On the ground and decaying materials.

The plants described under this name are similar to the preceding in external characters but the hymenium is usually darker. The spores are more narrowly-elliptical and spinulose, the markings resembling those of the spores of *L. hemispherica* (Schaeff.) Gill.

LACHNEA AURANTOPSIS (Ellis) Sacc., Syll Fung. 8: 180. 1889. Plate 11, f. II.

Peziza (*Sarcoscypha*) *aurantiopsis* Ellis, Bull. Torrey Cl. 9: 18. 1882.

Plants sessile, about 2 to 3 cm. in diameter, with a coarse, felt-like, black-brown mycelium at the base, cups also clothed with brown hairs; hairs septate, minutely rough toward the ends, flexuose, about 10μ in diameter and of nearly uniform thickness, blunt; hymenium clear, pale yellow, nearly sulphur-yellow, becoming dull orange when dry; asci cylindrical, 8-spored, 175 to 200μ long; spores elliptical, very large, about 15 by 28μ; paraphyses clavate.

On ground, decaying wood and other materials.

The specimens collected in Iowa by Mr. Holway which were referred to this species by Mr. Ellis do not conform well. The spores are smaller, the hairs rigid and the septa more numerous. The plants are also smaller.

Mr. Ellis indicated by a note on this specimen that it might be a form of *Peziza lanuginosa* Bull. The drawings in this paper were made from the type material in the Ellis collection.

LACHNEA STERCOREA (Pers.) Gill., Discom. 76. 1879.

Peziza stercorea Pers. Obs. Myc. 2: 89. 1799.

Plants gregarious or scattered, sessile, at first subglobose, then concave, becoming plane, dull red, clothed externally with a dense covering of brown hairs which are often branched or stellate; asci cylindrical, 8-spored; spores elliptical, smooth, 20 to 22 by 8 to 9μ; paraphyses clavate.

On cow dung.

The species is peculiar in its habitat and the presence of stellate hairs in addition to the ordinary straight ones on the exterior of the plants. Not common.

LACHNEA SETOSA (Nees) Gill. Discom., 75. 1879.

Peziza setosa Nees, Syst. Pilze. 260. 1817.

Plants thickly gregarious, 1 to 4 mm. in diameter, clothed with very long, brown, septate hairs; hairs as long as 600μ, hymenium plane, orange; asci cylindrical, 8-spored; spores elliptical smooth, 17 to 20 by 10 to 12μ filled with oil-drops; paraphyses clavate.

On rotten wood.

A common species on mossy logs in woods, distinguished by the presence of the very long hairs and the orange disc. The spores of this species are very similar to those of *Lachnea scutellata* (L.) Gill. but the external characters are quite different. This species has also been observed by the writer in North Dakota and is probably widely distributed.

*LACHNEA MELALOMA (A. & S.) Sacc., Syll. Fung. 8: 181. 1889.
Plate 10, f. II.

Peziza melaloma A. & S., Conspect. Fung. 336. 1805.

PEZIZA (Dill.) Linn., Sp. Pl. 2: 1180. 1753.

Peziza Dill., Cat. Pl. 76. 1719.

Receptacle at first closed, globose, then opening and becoming more or less cup-shaped or plane, substipitate or sessile, externally smooth, furfuraceous, or occasionally clothed with soft flexuose hairs (never with sharp-pointed bristles), asci cylindrical to clavate, 8-spored; spores elliptical to fusiform, smooth, verrucose, or spinulose; paraphyses filiform, mostly enlarged upwards; plants varying in color, growing on earth, wood or decaying materials of various kinds.

The genus as it has formerly been known has been broken into a number of new genera. Four species belonging properly to this genus are described here, but doubtless many more occur.

KEY TO THE SPECIES.

Plants light colored yellowish or whitish.
- Plants decidedly cup shaped. . . . . . . *P. vesiculosa.*
- Plants becoming repand with hymenium convex. . *P. repanda.*

Plants dark colored, brown or brownish-black.
- Plants large 3 to 10 cm. in diameter, cup-shaped. . *P. badia.*
- Plants small less than 2 cm., disc plane. . . . *P. brunneo-atra.*

PEZIZA VESICULOSA Bull., Champ. France 270. 1809.
Plate 16, f. I.

Aleuria vesiculosa Gill., Discom. 45. 1879.

Pustularia vesiculosa Fuckel, Symb. Myc. 329. 1869.

Cups large, gregarious or cespitose, at first hemispherical becoming expanded, but remaining cup-shaped, margin often contorted and undulate with age, fleshy, very fragile, furfuraceous, externally whitish or often reddish-brown near the margin, with the hymenium darker, yellowish, 2 to 3 cm. in diameter; asci cylindrical, operculate, 8-spored; spores elliptical, smooth, 20 to 22 by 10μ, granular within; paraphyses slender but enlarged upwards, granular within.

On rich ground and dung heaps, Iowa City, common.

The plants of this species are common on manure piles which are mixed with straw and on ground fertilized with such material. The plants are at first hemispherical and very regular becoming very much contorted with age especially when occurring in dense clusters as they often do. In younger specimens the exterior of the cups is very furfuraceous becoming more nearly smooth with age. This was listed in Discomycetes of Eastern Iowa as *Peziza cerea* Sow. which has been described as a variety of this species.

PEZIZA REPANDA Pers., Ic. Pictæ 49. 1806.
Plate 15. f. II.

Aleuria repanda Gill., Discom. 43. 1879.

Plants gregarious but not crowded, with a short but distinct stem; cups concave, nearly white, soon becoming repand and umbilicate, when mature more or less angular, often 3-sided and darker yellowish to brownish, stem obscured by the expanding disc, 2 to 10 cm. in diameter; asci cylindrical, 8-spored; spores elliptical, smooth, 15 to 18 by 10μ paraphyses clavate.

On coal dust in basement, Mt. Pleasant, and logs, Decorah.

This is a species concerning which there is much doubt as to the real nature of the specimens originally referred to it. Specimens collected by Mr. Holway in the northeast part of the state have been referred here. From plants collected in Mt. Pleasant the illustration in this work is drawn, which plants were studied during the entire summer. The cups are at first small with a conspicuous stem and almost perfectly white. Very soon the margin begins to turn back but failing to split the plants from necessity become angular commonly 3-sided. When mature the margin of the cup spreads on the ground so that the stem which was at first conspicuous is entirely obscured the plants at maturity attaining a size of 6 to 8 cm.; the color becomes darker as the plants mature. The characters mentioned in this description seem to be constant in the specimens studied. The plants were found in the basement of the main college building at Mt. Pleasant, the attention of the writer having been first called to them by Mr. Will Handy, a student at the college.

PEZIZA BADIA Pers., Obs. Myc. 2: 78. 1799.
Plate 14, f. II and 15, f. I.

Aleuria badia Gill., Discom. 43. 1879.

Plants gregarious, sessile, at first globose becoming expanded but remaining cup-shaped, margin at first turned inward becoming straight, color internally dark brown, externally lighter colored and pruinose; 2 to 10 cm. in diameter; asci cylindrical, 8-spored; spores elliptical, minutely rough, 15 to 18 by 8μ; paraphyses slender, clavate.

On the ground in woods, rather common.

Small plants, not exceeding 2 cm. in diameter, have often been collected on moist banks in woods, these plants being of a translucent reddish-brown color. One or two collections have been made of specimens which are as large as 6 to 8 cm. in diameter and dull dark-brown. Whether these two forms are the same seems doubtful. The habitat of the two forms is different the small plants occuring on damp naked soil while the larger specimens were found on rich soil in deep woods.

PEZIZA BRUNNEO-ATRA Desm., Ann. Sci. Nat. II. 6: 244. 1836.
Plate 14, f. III.

Plants scattered, sessile, entirely plane with a little depression in the center of the disc; fleshy, fragile, smooth, very dark-colored, brownish-black, 1 to 2 cm. in diameter; asci cylindrical, 8-spored; spores elliptical, minutely rough, 20 by 10μ; paraphyses clavate.

On damp soil in moist shady places.

The plants of this species resemble in color those of the preceding but are somewhat darker. The species is very distinct however in the general appearance of the plants which form small discs on the surface of the soil. This form has often been met with on naked soil among weeds in sheltered places. The spores are also similar to those of *Peziza badia* Pers. but there is some difference in the nature of the roughenings.

HUMARIA (Fries) Sacc., Syll. Fung. 8: 118. 1889.

Humaria Fries (as subgenus) Syst. Myc. 2: 42. 1822.

Plants small, sessile, for the most part bright colored, red or yellow; hymenium plane or convex; asci cylindrical to clavate, 4 to 8-spored; spores elliptical to fusiform.

The genus is distinguished from *Peziza* by the small size of the plants which grow commonly on moist soil among mosses, on naked soil or occasionally on the dung of animals. Four species are described here but the genus is probably represented in Iowa by many more.

KEY TO THE SPECIES

Asci 4-spored. . . . . *H. tetraspora.*
Asci 8-spored.
  Spores fusoid, twice as long as broad. . . . *H. muralis.*
  Spores broad-elliptical, about twice as long as broad.
    Plants externally granular, on dung. . . . *H. granulata.*
    Plants externally nearly smooth, on damp soil. *H. leucoloma.*

*HUMARIA TETRASPORA (Fuckel) Sacc., Syll. Fung. 8: 121. 1889.

Plate 13, f. I.

Ascobolus tetrasporus Fuckel, Hedwigia 5: 4. 1866.

Leucoloma tetraspora Fuckel, Symb. Myc. 317. 1869.

Peziza (Humaria) tetraspora Cooke, Grevillea 3: 73. 1874.

*HUMARIA MURALIS (Quel.) Sacc., Syll. Fung. 8: 127. 1874.

Plate 13, f. II.

Peziza (Humaria) muralis Quel., Grevillea 8: 116. 1879.

HUMARIA GRANULATA (Bull.) Sacc., Syll. Fung. 8: 129. 1889.

Peziza granulata Bull., Champ. France 258. 1809.

Ascophanus granulatus Speg., Michelia 1: 235. 1878.

Ascobolus granulatus Fuckel, Symb. Myc. 287. 1869.

Plants sessile, scattered or crowded, at first globose, becoming expanded, externally coarsely granular; hymenium orange; asci cylindrical, 8-spored; spores elliptical, smooth, 20 by 10μ; paraphyses clavate.

On cow dung, Decorah.

The only specimen seen is that in the Holway Collection in the State College at Ames.

HUMARIA LEUCOLOMA (Hedw.) Sacc., Syll. Fung. 8: 118. 1889.

Octospora leucoloma Hedw., Laub-Moose. 2: 17. 1789.

Leucoloma hedwigii Fuckel, Symb. Myc. 317. 1869.

Aleuria leucoloma Gill., Discom. 56. 1879.

Plants gregarious, sessile, 1 to 5 mm. in diameter; hymenium bright orange, slightly concave or plane; asci cylindrical, 8-spored; spores broad-elliptical, smooth, with one very large and conspicuous oil-drop near the center, large, 20 by 12 to 15μ; paraphyses enlarged upwards and filled with orange granules.

On damp soil among moss, Iowa City and Mt. Pleasant.

A common species on the margins of cinder walks overgrown with moss, where they have been found up to the late fall after the ground has been frozen. The plants are closely sessile so that the hymenium is about even with the surface of the soil.

The specimens listed in previous papers as *H. humosa* are probably only a form of this species. The habitat of the two is a little different as well as the size of the plants, but I can see no difference in microscopic characters.

PHÆOPEZIA Sacc., Michelia 1: 71. 1877.

Plants fleshy or subfleshy, sessile, cup-shaped or nearly plane, rarely bright colored, smooth or hairy; asci elongated, 6 to 8-spored; spores simple, elliptical, colored, greenish or brownish.

One species rather common in the state.

PHÆOPEZIA FUSCOCARPA (Ellis & Holw.) Sacc., Syll. Fung. 8: 474. 1889.

Peziza (*Humaria*) *fuscocarpa* Ellis & Holw., Jour. Myc. 1: 5. 1885.

Plants sessile, orbicular, 3 to 4 mm. in diameter, externally pruinose-tomentose, olivaceous-yellow; hymenium concave or nearly plane, dark greenish becoming greenish-black, when dry entirely black; asci cylindrical, 65 to 80 by 4 to 5μ; spores elliptical with ends narrowed, often unequal-sided, at first hyaline then greenish to brown, 7 to 8 by 3 to 3.5μ.

On rotten wood, rather common.

This species as described by Ellis and Holway was based on material collected in Iowa. The species was found by the writer to be rather common on rotten wood especially on overturned logs where the wood and soil came into contact with each other. The plants when fresh are decidedly greenish becoming darker with age especially when dry. The spores at maturity are smoky-brown, and in some cases apparently 1-septate. The presence of the two oil-drops makes it difficult to determine whether the spores are truly septate or only apparently so.

GEOPYXIS (Pers.) Sacc., Syll. Fung., 8: 63. 1889.

Geopyxis (subgenus) Pers., Myc. Eur., 1: 224. 1822.

Receptacle funnel-shaped or spreading, for the most part rather large fungi with a distinct stem which is generally short and thick.

One species has been found to be very common on rotten logs in woods.

*GEOPYXIS NEBULOSA (Cooke) Sacc., Syll. Fung., 8: 70. 1889. Plate 20, f. II.

Peziza nebulosa Cooke, Mycogr., 163.

In woods on rotten logs, Iowa City and Mt. Pleasant.

ACETABULA (Fries) Fuckel, Symb. Myc. 330. 1869.

Acetabula (as subgenus) Fries, Syst. Myc. 2: 43. 1822.

Cups scattered, medium large, supported by a short, thick, deeply furrowed stem; asci long, cylindrical, 8-spored; spores 1-seriate, oblong or ovate, simple, hyaline; paraphyses clavate.

Although this genus is commonly recognized among the discomycetes it is doubtful if it can stand as a valid genus, the name having been previously used as a generic name among the algæ. However it is thought best to leave this matter to be decided upon by those who shall monograph the North American fleshy discomycetes. Two species collected in the state.

KEY TO THE SPECIES.

Veins extending up the sides of the cup nearly to its margin. . . . . *A. acetabulum.*
Veins not extending up the sides of the cup. . . *A. sulcata.*

ACETABULA ACETABULUM (L.) comb. nov.
Plate 19, f. III.

Peziza acetabulum Linn., Sp. Pl. ed 2: 1650. 1763.

Acetabula vulgaris Fuckel, Symb. Myc. 330. 1869.

Aleuria acetabulum Gill., Discom. 36. 1879.

Helvella acetabulum Quel., Enchir. Fung. 275. 1886.

Cups medium large, 2 to 5 cm. in diameter, with prominent branching veins which extend nearly to the margin of the outside of the cup, with a short, thick stem; stem 1 to 2 cm. long and about 1 cm. thick, deeply furrowed; hymenium brown, externally paler, yellowish; asci cylindrical, 8-spored; spores elliptical, with one large globose oil-drop 18 to 20 by 12μ; paraphyses clavate.

In woods, various localities in eastern Iowa.

The species is very distinct in the ribs which extend from the grooved stem up the sides of the cup. The spores have each one large oil-drop which is so conspicuous that it is at first mistaken for the spore itself. This plant is commonly known under the specific name given by Fuckel although *Peziza acetabulum* is usually cited in the synonym of the species as it was in the Fuckel's description. Since it becomes necessary to cite the name given by Linnæus as a synonym we use this in combination with the genus under which the species is usually described.

ACETABULA SULCATA (Pers.) Fuckel, Symb. Myc. 330. 1869. Plate 19, f. II.

Peziza sulcata Pers., Syn. Fung. 643. 1801.

Plants stipitate, about 2 cm. in diameter, externally pruinose, light colored, yellowish; hymenium darker, brown; stem 1 to 2 cm. long by 5 to 1 cm. thick, with deep grooves which extend as far as the base of the cup; asci cylindrical, 8-spored; spores elliptical, smooth, 18 to 20 by 12μ; paraphyses enlarged above.

On damp ground in woods, Iowa City.

The species is quite different from the preceding in the absence of veins which extend up the sides of the cup. The stem itself is grooved as in *A. acetabulum* (L.).

Only one collection of this species was made but a number of plants were found.

MACROPODIA Fuckel, Symb. Myc., 331. 1869.

Receptacle cup-shaped or expanded, usually borne on a long, slender stem, externally rough with minute hairs or hair-like outgrowths appearing mealy; hymenium darker than the exterior of the cup; spores elliptical or fusoid.

Two species common in woods.

KEY TO THE SPECIES.

Plants with long, slender stem; spores subelliptical.	*M. macropus.*
Plants with short, thick stems; spores fusiform. . .	*M. fusicarpa.*

MACROPODIA MACROPUS (Pers.) Fuckel, Symb. Myc., 331. 1869. Plate 19, f. I.

Peziza macropus Pers., Obs. Myc., 1: 26. 1790.

Cups hemispherical then expanded, clothed externally with minute hair-like structures, giving the exterior of the cup and stem a pruinose appearance; hymenium brownish; stem long, slender, tapering upwards, even or lacunose, asci cylindrical, 8-spored; spores fusoid, or elliptical, becoming slightly rough at maturity, about 30 by 10 to 12μ; paraphyses enlarged upwards.

On the ground in woods, Iowa City and Mt. Pleasant.

The plants of this species are rather common but usually not abundant. They are recognized at once by the cup which is supported by the long slender stem. There seems to be a small form of this species which is rather common but does not grow larger than 1 to 2 cm. in height.

MACROPODIA FUSICARPA (Ger.) Durand, Jour. Myc. 12: 28. 1906.

Plate 21, f. I.

Peziza fusicarpa Ger., Bull. Torrey Cl., 4: 64. 1873.
Peziza (*Sarcoscypha*) pubida B. & C., Grevillea 3: 153. 1875.
Macropodia pubida Sacc., Syll. Fung. 8: 159. 1889.
Lachnea fusicarpa Sacc., Syll. Fung. 8: 172. 1889.
Peziza velutina Berk. & Curtis, Bot. N. Car. 132. 1867.
Peziza morgani Massee; Morgan, Jour. Myc. 8: 190. 1902.

Cups scattered or thickly crowded, nearly hemispherical, shortly stipitate, 1 to 2 cm. in diameter; hymenium dark brown to purplish, darker when dry; externally clothed with short, brown, septate hairs, giving the plant a mealy appearance; hairs longer near the base; asci cylindrical, 8-spored; spores fusiform, rough with 2 oil-drops, granular within, 38 to 42 by 10μ; paraphyses slender, enlarged upwards.

On the ground in woods, Iowa City and Mt. Pleasant, also studied in New York state.

The stem is short and generally covered with long, brown hairs, and immersed in the ground so that the cups seem to be entirely sessile. In the field the plants resemble somewhat those of *Lachnea hemispherica* (Schæff.) Gill., but are distinguished by the dark colored hymenium and by the sofe hairs instead of the sharp bristly ones which are found on the cups.

In the Discomycetes of Eastern Iowa it was suggested that *Peziza morgani* Massee might be identical with this species which has since been found to be the case, and several previous notes made on it in various numbers of the Journal of Mycology and Proceedings of the Iowa Academy of Sciences. The above synonomy is taken largely from Durand (Jour. Myc. 12: 28) in which he goes still farther and makes both supposed species synonymous with *Peziza fusicarpa* Ger.

This is a very common and interesting species.

ALEURIA Fuckel, Symb. Myc. 325. 1869.

Receptacle cup-shaped, often irregular, externally pruinose, usually bright-colored; asci cylindrical to clavate, 8-spored; spores at first smooth, becoming rough and at maturity delicately reticulated.

This genus was founded by Fuckel on *Peziza aurantia* Pers., a reticulate-spored *Peziza,* and although not mentioned by Fuckel this character has come to be recognized as the characteristic of the genus or subgenus as the case may be.

Two reticulate-spored forms occur in the state.

KEY TO THE SPECIES.

Plants small, about 1 cm., spores 1-guttulate. . . . *A. aurantia.*
Plants large, more than 2 cm., spores 2-guttulate. *A. rutilans.*

ALEURIA AURANTIA (Pers.) Fuckel, Symb. Myc. 325. 1869.

Peziza aurantia Pers., Syn. Fung. 637. 1801.

Plate 17, f. I.

Cups subsessile, at first regular, becoming irregular with age, 2 to 5 cm. in diameter, externally whitish; hymenium deep orange; asci cylindrical, 8-spored; spores elliptical, 1-seriate, 2-guttulate, at first smooth becoming reticulated, 15 to 17 by 8μ; paraphyses slender, enlarged upwards, filled with orange granules which give color to the hymenium.

In grassy places, Iowa City, also in woods.

This is probably one of the most attractive and best known forms of the discomycetes. Its large size and unusually bright color makes it easy of detection. The species is probably rather common throughout North America. A specimen was received by the writer from Dr. T. C. Frye of Seattle, Washington, with the statement that it occurred in abundance on the campus of the State University. During the present season the same species has been collected and studied by the writer in New York City. These go to indicate a wide distribution.

ALEURIA RUTILANS (Fries.) Gill., Discom. 53. 1879.

Plate 17, f. II.

Peziza rutilans Fries., Syst. Myc. 2: 68. 1822.

Gregarious, sessile, or with a short stem, about .5 to 1 cm. in diameter, externally clothed with very few minute white hairs; hymenium bright orange; asci cylindrical, 8-spored; spores elliptical, 1-guttulate, externally covered with net-like reticulations, giving the spore a roughened appearance, 22 to 25 by 12μ; paraphyses slender, enlarged upwards, filled with orange granules.

In woods among moss (*Polytrichum*), Iowa City, rather common.

Specimens described under this name are vecry interesting. The plants are distinct from the preceding in the size, habitat, and in their more decidedly stipitate character. They have always been found by the writer among the same kind of moss and in some cases were thought to grow from the stems of the mosses among which they are more or less immersed, but this could not be determined with certainty.

The plants described here have reticulate spores similar to those of the preceding. In the Discomycetes of Eastern Iowa this fact was mentioned and illustrated with the statement that in no available description were the spores of *Peziza rutilans* Fries described as being reticulate although they were always described as rough.

Since that statement was made a reference has come to hand (Grevillea 22: 108) in which the description drawn from a specimen named by Fries as *Peziza rutilans* states that the spores are delicately reticulated. The specimens described here conform well in that particular with authentic material, a point concerning which the writer was in doubt at the time the first record of the species was published.

In some respects these plants resemble more closely those of *Peziza polytrichi* Schum. The plants especially when young are quite hairy often with a distinct white fringe around the margin but older specimens are more nearly smooth or only slightly downy. The stem-like base is also a prominent character.

GALACTINIA (Cooke) Sacc., Syll. Fung., 8: 106. 1889.

Galactinia Cooke (as subgenus), Mycogr., 253.

Receptacle sessile, cup-shaped, entire, fleshy, when wounded exuding a milky, colored juice; asci cylindrical, 8-spored; spores elliptical hyaline.

One species common in Iowa.

GALACTINIA SUCCOSA (Berk.) Sacc., Syll. Fung., 8: 106. 1889.
Plate 16, f. II.

Peziza succosa Berk., Not. Brit. Fungi. No. 156 (reprint from Ann. Mag. Nat. Hist. 1841).

The plants of this species are not striking in external appearance but are easily distinguished by the bright yellow, milky juice which exudes when the flesh is broken. There seems to be two varieties of this species distinguished mainly by the difference in size. The one is small, scarcely reaching a size of 2 cm. in diameter and the cups very regular and almost perfectly hemispherical in form. The other is much larger often reaching a size of 4 to 5 cm. and the cups are not perfectly hemispherical but the sides are more nearly straight giving the plant more or less of a funnel-shaped appearance. Whether the two forms are entirely distinct is uncertain.

OTIDEA (Pers.) Fuckel, Symb. Myc., 329. 1869.

Otidea (subgenus) Pers., Myc. Eu. 1: 220. 1822.

Receptacle large, elongated or split on one side nearly to the base; cups more or less stipitate, scattered or densely crowded; asci cylindrical, 8-spored; spores elliptical, smooth, hyaline with one or two oil-drops; paraphyses clavate or bent in the form of a hook at the apex.

KEY TO THE SPECIES.

Plants large, hymenium brown, paraphyses, hooked. . . . *O. leporina.*
Plants comparatively small, yellowish, paraphyses straight. . . . . *O. ochracea.*

*OTIDEA LEPORINA (Batsch) Fuckel, Symb. Myc., 379. 1869.

Peziza leporina Batsch, Elench. Fung., 1: 118. 1783.

The large cups much elongated on one side are very good characters by which the present species may be distinguished.

*OTIDEA ONOTICA OCHRACEA (Fries) Sacc., Syll. Fung. 8: 95. 1889.

Plate 18, f. I.

Peziza onotica ochracea Fries, Syst. Myc., 2: 48. 1822.

The plants examined occur in dense clusters and the cups are split entirely to the base. The paraphyses are nearly straight, not hooked as in the preceding.

FAMILY 6. ASCOBOLACEÆ.

Receptacle generally sessile on the substratum, at first closed, later more or less expanded, nearly always found on dung; peridium thin or wanting; hypothecium for the most part well developed, consisting of roundish cells; asci at maturity protruding beyond the surface of the hymenium, generally operculate; spores hyaline or purple, globose to elliptical, smooth or marked with wart-like projections or reticulations.

This is one of the most interesting families of all the discomycetes. The plants are usually very small in size but occurring, as they do, on the dung of various animals may be detected by the guidance of the substrata on which they occur. The plants of the family seem to have the ability to endure long periods of extreme dryness and to spring into life again with the return of moisture. The group is of unusual interest on account of the ease with which the plants may be cultivated in the laboratory.

About twenty species of the family have been studied in Iowa most of which were first studied from material cultivated in artificial cultures. Later many of the same species were collected in the field.

In addition to the forms described here one species has been observed and studied by the writer in New York which is of some interest. This species was *Streptotheca boudieri* Vaill. which is the only representative of the genus, having been collected on (rabbit?) dung.

ASCOPHANUS Boud., Ann. Sci. Nat. V. 10: 241. 1869.

Receptacle at first closed then expanded, fleshy or fleshy-gelatinous, externally smooth or minutely granulated (not hairy); hymenium at maturity plane or convex; asci cylindrical or clavate, operculate, 8-spored, protruding beyond the surface of the hymenium at maturity; spores elliptical, hyaline, smooth or sometimes slightly rough, in one or two rows in the ascus.

The plants of the genus usually occur on dung of different animals. Five species are here described.

KEY TO THE SPECIES.

Plants very small, scarcely visible with lens.
  Spores 7 to 8μ long, paraphyses globose. . . *A. microsporus.*
  Spores 10 to 13μ long, paraphyses pyriform. . *A. granuliformis.*
Plants 1 to 2 mm. in diameter, easily visible.
  Receptacle cinereous to blackish. . . . . *A. cinereus.*
  Receptacle flesh-colored to red.
    Plants commonly on old hemp, paper, etc. . *A. testaceus.*
    Plants commonly on dung. . . . . . *A. carneus.*

*ASCOPHANUS MICROSPORUS (Berk & Br.) Phil., Brit. Discom. 307. 1887.

Plate 27, f. II.

Ascobolus microsporus Berk & Br., Not. Brit. Fungi. No. 1087. Ann. Mag. Nat. Hist. 1865.

Common in the field both at Iowa City and Mt. Pleasant.

ASCOPHANUS GRANULIFORMIS (Crouan) Boud., Ann. Sci. Nat. V. 10: 245. 1869 (reprint p. 55).

Ascobolus granuliformis Crouan, Ann. Sci. Nat. IV. 10: 195. 1858.

Plants minute, globose or hemispherical, pale yellowish, translucent, smooth; asci small, very wide, oblong, narrowed at the base, 8-spored; spores hyaline, smooth, elliptical, 10 to 13 by 7μ; paraphyses simple or branched, pear-shaped at the apices.

On cow-dung Decorah, Iowa. E. W. D. Holway.

The only specimen of this species seen is the one in the Holway collection, at Ames, Iowa. Probably not uncommon but easily overlooked.

The species derives its name from the fact that the plants appear like minute grains on the substratum.

*Ascophanus cinereus (Crouan) Boud., Ann. Sci. Nat. V. 10: 249. 1869.

Plate 28, f. I.

Ascobolus cinereus Crouan, Ann. Sci. Nat. IV. 10: 194. 1858.

Grown on horse-dung in culture in the laboratory, also since collected in the field.

The species is quite easily distinguished from any of the other forms described here by the cinereous or blackish color of the plants.

During the fall of 1906 a fine collection of this species was made on horse-dung in a wet swampy place in North Dakota.

*Ascophanus testaceus (Moug.) Phill., Brit. Discom. 310. 1887.

Plate 27, f. I.

Peziza testacea Moug.; Fries, Elench. Fung. 2: 11. 1827.

Ascobolus testaceus Berk. & Br., Not. Brit. Fungi, No. 1082.

Ascobolus testaceus Berk. & Br., Not. Brit. Fungi, No. 1980. (Reprint from Ann. Mag. Nat. Hist., 1865).

Abundant collections were made on old sacking, building paper and cloth.

The color of these plants varies according to conditions; they are generally bright red but often pale. The color becomes brighter as the plants dry. A piece of old sacking found near the experiment station at Lafayette, Indiana, was almost entirely covered with the plants of this species. It was also found on heavy building paper in a damp place.

During the fall of 1905 this species was collected in good quantity on old building paper and sacking at Mt. Pleasant, Iowa, and during the autumn of 1906 the same species was again collected on a similar habitat in North Dakota.

Ascophanus carneus (Pers.) Boud., Ann. Sci. Nat. V. 10: 250. 1869. (Reprint p. 59).

Ascobolus carneus Pers., Syn. Fung., 676. 1801.

Scattered or rarely crowded, minute, sessile, flesh-red, smooth, at first globose then flattened; hymenium convex, papillate, immarginate; asci broad, clavate, attenuated below, 8-spored; spores elliptical, smooth or very minutely roughened, hyaline. about 18 by 10μ; paraphyses enlarged upwards, septate.

On cow-dung, Iowa City and Mt. Pleasant.

The species was found to be very common about Mt. Pleasant. The plants when moist are pale reddish but when dry become bright red and easily seen. The species is quite similar to the preceding but differs in the habitat with slight differences in morphological characters.

LASIOBOLUS Sacc., Bot. Cent. 18: 220. 1884.

Receptacle similar to that of *Ascophanus* but externally clothed with sharp-pointed hairs.

Two species collected in the state, one of which is very common.

KEY TO THE SPECIES.

Hairs long, numerous and conspicuous. . . . . . . *L. equinus.*
Hairs obscure, few and inconspicuous. . . . . . . *L. raripilus.*

*LASIOBOLUS EQUINUS (Muell.) Karst., Act. Soc. Fauna Fl. Fenn. 2: 122. 1885.

Plate 32, f. I.

Elvela equina Mueller, Fl. Dan. pl. 779. 1782.

Ascobolus pilosus Fries, Syst. Myc. 2: 164. 1822.

Peziza papillata Pers., Syn. Fung. 650. 1801.

Ascobolus ciliatus Kunze & Schm., Myc. Heft 90. 1817.

These plants have been collected in large quantities on the usual (dung) substratum during the entire season. The plants vary much in color so that this seems unreliable as a specific character. They often occur densely crowded on the substratum or more or less scattered. The paraphyses also vary much often being branched several times and in other cases entirely unbranched.

*LASIOBOLUS RARIPILUS (Phill.) Sacc., Syll. Fung. 8: 537. 1889.

Plate 32, f. II.

Ascobolus raripilus Phill., Grevillea 7: 23. 1878.

THECOTHEUS Boud., Ann. Sci. Nat. V. 10: 235. 1869.

Receptacle waxy, sessile, at first conical in form and almost pointed above, later expanding, becoming cylindrical and about as broad as high; hymenium erumpent, immarginate, subpruinose, at first plane, then convex, rough with crystalline points, which are the emergent asci; asci large, elongated and broad, 32-spored, becoming much exserted; spores hyaline, each surrounded by a mucilaginous membrane.

The genus is represented by a single species which occurs commonly in Iowa. The genus is distinguished from *Ryparobius* by the larger size of the plants and their peculiar conical form when young, also by the erumpent hymenium.

THECOTHEUS PELLETIERI (Crouan) Boud., Ann. Sci. Nat., V. 10: 236. 1869.

Plate 33, f. I.

Ascobolus pelletieri Crouan, Ann. Sci. Nat. IV. 7: 173. 1857.

Ryparobius pelletieri Sacc., Syll. Fung. 8: 542. 1889.

Gregarious or scattered, conical, then cylindrical, dirty whitish to gray, externally pruinose; hymenium at first slightly concave, then plane or convex; asci few, very large, cylindrical, operculate, stipitate, 300 to 320 by 50 to 60μ; spores 32 in each ascus, arranged three to four abreast in irregular rows, large, attenuated at each end, often filled with large guttulæ, or granular, 23 to 24 by 35 to 38μ, paraphyses slender, branched.

Grown on cow-dung in the laboratory, Iowa City, also collected on horse-dung Mt. Pleasant; rather common.

The plants of this species were grown several times under glass in the laboratory at Iowa City previous to the publication of the Discomycetes of Eastern Iowa. They are at first white or nearly so and taper to a point at the apex which gradually spreads out until the plant becomes cylindrical with the hymenium convex. When mature the whole plant is from 2 to 3 mm. in diameter and about the same in height.

RYPAROBIUS Boud., Ann. Sci. Nat. V. 10: 237. 1869.

Receptacle, minute (usually less than 1 mm.) at first globose, then expanded or depressed, white or whitish, externally smooth or downy; asci cylindrical, or very broad and elliptical, present in small numbers, generally operculate, 16 to many-spored; spores elliptical or fusiform, hyaline, smooth; paraphyses slender, colorless.

Three species of the genus have been studied in Iowa.

KEY TO THE SPECIES.

Asci 16-spored. . . . . *R. sexdecimsporus.*
Asci more than 16-spored.
  Asci 64-spored. . . . . *R. pachyascus.*
  Asci many-spored, number indefinite. . . . *R. crustaceus.*

*RYPAROBIUS SEXDECIMSPORUS (Crouan) Sacc., Syll. Fung. 8: 541. 1889.

Plate 34, f. I.

Ascobolus sexdecimsporus Crouan, Ann. Sci. Nat. IV. 10: 195. 1858.

Ascophanus sexdecimsporus Phill., Brit. Discom. 311. 1887.

*RYPAROBIUS CRUSTACEUS (Fuckel) Rehm, Ber. Naturh. Ver. Augsburg 26: 17. 1881.

Plate 33, f. II.

Ascobolus crustaceus Fuckel, Hedwigia 5: 4. 1866.

RYPAROBIUS PACHYASCUS Zukal; Rehm, Hedwigia 27: 167. 1888.

Plate 34, f. II.

Gregarious or scattered, very minute, scarcely visible with the lens, 70 to 90μ in diameter, partly immersed, yellowish-brown; asci few in each plant, 3 to 5, broad, acute at the base, not stipitate, 70 to 76 by 32 to 35μ, many-spored; spores minute, elliptical, 5 to 7 by 3μ; paraphyses not distinct.

Grown on cow-dung in the laboratory, Iowa City.

Plants very small and could not be distinguished except as they were collected with other species. The number of asci in each plant is small varying from three to five. The entire ascus is filled with the spores which seem to be arranged radially around the outside of the ascus. The exact number of spores in each ascus could not be made out but there are more than 64. The paraphyses if present were indistinct.

ASCOBOLUS Pers., Obs. Myc., 1: 33. 1796.

Receptacle fleshy-gelatinous, at first closed, globose, later more or less cup-shaped or plane, externally smooth, furfuraceous or clothed with soft hairs; asci cylindrical or clavate, operculate, protruding at maturity, spores elliptical, smooth reticulate or verrucose, at first hyaline then purple and at last brown; paraphyses scarcely enlarged upwards; plants generally found on dung but often occuring on decaying plant materials; hymenium dotted with the end of the asci containing dark colored spores.

KEY TO THE SPECIES.

Plants very minute about 1 mm. or less in diameter,
smooth. . . . . *A. glaber.*
Plants externally furfuraceous or pilose.
Plants minute slightly hairy, spores very large
to 50μ. . . . . *A. immersus.*
Plants furfuraceous, spores not to exceed 30μ.
Spores rough, verrucose or reticulate.
Spores verrucose, plants on burnt ground. . *A. carbonarius.*
Spores delicately reticulate.
Plants light colored, yellowish-green, on
dung. . . . . *A. stercorarius.*
Plants dark colored, greenish to brownish, on soil. . . . . *A. viridis.*
Spores smooth, plants on horse-dung. . . . *A. leveillei.*

*Ascobolus glaber Pers., Obs. Myc. 1: 34. 1796.
Plate 31, f. ii.

The plants of this species which are from .5 to 1 mm. in diameter were found growing sparingly on the material described above. When growing they appear as small globose, shining dots but removed from the substratum they are found to be pyriform, the lower part of the plant being immersed. The spores of this species are similar to those of *Ascobolus stercorarius* (Bull.) Schroet. but are easily distinguished by the surface markings. The spores of the former are marked by a few branching reticulations which are for the most part longitudinal while in the latter they extend in any direction and are much more numerous, giving the spore a decidedly roughened appearance.

*Ascobolus immersus Pers., Obs. Myc., 1: 35. 1796.
Plate 31, f. I.

Ascobolus macrosporus Crouan, Ann. Ann. Sci. Nat., IV. 7: 173. 1857.

Ascobolus gigasporus De Notaris, Comm. Critt. It., 1: 360. 1863.

Ascobolus carbonarius Karst., Not. Fauna Fl. Tenn. 11: 202. 1870.

**Ascobolus atro-fuscus* Phill. & Plow., Grevillea 2: 186. 1873.
Plate 29, f. I.

Plants found growing on the banks of the Iowa River near Iowa City, where a brush pile had been burned, also later collections made where fires had been in various localities. The plants are usually densely crowded on or surrounding the pieces of charcoal with which the soil is mixed. They are very dark brown in color and rough on the outside.

A note was added by Phillips and Plowright in their original description cited above as follows: "We have little doubt of this being the same plant referred to by Mr. Boudier (l. c.) as *Ascobolus viridis* Curr.; it differs so much in sporidia, colour and habitat from Mr. Currey's species that we venture to consider it distinct."

Later *Ascobolus viridis* Curr., or what was suspected to be this, was collected by the writer on clay soil in other localities along the Iowa River in moist places and it was never suspected that this might be identical with *A. atro-fuscus* Phill. & Plow. until this note was read. In addition to the differences mentioned by Phillips and Plowright the spores of *A. viridis* are reticulate and in *A. atro-fuscus* we have seen no signs of reticulations but the spores are beautifully verrucose. It would seem that the two forms are distinct, but the illustration of Boudier conforms more closely to the description of *Ascobolus atro-fuscus* Phill. & Plow. than to that of *Ascobolus viridis* Curr.

Ascobolus viridis Curr., Trans. Linn. Soc., 24: 154. 1864.
Plate 30, f. I.

Plants sessile, plane or very slightly concave, nearly flat, 1 to 5 mm. in diameter, yellowish or greenish-yellow, becoming brown; externally furfuraceous and darker, brownish; asci clavate, 125 to 150 by 20 to 22μ, tapering into a rather long stem, 8-spored; spores elliptical or slightly accuminate, at first hyaline and granular within, becoming purple, then brown, when mature marked with net-like reticulations, 21 to 27 by 12μ, 1- to 2-seriate, when mature crowded together; paraphyses slender, simple or branched, granular within, surrounded by greenish-yellow mucus.

On the damp, clay soil, on the banks of the Iowa River, from June until late autumn, Iowa City, common.

The following is the original description of this species: "On clay ground; sessile, one-third of an inch wide, plane or very slightly concave, of a dark dingy yellowish green colour, externally very furfuraceous, almost tomentose; spores elliptical-accuminate, rugose-striate, amethyst purple."

Our plants conform very closely to this description but are a little smaller.

Ascobolus stercorarius (Bull.) Schroeter, E & P. Nat. Pfl. 1[1]; 198. 1897.
Plate 29, f. II.

Peziza stercoraria Bull. Herb. France, pl. 376, f. 1. 1787.

Ascobolus furfuraceus Pers., Obs. Myc. 1: 33. 1796.

Plants sessile, globose, then expanded, 1 to 5 mm. in diameter, externally pale yellow, covered with bran-like particles, especially near the margin; hymenium concave, sometimes plane or slightly convex, same color when young, becoming dark with age on account of the dark colored spores; flesh very brittle; asci clavate, emergent; spores elliptical, reticulate, violet, then brown, 20 to 25 by 10 to 12μ; paraphyses filiform, septate, imbedded in sulphur-yellow gelatine.

On old cow-dung in pastures and woods, also grown in culture. A very common species and easily recognized by the yellowish plants which are covered with dark dots, the ends of the emergent asci filled with dark purple spores. The plants occur scattered or densely crowded and vary much in size.

ASCOBOLUS LEVEILLEI Boud., Ann. Sci. Nat., V. 10: 225. 1869. Plate 30, f. II.

Plants thickly gregarious, small about 1 mm. in diameter or less, globose or expanded, externally brown, very rough almost pilose; hymenium dark with the emergent asci; asci 100 to 125 by 25μ, clavate, 8-spored; spores elliptical, smooth, at first hyaline, then purple and at last brown, 24 to 25 by 12μ paraphyses filiform, simple or branched, granular within.

On horse-dung, June, 1904, Iowa City.

These plants were referred to *Ascobolus brunneus* Cooke in An Annotated List of Iowa Discomycetes but they seem to conform more closely to the above. The general appearance of the plants as well as the spore characters conform very well to the illustration given with the original description cited above. The plants were collected in considerable mass on horse-dung.

Saccardo describes the spores of this species as being delicately reticulated. Neither the original description nor the illustrations accompanying it show this character, but the spores are represented as being entirely smooth as they are in our plants.

Our specimens were collected, described and the illustration drawn before the original description of this species was seen but in all points the descriptions conform unusually well.

SACCOBOLUS Boud., Ann. Sci. Nat. V. 10: 228. 1869.

Receptacle similar to *Ascobolus*, externally smooth; asci emergent, operculate, clavate, often stipitate, 8-spored; spores elliptical to fusiform, at first hyaline, then purple, at last brown, smooth, united into one globular mass in the ascus; plants generally occurring on dung.

KEY TO THE SPECIES.

Plants golden-yellow. . . . . *S. kerverni.*
Plants violet. . . . . *S. violacens.*

*Saccobolus kerverni (Crouan) Boud., Ann. Sci. Nat., V. 10: 229. 1869.

Plate 28, f. ii.

Ascobolus kerverni Crouan, Ann. Sci. Nat. IV. 10: 193. 1858.

Saccobolus violaceus Boud., Ann. Sci. Nat., V. 10: 230. 1869.

Ascobolus violascens Gill., Champ. France, 141. 1888.

Plants scattered or gregarious, minute, 1 to 2 mm. in diameter, smooth, soft, violet; hymenium convex of the same color as the exterior; asci broad more slender near the base, operculate, 8-spored; spores elliptical, subacute, at first hyaline, becoming violet to blackish, smooth, 15 by 9μ, enclosed in a common hyaline membrane; paraphyses violet, pyriform at the apex.

On cow-dung, Iowa City and Mt. Pleasant, rather common.

This species is very distinct from the preceding in the general color of the plants which are violet instead of golden-yellow, also the spores are a little smaller and darker. Several collections of the plants of this species have been made in Iowa by the writer.

FAMILY 7. HELOTIACEÆ.

Plants for the most part superficial, more rarely erumpent or produced from a sclerotium, sessile or stipitate, smooth or hairy; substance waxy or membranous or stout, composed of thin-walled, bright colored cells which form a pseudoparenchyma; cups at first closed, gradually becoming expanded; asci 8-spored, opening with a pore; spores globose to filiform, 1-8-celled.

SARCOSYPHA Fries, Sacc. Syll. Fung. 8: 153. 1889.

Sarcoscypha Fries (as tribe), Syst. Myc. 2: 78. 1822.

Sarcoscypha Cooke (as subgenus), Mycogr. 258.

Plants generally gregarious or tufted, more or less long-stipitate, receptacle generally cup-shaped becoming nearly plane in some cases, externally hairy; asci cylindrical, 8-spored; spores elliptical, usually smooth, hyaline, 1 to 2-guttulate; paraphyses slender, branched, enlarged above; plants usually bright colored, growing on decaying wood.

Three species common in Iowa.

KEY TO THE SPECIES.

Externally clothed with long rigid hairs. . . . . *S. floccosa.*
Externally clothed with soft flexuose hairs, or nearly naked.
Cups large, 3 to 4 cm.; stem short, thick. . . . *S. coccinea.*
Cups medium sized, 1 to 2 cm.; stem slender, usually long. . . . . *S. occidentalis.*

*SARCOSYPHA FLOCCOSA (Schw.) Sacc., Syll. Fung. 8. 156. 1889.

Plate 22, f. I.

Peziza floccosa Schw., Trans. Am. Phil. Soc. II. 4: 172. 1832.

*SARCOSCYPHA COCCINEA (Scop.) Sacc., Syll. Fung. 8: 154. 1889.

Plate 21, f. II.

Elvela coccinea Scop., Fl. Car. 2: 479. 1772.

Peziza coccinea Jacq., Fl. Austr. 2. pl. 163. 1774.

Lachnea coccinea Gill., Discom. 66. 1879.

Geopyxis coccinea Massee, Fung. Fl. York. 252. 1905.

On partially buried sticks in the woods, fall and spring, Iowa City and Mt. Pleasant. Also observed in North Dakota.

*SARCOSYPHA OCCIDENTALIS (Schw.) Sacc., Syll. Fung. 8: 154. 1889.

Plate 22, f. II.

Peziza occidentalis Schw., Trans. Am. Phil. Soc. II. 4: 171 1832.

On decaying sticks in woods, spring and summer, Iowa City, Mt. Pleasant, and Des Moines, Iowa. Also observed in North Dakota.

CHLOROSPLENIUM Fries, Summa Veg. Scand. 356. 1849.

Plants sessile or shortly stipitate, concave or plane, bright yellow to olivaceous or aeruginous-green, often staining the substratum green; asci clavate, 8-spored; spores ovoid to fusoid, simple, hyaline.

Three species of the genus not uncommon in Iowa.

KEY TO THE SPECIES.

Plants entirely sessile, bright to olivaceous. . . *C. chlora.*
Plants stipitate or substipitate, æruginous or olivaceous-green.
Plants bright æruginous-green. . . . . . *C. æruginosum.*
Plants dull olivaceous-green. . . . . . *C. versiforme.*

CHLOROSPENIUM CHLORA (Schw.) Massee, Jour. Linn. Soc. 35: 116. 1901.

Plate 23, f. III.

Peziza chlora Schw., Schr. Nat. Ges. Leipzig. 1: 122. 1818.

Chlorosplenium schweinitzii Fries, Summa Veg. Scand. 356. 1849.

Peziza crocitincta Berk. & Curtis; Berkeley, Grevillea 3: 160. 1875.

Plants thickly gregarious, soft, rather fleshy, at first closed and globose in form, then expanded but remaining concave with the margin incurved, bright yellow externally or often more or less faded; hymenium becoming greenish; cups appearing rough on the exterior but not hairy, 1 to 2 mm. in diameter; asci stipitate, 8-spored; spores 1-seriate, hyaline, simple, straight or curved, 5 to 6 by 1.5μ; paraphyses slender, slightly enlarged at their apices.

On old stumps especially oak, Iowa City and Mt. Pleasant, common.

Although this species is the type of the genus *Chlorosplenium* as founded by Fries the general appearance of the plants would scarcely suggest that genus as it is understood at the present time. The plants are usually very bright yellow, often orange-yellow with perhaps a slight tinge of green displayed especially by the hymenium. The species differs from the other members of the genus described here not only in color but in the entire absence of stem.

This species which has been collected often by the writer has always been associated with the genus *Helotium* rather than with the one to which it belongs.

CHLOROSPLENIUM ÆRUGINOSUM (Oeder) De Notaris, Comm. Critt. It. 1: 376. 1864.

Plate 24, f. I.

Helvella aeruginosa Oeder, Fl. Dan. pl. 534. 1770.

Peziza aeruginosa Vahl. Fl. Dan. pl. 1200. 1797.

Helotium aeruginosum Fries, Summa Veg. Scand. 355. 1849.

Plants gregarious with a short stem or nearly sessile, concave or nearly plane, bright æruginous-green externally, staining the substratum to some depth the same color; hymenium paler often yellowish; entire plant from 5 to 8 mm. in diameter and the same in height; stem stout, tapering below; asci cylindrical to clavate, 8-spored; spores fusiform or fusoid, 10 to 14 by 3 to 4μ, hyaline; paraphyses slender.

On old wood especially oak. Iowa City, Macbride and Shimek. Mt. Pleasant, Seaver, not uncommon.

The plants of the species are distinguished by the bright æruginous-green color of the exterior of the cups as well as that of the substratum on which they grow. The wood thus stained is made use of in the manufacture of various articles.

CHLOROSPLENIUM VERSIFORME (Pers.) De Notaris, Comm. Critt. It. 1: 376. 1864.

Plate 24, f. II.

Peziza versiforme Pers., Ic. Desc. 25. 1798.

Plants gregarious, stipitate or subsessile, concave or plane, often very irregular in outline, elongated on one side or variously contorted; externally brownish to olivaceous-green; hymenium dull olivaceous-green; asci cylindrical, 8-spored; spores elliptical or subelliptical, 12 to 14 by 3 to 4μ; paraphyses filiform, slender.

On old wood. Decorah, Iowa, E. W. D. Holway.

The only specimens of this species examined from Iowa are those collected by Holway at Decorah.

The color in this form is not nearly so bright as in the preceding and the plants are much more irregular in form. From the original description and illustration the color appears to be quite variable ranging from olivaceous-green to brownish or purplish but never so decidedly green as in *Chlorosplenium aeruginosum* (Oeder) DeNot.

CIBORIA Fuckel, Symb. Myc. 311. 1869.

Cups scattered, firm, often with a long stem, of medium size, waxy, externally smooth, or furfuraceous, hymenium concave or plane; color variable; asci elongated, 8-spored; spores oblong-oval, cylindrical or lanceolate, simple, hyaline; paraphyses present variable.

Plants larger and stem stronger than in the genus *Phialea*. One species reported from the state.

Ciboria sulphurella (Ellis & Everh.) Rehm; Durand, Bull. Torrey Cl. 29: 461. 1902.

Helotium sulphurellum Ellis & Everh., Bull. Torrey Cl. 10: 98. 1883.

Plants gregarious, stipitate; stem variable in length, sometimes as long as 2 cm. and slender, but often very short; cups 2 to 5 mm. in diameter, a little concave or nearly plane; plants very variable in color often sulphur-yellow when fresh with a tinge of green; hymenium darker becoming reddish or reddish-brown, when dry entire plant almost black; asci clavate, 8-spored, 75 by 8μ; spores 1-seriate with the ends overlapped, elliptical, narrowed at the ends, 10 to 12 by 3 to 4μ.

On petioles of ash (*Fraxinus*) Mt. Pleasant, common, Iowa City, Macbride.

The plants of this species were found to be abundant and quite attractive from their variable color. The species has been collected by the writer in New York and North Dakota and probably occurs coextensive with the host.

SCLEROTINIA Fuckel, Symb. Myc., 1: 330. 1869.

Plants for the most part medium large, single or in clusters springing from a sclerotium formed in the stems, leaves or fruits of plants; sclerotium resting over winter; cups at first closed, and globose, becoming expanded and cup-shaped or plane; asci cylindrical to clavate, 8-spored; spores elongated or elliptical, straight or curved, simple, hyaline, 1-seriate.

The genus is distinguished by the sclerotium from which the plants grow. Three species found in Iowa, two of which have their type locality in this state.

KEY TO THE SPECIES.

Sclerotium formed in acorns.	*S. pseudotuberosa.*
Sclerotium formed in seeds of bass wood. . . .	*S. tiliæ.*
Sclerotinum formed in seeds of wild cherry. . .	*S. seaveri.*

SCLEROTINA PSEUDOTUBEROSA Rehm. Rabenh. Krypt. Fl. 1[3]: 809. 1896.

Ciboria pseudotuberosa Rehm. Ber. Naturh. Ver. Augsburg 26: 28. 1881.

Stromatinia pseudotuberosa Boud., Bull. Soc. Myc. France, 1: 115. 1885.

Hymenoscypha pseudotuberosa Phill., Brit. Discom. 119. 1887.

Plants gregarious, stipitate; stem often 2 cm. long, subflexuose, when dry longitudinally striated, olivaceous to olivaceous-brown; cups at first closed and globose, becoming expanded when moist, 5 to 7 mm. in diameter; hymenium brownish; asci clavate, 8-spored, 120 by 6μ; spores elliptical to ovate, smooth, simple; paraphyses filiform, 3μ in diameter at their apices, hyaline.

On acorns. Decorah.

The only specimens of this species seen were those collected by Mr. E. W. D. Holway in the northeast part of the state.

SCLEROTINA (*Stromatinia*) TILIÆ Reade. Ann. Myc. 6: 114. 1908.

Apothecia mostly solitary, cyathoid, long stipitate, 0.5-1 cm. high, Isabelline color (R), stipe smooth, slender, cylindrical, 0.5 mm. or less thick; disc at first closed then expanded, saucer-shaped, 1 to 3 mm. across, excipulum with pseudoparenchymatous outer layer and a prosenchymatous medulla; asci cylindrical-clavate, 140 to 170 by 8 to 10μ, apex round-truncate, spores blue with iodine, continuous, 9 to 11 by 4 to 5μ; paraphyses scattering, filiform, hyaline.

From sclerotium in seeds of *Tilia americana* L. lying on the ground, Mt. Pleasant, Iowa, April 16, 1906. F. J. Seaver.

The above description is taken from the original without material change, the description having been drawn from Iowa material sent by the writer. The plants in external appearance are very much like those occuring on the seeds of wild cherry described below.

SCLEROTINIA (*Stromatina*) SEAVERI Rehm, Ann. Myc. 3: 519. 1905.

Apothecia 1 or 2 from a single mummy, about 1 cm. high, long stipitate, cyathoid, fawn to Isabella color (R); stipe smooth, slender, cylindrical, more or less tapering and frequently tomentose below, 5 to 20 by 11 mm. without rhizoid-like organs; disc at first closed then expanding saucer shaped, to convex and umbilicate; excipulum with a pseudoparenchymatous outer layer and a prosenchymatous medulla; asci cylindrical-clavate, 155 to 180 by 8 to 11μ, apex round, spores blue with iodine; spores 8, obliquely 1-seriate, ellipsoid, ends rounded, hyaline, continuous, 11 to 17 by 5 to 8μ; paraphyses scattering, filiform, slightly wider at the tips, mostly simple, septate, hyaline.

Chlamydospores (*Monilia seaveri* Reade n. f.) effuse, ash-gray; epiphyllous sometimes later on twigs also, still later in minute cespitulæ on immature fruits citron-shaped, continuous hyaline, 7 to 15 mostly 8 to 10μ, in. long di- and trichotomously branched chains with slender, fusiform disjunctors 3 or 4μ long.

Sclerotia formed in mummified fruits.

Parasitic on leaves, twigs and fruits of *Prunus serotina* Ehrh. growing by roadsides and along fences, Ithaca, N. Y., and Malloryville, N. Y. Apothecia were collected in the latter part of April and the first of May. Chlamydospores were abundant on the leaves during the first part of June and on the fruit in July.

The attention of the writer was first directed to this species by Prof. B. Shimek who collected a number of plants on the seeds of the wild cherry, in March, 1905, in woods near Iowa City. As this was the first occurence of any of the plants of this genus, to my knowledge, in the state it was of more than usual interest. A search was made for more of the material and it was found to be quite common in the early spring so that sufficient material was collected to be issued in exsiccati. Nearly a year later the material was sent to Dr. Rehm of Germany for determination who described it as new.

DASYSCYPHA (Fries) Fuckel, Symb. Myc. 304. 1869.

Dasyscypha (as tribe) Fries, Syst. Myc. 2: 89. 1822.

Cups gregarious, small, distinctly stipitate, expanded, when dry closed, externally clothed with hairs: hymenium concave; asci elongated, 8-spored: spores variable in form, simple, hyaline.

Distinguished from *Trichopeziza* by the stipitate cups.

Two species collected in Iowa.

KEY TO THE SPECIES.

Plants small 1 to 2 mm. in diameter, white. . . .	*D. nivea.*
Plants comparatively large 2 to 5 mm., yellowish. . .	*D. pygmæa.*

DASYSCYPHA NIVEA (Hedw.) Sacc., Syll. Fung. 8: 437. 1889.
Plate 25, f. III.

Octospora nivea Hedw. Obs. Bot. 13. 1802.

Peziza nivea Fries, Syst. Myc. 2: 90. 1822.

Lachnella nivea Phill., Brit. Discom. 245. 1887.

Plants small about 1 mm. in diameter, tapering below into a distinct stem which is sometimes very short or 1 to 2 mm. long, clothed externally with a dense covering of hyaline (white) hairs; hairs enlarged, clavate smooth or minutely roughened; hymenium concave or nearly plane; asci clavate, 8-spored; spores small, simple, hyaline, 7 to 9 by 2μ; paraphyses present.

On decaying wood and herbaceous stems. Iowa City and Mt. Pleasant, common.

In the specimens from which the description is drawn the hairs are decidedly enlarged upwards so as to appear club-shaped and nearly smooth or a little roughened.

DASYSCYPHA PYGMÆA (Fries) Sacc., Syll. Fung. 8: 436. 1889.
Plate 24, f. III.

Peziza pygmea Fries, Syst. Myc. 2: 79. 1822.

Helotium pygmæum Karst., Myc. Fenn. 1: 153. 1871.

Lachnea pygmæa Gill. Discom. 71. 1879.

Lachnella pygmæa Phill., Brit. Discom. 242. 1887.

Plants thickly gregarious, 2 to 3 mm. in diameter with a distinct stem which varies much in length, externally hairy, pale yellowish; stem often branched; hairs not so numerous as in the preceding; asci clavate, 8-spored; spores elliptical or subclavate, hyaline, about 7 to 10 by 2μ paraphyses filiform.

On roots and twigs partially exposed, Iowa City.

The plants were numerous and grew with the stems often to-fully pilose; hymenium concave; asci, 8-spored; spores cylindrical or oblong, simple, hyaline; paraphyses present.

TRICHOPEZIZA Fuckel, Symb. Myc. 195. 1869.

Cups fleshy-coriaceous, for the most part small, only a few mm. in diameter, sessile or subsessile, when dry becoming closed and globose, when moist more or less expanded, externally beautifully pilose; hymenium concave; asci, 8-spored; spores cylindrical or oblong, simple, hyaline; paraphyses present.

KEY TO THE SPECIES.

Hairs hyaline, appearing white to the naked eye.

On branches of basswood. . . . . *T. tiliæ.*

On decaying oak leaves. . . . . *T. comata.*

Hairs sulphur-yellow becoming brownish when dry.

Plants occuring on wood, spores 6 to 8μ long. . . . *T. albo-lutea.*

Plants on herbaceous stems, spores 16 to 20μ long. . . . . *T. sulphurea.*

TRICHOPEZIZA TILIÆ (Peck) Sacc., Syll. Fung. 8: 428. 1889.

Peziza tiliae Peck, Ann. Rep. N. Y. St. Mus. 24: 96. 1872.

Plate 25, f. I.

Plants gregarious, minute, 1 to 2 mm. in diameter, sessile, concave, closed when dry, expanding when moist, externally densely clothed with hyaline (white) hairs; hairs delicately roughened externally; hymenium pale yellowish or white; asci present but spores not seen.

On dead branches of basswood (*Tilia americana*), Unionville, Iowa.

One collection of the plants of this species has been made in

Iowa by the writer and the plants were found to occur in great abundance in the locality named above. During the season of 1907 the same species was found in abundance on dead branches of basswood along the Red River in North Dakota. It is probably not uncommon where the host occurs.

TRICHOPEZIZA COMATA (Schw.) Sacc., Syll. Fung. 8: 431. 1889. Plate 25, f. II.

Peziza comata Schw., Trans. Am. Phil. Soc. II. 4: 173. 1832.

Plants similar in external appearance to the preceding but smaller scarcely reaching 1 mm. in diameter; hairs tapering to a rather sharp point and covered externally with irregular granules, consisting of elongated interrupted ridges, very different from those of the preceding; asci and spores indistinct.

On decaying oak leaves Iowa City, common.

Well distinguished by the habitat, size of the plants and the peculiar markings of the hairs. In the specimens examined the asci and spores could not be made out and it may be that the plants are immature.

TRICHOPEZIZA SULPHUREA (Pers.) Sacc., Syll. Fung. 8: 401. 1889.

Peziza sulphurea Pers., Tent. Disp. Meth. Fung. 33. 1797.

Lachnum sulphureum Karst., Myc. Fenn. 1: 176. 1871.

Plants small, about 1 mm. in diameter, gregarious, sessile, hemispherical, when dry closed, when moist expanded, clothed externally with a dense covering of delicate hairs which are filled with yellow coloring matter so that the whole plant when fresh has a beautiful sulphur-yellow color, when dry becoming chestnut-brown; hairs variable in length as long as 75μ, smooth below and delicately rough near their apices; asci 65 to 75 by 6μ, 8-spored; spores fusiform, nearly straight or curved, with several oil-drops, 16 to 20 by 2μ; paraphyses 2 to 4μ broad at their apices.

On dead herbaceous stems, Mt. Pleasant, Iowa.

Two collections of this species were made in Mt. Pleasant. The sulphur-yellow color and the habitat are sufficient characters by which the species may be recognized. On microscopic examination the long fusiform spores are characteristic.

TRICHOPEZIZA ALBO-LUTEA (Pers.) Sacc., Syll. Fung. 8: 412. 1889.

Peziza sulphurea albo-lutea Pers., Syn. Fung. 649. 1801.

Helotium albo-luteum Karst., Myc. Fenn. 1: 160. 1871.

Peziza flavo-fuliginea A. & S., Consp. Fung. 319. 1805.

Peziza variecolor Fries, Syst. Myc. 2: 100. 1822.

Plants similar in general appearance to the preceding but larger often 2 mm. in diameter and expanded, when dry becoming closed or partially closed; hymenium smooth, whitish or slightly yellowish, externally clothed with sulphur-yellow hairs which become brown when dry (to the naked eye) slightly rough on the exterior, often a little enlarged at their apices; asci cylindrical to clavate, 8-spored; spores elliptical or slightly clavate, straight or curved, 7 to 8 by 2μ; paraphyses present.

On old wood, Mt. Pleasant, Iowa.

This species was originally described as a variety of the preceding which it resembles in external characters but is very distinct in the size and form of the spores. The plants occur gregarious on old but rather hard wood and this habitat with the generally large size of the plants would enable one to distinguish it from *T. sulphurea* (Pers.) Sacc. which always occurs on herbaceous stems. The color is a very prominent character in both species but the plants when dry change their external appearance from sulphur-yellow to chestnut brown. On microscopic examination the hairs are found to show their original color when moist.

PHIALEA (Pers.) Gill. Discom. 93. 1879.

Phialea (as subgenus) Pers., Myc. Eu. 1: 276. 1822.

Apothecia waxy-membranaceous, at first closed, then spreading, concave or convex, smooth or pruinose, with rather long, slender stem, and even margin (not dentate); asci cylindrical to clavate, 8-spored; spores ovoid, oblong or clavate, simple, hyaline.

Distinguished from *Helotium* by the more slender stem. Two species described from Iowa but probably many more occur.

KEY TO THE SPECIES.

Plants occurring on acorns, hickory-nut husks, etc., stem often long. . . . . *P. fructigena.*

Plants on stems of *Polygonum*, stem usually short 1 mm. . . . . *P. scutula fucata.*

PHIALEA FRUCTIGENA (Bull.) Gill., Discom. 99. 1879.

Plate 23, f. I.

Peziza fructigena Bull. Champ. France. 1: 236. 1809.

Helotium fructigenum Karst., Myc. Fenn. 1: 113. 1871.

Hymenoscypha fructigena Phill. Brit. Discom. 135. 1887.

Hymenoscypha virgultorum fructigenum Rehm. Rabenh. Krypt. Fl. 1^3: 783. 1896.

Plants small, usually 1 to 3 mm. in diameter, at first closed, then opening disc becoming concave or nearly plane, rather pale yellowish, smooth; asci clavate, 8-spored; spores clavate, nearly pointed at the smaller end, guttulate, 14 to 18 by 4 to 5μ; paraphyses filiform, enlarged upwards.

On decaying acorns and husks from hickory-nuts, Iowa City. Plants found to be abundant at times. The stems of the plants of this species are quite variable in length sometimes being nearly 1 cm. while at other times the cups are almost sessile, the length of the stem depending on the conditions as in other stipitate forms.

PHIALEA SCUTULA FUCATA (Phill.) Sacc., Syll. Fung. 8: 266. 1889.

Hymenoscypha scutula fucata Phill., Brit. Discom. 137. 1887.

Plants similar in general appearance to the preceding but smaller scarcely exceeding 1 mm. in diameter with the stem of about the same length; asci clavate, 8-spored; spores clavate, nearly pointed at the narrow end, 18 to 22 by 3 to 4μ; 2- to 3-guttulate, often appearing to be 1-septate.

On dead stems of *Polygonum*, Mt. Pleasant.

Plants are gregarious and occur in large numbers. Similar forms occur on various kinds of herbaceous stems in wet places.

HELOTIUM Fries, Summa Veg. Scand, 354. 1849.

Plants generally gregarious, stipitate or sessile; stem when present short, stout; substance waxy, bright colored; hymenium concave or convex; asci 8-spored; spores elliptical or fusiform, ends blunt or sharp-pointed, simple or occasionally pseudo-septate; paraphyses slender; for the most part small plants growing on wood, stems and leaves.

Several species occur in Iowa, three of which have been studied.

KEY TO THE SPECIES.

Plants more or less stipitate.
  Plants deep lemon yellow; stem very stout, on old wood. . . . . *H. citrinum.*
  Plants pale yellow, stem more slender or wanting, on decaying leaves. . . . . *H. friesii.*
Plants entirely sessile, on dead stems of *Carex.* .*H. citrinulum seaveri.*

*HELOTIUM CITRINUM (Hedw.) Fries, Summa Veg. Scand. 355. 1849.

Plate 20, f. I.

Octospora citrina Hedw., Laub-Moose 2: 33. 1789.

HELOTIUM FRIESII (Weinm.) Sacc., Syll. Fungi 8: 228. 1889.

Plate 23, f. II.

Peziza friesii Weinm., Hymeno-Gastero-Mycetes 469. 1836.

Plants 1 to 2 mm. in diameter, usually with a short stem but often nearly sessile; hymenium plane or convex, pale yellow, when dry rather deep yellow, color resembling that of the preceding but much paler; asci clavate, 65 to 70 by 5 to 6μ, 8-spored; spores slightly clavate, 8 to 9 by 3 to 4μ; paraphyses filiform, slender.

On decaying leaves of *Populus* sp. in damp place in woods, Iowa City.

The plants described here under this name were abundant on the substratum named above, and while the microscopic characters of the species under which this is here described are not mentioned in the original description, the plants correspond well in external characters.

HELOTIUM CITRINULUM SEAVERI Rehm. Ann. Myc. 4: 67. 1906.

Apothecia scattered, sessile, at first globose, becoming spread out and patellate in form, disc orbicular; hymenium lemon-yellow, .5 to 4 mm. in diameter, externally smooth, whitish; excipulum prosenchymatous; margin undulate, when dry, hymenium orange-yellow; asci clavate, apex rotundate, 40 to 45 by 5 to 7μ, 8-spored; spores fusiform, straight or slightly curved, simple, hyaline, 7 to 10 by 1.5μ, 2-seriate; paraphyses filiform, hyaline, 1μ in diameter.

On dead stems of *Carex* sp., hillsides, Iowa City, Iowa, May, 1905.

Two collections of this material were made at Iowa City in localities about two miles apart. The material was collected in quantity sufficient for distribution in exsiccati. In color the plants resemble those of *Helotium citrinum* but the plants are very different in other characters. The stem is entirely wanting and the discs are spread out so that the hymenium is entirely plane. Compare *H. flexuosum* Massee.

GORGONICEPS Karst., Myc. Fenn. 1: 15. 1871.

Apothecia sessile or substipitate, obconic or elongated, finally expanded, soft, almost gelatinous, excipulum composed of brown filaments; asci clavate; spores crowded together, fasciculate, rod-like, or filiform, hyaline, many-septate or guttulate; paraphyses filiform.

At least one species rather common on rotten wood.

GORGONICEPS IOWENSIS Rehm. Ann. Myc. 4: 338. 1906.
Plate 26, f. II.

Apothecia scattered, sessile, subglobose, tapering below into a stem-like base; margin becoming convex and immarginate, whitish, externally smooth, slightly greenish or bluish-green, .2 to .5 mm. in diameter and high, when dry brownish; asci clavate, apex rotundate, 80 to 100 by 10 to 12μ, 8-spored; spores subcylindrical, a little curved or almost straight, about 7-septate, scarcely constricted, hyaline, 30 to 33 by 3 to 4μ; paraphyses filiform, 3μ thick, apices 2.5 to 3μ, hyaline.

On decaying wood, Mt. Pleasant.

One collection of this material was made in which the bluish-green color of the plants seemed to be a conspicuous character. Whether this is constant or not we cannot say.

The specimen described in the Discomycetes of Eastern Iowa and doubtfully referred to *Patellaria melaxantha* (Fries) Phillips is a *Gorgoniceps* the genus differing from *Patellaria* in the soft, waxy consistency of the plants. This specimen differs from the above mainly in the color of the plants which is yellowish to brown, and the plants were often found to be confluent. There also seems to be a difference in the size of the spores but as the original material is not at hand a more careful comparison cannot be made at present. Unless field study shows these differences to be constant it is thought best to refer this material all to the above name. The following is the description which was drawn from fresh material.

Plants minute, not more than 1 mm. in diameter, generally less, gregarious, or often confluent, depressed, yellowish-brown, darker externally near the base; hymenium concave, plane or slightly convex, more or less papillate or rough; asci clavate, 12 to 14 by 100 to 110μ, very slender at the base, apex rounded, attenuated; spores 8, fusiform, generally curved, 5- to 7-septate, hyaline, 35 to 40 by 3 to 4μ, obliquely arranged in the ascus, more or less twisted around each other; paraphyses filiform, branched.

On decaying wood, Iowa City.

The plants described here have been collected several times in the summer and fall. They are minute in size but always gregarious and often form a confluent yellowish mass. The internal characters are quite distinct. Spores are fusiform, generally curved or double-curved, becoming very slightly S-shaped, from 5- to 7-septate, (generally 7) and often apparently constricted at the septa. Paraphyses are less distinct but filiform and branched.

Also a third collection of *Gorgoniceps* was made at Mt. Pleasant on old wood of *Platanus occidentalis*. This species is undoubtedly the same as the one collected at Iowa City although the plants are rather smaller and do not show the same tendency to become confluent. The plants are very numerous but small and on account of their dull color not easily seen. In spite of the slight differences we feel safe in saying that this is the same species collected at Iowa City but whether these are both the same as that describd as *Gorgoniceps iowensis* Rehm we are uncertain.

These specimens are close to *Gorgoniceps pumilionis* Rehm.

CORYNE Tul., Carp. 3: 190. 1865.

Plants tufted, with a short, thick stem, externally smooth; substance gelatinous, hard when dry; hymenium at first concave, becoming nearly plane, generally dark-colored; asci cylindrical, 8-spored; spores fusiform, at last 2- to 8-celled, generally in two rows; paraphyses slender, enlarged upwards; plants usually occurring on decaying wood.

Two forms occur in the state.

KEY TO THE SPECIES.

Plants small, usually not to exceed 1 cm. in diameter, spores 20µ.	*C. sarcoides.*
Plants large often 2 to 3 cm., spores large, 25 to 30µ.	*C. urnalis.*

*CORYNE SARCOIDES (Jacq.) Tul., Carpol. 3: 190. 1865.
Plate 26, f I.

Lichen sarcoides Jacq., Misc. Aust., 2: 378. 1781.

Peziza sarcoides Pers., Syn. Fung., 633. 1801.

Bulgaria sarcoides Fries, Syst. Myc., 2: 168. 1822.

Ombrophila sarcoides Karst., Myc. Fenn., 1: 86. 1871.

CORYNE URNALIS (Nyl.) Sacc., Fungi Ven., IV., 31.

Bulgaria urnalis Nyl., Obs. Pez. Fenn. 73. 1868.

Sarcoidea sarcoides urnalis Karst., Myc. Fenn., 1: 87. 1871.

Coryne purpurea Fuckel. Symb. Myc., 284. 1869.

Ombrophila purpurea Phill., Brit. Discom., 324. 1887.

The characters of this species are identical with those of the preceding except the size of the plants and spores. The spores are mostly 25 to 30µ long, and the plants are often 2 to 3 cm. in diameter.

Plants collected at Mt. Pleasant in woods along the Skunk River.

In the study of the preceding species no trace could be made out of the septa of the spores notwithstanding the fact that this is one of the characteristics of this genus. But in the last named species the septa could be quite easily seen although they are very narrow and delicate and for this reason may be overlooked. The septa are more or less irregular not always extending straight across the spore.

FAMILY 8. MOLLISIACEÆ.

Plants either superficial or erumpent-superficial, mostly sessile on the substratum; substance fleshy, soft, composed of roundish dark cells; cups at first closed gradually spreading; asci 8-spored, opening with a pore; spores hyaline, 1- to many-septate.

MOLLISIA (Fries) Karsten, Myc. Fenn. 1: 187. 1871.

Mollisia Fries (as subgenus) Syst. Myc. 2: 137. 1822.

Plants small, sessile, at first globose, becoming expanded; apothecium soft, waxy; asci cylindrical, 8-spored; spores elliptical to fusiform, simple, straight or curved.

The genus is distinguished by the small size of the plants and the soft consistency of the apothecium as well as by the microscopic characters of its component cells. Four species collected but others probably occur.

KEY TO THE SPECIES.

Plants parasitic on leaves and stems of *Potentilla*. . . . *M. dehnii.*
Plants saprophytic on wood and stems of herbaceous plants.
  Plants occurring on dead wood, cinereous. . . . *M. cinerea.*
  Plants occurring on herbaceous stems.
    On stems of Polygonum. . . . . *M. polygoni.*
    On dead stems of *Ambrosia* etc. . . . . *M. atrata.*

*MOLLISIA DEHNII (Rabenh.) Karst., Myc. Fenn. 1: 206. 1871.
Plate 35, f. I.

Peziza dehnii Rabenh., Bot. Zeit. 1: 11-12. 1843.

This is a common species and known by its parasitic habits. The species appears to have a wide distribution, specimens having been collected by the writer in New York, North Dakota as well as in Iowa. The plants grow in such numbers as to almost completely cover the stems and leaves of the host.

MOLLISIA CINEREA (Batsch) Karst., Myc. Fenn. 1: 189. 1871.

Peziza cinerea Batsch, Elench. Fung. 2: 198. 1786.

Niptera cinerea Fuckel, Symb. Myc. 292. 1869.

Plants gregarious or scattered, at first globose becoming expanded, cinereous or sublivid, margin often elevated, whitish, undulated or wavy, .5 to 2 mm. in diameter; asci cylindrical to clavate, 45 to 70 by 5 to 6μ; paraphyses filiform scarcely enlarged at their apices.

On decaying wood of various kinds, common.

*MOLLISIA POLYGONI (Lasch.) Gill., Discom. 120. 1879.
Plate 35, f. II.

Peziza polygoni Lasch., Rabenh. Herb. Myc. 1127.

Niptera polygoni Rehm. Ber. Nâturh. Ver. Augsburg 26: 21. 1881.

Peziza luctuosa Cooke, Hedwigia 14: 83. 1875.

MOLLISIA ATRATA (Pers.) Karst., Myc. Fenn. 1: 200. 1871.

Peziza atrata Pers. Syn. Fung. 669. 1801.

Pyrenopeziza atrata Fuckel, Symb. Myc. 294. 1869.

Plants gregarious, at first globose, becoming expanded, .5 to 1 mm. in diameter, externally blackish, hymenium concave, yellowish to cinereous or quite black; asci cylindrical to clavate, 25 by 5 to 6μ; spores elongated elliptical 5 to 6 by 2μ; paraphyses very slender.

On dead stems of *Ambrosia trifida*.

As stated in previous reports the plants referred to this name here are larger than is usually indicated for this species but in other respects seem to conform well.

There seems to be some difference of opinion as to what the real *Peziza atrata* Persoon was, the species having been originally reported on wood, which at the present time is known only on herbaceous stems. While the same species do often occur on wood and herbaceous stems this difference here suggests a possibility that the species has been misinterpreted.

ORBILIA Fries, Summa Veg. Scand. 357. 1849.

Plants orbicular, waxy-membranaceous, patellate, margin often undulated, when dry horny; asci clavate, 8-spored; spores minute, straight or curved, slender.

The plants of this genus occur commonly on rotten wood and bark and are characterized by the small, delicate, membranaceous discs which vary in color from nearly white to deep flesh-red. Two forms reported here which are very distinct, probably many others occur.

KEY TO THE SPECIES.

Plants deep flesh-red. . . . . *O. vinosa.*
Plants pale yellowish. . . . . *O. chrysocoma.*

ORBILIA VINOSA (A. & S.) Karst. Myc. Fenn. 1: 101. 1871.

Peziza vinosa (A. & S.) Consp., Fung. 308. 1805.

Calloria vinosa Fries, Summa. Veg. Scand. 359. 1849.

Plants thickly gregarious, often confluent, patellate with the hymenium nearly plane when occurring singly or very irregular when confluent, thin membranaceous, becoming horny when dry, bright flesh-red when fresh, fading somewhat when preserved for long periods, 1 to 2 mm. in diameter, margin even when young becoming undulate with age; asci clavate, 35 by 4 to 5μ, 8-spored; spores very slender, straight or curved, about 10 to 15 by 1.5μ; paraphyses present.

On rotten wood, Mt. Pleasant.

Plants distinguished externally by the bright, flesh-red color and microscopically by the character of the spores. The species was collected in quantity.

ORBILIA CHRYSOCOMA (Bull.) Sacc., Syll. Fung. 8: 624. 1889

Peziza chrysocoma Bull., Champ. France, 254. 1809.

Calloria chrysocoma Fries, Summa Veg. Scand. 359. 1849.

Plants sessile, at first closed becoming expanded, scattered or crowded and often confluent, .5 to 1 mm. in diameter, golden-yellow, thin and membranaceous; asci and spores as in the preceding.

The plants are very similar in every respect to the preceding except that the color is golden-yellow instead of flesh-red as in that species. The spores of the two species are so minute that they are studied with difficulty.

FAMILY 9. PATELLARIACEÆ.

Plants either superficial on the surface of the substratum or at first immersed becoming erumpent, for the most part leathery or hard, dark colored, black, hemispherical or hysteriform, then expanded becoming elliptical or circular in outline; asci 8- to many-spored; spores globose, elliptical or elongated and filiform, 1- to many-septate, hyaline or colored.

The plants of this family are dark in color resembling in this respect those of the Pyrenomycetes. The family also grades into the lichens so that it is difficult to draw any fast line between the two groups.

PATELLARIA Fries. Syst. Orbis. Veg. 113. 1825.

Apothecia for the most part, sessile, and never immersed, black, often bluish with transmitted light, rounded, or linear; asci clavate, thick-walled, 4- to 8-spored; spores fusoid, often larger at one end becoming clavate, straight or bent 3- to many-septate, 2-seriate, hyaline; paraphyses branched, forming an epithecium.

When the genus *Patellaria* was established by Fries *Patellaria atrata* (Hedw.) was designated as the type of the genus, the species being a hyaline-spored form, but notwithstanding this fact that species has been taken out of this genus and placed in the genus *Lecanidion* by recent writers. The genus *Patellaria* as treated by Saccardo in Syll. Fung. is represented by the colored-spored forms. If the genus as founded by Fries is valid it should contain the hyaline-spored species and the brown-spored forms should be placed in the genus *Mycolecidea* founded by Karst.

Two species; one very common in the state.

KEY TO THE SPECIES.

Asci 8-spored. . . . . *P. atrata.*
Asci 4-spored. . . . . *P. tetraspora.*

PATELLARIA ATRATA (Hedw.) Fries, Syst. Orbis. Veg. 113. 1825.

Lichen atratus Hedw., Laub-Moose 2: 73. 1789.

Peziza patellaria Pers., Syn. Fung. 670. 1801.

Lecanidion atratum Rabenh., Krypt Fl. 1: 342. 1844.

Plants small, 1 to 2 mm. in diameter, sessile, patelliform with the margin elevated, black (bluish with transmitted light); hymenium plane, of the same color; asci clavate, 8-spored; spores fusoid to clavate, 5 to 7-septate, hyaline 35 to 50 by 6 to 7μ; paraphyses filiform, branched, ends enlarged forming an epithecium.

On various kinds of dead wood, *Carpinus, Celtis, Carya, Juglans, Populus, Quercus, Salix, Viburnum, Vitis, Ulmus* and on herbaceous stems, common.

PATELLARIA TETRASPORA Massee & Morgan; Morgan, Jour. Myc. 8: 180. 1902.

Plate 36, f. III.

Lecanidion tetraspora Seaver, Proc. Iowa Acad. Sci. 12: 118. 1905.

This species is similar in every way to the preceding with the exception of the asci and spores. The asci are 8-spored and naturally a little narrow and the spores are somewhat larger.

This might seem to be only a variety of the preceding but careful study of the plants of the species which have been collected several times in Iowa seems to show the 4-spored character to be constant. In none of the plants were both 4-spored and 8-spored asci found but they were always either 4 or 8-spored. The plants containing 8-spored asci show the asci to be broader and clavate while those containing 4-spored asci show them to be more nearly cylindrical and much narrower as would follow from the smaller number of spores contained.

KARSCHIA Koerber, Parerga Lich. 459. 1865.

External characteristics the same as those of the genus *Patel-*

laria from which the plants can be distinguished only on microscopic characters; asci clavate, 8-spored; spores elliptical to fusoid, 1-septate, becoming brown.

One species of the genus found to be very common in Iowa.

KARSCHIA TAVELIANA Rehm, Rabenh. Krypt. Fl. 1^3: 1223. 1896.
Plate 36, f. I.

Plants scattered or closely crowded, at first concave, becoming plane with the margin often slightly elevated, black, rounded in form or when crowded becoming irregular often in dense masses; asci clavate, 8-spored; spores irregularly crowded, elliptical or with ends slightly narrowed, 1-septate, brown, often a little curved; 14 to 18 by 4μ; paraphyses a little enlarged upward and forming an epithecium.

On old wood especially butternut (*Juglans*), Iowa City and Mt. Pleasant.

This species has been listed in previous reports as *Karschia lignyota* but according to Dr. Rehm it is distinct from that species although apparently close to it. The plants have been found to be very common in Iowa on partially decayed wood but seem to show a decided preference for butternut.

MYCOLECIDEA Karst., Medd. Soc. Fauna Fl. Fenn. 16: 27. 1888.

External characteristics the same as those of the genus *Patellaria;* asci clavate, 8-spored; spores 3 to many-septate, brown; paraphyses branched and enlarged upwards forming an epithecium, brownish.

One species collected in Iowa which is the type of the genus as founded by Karsten.

MYCOLECIDEA TRISEPTATA Karst., Medd. Soc. Fauna Fl. Fenn. 16: 27. 1888.
Plate 40, f. I.

Patellaria triseptata Sacc., Syll. Fung. 8: 787. 1889.

Leciographa triseptata Morgan, Jour. Myc. 8: 180. 1902.

Plants scattered, superficial, patellate, .5 to 1 mm. in diameter;

hymenium at first concave, becoming plane with the margin often a little elevated; asci clavate, 8-spored; spores crowded in the ascus, elliptical, a little curved, 3-septate, at first hyaline becoming pale brown, 15 to 20 by 5μ, slightly constricted at the septa; paraphyses filiform, thickened above and forming a brown epithecium.

On old wood of oak, Mt. Pleasant.

The plants are very similar in general appearance to those of *Patellaria atrata* (Hedw.) Fries but appear brown with transmitted light rather than bluish as in that species. Also the spores are very different being much smaller and brown. One collection of the species was made but in considerable quantity.

HYSTEROPATELLA Rehm, Rabenh. Krypt. Fl. 1^3: 367. 1896.

Apothecia at first buried becoming erumpent, sessile, linear, straight or bent, simple or branched, later elliptical or roundish, often becoming patelliform, black; asci ovate or very broad, 8-spored; spores elongated, straight or curved, usually 4-celled, at first hyaline, becoming brownish.

The plants of this genus stand intermediate between those of the *Hysterineæ* on the one side and the *Patellariaceæ* on the other. They are at first hysteriform the lips expanding until they become boat-shaped and under favorable conditions of moisture entirely patelliform at least in some of the species included here with this genus.

KEY TO THE SPECIES.

Spores elliptical.
  Spores about 15 by 4μ. . . . . *H. prostii.*
  Spores about 23 by 8μ. . . . . *H. elliptica.*
Spores clavate. . . . . *H. clavispora.*

HYSTEROPATELLA PROSTII (Duby) Rehm, Rabenh. Krypt. Fl. 1^3: 367. 1896.

Hysterium prostii Duby, Bot. Gall. ed. 2. 719. 1830.

Plants gregarious or scattered, at first hysteriform, .5 to 1 mm. in length, lips soon spreading becoming boat-shaped, especially when moist; asci broad, ovate, 8-spored, about 50 by 10μ; spores slightly curved, pale brownish when mature, 3-septate, elliptical, 15 by 4μ.

On bark of *Ulmus*, Iowa City and Mt. Pleasant, rather common. The species has also been observed and studied in North Dakota and probably has a wide distribution.

HYSTEROPATELLA ELLIPTICA (Fries) Rehm, Rabenh, Krypt. Fl. 1^3: 368. 1896.

Hysterium ellipticum Fries, Obs. Myc. 1: 195. 1815.

Plants gregarious or often crowded in little clusters bursting through the epidermis, similar in general appearance to the preceding but a little larger; asci clavate, 8-spored; spores elliptical, at first hyaline, becoming pale brown, 3-septate, 23 by 8μ.

On bark (*Pyrus*) Mt. Pleasant.

The plants are quite similar in external appearance to the preceding but show a marked difference in the size of the spores. The plants from which the description has been drawn have been examined by Dr. Rehm and referred to this species.

HYSTEROPATELLA CLAVISPORA (Peck) comb. nov.
Plate 36, f. II.

Tryblidium clavisporum Peck, Ann Rep. N. Y. St. Mus. 35: 143. 1883.

Patellaria clavispora Sacc., Syll. Fung. 8: 787. 1889.

Leciographa clavispora Morgan, Jour. Myc. 8: 180. 1902.

Plants gregarious, at first immersed becoming erumpent, hysteriform with the lips gradually spreading becoming boat-shaped and under favorable conditions of moisture the plants become entirely rounded and patelliform, black; asci broad-clavate, continued below into a stem-like base, 75 by 15 to 18μ, 8-spored; spores 2-seriate or irregularly crowded, at first hyaline, becoming yellowish finally pale brown, 3 to 5-septate (rarely 5), clavate with the narrow end below, with an oil-drop in each cell, 25 to 30 by 8 to 9μ; paraphyses forming a black epithecium.

On bark of willow also on decorticated wood of willow (*Salix*) and cottonwood (*Populus*), Iowa City and Mt. Pleasant, common.

The plants of this species have been collected and studied by the writer for several years and so far have been found only on the two hosts named above. They are most common on the inside of dead, loose bark of willow where they occur often in great abundance. The inner bark of a dead willow in Mt. Pleasant was found to be entirely covered with these plants. Specimens which had fallen in a damp place showed the apothecia to be expanded and entirely circular in form while younger specimens of those in drier conditions were hysteriform with the lips more or less spreading.

In the judgment of the writer, this would seem to be a typical representative of the genus *Hysteropatella* as established by Rehm and for this reason I have ventured to make the combination.

Specimens from the herbarium of the writer have been examined by Mr. Peck and the identification reported to be correct. This is a fine species very distinct in the decidedly clavate pale brown spores, entirely different from *Patellaria clavispora* Berk & Br.

BLITRYDIUM DeNotaris, Comm. Critt. It. 1: 374. 1863.

Apothecia fleshy-coriaceous, at first buried, becoming erumpent, opening irregularly finally becoming patelliform; asci clavate, 4 to 8-spored; spores elliptical or elongated, becoming muriform, at first hyaline, becoming pale yellowish-brown.

One species found in Iowa.

Blitrydium fenestratum (Cooke & Peck) Sacc., Syll. Fung. 8: 805. 1889.

Plate 40, f. II.

Patellaria fenestrata Cooke & Peck; Peck Ann. Rep. N. Y. St. Mus. 28: 68. 1879.

Plants at first immersed springing through the outer bark singly or in small groups, at first linear or triangular or more or less star-shaped, lips expanding gradually becoming patellate and at last entirely circular in outline; hymenium plane with the margin elevated, black, appearing rough; asci very broad-clavate, with a long stem-like base, 8-spored, 125 by 25μ; spores very large, clavate, at first hyaline, then yellowish-brown about 10 to

12-septate and muriform with an oil-drop in each cell, 45 to 50 by 15 to 18μ; paraphyses forming an epithecium.

On dead branches of *Populus tremuloides*, Decorah.

The only Iowa material of this species seen was that collected by Mr. Holway but the species has been found by the writer to be very common in North Dakota on dead branches of the above host in aspen timber near Fargo.

FAMILY 10. CENANGIACEÆ.

Plants at first immersed, becoming erumpent for the most part dark colored, at first closed later opening and concave to plane; asci mostly 8-spored; spores elongated to filiform, 1 to many-celled, often muriform, hyaline to brown; paraphyses branched forming an epithecium.

CENANGIUM Fries, Syst. Myc. 2: 177. 1822.

Cups scattered or tufted at first immersed, then breaking through the substratum, sessile, leathery or waxy, brown or blackish; receptacle cup-shaped or nearly plane; asci clavate, 8-spored. elongate, cylindrical or tapering at the ends; spores simple, hyaline; paraphyses enlarged at their apices, forming an epithecium.

Two species collected in the state.

KEY TO THE SPECIES.

Plants sessile, deep, cup-shaped. . . . . . . *C. populneum.*
Plants short stipitate, hymenium nearly plane. . . *C. rubiginosum.*

*CENANGIUM POPULNEUM (Pers.) Rehm, Rabenh. Krypt. Fl. 13: 220. 1896.

Plate 39. f. I.

Peziza populnea Pers., Tent. Disp. Meth. Fung. 35. 1797.

Peziza fascicularis A. & S., Conspect. Fung., 315. 1805.

Dermatea fascicularis Fries, Summa. Veg. Scand., 362. 1849.

Encoelia fascicularis Karst., Myc. Fenn. 1: 217. 1871.

Cenangium fascicularie Karst., Act. Soc. Fauna Fl. Fenn. 2: 145. 1885.

CENANGIUM RUBIGINOSUM (Fries) Sacc., Syll. Fung. 8: 569. 1889.

Plate 38, f. II.

Peziza rubiginosa Fries, Elench. Fung 2: 7. 1828.

Plants springing singly or in clusters of 2 to 4 from beneath the bark tapering below into a short stem-like base; hymenium concave, becoming nearly plane; plants about 2 mm. in diameter, externally reddish-brown and rough, more or less wrinkled; hymenium darker, nearly black or purplish; asci clavate, 8-spored, 125 by 15μ, spores 1-seriate or slightly crowded near the apex of the ascus, elliptical to fusoid, mostly narrower toward the lower end, pyriform, and unsymmetrical, 17 by 7 to 8μ; paraphyses numerous, a little enlarged upwards.

On dead limbs of *Carpinus caroliniana,* Decorah, Iowa, E. W. D. Holway, also reported from London, Canada, and South Carolina.

The material collected in Iowa is distributed in Ellis, North Am. Fungi, 992.

According to Saccardo *Cenangium rubiginosum* Cooke in Ravenel, Fungi. Am. Exsicc 635 is different.

While this species seems to have been collected in several localities there is little mention of it in the literature of N. Am. Fungi.

DERMATEA Fries, Summa Veg. Scand. 362. 1849.

Apothecia erumpent-superficial, often cespitose at the base, and with a more or less well developed stroma; hymenium concave or plane; asci cylindrical to clavate, 8-spored; spores elliptical or elongated, simple, hyaline.

The genus is close to *Cenangium.* One species which has been described from Iowa material.

DERMATEA OLIVASCENS Rehm, Ann. Myc. 5: 80. 1907.

Plate 38, f. I.

Apothecia scattered and occuring singly or in small clusters at first immersed, becoming erumpent, subglobose becoming patelliform with the hymenium plane or convex, olive-brown, pruinose, .5 to 1.5 mm. in diameter with a short stem; asci clavate, 150 by 20 to 25μ, 8-spored; spores elliptical, simple, 20 to 25 by 10 to 12μ, 2-seriate with conspicuous oil drops; paraphyses 2μ in diameter.

On (dead?) branches of *Cratægus* sp. Mt. Pleasant.

The plants from which this species was described were collected during the winter on branches of *Cratægus* near Mt. Pleasant, where they occurred in abundance.

According to Dr. Rehm the species is distinct from *Dermatea cratoegicola* Durand in which the spores are 35 to 50 by 15 to 17μ. There is also some difference in the color of the plants in the two species. The asci appear to be filled with large, irregular oil drope, which are so conspicuous that it is with difficulty that the outline of the spores may be seen, but a faint outline can be detected. The spores when removed from the asci are often seen to contain 1 or more of these drops.

TYMPANIS Tode, Fungi Meckl. 1: 24. 1790.

Plants erumpent, single or in dense clusters, at first globose, closed, becoming expanded, for the most part with short, thick stem; asci thick-walled, 8-spored, spores producing numerous minute bodies which fill the ascus.

One species collected in the state.

TYMPANIS CONSPERSA Fries, Syst. Myc. 2: 175. 1822.

Plants springing in minute dense clusters through the outer bark of the host, at first globose, becoming expanded, black; asci clavate, thick-walled, filled with granular material; spores not well developed; paraphyses branched, enlarged upwards.

On bark of *Populus* sp. Iowa City.

Dead branches of the host were thickly covered with the plants of this species which resemble those of the genus *Dermatea* externally. The asci are well developed but the spores are indistinct or not well developed.

SARCOSOMA Caspary; Rehm, Rabenh. Krypt. Fl 1^3: 497. 1896.

Plants globose to ovate or cylindrical, sessile or stipitate, externally dark colored, brown or blackish; tissue gelatinous; asci cylindrical, 8-spored; spores hyaline, simple, elliptical.

Distinguished mainly by the hyaline spores. One species rather common in Iowa.

*SARCOSOMA RUFA (Schw.) Rehm, Rabenh. Krypt. Fl. 1³: 497. 1896.

Plate 37, f. I.

Bulgaria rufa Schw., Trans. Am. Phil. Soc. II. 4: 178. 1832.

BULGARIA Fries, Syst. Myc., 2: 166. 1821.

Cups gregarious with a short, thick stem; forming at first under the bark, later breaking through; externally dark colored, rough, often with short hairs, gelatinous, shrinking much when dried; asci cylindrical, generally 8-spored; spores elliptical, or unequal-sided, simple, hyaline, then brown; paraphyses forming a colored epithecium; plants large, growing on wood.

One species common about Iowa City.

*BULGARIA INQUINANS (Pers.) Fries, Syst. Myc. 2: 167. 1823.

Plate 37, f. II.

Peziza polymorpha Oeder, Fl. Dan. pl. 464. 1769.

Peziza nigra Bull., Herb. France, pl. 116. 1782.

Peziza inquinans Pers., Syn. Fung. 631. 1801.

HOLWAYA Sacc., Syll. Fung. 8: 646. 1889.

Plants stipitate; stem more or less tomentose; entire plant dark brown; hymenium plane or convex; asci clavate, 8-spored; spores elongated approaching filiform, many-septate.

One species occurs in Iowa, which is the only representative of the genus.

HOLWAYA GIGANTEA (Peck) Durand, Bull. Torrey Cl. 28: 354. 1901.

Plate 38, f. II.

Stilbum giganteum Peck, Ann. Rep. N. Y. St. Mus. 24: 93. 1871.

Bulgaria ophiobolus Ellis, Am. Nat. 17: 193. 1883.

Graphium giganteum Sacc., Syll. Fung. 4: 611. 1886.

Holwaya ophiobolus Sacc., Syll. Fung. 8: 646. 1889.

Plants occurring singly or in cespitose clusters, stipitate; hymenium concave, becoming plane or convex about 1 cm. in diameter, dark-colored, brownish-black; asci clavate, 8-spored; spores in a fascicle in the ascus, very long, more or less tapering toward the end, many-septate, about 65 by 3 to 4μ, paraphyses filiform, slender and enlarged at their apices.

On partially decayed wood, Decorah.

The only specimens of this species examined are those collected by Mr. Holway in the northeast part of the state. The plants are very distinct in the long filiform, many-septate spores.

URNULA Fries, Summa Veg. Scand. 364. 1849.

Cups stipitate, urn-shaped, at first closed, then opening by a circular or stellate aperture, externally dark colored, furfuraceous or clothed with dark colored, minute hairs; asci cylindrical, 8-spored; spores oblong-elliptical.

One species is common in woods in the early spring.

Urnula craterium (Schw.) Fries, Summa Veg. Scand. 364. 1849.

Plate 39, f. II.

Peziza craterium Schw., Schr. Nat. Ges. Leipzig 1: 117. 1822.

Cenangium craterium (Schw.) Fries, Elench. Fung. 2: 21. 1828.

Dermea craterium Schw., Trans. Am. Phil. Soc. II. 4: 237. 1832.

Geopyxis craterium (Schw.) Rehm, Rabenh. Krypt. Fl. 1[3]: 974. 1896.

Cups large, long stipitate, subcespitose, dark brownish-black, at first closed, hollow within, opening at the top by an irregular rupture, leaving the margin notched, involute, clothed externally with minute black hairs; asci very long, cylindrical, 8-spored; spores oblong, hyaline, granular within, 25 to 30 by 10μ; paraphyses slender, septate.

On half-buried branches and sticks in woods, Iowa City and Mt. Pleasant.

A large species very common on decaying sticks in woods in the spring. A number of the plants may often be found attached to a small stick standing upright in a row. They are at first club-shaped, black structures, hollow in the center, finally opening by a star-shaped aperture at the apex, when mature leaving the margin notched. In Engler-Prantl Natülichen Pflanzenfamilien this species is included with the subgenus *Geopyxis* and there seems to be some difference of opinion as to whether this plant should be included with that subgenus, which is now treated as a genus, or allowed to remain where it is.*

ORDER III. PHACIDIINEÆ.

Apothecia free on the substratum or forming a stroma, at first immersed, becoming erumpent, roundish or elongated.

FAMILY 11. STICTIDACEÆ.

Apothecia bright-colored, never black, surrounded by the rough edges of the broken epidermis.

PROPOLIS Fries, Syst. Myc. 2: 198. 1822.

Apothecia at first immersed, becoming erumpent, surrounded by the rough edges of the broken epidermis; asci 8-spored; spores elliptical, simple, hyaline, usually with 2 oil-drops, 2-seriate, straight or curved.

But one species of the genus and order can be reported on at this time.

PROPOLIS FAGINEA (Schrad.) Karst., Myc. Fenn. 1: 244. 1871. Plate 40, f. II.

Hysterium fagineum Schrad., Jour. Bot. 2: 68. 1799.

Stictis versicolor Fries., Syst. Myc. 2: 198. 1822.

Propolis versicolor Fries, Summa Veg. Scand. 372. 1849.

Plants at first immersed, becoming erumpent, usually elongated but often rounded; margin laciniate; hymenium farinose,

*Bull. Torrey Cl. 29: 137.

white or whitish, plane or a little convex especially when moist; asci broadly clavate, 8-spored; spores oblong, rounded at the ends, slightly curved with (usually) 2 oil-drops, large, 24 to 30 by 7 to 9μ; paraphyses present, slender.

On wood of various kinds, Mt. Pleasant, common.

The plants are quite easily recognized by the elongated white patches on the surface of old pieces of wood and logs, the white patches which are often several millimeters in length being surrounded by the rough torn edges of the broken epidermis. This is a variable species and a long list of synonyms might be given. It has been collected by the writer at Mt. Pleasant on the following kinds of wood; *Platanus occidentalis, Vitis vulpina,* and *Carpinus caroliniana.*

The species has also been collected by the writer in New York and North Dakota and probably has a wide distribution.

ORDER IV. HYSTERIINEÆ.

Apothecia at first immersed or always free on the substratum, more or less elongated, simple or occasionally branched, opening with a longitudinal cleft; asci 8-spored; paraphyses present, slender.

FAMILY 12. HYSTERIACEÆ.

Apothecia free on the substratum, elongated, straight or bent, occasionally branched, opening with a longitudinal cleft; asci 8-spored, spores variable.

HYSTERIUM Tode, Fungi Meckl. 2: 3. 1791.

Apothecia superficial or erumpent becoming superficial, oblong or elliptical, carbonaceous or subcarbonaceous, opening with a longitudinal cleft; asci clavate or cylindrical, mostly 8-spored; spores elliptical, straight or curved, 2 to many-septate, brown.

One species of the genus reported here.

HYSTERIUM PULICARE Pers., Syn. Fung. 98. 1801.

Hysterographium pulicare Corda, Ic. Fung. 5: 77. 1842.

Apothecia scattered or gregarious, superficial, variable in form, oblong or elliptical, longitudinally striated, black, lips slightly opening, about 1 mm. long and half as broad; asci clavate, 8-spored; spores partially 2-seriate, straight or slightly curved. 3-septate, scarcely constricted, 20 to 25 by 8μ.

On bark of wild cherry (*Prunus* sp.)

The spores of this genus are similar to those of the genus *Hysteropatella* but the plants differ in that the lips do not expand as in that genus or, if at all, only slightly.

GLONIUM Muehl; Schw. Schr. Nat. Ges. Leipzig 1: 50. 1822.

Plants erumpent, linear, elongated, sometimes radiately arranged, carbonaceous or tough-membranaceous, opening by a longitudinal cleft; asci cylindrical to clavate, 8-spored; spores 1-septate, hyaline.

Distinguished by the hyaline, 1-septate spores. Two species common.

KEY TO THE SPECIES.

Plants radiately arranged. . . . . *G. stellatum.*
Plants lying parallel with each other. . . . . . *G. parvulum.*

GLONIUM STELLATUM Schw., Schr. Nat. Ges. Leipzig 1: 50. 1822.

Subiculum effused, brownish-black, often covering considerable area (2 or more cm.) composed of slender, branching, interwoven hyphæ; apothecia seated on the subiculum, radiately arranged forming patches 2 to 4 cm. in diameter, entirely covering the subiculum, opening by narrow clefts; asci cylindrical, 8-spored; spores more or less crowded, fusoid, hyaline, 1-septate and constricted at the septum, 20 to 22 by 5 to 6μ.

On rotten wood of various kinds.

A species very distinct from any of the other forms here described in the presence of the black subiculum and the stellately arranged apothecia. The species was wound in great quantity at Mt. Pleasant on decaying logs of butternut. It has also been observed in North Dakota and probably has a wide distribution.

GLONIUM PARVULUM (Ger.) Sacc., Syll. Fung. 2: 735. 1883.

Hysterium parvulum Ger., Bull. Torrey Cl. 5: 40. 1874.

Apothecia densely gregarious, or occasionally scattered, small, .5 to 1 mm. long, roundish, mostly lying parallel with each other, opening with a longitudinal cleft; asci cylindrical, 8-spored; spores very small, hyaline, 1-septate, and constricted at the septum, 7 by 3μ.

On old wood, common.

Quite distinct in the small roundish apothecia and the very small much constricted spores. Ellis makes *G. microsporium* Sacc. identical with this species. Probably common and widely distributed.

GLONIELLA Sacc., Syll. Fung. 2: 765. 1883.

Apothecia erumpent, oblong or linear, carbonaceous, black, with a longitudinal cleft; asci 4 to 8-spored; spores elongated, fusoid, 2 to many-septate, usually 3-septate, hyaline.

One species of the genus collected in the state.

GLONIELLA OVATE (Cooke) Sacc., Syll. Fung. 2: 765. 1883.

Hysterium ovatum Cooke, Grevillea 11: 107. 1883.

Plants gregarious, becoming superficial, ovate, obtuse, black, .5 to 1 mm. in length, longitudinally striated, lips for the most part closed; asci cylindrical to clavate, 8-spored; spores 15 to 18 by 8μ, hyaline, becoming 3-septate.

On oak wood, Mt. Pleasant.

The species was collected in considerable quantity on old wood near Mt. Pleasant. The 3-septate character of the spores was at first overlooked but close examination shows them to be 3-septate at maturity, the middle septum being formed first.

HYSTEROGRAPHIUM Corda, Ic. Fung. 5: 34. 1842.

Plants erumpent, sessile, elongated or elliptical, obtuse or subacute, mostly simple, opening with a narrow, elongated cleft, black, carbonaceous; asci clavate, 8-spored; spores 1 to 2-seriate, elliptical or ovate, obtuse, becoming muriform, brown.

Only three species of this genus collected which seem distinct, but others doubtless occur in the state.

KEY TO THE SPECIES.

Spores large, more than 25μ long.
  Spores 25 to 30 by 8 to 10μ, on bark of oak. . . *H. kansense.*
  Spores 30 to 40 by 15 to 28μ, on branches of ash. *H. fraxini.*
Spores small, less than 25μ in length. . . . . . *H. mori.*

HYSTEROGRAPHIUM KANSENSE Ellis & Everhart, Erythea 2: 22. 1894.

Plate 41, f. I.

Perithecia scattered, oblong, ends subacute, 1 to 1.25 by .5μ, black, subconchiform, longitudinally striated, lips closed or slightly open so as to leave a narrow cleft; asci clavate, 80 to 110 by 12 to 14μ, 8-spored; spores 2-seriate or partially so, ovate or fusoid, 7 to 9-septate, with most of the cells finally divided by a longitudinal septum, brown, 25 to 30 by 8 to 10μ.

On bark of various species of *Quercus.*

This species has been collected several times by the writer and on the bark of several different species of oak. It was at first taken to be *H. stygium* Cooke, but comparison with an authentic specimen of this species shows the spores to be much too narrow. This difference is also mentioned in the original description of the species. Iowa material conforms well with the type of the species to which it is referred.

HYSTEROGRAPHIUM FRAXINI (Pers.) De Not., Giorn. Bot. It. 2: 22. 1847.

Plate 41, f. III.

Hysterium fraxini Pers., Syn. Fung. 100. 1801.

Plants scattered or gregarious, erumpent, elliptical, black, obtuse, 1 to 1.5 mm. long, .5 to .75 mm. wide; lips swollen, smooth, partially open so as to expose the elongated hymenium; asci clavate, rounded above, 150 to 200 by 30 to 40μ, 8-spored; spores 2-seriate, oblong-elliptical, scarcely constricted in the middle, 7 to 9-septate and muriform, dark brownish, 30 to 40 by 15 to 18μ.

On dead branches of *Fraxinus.*

This species occurs in abundance on the dead branches and twigs of various species of *Fraxinus* before or after the bark is removed. The species appears to be common in localities where the ash is native and its distribution is probably coëxtensive with that of the host.

In North Dakota this species has been observed in great quantities. One collection on branches of *Xanthoxylum americanum* seems identical both in internal and external characters.

HYSTEROGRAPHIUM MORI (Schw.) Rehm., Ber. Natuhr. Ver. Augsburg 26: 90. 1881.

Plate 41, f. II.

Hysterium mori Schw., Trans. Am. Phil. Soc. II. 4: 244. 1832.

Plants erumpent-superficial, elliptical to linear or cylindrical, 1 to 3 mm. long, and .5 to 1 mm. wide, mostly straight or lying parallel with the grain of the wood, gregarious or crowded, often covering the substratum more or less longitudinally striated; lips mostly closed at first, finally more or less spreading; asci cylindrical, about 100 by 12μ, 8-spored; spores 1-seriate or more or less crowded together above, ovate, smaller below, 3 to 5-septate, a little constricted at the middle septum, cells divided by a longitudinal septum, brown, 15 to 25 by 7 to 8μ.

On decorticated wood of various kinds.

This is a very common, abundant and variable species, occurring on nearly every kind of wood. Specimens found commonly on old wood of butternut conform well with the description of *H. cinerascens* Schw., but I can find no reliable character by which it can be distinguished from the present species.

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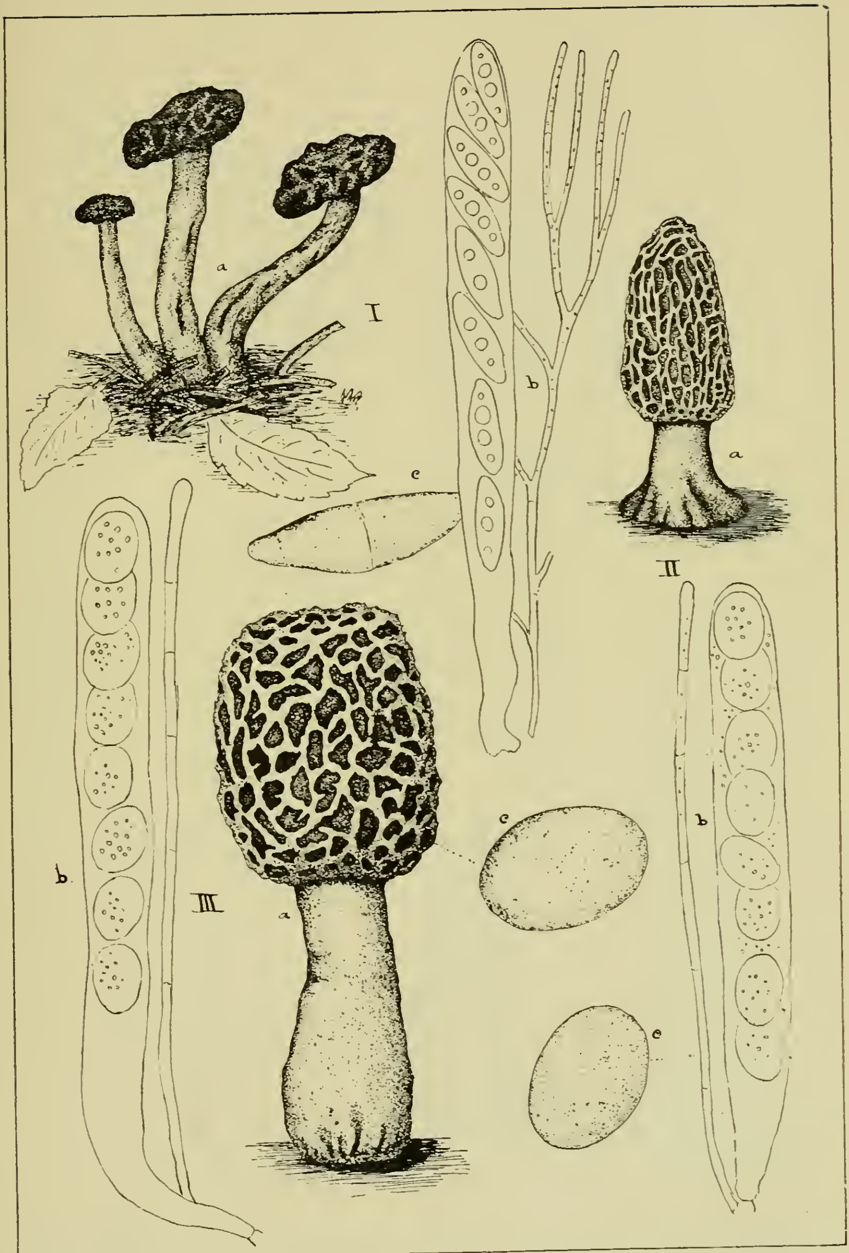
Explanation of Plate 2

I. Leotia lubrica (Scop.) Pers.
  a. Cluster of plants natural size.
  b. Ascus with paraphysis and spores × 500.
  c. One spore × 1500.

II. Morchella deliciosa Fries.
  a. One plant natural size.
  b. Ascus with paraphysis and spores × 500.
  c. One spore × 1200.

III. Morchella esculenta (L.) Pers.
  a. One plant natural size.
  b. Ascus with paraphysis and spores × 500.
  c. One spore × 1200.

PLATE 2

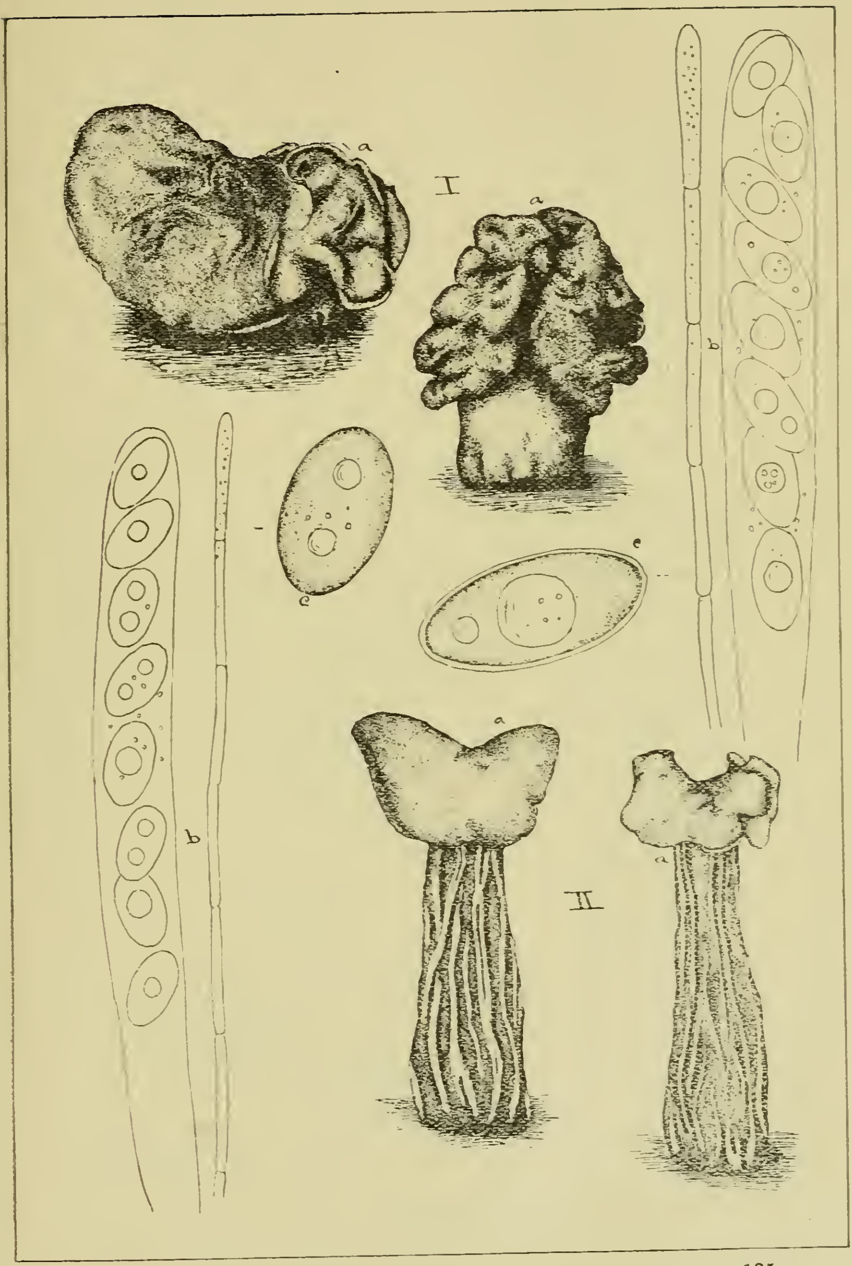


Explanation of Plate 4

I. GYROMITRA ESCULENTA (Pers.) Fries.
  - a. Plants natural size.
  - b. Ascus with paraphysis and spores × 700.
  - c. One spore × 1500.

II. HELVELLA LACUNOSA Afzel.
  - a. Plants natural size.
  - b. Ascus with paraphysis and spores × 700.
  - c. One spore × 1500.

PLATE 4

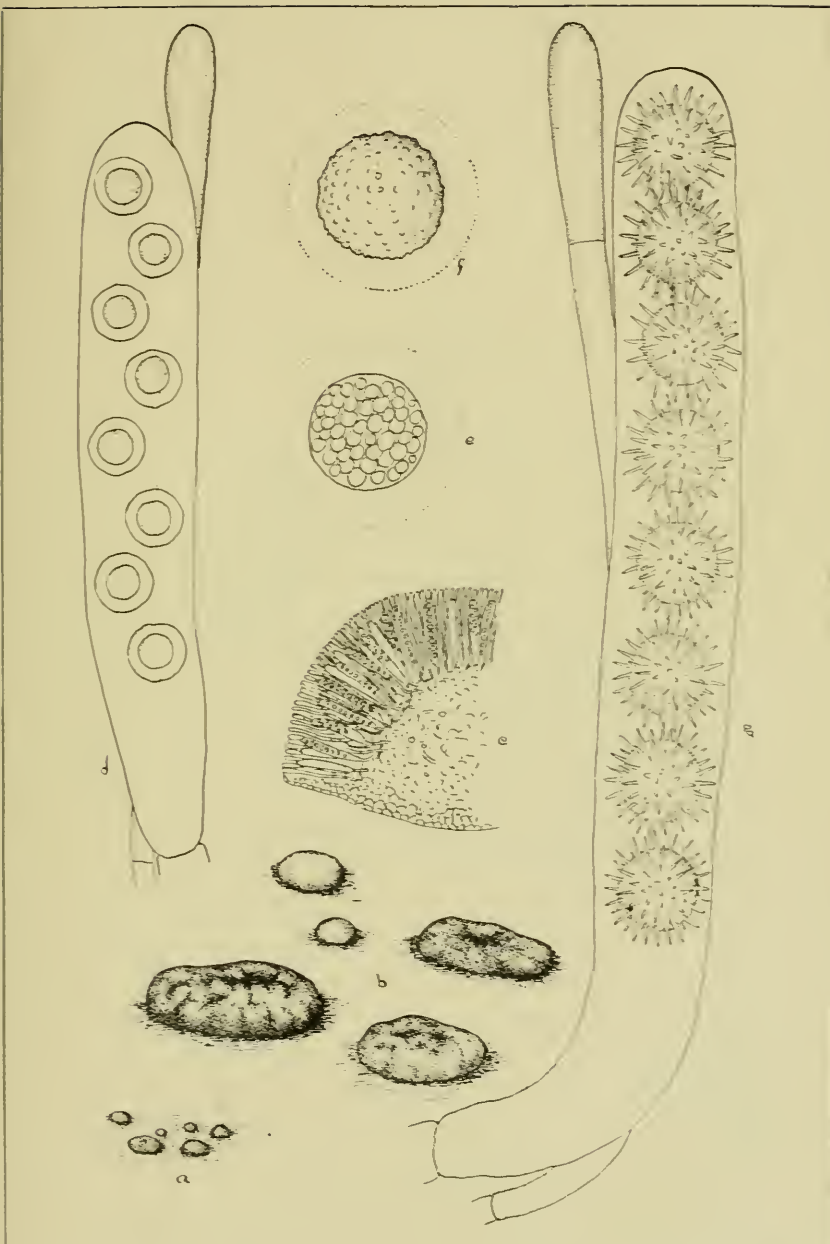


Explanation of Plate 6

Sphærosoma echinulatum Seaver.

a. Several plants natural size.
b. Plants of different ages × 5.
c. Section of a plant showing position of Hymenium × 30.
d. Ascus with spores before maturity × 500.
e. Young spore showing surrounding membrane × 1000.
f. Spore showing the early stages in the roughening of the outer surface × 1000.
g. Ascus with paraphysis and spores at maturity × 600.

PLATE 6



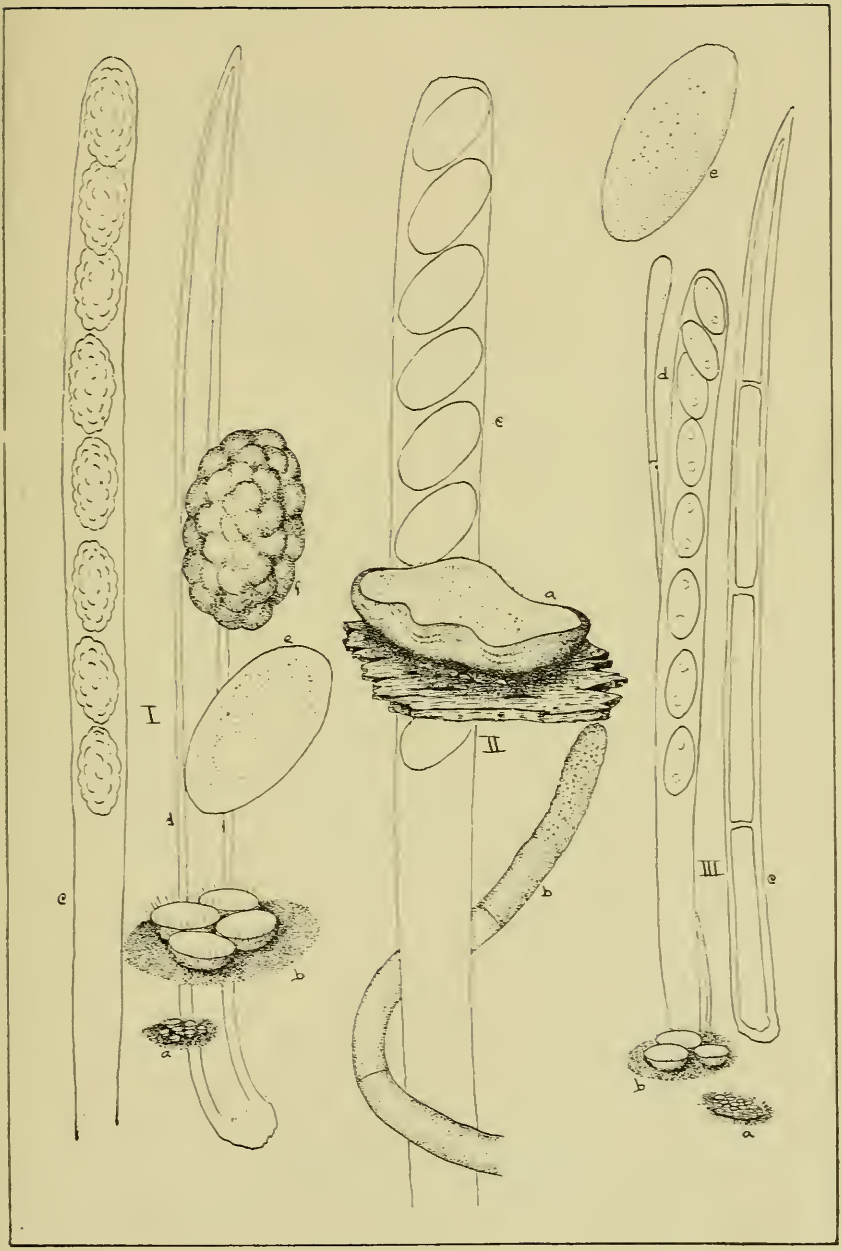
Explanation of Plate 11

I. Lachnea paludosa (Boud.) Sacc.
- a. Plants natural size.
- b. Several plants × 5.
- c. Ascus with spores × 600.
- d. One hair from exterior of cup × 300.
- e. Spore showing internal characters × 1500
- f. Mature spore showing external markings × 1500.

II. Lachnea aurantiopsis Ellis from type material.
- a. One plant about natural size.
- b. Hair from exterior of cup × 500.
- c. Ascus with spores × 500.

III. Lachnea abundans (Karst.) Sacc.
- a. Plants natural size.
- b. Several plants × 5.
- c. Hair from exterior of cup × 600.
- d. Ascus with spores and paraphyses × 800.
- e. One spore × 2500.

Plate 11



Explanation of Plate 12

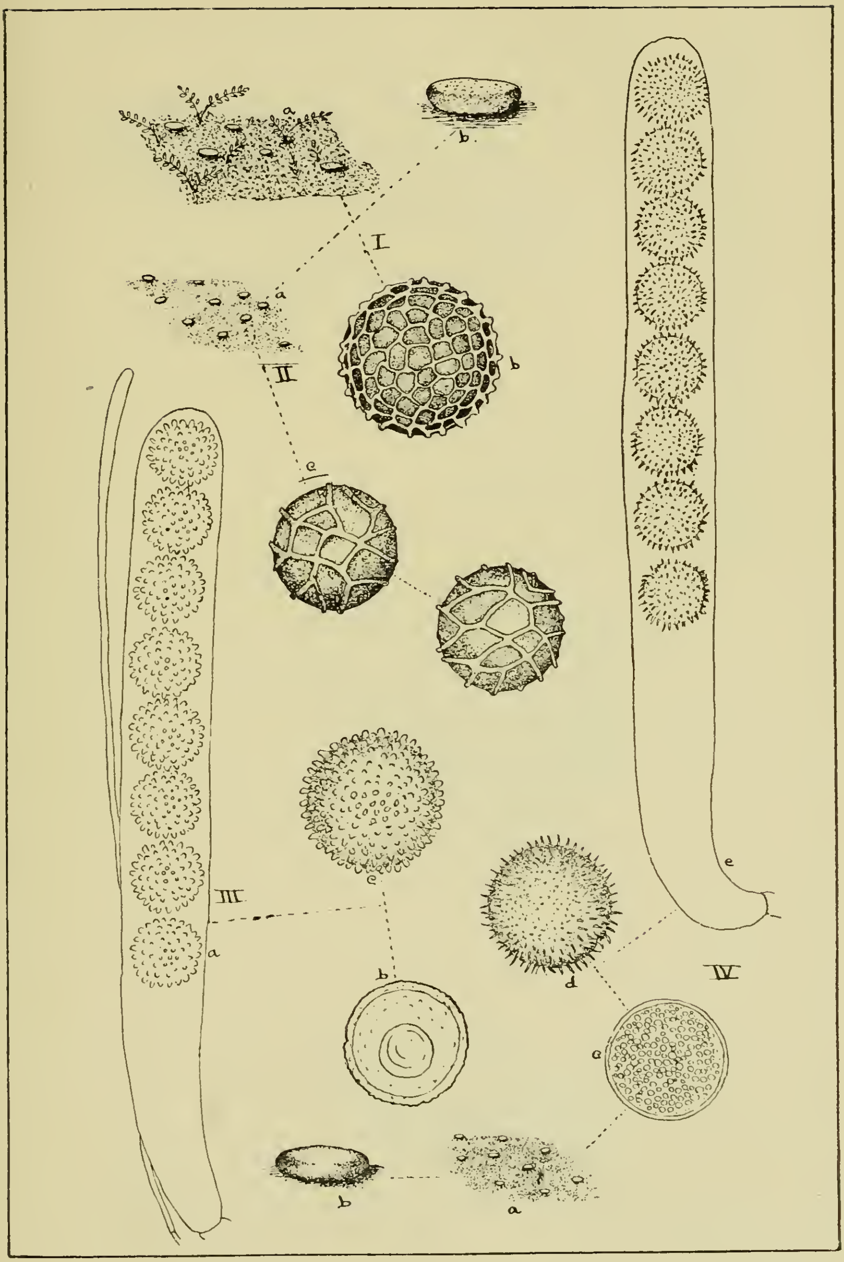
I. Barlæa miniata (Crouan) Sacc.
   a. Plants natural size.
   b. One spore × 1500.

II. Barlæa cinnabarina (Fuckel) Sacc.
   a. Plants natural size.
   b. Two spores × 1200.

III. Barlæa amethystina (Quel.) Sacc.
   a. Ascus with spores and paraphyses × 600.
   b. One spore showing internal markings × 1500.
   c. One spore showing external markings × 1500.

IV. Barlæa crec'hqueraultii (Crouan) Sacc.
   a. Plants natural size.
   b. One plant × 5.
   c. Immature spore × 1500.
   d. Mature spore showing external characters × 1500.
   e. Ascus with spores × 600.

PLATE 12



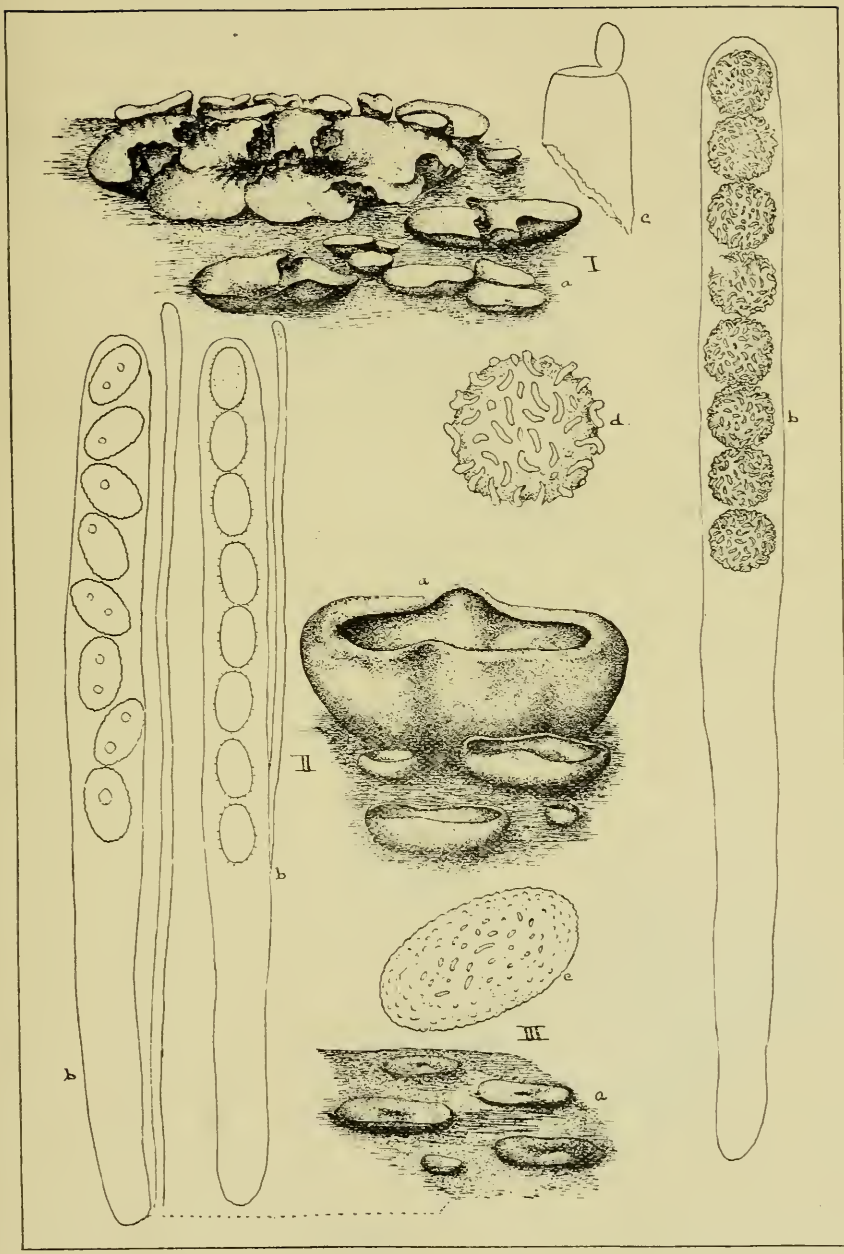
Explanation of Plate 14

I. Detonia trachycarpa (Curr.) Sacc.
- a. Plants natural size.
- b. Ascus with spores × 700.
- c. Ascus showing operculum × 1000.
- d. One spore showing external markings × 1500.

II. Peziza badia Pers.
- a. Plants natural size.
- b. Ascus with spores and paraphysis × 600.

III. Peziza brunneo-atra Desm.
- a. Plants natural size.
- b. Ascus with spores × 500.
- c. One spore showing markings × 1500.

PLATE 14

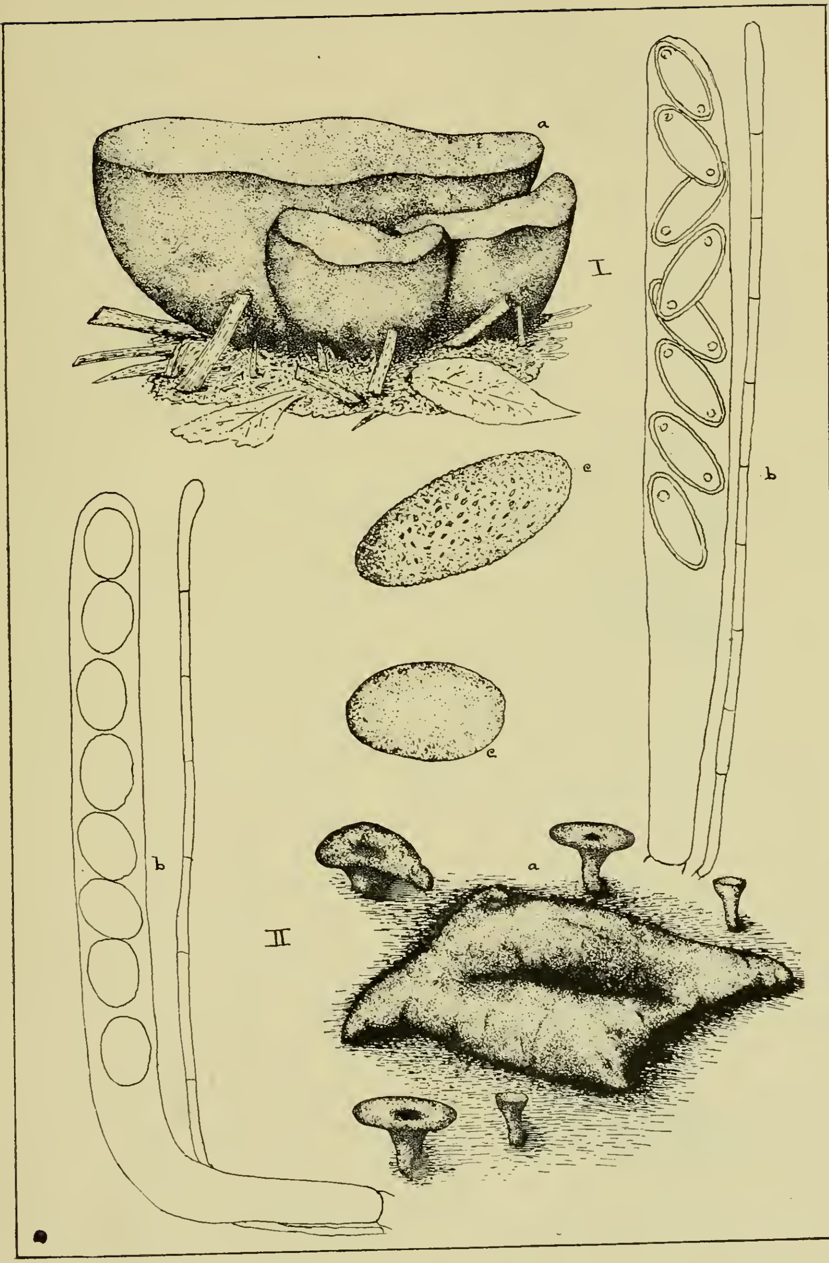


Explanation of Plate 15

I. Peziza badia Pers. (form collected in deep woods).
   a. Plants natural size.
   b. Ascus with spores and paraphysis × 800.
   c. One spore showing markings × 1500.

II. Peziza repanda Pers.
   a. Plants of several ages natural size.
   b. Ascus with spores and paraphysis × 700.
   c. One spore × 1500.

PLATE 15



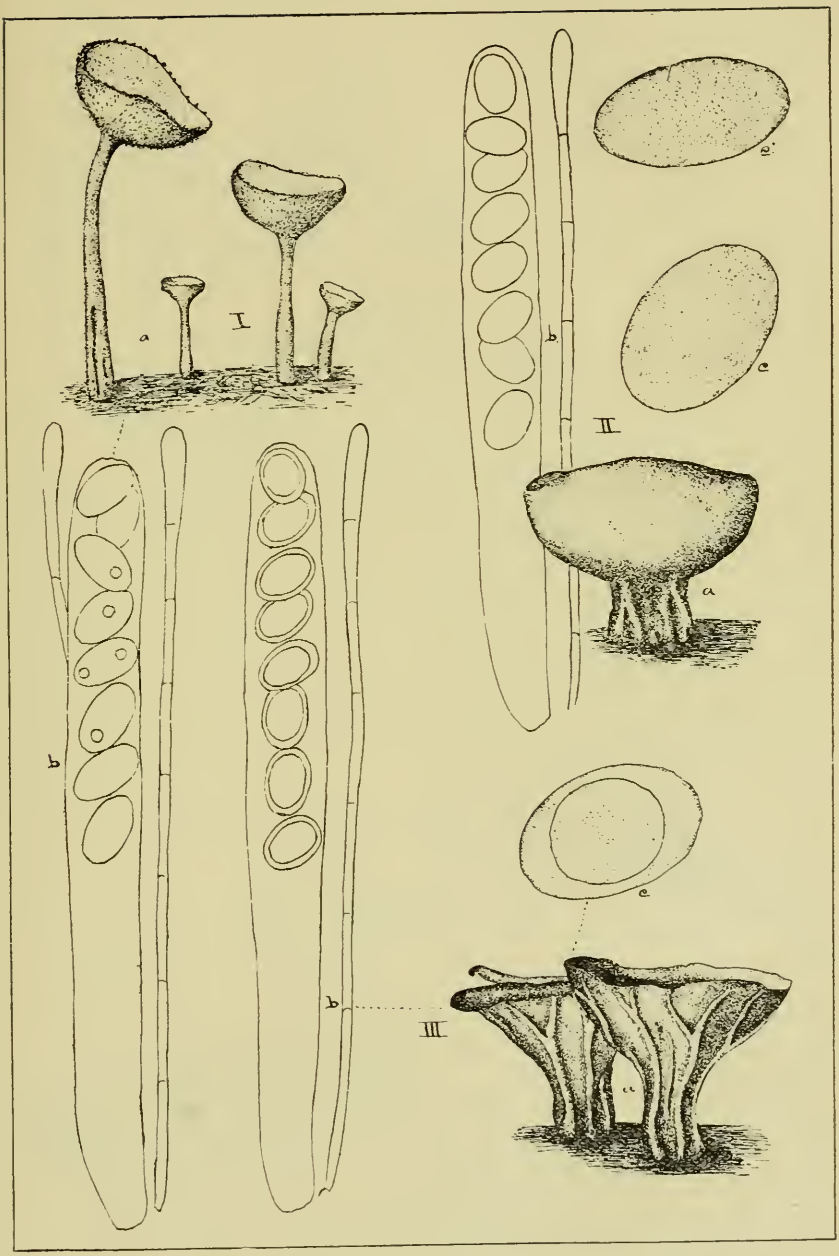
Explanation of Plate 19

I. Macropodia macropus (Pers.) Fuckel.
   a. Plants of different ages natural size.
   b. Ascus with paraphyses and spores × 300.
   c. One spore × 800.

II. Acetabula sulcata (Pers.) Fuckel.
   a. One plant natural size.
   b. Ascus with paraphysis and spores × 400.
   c. One spore × 1200.

III. Acetabulum acetabulum (L.) comb. nov.
   a. Two plants natural size.
   b. Ascus with paraphysis and spores × 500.
   c. One spore × 1200.

PLATE 19



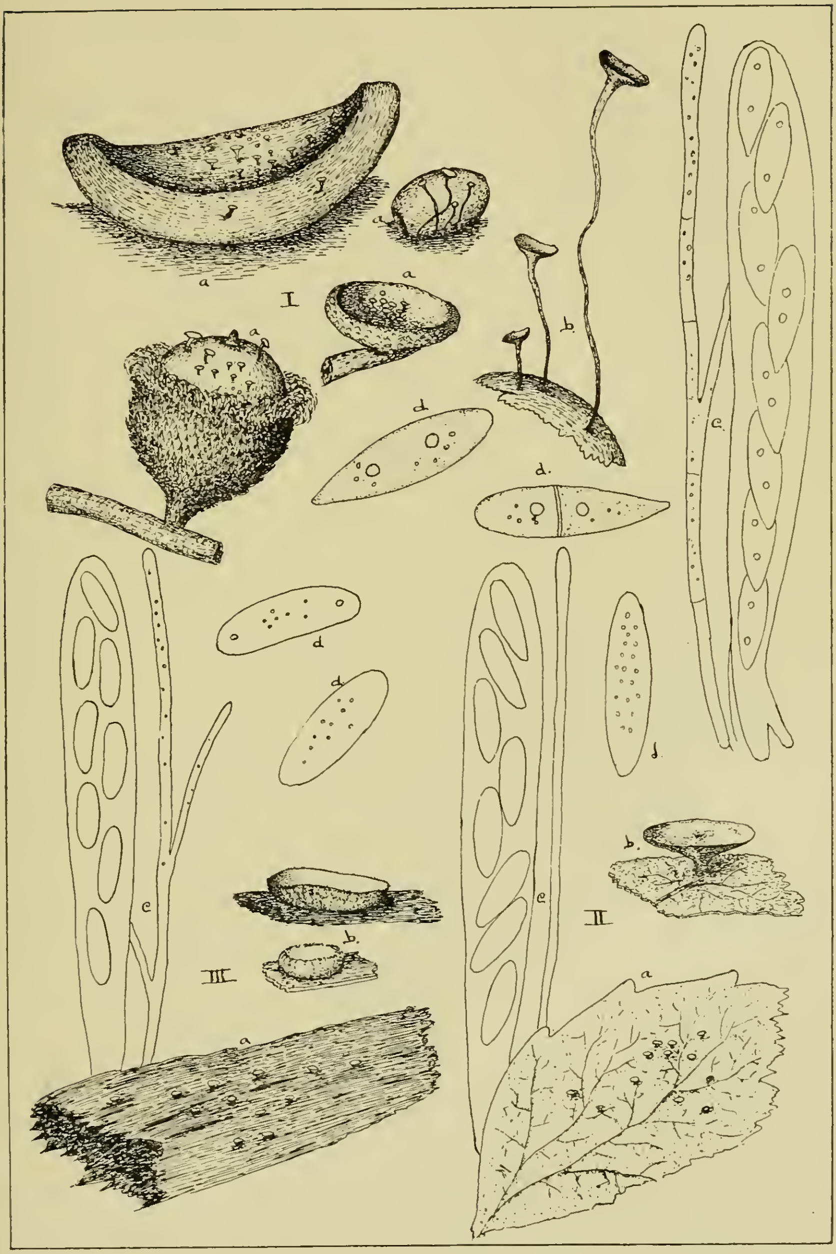
Explanation of Plate 23

I. Phialea fructigena (Bull.) Gill.
   a. Plants natural size showing substrata.
   b. Several plants × 5.
   c. Ascus with spores and paraphysis × 1000.
   d. Spores × 2000.

II. Helotium friesii (Weim.) Sacc.
   a. Plants natural size.
   b. One plant × 10.
   c. Ascus with spores and paraphysis × 1500.
   d. One spore × 3000.

III. Chlorosplenium chlora (Schw.) Massee.
   a. Plants natural size.
   b. Two plants × 10.
   c. Ascus with paraphysis and spores × 2000.
   d. Two spores × 4000.

PLATE 23



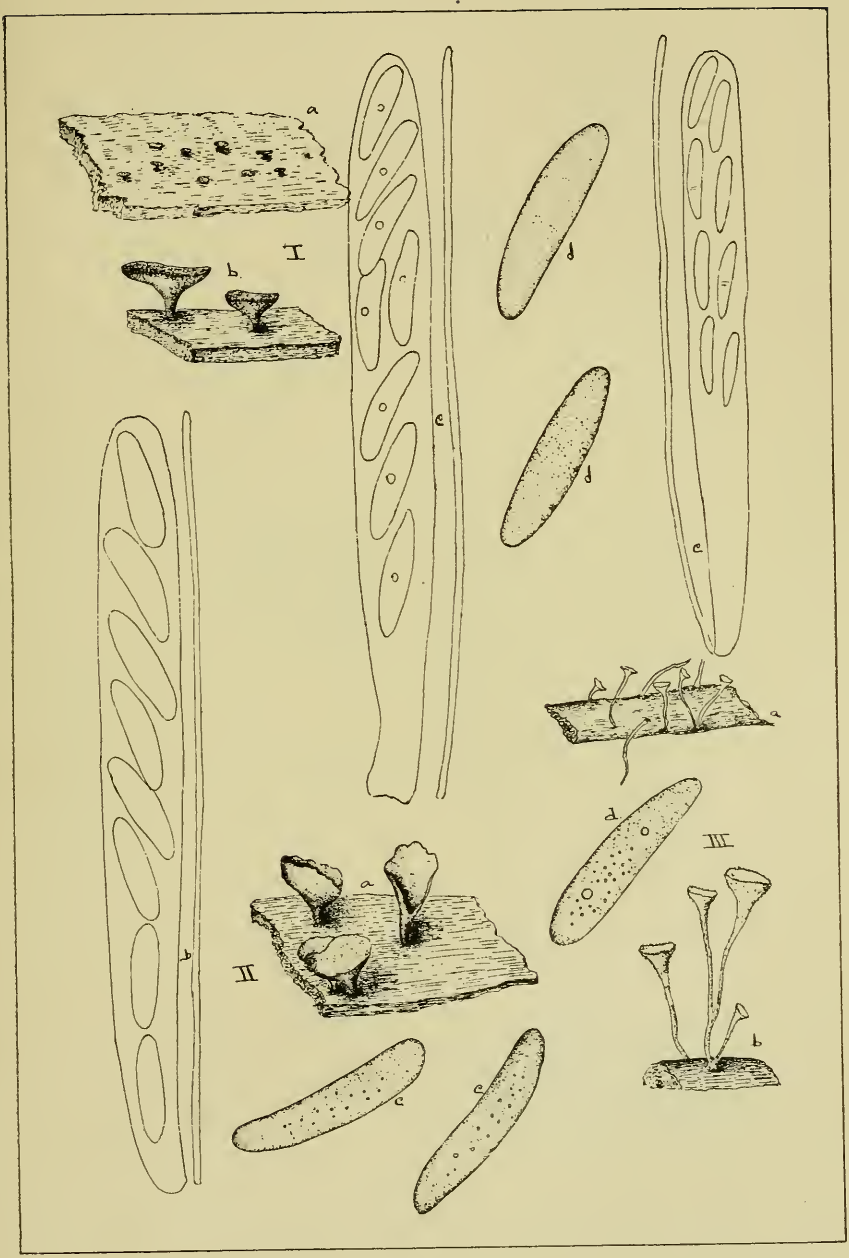
Explanation of Plate 24

I. Chlorosplenium æruginosum (Œder) DeNotaris.
- a. Plants natural size.
- b. Two plants × 5.
- c. Ascus with paraphysis and spores × 1500.
- d. Spores × 3000.

II. Chlorosplenium versiforme (Pers.) DeNotaris.
- a. Plants about natural size.
- b. Ascus with paraphysis and spores × 2000.
- c. Spores × 4000.

III. Dasyscypha pygmæa (Fries) Sacc.
- a. Plants natural size.
- b. Several plants × 3.
- c. Ascus with paraphysis and spores × 1000.
- d. One spore × 3000.

Plate 24



Explanation of Plate 25

Trichopeziza tiliæ (Peck) Sacc.

a. Plants natural size.

b. Plants of different ages × 10.

c. Hairs from exterior of cups showing markings.

II. Trichopeziza comata (Schw.) Sacc.

a. Plants natural size.

b. Two plants × 10.

c. Hairs from exterior of cup.

III. Dasyscypha nivea (Hedw.) Sacc.

a. Plants natural size.

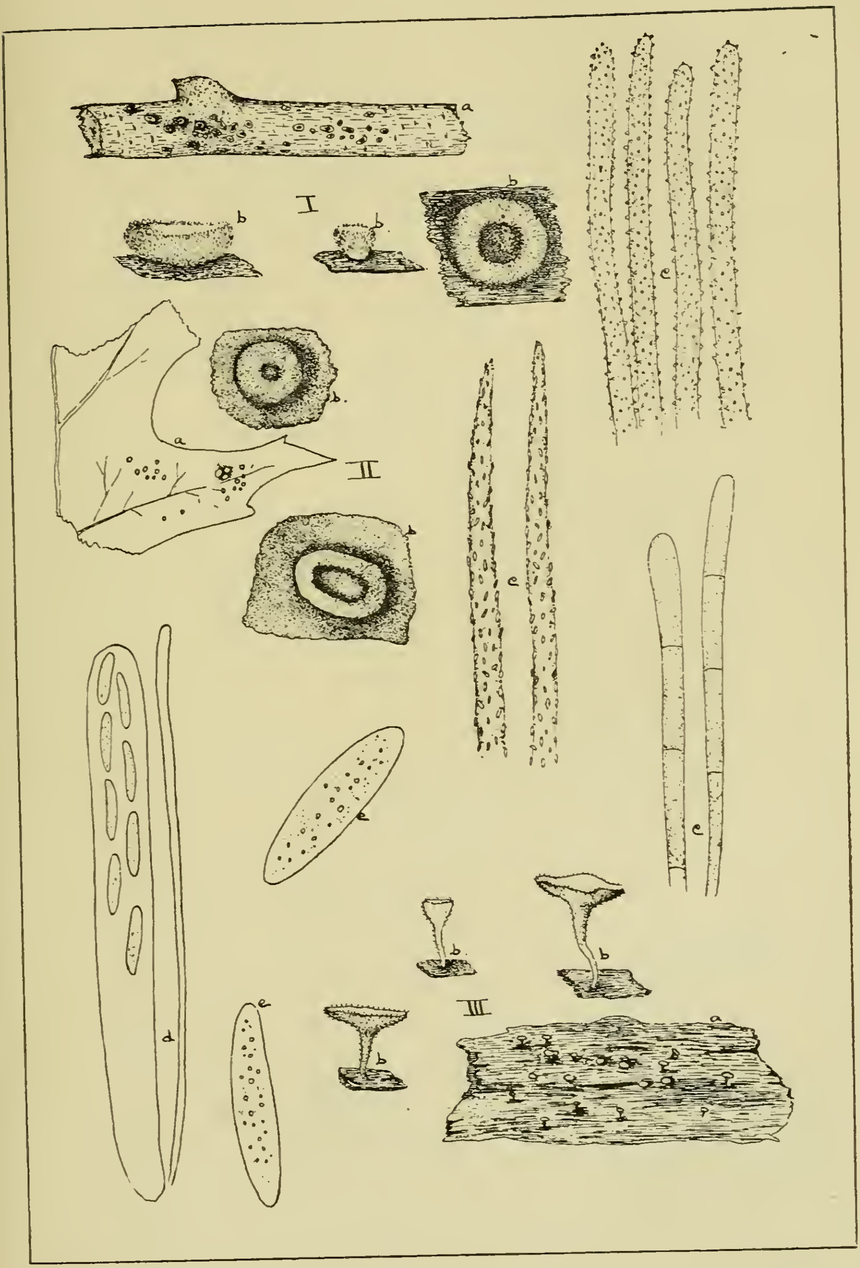
b. Several plants × 10.

c. Hairs from exterior of cups.

d. Ascus with paraphyses and spores × 1000.

e. Spores × 3000.

Plate 25



Explanation of Plate 30

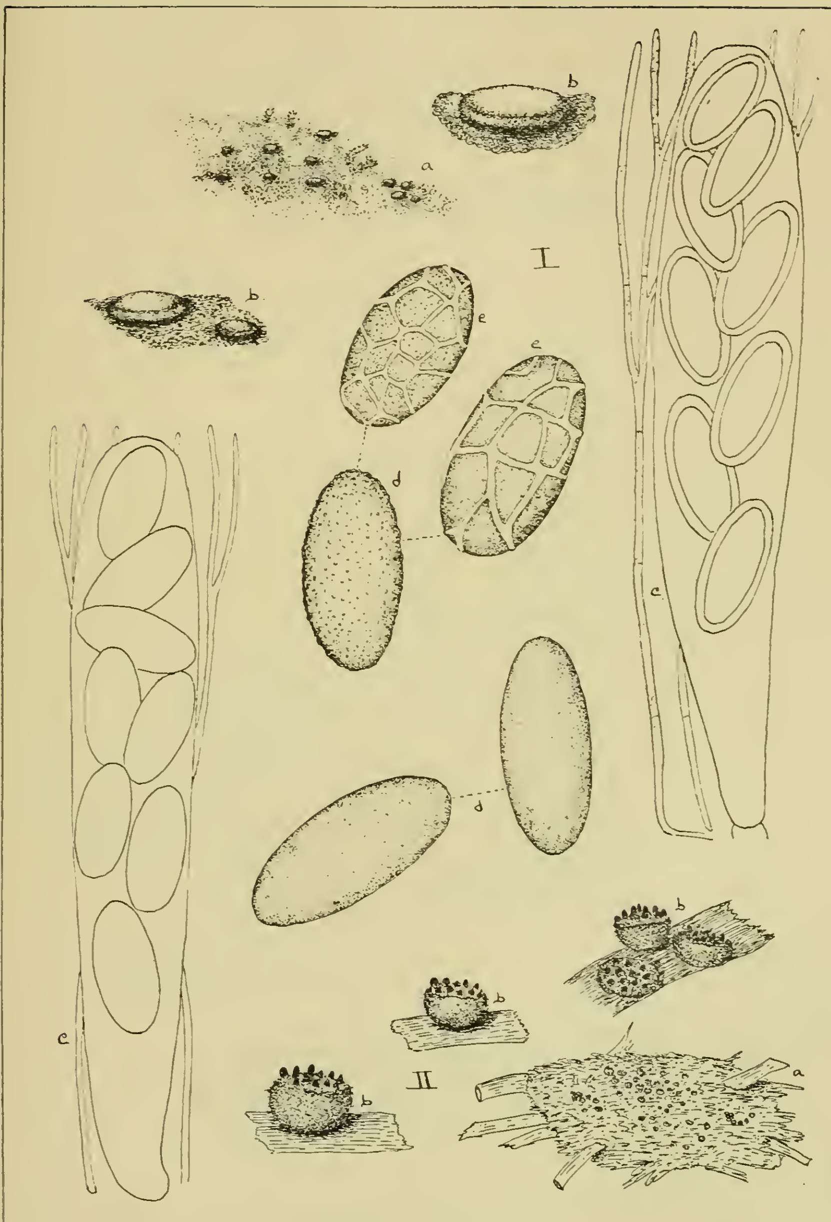
I. Ascobolus viridis Curr.

- a. Plants natural size.
- b. Plants × 5.
- c. Ascus with spores and paraphyses × 800.
- d. One spore not fully mature × 1200.
- e. Mature spores × 1200.

II. Ascobolus leveillei Boud.

- a. Plants natural size.
- b. Several plants × 10.
- c. Ascus with spores and paraphyses × 800.
- d. Two spores × 1500.

Plate 30



Explanation of Plate 36

I. Karschia taveliana Rehm.
- a. Plants natural size.
- b. Plants a little enlarged.
- c. Ascus with paraphyses and spores × 800.
- d. Portion of an empty ascus × 1000.
- e. Two spores × 1800.

II. Hysteropatella clavispora (Peck) comb. nov.
- a. Plants natural size.
- b. Plants a little enlarged.
- c. Several plants showing different forms × 5.
- d. Ascus with paraphyses and spores × 800.
- e. Two spores × 1500.

III. Patellaria tetraspora Massee & Morgan.
- a. Plants natural size.
- b. Ascus with spores × 1000.
- c. Plants × 3.

Plate 36

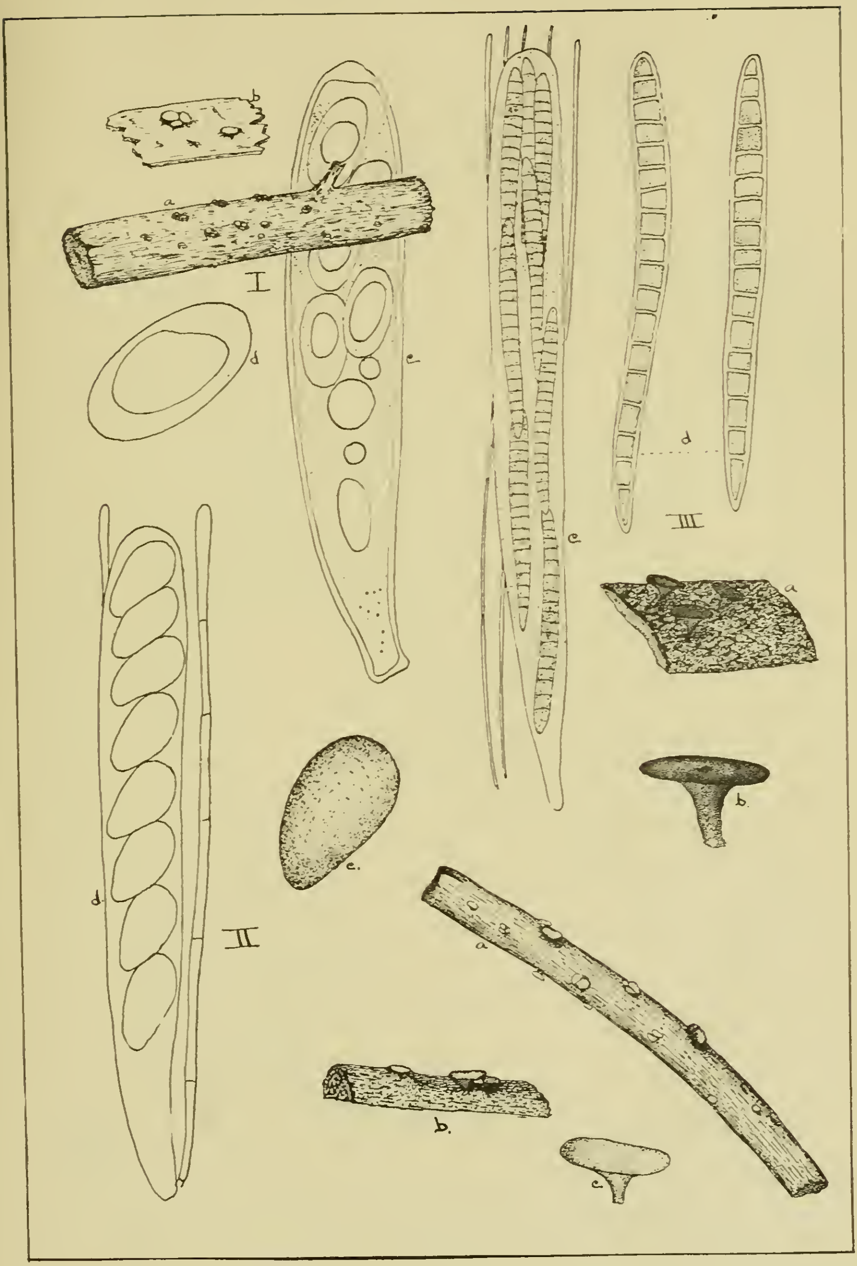
Explanation of Plate 38

I. Dermatea olivascens Rehm.
- a. Clusters of plants natural size.
- b. Several clusters × 4.
- c. Ascus with spores × 600.
- d. One spore × 1200.

II. Cenangium rubiginosum (Fries) Sacc.
- a. Clusters of plants natural size.
- b. Two clusters of plants × 3.
- c. One plant × 5.
- d. Ascus with spores × 700.
- e. One spore × 1500.

III. Holwaya gigantea (Peck) Durand.
- a. Plants natural size.
- b. One plant × 5.
- c. Ascus with spores and paraphyses × 500.
- d. Two spores × 1000.

PLATE 38



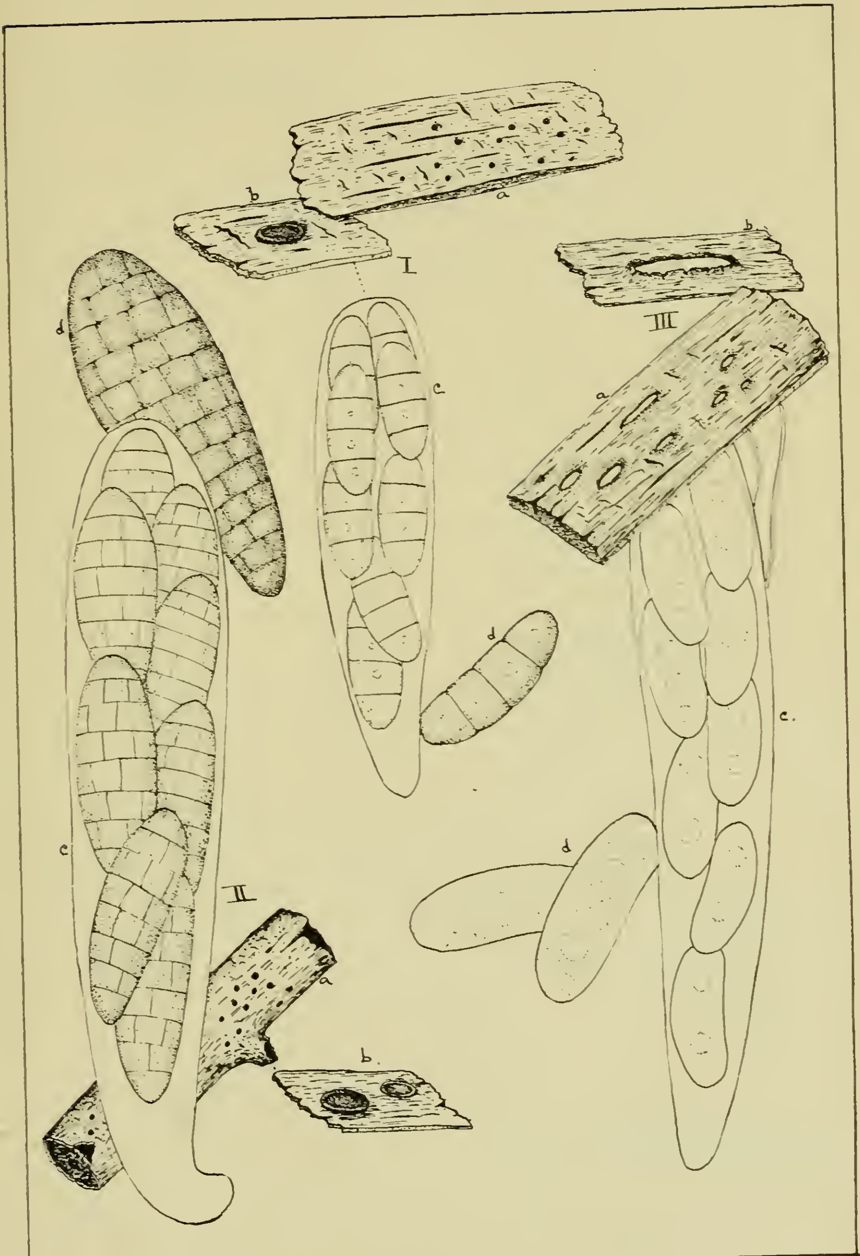
Explanation of Plate 40

I. Mycolecidea triseptata Karst.
- a. Several plants natural size.
- b. One plant × 10.
- d. Ascus with spores × 1000.
- e. One spore × 1200.

II. Blitrydium fenestratum (Cooke & Peck) Sacc.
- a. Several plants natural size.
- b. Two plants × 10.
- c. Ascus with spores × 600.
- d. One spore × 1000.

III. Propolis faginea (Schrad.) Karst.
- a. Several plants natural size.
- b. One plant × 5.
- c. Ascus with spores × 600.
- d. Two spores × 800.

Plate 40



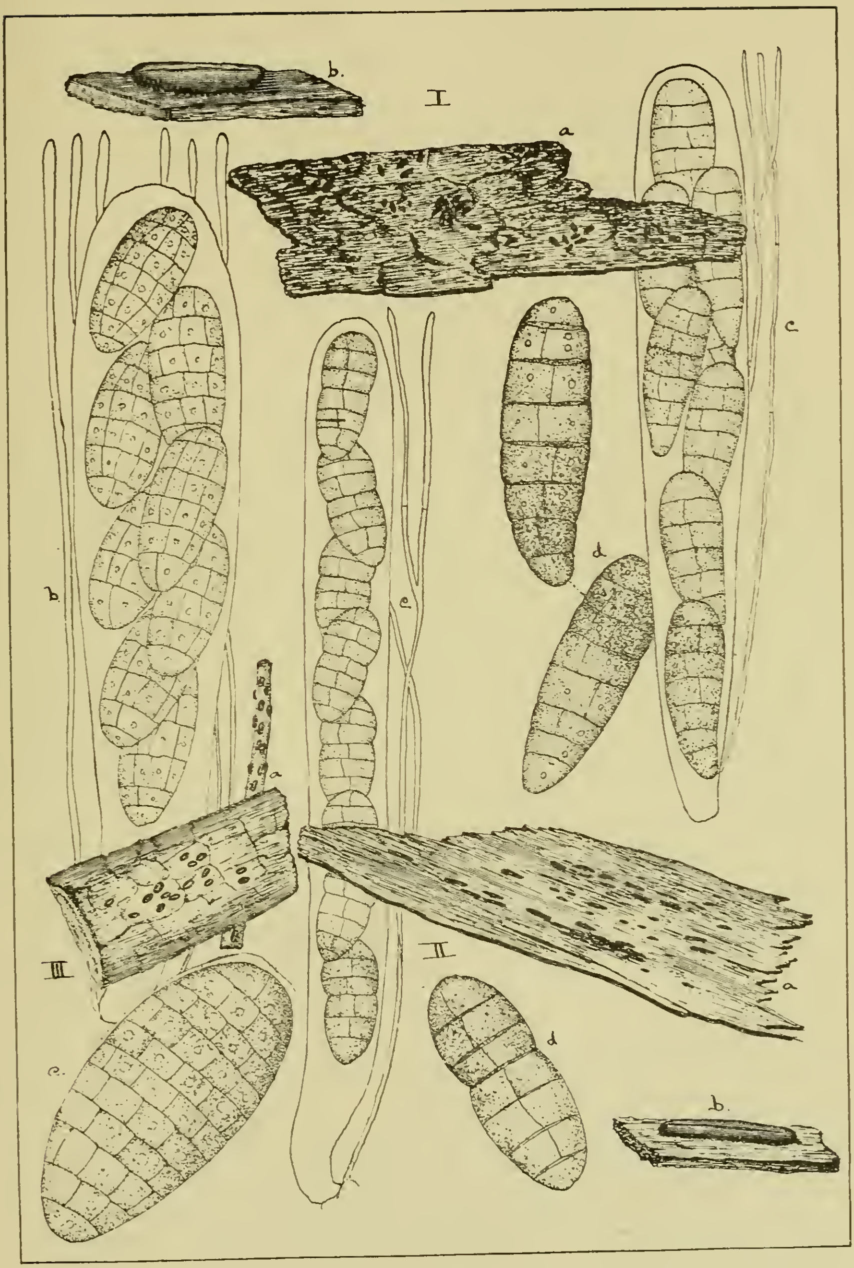
Explanation of Plate 41

I. Hysterographium kansense Ellis & Everhart.
   a. Plants natural size on bark.
   b. One plant × 10.
   c. Ascus with spores and paraphyses × 800.
   d. Two spores × 1500.

II. Hysterographium mori (Schw.) Rehm.
   a. Plants natural size.
   b. One plant × 10.
   c. Ascus with paraphyses and spores × 700.
   d. One spore × 1500.

III. Hysterographium fraxini (Pers.) DeNotaris.
   a. Plants natural size.
   b. Ascus with paraphyses and spores × 800.
   c. One spore × 1500.

PLATE 41



A FOSSIL BURROWING SPONGE FROM THE IOWA DEVONIAN

BY A. O. THOMAS.

Cliona hackberryensis, nov. sp.
Plate

Burrows tubular and of uniform size being from two to three tenths of a millimeter in diameter; usually found penetrating the shells of brachipods especially those of *Orthis striatula* Schloth. and of *Strophonella hybrida* H. & W.

The ramifying burrows extend parallel to the surface as well as obliquely and vertically to it and are generally filled with some foreign substance which, if softer than its surrounding walls, crumbles out leaving them open; as the outside of the brachiopod shell weathers away the underlying borings appear on the new surface as delicate intersecting grooves. This labyrinthine maze of passages often weakens the shell causing it to disintegrate. A single valve containing many borings was cut and polished but none of the tubes were found to perforate the inner surface, showing that in case the sponge inhabited the shell of a living brachiopod it did not disturb the occupant in the least.

This genus of sponges lives in our modern seas and '''burrows in the shells of oysters and other bivalves, but for protection not food.'' (Parker and Haswell. *Textbook of Zoology. Vol. 1, p. 116.*)

It is not known how the process of boring is effected, ''the presence of an acid in the tissue was suspected, but has been searched for in vain''. (Hartog, Sollas, Hickson, Macbride. *Protozoa, Coelenterates, and Echinoderms. p. 218.*) Zittel says that they ''secrete pin-shaped siliceous elements . . . . by means of which they bore labyrinthic passages in the shells of molluscs''. (Zittel. *Textbook of Paleontology. Vol. 1, p. 46.*) ''The characteristic borings of *Cliona* are known from the Tertiary, Cretaceous, and Jurassic, and are even present in the Silurian." (Zittel, *Handbuch der Paläoneologie, Vol. 1, part 1, p. 143.*)

The presence of the borings of this little sponge in the brachiopod shells was first pointed out by Dr. Calvin, and whatever of merit this original description may have is greatly due to his valuable suggestions and kind assistance.

Locality and position: Collected by the writer in the Lime Creek shales, Upper Devonian series at Hackberry Grove, Iowa.

Explanation of Plate

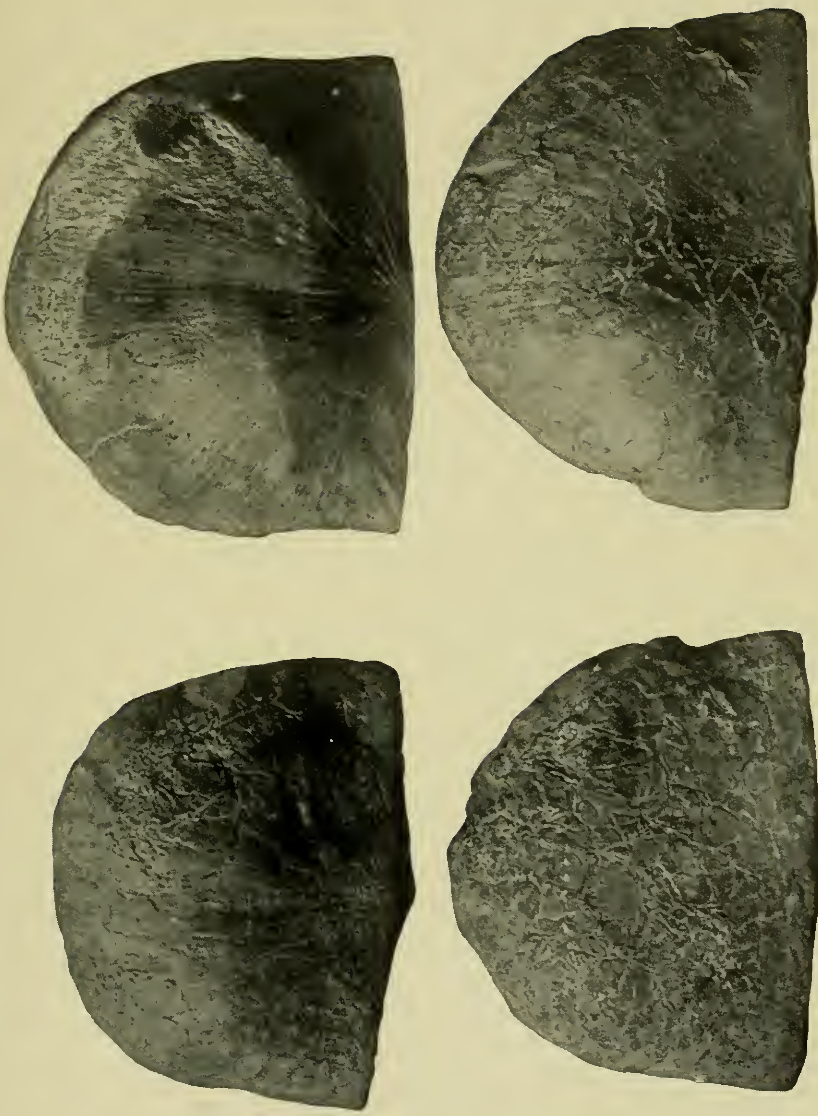
Cliona hackberryensis, Thomas.

The plate illustrates the characteristic borings of the species as seen on valves of *Strophonella hybrida* H. & W.

In the two upper specimens figured the passages still contain more or less of the original filling; in the lower right hand specimen the filling has been nearly all removed leaving the passages open.

The test of the lower left hand specimen, near the anterior margin, has begun to crumble away due to being undermined by the numerous tunnels beneath.

The figures are nine-fifths natural size.



THE PRAIRIES

B. SHIMEK

Few phenomena have attracted as much attention from layman, amateur and scientific observer alike as the absence of trees from the prairies of the Mississippi valley, and for that reason the literature of few subjects presents as great a variety in quality and value. Prairies and "barrens" were encountered by the first settlers of the great valley, and some of the earliest discussions of the problem are concerned with the prairies of Ohio.[1]

But it was not until the white man crossed the Wabash river in his westward advance that he beheld the prairies in all their splendor, and all their monotonous magnitude.

These prairies presented varying aspects. The early settler avoided them at first in part for the reason that he thought them not fertile because treeless, and in part because they did not furnish the much needed building materials, fuel and water; but as his experience increased, there were added to these reasons the menace of the prairie fires and the terror of winter storms.

Both of these dangers have practically disappeared with the settlement of the prairies and the development of shelter-belts, but neither will be forgotten by those who witnessed their mad fury.

The old-time blinding, bewildering blizzard of the prairies has lost its horror, and though it may still cause personal discomfort, it no longer menaces the safety of its hapless victims.

But even in winter the prairie was often attractive, for the storms subsided, and by day the sun-lit sea of snow sparkled with countless ice-crystals which covered its surface, or formed filmy festoons on every projecting culm and blade, and by night it rested in impressive silence under the star-spangled sky.

[1]Atwater, Caleb. Am. Jour. Sci. and Arts, 1st Series, 1818, p. 116.

But the horrors and the charms of winter finally passed, and with opening spring the ponds and lakes were soon gilded with the water crowfoot, and the hills and higher prairies were dotted with the early pasque-flower, the prairie violet and a variety of rapidly succeeding spring flowers. The broad prairies were swept by great whirl-wind clouds of golden plovers, the long-billed curlew hovered between earth and space in marvelous manner, an easy mark for every pot-hunter in the land; the bobolink and the marsh blackbird made the welkin ring with their songs; the mournful "boom" of the prairie chicken resounded everywhere; and soon countless nests were occupied by wild geese, ducks and prairie hens on all sides, giving promise of new generations in untold numbers to enliven these prairies in a fashion which will never again be known to this or coming generations. Soon the grasses covered the surface with a great carpet of green painted with puccoons, prairie phlox and other flowers of late spring.

But the real rich beauty of the prairie was developed only after mid-summer when myriads of flowers of most varied hues were everywhere massed into one great painting, limited only by the frame of the horizon, uniform in splendid beauty, but endlessly varied in delicate detail.

In the fall this in turn was followed by the rusty-red or brown expanse of drying grasses which portended the coming of the terror and the splendor of that scourge of the early prairie settlers, the prairie fires, whose fascinating fury can be appreciated only by those who in earlier years had the privilege of looking upon them in hopeless helplessness.

And again winter, with its brilliant monotony and its dreary desolation followed, and the cycle was complete.

Such were the prairies as we knew them in Iowa. But the native prairie is fast disappearing before the army of home-builders, whose invasion is everywhere followed by the disappearance of the native prairie flora, and the appearance, in its stead, of artificial groves, cultivated crops and introduced weeds.

In Iowa the prairie formerly covered the greater part of the surface of the state. The area has been variously estimated at from sixteen-seventeenths to four-fifths,[2] but a careful compilation of available records and observations in the field indicates that a little more than seven-eighths of the surface was prairie, leaving less than one-eighth for the forest area, which, however, included the thickets bordering streams, and the scrub-oak thickets in various parts of the state, which should scarcely be dignified by being called forests.

The prairie was very variable in topography, for it occurred in alluvial valleys, upon flat drift plains, on abrupt slopes,—indeed upon all types of topography in the state from the flattest to the most broken.[3] Neither was it restricted to particular geologic formations, for it was found, and still exists to a limited extent in its primitive condition, upon every kind of formation which reaches the surface, not only in Iowa but in the entire Mississippi valley.

In the upper Mississippi valley typical prairie is found lying over all the older rocks from the Algonquin to the Cretaceous; on all the drift areas from the Nebraskan to the Wisconsin; on loess of every horizon; on alluvial flats; on sand-dune areas; and on the limited areas in which geest forms the immediate subsoil.

On Murray hill northeast of Little Sioux, Iowa, Aftonian sand and gravel are exposed along the basal third, Kansan till and Loveland joint clay occupy the middle of the slope, and loess forms the surfaces of the uppermost two-fifths, yet the flora is essentially the same from base to summit so far as the species are concerned, upon the portions of the surface having the same exposure. The only noticeable difference appears in the vigor and size of the plants, those on the Aftonian surfaces being stunted and less densely crowded.

Among scientific observers the problem of the prairie has usually been assigned to, or assumed by, the geologists, and Dana, Whitney, White, Alexander Winchell, N. H. Winchell, Foster,

[2]The latter was published by Baker, Native and Planted Timber in Iowa, Forest Service Circular, 154, U. S. Dept. Agr., Sept. 15, 1908, p. 8.

[3]It included territory which varied from the comparatively moist borders of swamps, lakes and streams, to the highest, dryest ridges of loess or drift. Indeed, drainage or absence of water had little to do in determining its distribution, for it frequently extends to the very border of swamp, or stream, or lake, extending alike over areas of very unequal drainage.

Newberry, D. D. Owen, Shaler, Upham, Worthen, and other well-known geologists wrestled with it with varying success. White specially states[4] that the "'question of the origin of the prairie has become more hackneyed perhaps, than any other of the speculative questions which North American geology affords,'' and Willard says[5] that "their explanation belongs to the science of Landscape Geology."

Yet the problem is one which belongs in its most striking aspects to plant ecology and falls properly within the province of the botanist, for no matter what may be the variation in the surface characteristics of the prairies there is comparative uniformity in the nature of their floral covering. Not only are prairies striking because of the absence of trees, but they are marked none the less definitely by the presence of a flora which is wholly distinct from the smaller (chiefly herbaceous) flora of the forest.

The areas which were originally covered with a prairie flora in Iowa are of six more or less distinct types:

1. The broad flat plains which characterized the Wisconsin (see plate I, figure 1) and Iowan drift areas and a part of the un-eroded Kansan drift area such as may be observed in Osceola county and southward. These plains contained large undrained areas, the swamps, ponds and lakes of which possessed a rich hydrophytic flora the discussion of which does not fall within the limits of this paper.

2. The more rolling drift surfaces such as are presented by the greater part of the Kansan area and the more or less distinct moraines bordering the Wisconsin and Iowan areas.[6] A part of the Kansan area is covered with a rather thin veneer of loess.

3. The very rough loess ridges which border the Missouri valley and which present the most extreme xerophytic conditions in Iowa. Similar conditions are found in the rough Wisconsin morainic (?) region in southwestern Lyon county, and the floras of the two areas are practically identical. (See plate III; plate IV, fig. 2; plate V, fig. 1; and plate VII, fig. 1).

[4] Report on the Geological Survey of Iowa, Vol. I, 1870, p. 132.

[5] Willard, Daniel E., The Story of the Prairies, 1903, p. 21.

[6] For the distribution of the drift areas in Iowa see map, plate III, Report of Iowa Geological Survey, Vol. XIV, 1904.

4. The well-drained alluvial plains such as are shown at their best along the Missouri, but which are more or less developed along all the larger streams. The undrained portions of these plains develop, of course, a hydrophytic flora.

5. The prairie ridges which appear in all the forested rougher parts of the state, but are most striking in the more heavily timbered eastern parts where they have been known as "oak openings" because the surrounding forest, consisting largely of oaks, encroached upon them. These prairie openings are sometimes mere tongues of greater prairie areas which extend into the forest, but they are frequently surrounded by forest and may be several miles from larger prairie tracts. They vary in area down to a few square rods and are developed independently of geological formations except in so far as these determine topography. Detached areas of this kind are shown in plate II.

6. The sand-dune areas (see plate XI, fig. 2). These are usually considered distinct from the prairie but a comparison of the floras shows that they differ but little.

In the following table a comparison is made between the floras of these several types of prairie areas and the abundance and relative distribution of the species is roughly indicated by letters: a) indicating a dominant type or species; b) principal species which are common and widespread; c) rather common species, also widely distributed, and sometimes locally common in families, but on the whole less abundant than (b); d) species which are locally common in families, but these often widely separated: e) species represented by but few scattered individuals, but almost always present on the prairie; and f) rare species, often absent.

In addition to the letters symbolizing distribution other letters are sometimes added to indicate that the species listed was found at but one of the localities which represent a given type area. The additional letter in each case is the initial of the name of the county. Thus in the sand-dune column cM means that the species so marked is quite common but was obtained only from the Muscatine county locality. The following localities were selected to represent the several type areas:

1. The flat prairie: Emmet county, chiefly the northeastern

and western parts,[7] and the vicinity of Roland in Story county, both in the Wisconsin area.

2. The rolling prairie: Johnson county, near Iowa City, and the northwestern part of Lyon county north and northeast of Granite. Both are loess-Kansan and the latter is somewhat rougher.

3. The western ridges: the loess ridges of Harrison county and the Wisconsin hills of southwestern Lyon county. While they are unlike geologically they are very similar in their rough topography and their flora.

4. The alluvial prairie: Harrison county, in the Missouri valley, and the valley of the Iowa river in Johnson county, and the adjoining part of Iowa county.

5. The prairie openings: Johnson county, north of Iowa City, and Winneshiek county along the Upper Iowa river.

6. The sand-dunes: Muscatine county, south of Muscatine, and the western part of Harrison county.

It should be noted that too much emphasis should not be placed upon relative abundance of individuals of species as this varies in different localities and in different seasons.

The following list contains the typical prairie plants of Iowa:

	Flat I	Rolling II	Ridges III	Prairie Openings IV	Alluvial V	Sand Dunes VI
Acerates floridana (Lam.) Hitch.......	eE	eJ	eH	—	—	—
Acerates viridiflora (Raf.) Eaton......	—	eJ	eH	—	—	eM
Acerates viridiflora lanceolata (Ives) Gray	—	e	e	—	eJ	eM
Acerates viridiflora linearis Gray.....	—	—	f	—	—	—
Achillea millefolium L...............	c	e	cL	c	c	cM
Agoseris cuspidata (Pursh) Steud......	c	—	cH	—	—	—
Agropyron Smithii Ryd..............	d	dL	—	dJ	d	dM
Agrostis alba vulgaris (With.) Thurb.....	—	—	—	c	c	cM

[7]The Emmet county list is made up in large part of plants collected by the writer but additional information was secured from Mr. R. I. Cratty's collection.

	I Flat	II Rolling	III Ridges	IV Prairie Openings	V Alluvial	VI Sand Dunes
Allium canadense L.	c	c	—	c	e	—
Allium cernuum Roth	dE	—	—	—	—	—
Allium stellatum Ker	c	—	c	—	—	—
Ambrosia artemisiaefolia L.	b	b	b	c	c	cM
Ambrosia psilostachya DC.	c	cL	c	cJ	c	c
Ambrosia trifida integrifolia (Muhl.) T. & G.	—	—	cH	cW	—	cM
Amorpha canescens Pursh	c	c	c	c	c	c
Andropogon furcatus Muhl.	a	a	a	e	c	e
Andropogon scoparius Michx.	a	a	a	c	c	c
Anemone canadensis L.	d	d	—	—	d	dM
Anemone cylindrica A. Gray	c	c	c	c	eJ	cM
Anemone patens Wolfgangiana (Bess.) Koch.	c	c	cH	fW	—	—
Antennaria neodioica Greene	d	d	d	d	dJ	dM
Antennaria plantaginifolia (L.) Rich.	d	dJ	dH	d	dJ	dM
Aplopappus spinulosus (Pursh.) DC.	—	—	cH	—	—	—
Apocynum androsaemifolium L.	—	—	—	c	cJ	—
Apocynum cannabinum L.	cE	c	—	cJ	c	cM
Apocynum cannabinum hypericifolium (Ait.) Gray.	—	—	—	—	cH	—
Apocynum cannabinum pubescens (R.Br.) DC.	—	—	—	—	—	cM
Aristida basiramea Engelm.	dS	—	—	cW	—	cH
Artemisia caudata Michx.	c	cL	cL	cW	cH	bM
Artemisia dracunculoides Pursh	cE	—	dH	cW	—	cM
Artemisia frigida Willd.	—	—	fL	—	—	—
Artemisia ludoviciana Nutt.	c	c	c	c	c	cM
Asclepias ovalifolia Dec.	eE	—	—	—	eJ	—
Asclepias purpurascens L.	eS	e	e	eJ	—	—
Asclepias speciosa Torr.	eE	eL	—	—	—	—
Asclepias Sullivantii Engelm.	eE	eJ	—	—	e	—
Asclepias syriaca L.	c	c	e	c	c	cM
Asclepias tuberosa L.	c	c	c	c	c	cM
Asclepias verticillata L.	c	b	c	c	c	cM

	Flat I	Rolling I	Ridges III	Prairie Openings IV	Alluvial V	Sand Dunes VI
Aster laevis L.	cE	eJ	eH	e	cJ	—
Aster multiflorus exiguus Fernald	c	c	c	c	eJ	cM
Aster novae-angliae L.	c	c	eH	cJ	c	cM
Aster oblongifolius Nutt.	—	cL	c	eJ	—	cM
Aster ptarmicoides (Nees) T. & G.	cE	cL	cL	fW	—	fM
Aster sericeus Vent.	c	c	c	c	—	cM
Astragalus canadensis L.	c	—	cH	—	eJ	cH
Astragalus caryocarpus Ker	c	cL	c	—	—	—
Astragalus distortus T. & G.	—	—	—	—	—	eM
Astragalus lotiflorus Hook	—	—	e	—	—	—
Astragalus plattensis Nutt	—	—	cH	—	—	—
Baptisia bracteata Ell	e	—	—	—	eJ	eM
Baptisia leucantha T. & G.	—	eJ	—	—	eJ	eM
Bouteloua curtipendula (Michx.) Torr.	cS	cL	c	c	—	cM
Bouteloua hirsuta Lag	dS	—	d	—	—	dM
Brauneria angustifolia (DC.) Heller	c	bL	b	—	—	—
Brauneria pallida (Nutt.) Britt	—	bJ	—	cJ	cJ	eM
Cacalia tuberosa Nutt	e	eJ	eH	—	cJ	cM
Carex Bicknellii Britt	cE	cJ	—	—	—	—
Carex cephalophora Muhl	—	cJ	—	—	—	cM
Carex festucacea Schk	—	c	c	cJ	c	cM
Carex gravida Bailey	cS	—	—	—	d	cM
Carex pennsylvanica Lam	—	—	cH	c	cJ	cM
Cassia chamaecrista L.	cS	c	c	c	c	a
Castilleja coccinea (L.) Spreng	—	—	—	cJ	—	—
Castilleja sessiliflora Pursh	c	—	c	—	—	—
Ceanothus americanus L.	c	c	e	c	eJ	eM
Ceanothus ovatus pubescens T. & G.	—	—	cH	fW	—	—
Cenchrus carolinianus Walt	—	cL	c	—	—	b
*Chenopodium album L.	—	cJ	c	—	cJ	c
Chenopodium leptophyllum Nutt	—	cJ	—	—	cJ	cM
Chrysopsis villosa (Pursh) Nutt	—	—	c	—	—	—
Cirsium altissimum L.	cS	c	—	—	eJ	eM
Cirsium discolor (Muhl.) Spreng	cS	—	cH	cW	—	—

* Introduced.

	Flat I	Rolling II	Ridges III	Prairie Openings IV	Alluvial V	Sand Dunes VI
Cirsium iowense (Pam.) Fern.	cE	cL	c	eW	eH	cH
Clematis Simsii Sweet	—	cJ	—	c	cJ	cM
Comandra umbellata (L.) Nutt.	cE	cJ	c	c	cJ	dM
Convolvulus sepium L.	c	c	—	—	c	cM
Coreopsis palmata Nutt.	c	c	e	c	cJ	cM
Corydalis aurea occidentalis Engelm.	—	—	—	—	eH	dM
Crotalaria sagittalis L.	—	—	—	eJ	—	c
Cuscuta arvensis Beyrich	cE	—	—	—	—	eM
Dalea alopecuroides Willd.	—	—	cH	—	—	—
Dalea enneandra Nutt.	—	dL	d	—	dH	dH
Delphinium Penardi Huth.	c	cL	cH	—	—	dM
Desmodium canadense (L.) DC.	c	c	cL	cJ	c	c
Desmodium illinoense A. Gray	cS	dJ	—	—	cJ	eM
Dodecatheon Meadia L.	—	—	—	c	cJ	—
Draba caroliniana Walt.	—	—	—	—	—	cM
Dyssodia papposa (Vent.) Hitch.	—	—	cH	cJ	—	cM
Ellisia nyctelea L.	c	dJ	—	—	dJ	dM
Elymus canadensis L.	—	c	c	cJ	cJ	c
***Equisetum arvense** L.	c	cJ	cL	—	c	cM
Equisetum hyemale L.	c	—	cH	—	c	c
Equisetum laevigatum A. Br.	c	c	c	—	c	c
Erigeron canadense L.	b	c	b	c	c	c
Erigeron divaricatum Michx.	cE	—	—	—	—	cM
Erigeron pulchellus Michx.	—	dJ	—	dJ	—	—
Erigeron ramosus (Walt.) B. S. P.	b	b	b	c	c	c
Eryngium yuccifolium Michx.	c	cJ	—	cJ	cJ	cM
Eupatorium altissimum L.	—	—	d	e	—	—
Euphorbia corollata L.	c	c	c	c	c	cM
Euphorbia glyptosperma Engelm.	cE	cL	eL	—	—	—
Euphorbia maculata L.	—	c	eL	cJ	—	cM
Euphorbia marginata Pursh.	—	—	c	—	—	—
Euphorbia Preslii Guss.	—	c	c	cJ	c	cH
Euphorbia serpens H. B. K.	—	—	—	—	—	dH
Euphorbia serpyllifolia Pers.	—	—	c	—	—	—

* Introduced.

	Flat I	Rolling II	Ridges III	Prairie Openings IV	Alluvial V	Sand Dunes VI
Festuca octoflora Walt.	—	—	—	—	dH	dM
Fragaria virginiana Duchesne	c	c	c	c	c	c
Galium boreale L.	cE	dJ	—	cW	—	—
Gentiana puberula Michx.	cE	eL	—	fJ	—	—
Geranium carolinianum L.	—	—	—	dJ	—	dM
Gerardia aspera Dougl.	cE	eL	e	eW	—	eM
Glycyrrhiza lepidota Pursh	cE	cL	cL	—	dH	—
Gnaphalium polycephalum Michx.	—	—	—	e	cJ	eM
Grindelia squarrosa (Pursh) Dunal	—	cL	e	—	—	—
Hedeoma hispida Pursh	—	b	dL	c	cJ	dH
Hedeoma pulegioides (L.) Pers.	—	—	dL	cJ	—	dM
Helianthemum canadense (L.) Michx.	—	—	—	cJ	eJ	cM
Helianthemum majus (L.) B. S. P.	—	—	—	c	—	cM
Helianthus annuus L.	c	cL	c	—	cH	c
Helianthus hirsutus Raf.	—	—	cH	—	—	—
Helianthus Maximiliani Schrad.	cE	cL	—	—	eH	—
Helianthus occidentalis Rid.	—	—	—	e	—	dM
Helianthus scaberrimus L.	c	c	b	c	c	cM
Heliopsis scabra Dunal	c	c	e	c	c	—
Heuchera hispida Pursh	cE	cJ	e	cJ	cJ	dM
Hordeum jubatum L.	—	b	c	c	c	dM
Houstonia angustifolia Michx.	—	—	cH	—	—	—
Hypericum cistifolium Lam.	cJ	cJ	—	—	cJ	—
Hypoxis hirsuta (L.) Coville	c	cJ	—	cJ	—	—
Isanthus brachiatus (L.) B. S. P.	—	—	c	e	—	—
Iva xanthiifolia (Fresen.) Nutt.	—	cL	cH	—	cH	—
Juncus tenuis Willd.	c	c	—	c	cJ	dM
Koeleria cristata (L.) Pers.	—	c	c	dW	—	dM
Krigia amplexicaulis Nutt.	—	cJ	—	cJ	cJ	cM
Kuhnia eupatoroides corymbulosa T. & G.	c	cL	c	c	eJ	cM
Lactuca canadensis L.	c	c	c	—	cJ	c
Lactuca ludoviciana (Nutt.) DC.	—	c	c	—	—	—
Lactuca sagittifolia Ell.	—	cL	eH	—	—	—
*Lactuca scariola L.	—	c	c	e	c	—

*Introduced.

	Flat I	Rolling II	Ridges III	Prairie Openings IV	Alluvial V	Sand Dunes VI
Lappula Redowskii occidentalis (Wats.) Ryd.	—	—	eH	e	—	—
Lathyrus ochroleuca Hook.	eE	—	—	—	—	—
Lechea stricta Legg.	—	—	—	d	—	dM
Lechea tenuifolia Michx.	—	—	—	d	—	—
Lepachys pinnata (Vent.) T. & G.	b	b	cL	c	cJ	—
Lepidium apetalum Willd.	c	c	c	c	c	cM
Lespedeza capitata Michx.	c	eL	—	c	c	c
Liatris cylindracea (Michx.) Kuntze	dS	—	—	eW	—	cM
Liatris punctata (Hk.) Kuntze	cE	cL	c	—	—	—
Liatris pycnostachya (Michx.) Kuntze	cE	c	—	eJ	cJ	cM
Liatris scariosa Willd.	cE	c	c	eW	—	eM
Liatris squarrosa Willd.	—	—	cH	—	—	—
Lilium philadelphicum L.	cE	eJ	—	—	eJ	—
Linum sulcatum Riddell.	—	c	c	c	cJ	—
Lithospermum angustifolium Michx.	e	cL	c	eW	eH	—
Lithospermum canescens (Michx.) Lehm.	c	c	cH	c	e	eH
Lithospermum Gmelini (Michx.) A. S. H.	—	c	eL	—	cJ	cM
Lobelia spicata Lam.	e	e	—	e	eJ	eM
Lygodesmia juncea (Pursh.) D. Don.	cE	cL	c	—	—	—
***Melilotus alba** Desv.	—	c	cH	—	c	c
Monarda mollis L.	c	c	cH	c	cJ	cM
Muhlenbergia racemosa (Michx.) B. S. P.	—	cL	eH	—	—	cH
***Nepeta cataria** L.	—	c	e	c	—	—
OEnothera biennis L.	c	c	c	c	cJ	c
OEnothera rhombipetala Nutt.	—	cJ	—	—	—	—
OEnothera serrulata Nutt.	c	cL	c	c	—	—
Onosmodium occidentale Macken.	eE	cL	e	—	—	dM
Oxalis stricta L.	c	c	c	c	c	cM
Oxalis violacea L.	d	c	c	cJ	c	cM
Oxybaphus hirsutus (Pursh.) Sweet.	eE	—	eL	—	—	—
Oxybaphus nyctagineus (Michx.) Sweet	c	c	—	eJ	c	cM
Oxytropis Lamberti Pursh.	—	cL	c	—	—	—
***Panicum capillare** L.	cS	c	c	cJ	cJ	cH

*Introduced.

	Flat I	Rolling II	Ridges III	Prairie Openings IV	Alluvial V	Sand Dunes VI
Panicum Scribnerianum Nash..........	c	c	c	c	cJ	c
Panicum virgatum L..................	cS	c	cL	cJ	c	c
Parthenium integrifolium L...........	—	eJ	—	—	cJ	—
Pedicularis canadensis L..............	d	dJ		c	dJ	—
Pentstemon gracilis Nutt.............	—	—	e	—	—	cM
Pentstemon grandiflorus Nutt.........		eL	b	—	—	cM
Pentstemon laevigatus digitalis (Sweet.) Gray.	—	eL	—	eJ	eJ	—
Petalostemum candidum Michx........	c	c	c	c	c	cM
Petalostemum purpureum (Vent.) Ryd..	c	c	c	c	c	c
Phlox pilosa L........................	c	b	d	c	cJ	cM
Physalis pubescens L..................	—	c	cH	cJ	cJ	cM
Plantago aristata Michx..............	—	cL	c		—	dM
Plantago Rugelii Dec..................		c	cH		cJ	—
Poa compressa L......................	cS	e	cH	—	—	—
Poa pratensis L.......................	a	a	c	b	b	cM
Polygala sanguinea L.................	—	—		eW	cJ	eM
Polygala senega L....................			—	e	cJ	—
Polygala verticillata L................	eE	—	e	d	—	eM
***Polygonum convolvulus** L............	—	c	c	c	cJ	cM
Polygonum ramosissimum Michx.......	eE	eL	e	—	e	eM
Polygonum tenue Michx...............	—	—	dL	—	—	dM
Potentilla arguta Pursh...............	c	c	e	eJ	cJ	eM
Potentilla canadensis L..............	—	c	—	c	—	—
Potentilla monspeliensis L............		cJ	e	e	e	eM
Prenanthes aspera Michx.............	eE	cL	fH	—	—	—
Prenanthes racemosa Michx............	eE	eL	—	—	—	—
Psoralea argophylla Pursh.............	c	cL	c		—	—
Psoralea esculenta Pursh..............	eE	eL	c	—	—	—
Pycnanthemum flexuosum (Walt.) B. S. P.	c	cJ		c	cJ	eM
Pycnanthemum pilosum Nutt..........	—	dJ	—	eJ	—	cJ
Quercus macrocarpa olivaeformis A. Gray.	eE	—	c	—	—	—
Ranunculus fascicularis Muhl..........	c	—	—	c	cJ	dM

* Introduced.

	I Flat	II Rolling	III Ridges	IV Prairie Openings	V Alluvial	VI Sand Dunes
Ranunculus rhomboideus Goldie........	e	—		—	—	—
Rhus glabra L........................	c	—	c	c	c	eM
Rhus toxicodendron L.................	c	cJ	—	c	c	c
Rosa humilis Marsh..................	—	cJ	—	eJ	—	dM
Rosa pratincola Greene...............	c	c	c	—	c	c
Rosa Woodsii Lindl..................	—	—	cH	e	e	—
Rubus occidentalis L................	—	e	eH	e	e	eH
Rudbeckia hirta L...................	cE	cJ	—	cJ	cJ	eM
Ruellia ciliosa Pursh...............	—	—	—	cJ	cJ	eM
***Rumex acetosella** L..................	dS	dJ	—	eW	dJ	dM
Rumex altissimus Wood..............		c				
***Rumex crispus** L....................	—	cJ	cH	—	e	eM
Salix humilis Marsh.................	c	c	cH	c	dJ	c
***Salsola kali tenuifolia** G. F. W. Mey..	e	e	c	—	—	c
Scrophularia leporella Bickn..........	eE	dJ	fH	e	cJ	cM
Scutellaria parvula ambigua (Nutt.) Fern.	dE	dJ	fL	c	—	—
Senecio plattensis Nutt..............	d	dJ	dH	d	d	dM
***Setaria viridis** (L.) Beauv...........	—	b	c	c	—	c
Silene antirrhina L..................	e	eJ	eL	eJ	—	cM
Silene stellata (L.) Ait...............	—	—	—	e	eJ	cM
Silphium integrifolium Michx..........	—	cJ	—	—	eJ	cM
Silphium laciniatum L................	c	b	c	eJ	cJ	—
Sisymbrium canescens brachycarpon (Rich.) Wats.	d	d	—	c	d	c
Sisyrinchium campestre Bickn..........	c	cJ	cH	c	c	cM
Smilacina stellata (L.) Desf..........	—	dJ	—	d	—	—
Solanum carolinense L...............	—	cJ	—	—	—	—
Solidago canadensis L................	c	c	cH	—	—	cH
Solidago graminifolia (L.) Salisb......	dE	—	—	—	dJ	eM
Solidago missouriensis Nutt...........	c	c	c	c	—	eM
Solidago nemoralis Ait................	c	c	c	c	—	—
Solidago rigida L....................	c	c	a	c	—	cM
Solidago serotina Ait.................	c	c	cH	cJ	—	cH

* Introduced.

	Flat I	Rolling II	Ridges III	Prairie Openings IV	Alluvial V	Sand Dunes VI
Solidago speciosa angustata T. & G....	c	c	c	cW	—	—
Sorghastrum nutans (L.) Nash.........	—	bL	c	e	cH	cM
Specularia perfoliata (L.) A. DC.	—	—	—	eW	eJ	eM
Stipa spartea Trin....................	—	b	c	—	—	dM
Strophostyles pauciflora (Benth.) S. Wats.	—	—	eH	—	—	c
Symphoricarpos occidentalis Hook......	d	cL	e	eW	—	—
Symphoricarpos orbiculatus Moench....	—	—	—	eW	dH	—
Taenidia integerrima (L.) Drude.....	—	cJ	—	c	—	—
*Taraxacum officinale Weber..........	d	c	c	c	c	c
Tephrosia virginiana L................	—	—	—	cJ	—	cM
Teucrium canadense L................	—	eJ	—	eJ	cJ	—
Thalictrum dasycarpum Fisch. & Lall...	c	cJ	—	—	cJ	—
Tradescantia bracteata Small..........	—	—	d	eW	—	—
Tradescantia reflexa Raf..............	—	cJ	—	c	cJ	cM
Trifolium repens L....................	—	cJ	—	—	cJ	dH
Trifolium stoloniferum Muhl...........	—	—	—	eJ	—	eM
*Verbascum thapsus L...............	—	eJ	c	eJ	—	eM
Verbena angustifolia Michx...........	—	—	eL	cJ	—	cM
Verbena bracteosa Michx..............	dS	cJ	eH	c	dJ	eM
Verbena hastata L....................	c	c	—	eJ	c	cM
Verbena stricta Vent..................	b	b	b	c	c	c
Vernonia noveboracensis (L.) Willd....	—	—	eH	—	—	—
Veronica virginica L..................	e	eJ	—	—	cJ	eM
Vicia americana Muhl.................	c	—	eL	cJ	eH	—
Vicia americana linearis Nees.........	—	—	c	—	—	—
Viola fimbriatula Sm..................	—	dJ	—	dJ	dJ	dM
Viola palmata L.......................	—	—	eH	—	cH	—
Viola papilionacea Pursh..............	c	cJ	eH	e	—	cH
Viola pedata L........................	dS	—	—	d	c	cM
Viola pedatifida Don..................	c	—	eH	—	c	—
Vitis vulpina L.......................	e	—	—	—	—	e
Xanthium commune Britt..............	—	—	cL	eJ	—	cH
Zizia aurea (L.) Koch.................	c	c	—	eJ	c	—

*Introduced.

In addition to the species included in the table there are several which belong to dry prairies, but they are local and quite rare, and were not collected at the localities specifically included in the table. They are given in the following supplementary list:

Agropyron tenerum Vasey.
Amorpha microphylla Pursh.
Artemisia canadensis Michx.
Aster amethystinus Nutt.
Aster ericoides L.
Bouteloua oligostachya (Nutt.) Torr.
Cirsium Hillii (Canby) Fern.
Euphorbia dictyosperma F. & M.
Gaura parviflora Dougl.
Oxybaphus floribundus Chois.
Oxybaphus linearis (Pursh) Rob.
Sphenopholis obtusata var. lobata (Trin.) Scrib.
Synthyris Bullii (Eaton) Haller.
Tradescantia brevicaulis Raf.

These species are found in the driest parts of the state, with the exception of the last two but one chiefly in the western part of the state and they are frequently associated with those included in the special list of the species belonging more distinctly to the dry plains which have invaded the prairie.

A second supplementary list contains species which frequently occur on the prairie, but usually near the border of groves or in somewhat sheltered localities. They are sometimes associated with the invaders from the groves and bogs. The list follows:

Agastache scrophulariaefolia (Willd.) Ktze.
Amphicarpa Pitcheri T. & G.
Clematis virginiana L.
Coreopsis tripteris L.
Lobelia leptostachys A. DC.

In preparing the foregoing table and accompanying lists the writer studied the flora of about sixty localities, chiefly in Iowa, and the studies have extended over a period of twenty years.

As only twelve of these localities are represented in the table of plants, and as only those species are included of which specimens were collected and deposited in the herbarium of the State University of Iowa, a number of blanks appear in the table.

More frequent visits to the several localities selected for the table, and an examination of larger areas in each locality, would no doubt have filled many of the vacant places, for there are variations in the abundance of many of the species from year to year some apparently disappearing for a time, and different (even closely contiguous) parts of the same prairie show variations which may result in part from differences in topography or which may be due to the accident of distribution.

But with the exception of the species appearing as invaders, a more complete discussion of which follows, the flora of any of the types of prairie here discussed will be practically contained within the limits of the foregoing table. The exact lists are not always the same, but such variation as exists is not due to differences in the types of prairies, but may occur within any one of the areas. The variation is well illustrated in the table.

The invasion of additional species which do not properly belong to the flora of the prairie takes place chiefly from four distinct sources:

1. *From wooded areas.* This may usually be observed only in a narrow belt along the border between forest and prairie and is of little significance, as forest plants seldom extend beyond the scrubby border and that only during moist years. It would probably be better to say that here the prairie invades the forest, as none of the mesophytes of the forest extend to the open prairie while along the drier borders of groves there is a distinct scattered invasion of prairie plants.

An illustration of the mixing of species in these border belts is given in the list of plants from the border between evaporation stations (1) and (2) at Missouri Valley.

2. *From prairie bogs.* The plants which invade the prairie from this source occur on dry prairies only occasionally, and then in places which at least during some part of the season, or during some seasons, are comparatively moist. Thus *Habenaria blephariglottis* seemed to have disappeared in large part from some sections of the state during the dry years of the middle nineties, occurring only here and there in what seemed to be dry places, yet the restoration of the prairie bogs which occurred in the wetter years which followed caused a reappear-

ance of the species in old-time abundance in the limited areas of undisturbed prairie chiefly along railways.

The most common species of this group of invaders are the following:

Cicuta maculata L.
Galium tinctorium L.
Gerardia tenuifolia Vahl.
Habenaria blephariglottis (Willd.) Torr.
Lilium canadense L.
Lythrum alatum Pursh.
Potentilla paradoxa Nutt. (usually from sandy areas).
Prenanthes racemosa Michx.
Salix longifolia Muhl.
Spiraea salicifolia L.
Spiranthes cernua (L.) Rich.
Stachys palustris L.

Several sedges also appear in similar situations, the most common perhaps being the following:

Carex Sartwellii Dew.
Carex scoparia Schk.
Carex tetanica var. Meadii (Dew.) Bail.

With these species *Anemone canadensis* and *Thalictrum dasycarpum*, which are included in the table, are also frequently associated.

3. *From the western plains.* The more xerophytic sections of the western part of the state, chiefly the loess ridges bordering the Missouri valley on the east and the Kansan ridges bordering the Big Sioux in Iowa, yield a noticeable scattering of species belonging more properly to the dry western plains.

In addition to the more common species of this group, which are included in the table, such as *Acerates viridiflora var. linearis, Aplopappus spinulosus, Artemisia frigida, Astragalus lotiflorus, Astragalus plattensis, Euphorbia marginata, Lygodesmia juncea* and *Oxytropis Lamberti*, the following species occurring locally in the western part of the state should be classed here:

Buchloe dactyloides (Nutt.) Engelm. Once probably quite common.
Carex stenophylla Wahlenb.
Cerastium brachypodum (Engelm.) Rob.
Comandra Richardsoniana Fern.

Euphorbia hexagona Nutt.
Gilia linearis (Nutt.) Gray.
Hosackia americana (Nutt.) Piper.
Lepachys columnaris (Sims.) T. & G.
Malvastrum coccineum (Pursh) Gray.
Mentzelia oligosperma Nutt.
Opuntia fragilis (Nutt.) Haw.
Oxybaphus linearis (Pursh) Rob.
Pentstemon hirsutus (L.) Willd.
Solanum rostratum Dunal.
Yucca glauca Nutt.

Several of these species are gradually being carried eastward along the railways.

4. *Introduced weeds.* These are chiefly European and have been incidentally introduced by man. Quite a number of these weeds have become established on the prairie and even invade unbroken areas. Some of the species are included in the table and are marked with an asterisk. The following may be added:

Asparagus officinalis L.
Brassica arvensis (L.) Ktze.
Brassica nigra (L.) Koch.
Bromus racemosus L.
Cannabis sativa L.
Capsella bursa-pastoris (L.) Medic.
Chrysanthemum leucanthemum L.
Digitaria sanguinalis (L.) Scop.
Echinochloa crus-galli (L.) Beauv.
Melilotus officinalis (L.) Lam.
Trifolium hybridum Muhl.
Trifolium pratense L.
Verbena urticifolia L.

These species occur most frequently on or near lands which have been cultivated, and their abundance is probably determined in large part by the accident of seed-dispersal.

The list does not include the numerous species of weeds which have everywhere invaded cultivated lands, but is confined to the species which seem to be able to establish themselves even in competition with the native prairie flora.

The table of plants brings out the fact that neither topography nor geological formation determines the character of the flora, for in the localities represented we find various types of topography and geological formations, yet the flora is practically the same, and this flora is the best ear-mark of the prairie.

Some of the species reported herein as belonging to the prairie are occasionally found in the woods, but so far as the writer's observation goes, almost uniformly in more or less open places where there is exposure to the sun and wind, and where topography and soil permit of rapid run-off or evaporation of water,—hence where the conditions are at least in part xerophytic. Places of this kind are simply a step toward the "oak-barrens" or "oak-openings", whose edges they exactly simulate. Otherwise individuals only of these prairie plants find their way into forested areas, and that rarely.

Likewise not only forest trees but also herbs of the forest fail to appear on the open prairie. There is indeed very little mingling of these two floras except in the narrow border belts already mentioned, and few species are found in both situations. The latter are foreign and native herbs and shrubs several of which have become well-established weeds. The most common of these are the following:

Chenopodium album L.	**Silene stellata** (L.) Ait. f.
Nepeta cataria L.	**Taraxacum officinale** Weber
Oxalis stricta L.	**Veronica virginica** L.
Rhus glabra L.	**Vitis vulpina** L.
Rhus toxicodendron L.	**Zanthoxylum americanum** Mill.

Taken as a whole the floras of the forest and prairie are strikingly different.[5]

As noted, some variations may be observed in the prairie flora, but this occurs practically within the limits of the prarie list and is of equal extent on each of the types or kinds of prairie areas. The major part of the flora of all these types is the same, and constitutes one of the most distinctive characteristics of all prairie.

[5] For a more detailed comparison of the prairie flora and the floras of other habitats see the botanical report on Harrison and Monona counties in the Report of the Iowa Geological Survey, vol. XX, 1910.

EXPOSURE OF PRAIRIE TO EVAPORATION

One other characteristic is also possessed by all types of prairies,—namely, all are exposed at least at times to excessive evaporation. The factors chiefly concerned in evaporation are temperature, relative humidity of the air controlled in large part by temperature, and the wind.

The maximum heat of the day is reached at about two o'clock in the afternoon. The "two-o'clock sun" beats down upon the southerly and southwesterly slopes of rough areas, and equally affects uniformly flat areas; the prevailing winds of summer to which the prairie flora is exposed are from the south or southwest, and the sun-scorched southwesterly slopes are also most exposed to these winds, the flat prairie again suffering almost equally; hence southwesterly slopes and large flat areas suffer from the combined influence of the afternoon sun and the prevailing summer winds.

Countless illustrations of the effect of this exposure may be observed throughout Iowa and the neighboring states. They are most strikingly shown in the rougher parts of the state, and no where more strikingly than in the loess bluffs which border the Missouri valley in Iowa. From Sioux City to Hamburg these bluffs present bare surfaces to the west, their somewhat northwesterly direction along the east side of a broad valley exposing them to both sun and summer winds. These surfaces are wholly treeless excepting where by a bending of the line of bluffs a portion of the latter is protected, and they are covered with a typical dry-prairie flora. It is only on the east side of ridges which form the bluffs, and in pockets and valleys which are protected on the south and west by ridges, that groves appear, and in these groves the prairie flora is in part or wholly displaced by a mesophytic flora, the extent of this displacement being determined by the degree of exposure and the consequent density of the grove.

Very striking illustrations of the effect produced by a bend in the line of bluffs may be found in a number of localities on the Iowa side of the Missouri. Thus in Lyons township, Mills county, in Lewis and Crescent townships in Pottawattamie county, in St. Johns and Little Sioux townships, Harrison county and Belvidere and Kennebec townships in Monona county, where there are abrupt bends in the line of bluffs, or where the latter turns to follow a tributary valley, groves are well developed on the south side of the crescent or valley, where the bluffs face the northwest or north. A similar effect is produced by a more gentle swerving of the line from the prevailing northwesterly direction, as in St. Mary's township in Mills county, in Raglan township, Harrison county, and at various other points along the Missouri bluffs.

Local illustrations of the effect of topography upon the flora are abundant along the bluffs in Missouri, and several are shown in the figures. Thus plate III, figure 2 shows a loess ridge at Hamburg, Iowa. Its western portion (the left side as shown in the figure) forms the bluffs of the Missouri valley, and is covered with a typical prairie flora. The eastern slopes, sheltered from the southwesterly summer winds and to some extent from the afternoon sun, are more or less densely covered with a forest growth. This is typical of innumerable ridges in the western part of the state.

Plate IV, figure 2 represents the bluffs north of Missouri Valley, Iowa, looking west of north. The more remote bluff shelters the forested valley to the right, while the bluff itself is covered with a prairie flora.

Plate V, figure 1 represents a series of loess ridges jutting into a short tributary valley south of Murray hill near Little Sioux, Iowa. The view was taken looking almost east. This valley is almost continually wind-swept in the summer, and every ridge which projects into it is a treeless prairie, while every sheltered ravine has developed a grove.

Plate IX, figure 1, shows a sheltered valley just north of Missouri Valley, Iowa, looking east. The bare ridges at 1 and 3 form the bluffs of the Missouri valley and are covered with a typical prairie flora which is listed in the third column of the table. The sheltered valley shows a small grove, and the edge of another grove may be seen just beyond the top of ridge 1.

Other illustrations on a much larger scale are also shown in other figures. Thus plate IV illustrates the opposite bluffs of the Missouri valley above Omaha, looking north. Figure 1 shows the sheltered bluffs extending north from Florence, Nebraska.

They extend in a northeasterly direction. They were formerly well forested and still show more or less timber on their rounded slopes. Figure 2 shows the much more rugged and abrupt bluffs on the Iowa side above Missouri Valley, looking north, almost opposite those shown in figure 1. They are fully exposed to the southwest and are covered with a typical prairie flora.

The two views on plate VI show opposite sides of a valley which branches off from the main Missouri valley in a northeasterly direction north of Turin, Iowa. The views were taken from the same point, figure 1 looking southeast at the exposed prairie side, and figure 2 looking southwest at the sheltered forested side.

Plate VII presents two views taken just north of Missouri Valley. Figure 1 shows the bluffs of the main valley, looking north. They are here exposed to the southwest, and are covered with a typical prairie flora. The Harrison county plants included in column III of the table of plants were collected here. Evaporation station 3 was located on the prominent point at the north end of the bluffs. The view in figure 2 was taken from the top of the same ridge, looking northeast, and shows the strongly contrasting interior wooded valley known as Snyder's Hollow. This valley has a narrow entrance and is well sheltered by the ridge shown in figure 1. The area shown in plate IX, figure 2 is a part of this sheltered tract.

The foregoing illustrations were all taken from the loess region of western Iowa, but abundant illustrations may be found on other formations.

Thus plate III, figure 1, shows a portion of the rough Kansan drift surface in the southwestern part of Lyon county, Iowa, looking almost due east. To the right the valley is sheltered by a great ridge of Kansan extending almost east and west, and causing a deflection of the Big Sioux river almost due west. A forest has developed in the shelter of this great ridge, on its northern slope, and the border of this forested area is shown in the figure. In the lower part of the sheltered valley the trees, belonging to twenty or thirty species, are well-developed, but as they ascend the species become fewer and the individuals more stunted, until the uppermost, or border portions contain only the dwarf bur-oak, *Quercus macrocarpa* var. *olivæformis,* which here often fruits before it has reached the height of one foot. But even this hardy xerophyte cannot resist the southwesterly winds and sun and it runs out before reaching the exposed top of the great ridge which is likewise covered with a typical prairie flora. The effect is exactly the same as on the loess ridges.

Another interesting illustration is shown in plate II. figure 1. This view was taken looking northeast near Reno. Minnesota, and shows the treeless exposed rock and geest-covered southwesterly surfaces. These exposed surfaces were covered with a prairie flora, while the sheltered forested areas showed a typical forest flora.

Similar illustrations may be observed on all the geological formations which form the surface soil in the rougher parts of the prairie states. In Iowa. as already noted. the distribution of forest and prairie is independent of geological formations excepting in so far as the latter determine topography. This is illustrated by the forest map[9] (plate XIV) which shows the distribution of the original forest and prairie areas in Iowa. the former being represented in black.

It will be noticed that the forests were found chiefly in the northeastern. southeastern and south-central parts of the state, and usually adjacent to the larger streams. The latter fact gives color to the view that the proximity of the stream is directly responsible for the forest. but not only were groves found at points remote from streams. as in the extreme northeastern part of the state and elsewhere. but many streams were entirely destitute of the forest border. This was and is especially true of the upper courses of the streams in the north-central part of the state. and of practically all the streams which empty into the Missouri river.

The explanation of the absence of forests from the vicinity of these streams is again evidently to be found in peculiarities of topography. The north-central part of the state is occupied by the Wisconsin drift area the limits of which are indicated on the map by the heavy line drawn from Osceola through Dallas to Worth counties. This is a flat plain into which the larger streams have cut narrow valleys which form the only variation in the to-

[9] Originally published in the Proceedings of the Iowa Academy of Sciences, vol. VII. 1899.

pographic monotony of the plain. The forest areas within the Wisconsin plain are almost restricted to these valleys, the outlying groves being mere thickets confined to the borders of swamps and lakes, or small groves developed on kame-like knobs or ridges. It is a striking fact that where in the upper courses of streams no valleys were cut into the plain no forest-border appears.

East of the Wisconsin area the Iowan drift, with a surface only slightly undulating, presents similar conditions and the river valleys again offer the only shelter to groves.

East of the Iowan area a belt of Kansan drift extends from Howard and western Winneshiek counties to Dubuque county. This is typical rolling Kansan cut by streams and presents a topography sufficiently varied to give opportunity for the development of numerous groves.

East of this Kansan strip, extending from eastern Winneshiek and Allamakee counties to Dubuque county, lies the so-called driftless area. This is the oldest topography in the state, and presents a very rough surface cut by deep and narrow valleys. This was one of the most heavily forested regions in the state.

The southeastern part of the state is occupied by the Illinoian which is limited by a line drawn from Scott through Muscatine and Henry counties to the southeastern corner of the state. The western part of this area is morainic and sufficiently rough to shelter numerous groves. The eastern part is cut by the Mississippi and the bluffs on the west side afford a similar protection to forests which developed both on the bluffs and on portions of the adjacent alluvial plain.

Westward, extending across the state and northward to its northwest corner, lies the great Kansan drift area. This is also an old surface, and is for the most part undulating, becoming very rough in the south-central part of the state where the heaviest forest-growth also appeared. Locally and over larger areas in the northwestern part of the state, the Kansan has been but little eroded and presents flat surfaces, which were treeless.

In the western part of the state the Kansan topography blends with that of the Missouri valley bluffs. The latter extend from Sioux City to Hamburg and portions of them are illustrated in plate IV, figure 2, and plate VII, figure 1. This bluff region is very rough, but as already noted, the exposed western faces are treeless, while the groves appear in sheltered places only.

The flat alluvial plain of the Missouri, varying from two to eighteen miles in width, also shows fringes of trees along the tributary streams, and groves of the more or less xerophytic cottonwood on the sand-dunes and sandy flats.

The absence of trees from the upper courses of many of the streams and from the valleys of the western streams, and, indeed, the distribution of forest and prairie in Iowa, is entirely consistent with the argument that prairies are due to exposure to the chief evaporating agents. The more extended flat areas are all treeless. Along the upper courses of the streams in the Wisconsin and Iowan areas, and others similar to them, no deep valleys have been cut, and no shelter is offered to groves. The drainage of the state suggests an explanation of the comparative abundance of trees in the eastern and southern parts of the state, and their absence from the river valleys in the western part. The streams in the eastern and southern areas flow toward the southeast, or their valleys are so short and tortuous that they are not exposed to the prevailing summer southwestern winds. Their valleys are therefore more or less sheltered, and trees thrive in their less-disturbed and hence here more moist atmosphere, for the wind quarters the valleys.

But in the western part of the state the principal valleys extend toward the southwest and as they are comparatively straight the wind sweeps their entire length without hindrance, and as a result of this, combined with exposure to the sun, no forests appear on the flat bottom lands, but such groves as do occur are in the sheltered ravines and pockets, often at a considerable altitude above the plain.

In many places there are northern and eastern slopes which are almost devoid of groves. Sometimes this is due to the fact that local topography causes a lateral deflection of the prevailing winds in such a manner that these slopes are more frequently swept by them. The deflection is sometimes downward, as along surfaces which slope downward gradually toward the north. In such cases the currents of air follow the sloping surface in accordance with the well-known tendency of moving gases to follow somewhat irregular surfaces,[10] whereas when the northern slope is more abrupt the prevailing southwesterly winds often pass over without following it.

In the latter case, however, there is sometimes a division of the current in which case a part of the current sweeps back up the leeward slope. This occurs in rough territory where ridge after ridge intercepts the air-currents and causes disturbances in their lower strata, and was observed only where a ridge in front caused this deflection. The writer has frequently tested this by releasing bits of paper, the pappus of composites and other light objects from the summit of such ridges, and invariably when strong winds were blowing most of these objects were swept upward again, often to the feet of the experimenter. In such cases the leeward slope is almost as much exposed to the dry winds as the windward side, and it is then wholly or largely prairie.

In all cases where the topography of the prairie is rough the rapid run-off of the rains precipitated upon the steep slopes assists in more rapidly making the surfaces xerophytic. That this is not the prime cause, however, is evident from the fact that steep slopes (especially those facing the north or northeast) are densely covered with a mesophytic forest-growth where sheltered from the winds. Excellent illustrations are furnished by practically every timbered hollow or valley in the Missouri river territory, for all are similarly situated. The fact that the groves are practically restricted in this and similar territory to the roughest areas is also worthy of consideration.[11]

The striking distribution of the groves on rougher lands in the western part of Iowa and elsewhere suggested a series of observations on the relative rate of evaporation from the sheltered and protected slopes. The bluffs and ridges bordering the Missouri

[10] Plate V, figure 2 illustrates such prairie areas on gradual northern slopes.

[11] The clumps and narrow belts of trees along the larger streams on the broad alluvial plain of the Missouri river form an exception to the rule. The diffusion of moisture from the stream in both soil and air evidently makes this possible as the plants in these belts are practically all mesophytic.

valley on the east side are exceptionally well-suited for such observations as the exposure of the faces of the bluffs is extreme, and as the ridges are often very sharp so that the transition from prairie to forest is very rapid. For that reason a portion of this bluff region was selected for the observations on the relative rate of evaporation and its relation to the native flora.

Evaporation.

In order that all the conditions affecting evaporation might be properly taken into account a series of meteorological observations was undertaken at Missouri Valley in the summer of 1908. This work included observations on evaporation, temperature and relative humidity, velocity and direction of wind, clearness of sky, barometric pressure, and in a general way on rain-fall.

Evaporation. An effort was made to employ three kinds of evaporimeters. An open tin pan, one foot in diameter, and with upright sides, was buried to the rim at each of the four stations described below.

At two of the stations Piche evaporimeters, graduated to hundredths of a cubic inch, were suspended eight inches above the surface of the soil on iron rods driven into the ground. These evaporimeters were frequently tested and worked together perfectly.

An effort was also made to employ porous cup-evaporimeters at these two stations,[12] but owing to various accidents they failed several times.

Temperature and Relative Humidity. For this purpose a Marvin Sling Psychrometer with the Fahrenheit scale (the U. S. standard) was employed, rain-water being used for the wet-bulb. Readings were also taken from two Centigrade psychrometers as an additional check.

Wind Velocity. The velocity of the wind was measured at one of the stations (number 1) by a Green's cup anemometer which was set up at this station throughout each of the observation days. A small mill anemometer (air-meter) was also employed for short periods at various intervals at all the stations.

[12] These were kindly furnished for the purpose by Dr. Forrest Shreve of the Carnegie Desert Botanical Laboratory.

Barometric Pressure. This was measured by an aneroid barometer.

Rain-fall. No effort was made to measure the rainfall, but during August and September, 1908, when these observations were made, Mr. Glenn H. Stern reported the rainfall at Logan, eight miles away, as follows:

August 2.03 inches.

September .79 inches.

This also probably approximately measured the rainfall at Missouri Valley, and by far the greater part of this was precipitated during the first half of August, which was decidedly rainy. The latter half of August and the first half of September were very dry. By the middle of September the hills were dry and brown, and in the more exposed places only a few of the more pronounced xerophytes were in flower. The following were observed in flower at that time near stations 1 and 3:

Aster oblongifolius
Aster sericeus
Chrysopsis villosa
Grindelia squarrosa
Helianthus scaberrimus
Kuhnia eupatoroides var. corymbulosa
Liatris punctata
Solidago rigida
Solidago speciosa var. angustata

By this time even the leaves on the buroaks curled, and during the day most plants which still retained leaves were wilted.

The Stations.

Four stations were selected for the observations:

Station 1 was located at an elevation of 140 feet above the alluvial plain on the west side of the ridge forming the bluffs of the Missouri valley just above Missouri Valley. It was fully exposed to the southwest and west, but was somewhat sheltered by the ridge to the south and southeast. Its vicinity was covered with a typical prairie flora. This station, with some of the apparatus in place is shown in the foreground in plate VIII, figure 1, looking south, and at the point marked 1 in plate IX, figure 1, looking east.

Station 2 was located in the grove on the leeward side of the same ridge at the same altitude as station 1, and ninety-five feet east of it. It was stationed fifty feet east of the west edge of the grove shown to the left in plate IX, figure 1, and also in plate VIII, figure 2. The latter figure also shows in the foreground the border strip, about twenty-five feet wide, which separates the grove in which this station is located from the typical prairie surrounding station 1. The latter station is located about twenty feet west of the west side of this border strip. The border strip follows the very top of the ridge between stations 1 and 2, and the latter station is sheltered partly by this intervening low ridge and to a greater extent by the higher ridge to the south, besides being under cover of the forest.

The observations at stations 1 and 2 should be compared to show the combined influence of the protecting ridge and grove on evaporation.

The floras of the two stations were very distinct. That of the prairie at stations 1 and 3, which is essentially one, is recorded in the first (or loess) column of the table of prairie plants. In the immediate vicinity of station 2 the following plants were collected, practically all, excepting the introduced weeds, belonging to the flora of the forest:[13]

Aquilegia canadensis	Psedera quinquefolia
Arabis canadensis	Quercus macrocarpa
Campanula americana	Ranunculus abortivus
Chenopodium album (introduced)	Rhus glabra (large)
Corylus americana	Ribes gracile
Crataegus mollis	Silene stellata
Cystopteris fragilis	Smilax hispida
Dicentra cucullaria	Solanum nigrum (introduced)
Ellisia nyctelea	Symphoricarpos orbiculatus
Elymus striatus	Taraxacum officinale (introduced)
Eupatorium urticaefolium	Tilia americana
Festuca nutans	Ulmus americana
Fraxinus pennsylvanica	Ulmus fulva
Hydrophyllum virginianum	Viola sororia
Ostrya virginiana	Vitis vulpina
Polygonatum commutatum	Zanthoxylum americanum
Prunus virginiana	

[13] The nomenclature used throughout this paper is that of Gray's Manual, 7th edition.

The following plants were collected on the border strip between stations 1 and 2. They present a mixture of species of both forest and prairie, the latter predominating:

Amorpha canescens	**Monarda mollis**
Anemone cylindrica	**Onosmodium occidentale**
Aster sericeus	**Poa pratensis**
Ceanothus ovatus var. pubescens	**Quercus macrocarpa var. olivaeformis**
Eupatorium altissimum	**Rhus glabra** (small)
Fragaria virginiana	**Sanicula marilandica**
Fraxinus pennsylvanica (small)	**Symphoricarpos occidentalis**
Gerardia aspera	
Helianthus scaberrimus	

Station 3 was located at an elevation of 175 feet above the valley on the most prominent point on this side of the bluffs, and fully exposed to the south and west. It was about 350 feet almost due south of station 1, and like the latter was surrounded by a distinct prairie flora. Its position is shown at the point marked (3) in plate VIII, figure 1, and plate IX, figure 1. See also plate VII, figure 1. This is the most exposed station of the series.

Station 4 was located on the east side of the same ridge at a point 375 feet east and 220 feet south of station 3 and at the same altitude as that station. The ridge between stations 3 and 4 rises about twenty-five feet above them and its slope on the east side is sufficiently steep to afford protection from excessive evaporation on that side. The eastern slope was formerly covered with forest, but this had been removed and a young orchard has been set out on a part of the slope. Station 4 was in an open place sheltered only by the ridge but in an area which had been but recently forested. This station is shown at the point marked (4) in plate IX, figure 2, looking south along the cleared slope.

The observations at stations 3 and 4 should be compared to bring out the protective influence of the ridge alone.

Care was exercised in placing the pieces of apparatus required for these observations in such manner that they did not interfere with each other.

The observations were continued for a whole day at intervals of about a week from the 13th of August to the 12th of September. Each observation day was given wholly to this work and hourly readings (excepting those of the evaporating pans) were made from 7 o'clock A. M. to 7 o'clock P. M. Earlier and later readings were also at first taken but they could not be continued as the days grew shorter, and they are not here included. So far as made they did not in any way modify the results obtained.

Notwithstanding the care which was exercised in making these readings it is probable that occasional errors were made, the possibility of which will be appreciated by those who have ventured to face the tedium of such work in mid-summer in a rough territory. The results which were obtained however are so generally consistent, and they agree so well with observations made at other points, notably at Ute by Superintendent D. H. Boot under the writer's direction, and at Omaha and Council Bluffs and in the vicinity of Lake Okoboji, Iowa, by the writer himself, that they are here offered with the confident conviction that such errors as may have occurred are rare or insignificant and would not materially affect the general results.

Rate of Evaporation.

The several types of evaporimeters did not show the same relative rate of evaporation at the several stations, but this was evidently due largely to the difference in position and altitude above the surface. In all cases, however, evaporation was shown to be much greater at the exposed stations 1 and 3 than at the more or less sheltered stations 2 and 4.

Evaporating Pans. The evaporating pans were filled to the index (a pointed wire) at 7 o'clock A. M. Readings were then taken at 2 and 7 o'clock P. M. During the nights of the 13th and 14th days of August and the 28th and 29th of August, the pans were also left in the field and readings were taken at 7 o'clock A. M. On the 28th of August observations were also made from 4 to 7 o'clock P. M. and were continued on the following day.

The total amount of diurnal evaporation increased as the dry season advanced, excepting that on September 5th it was checked, evidently because of the shifting wind and abrupt lowering of temperature late in the day.

Evaporating pans were located at each of the four stations, and the total amount of evaporation from each for the periods indicated is given in the following table:

Rate of Evaporation from Evaporating Pans.

1908		Stations.			
Date	Hours	1-Prairie	2-Grove	3-Prairie	4-Cleared
Aug. 13	6 A.M—7 P.M.	221 cc.	98 cc.	360 cc.	296 cc.
	7 P.M—6 A.M.	131 cc.	57 cc.	144 cc.	111 cc.
Aug. 21	7 A.M.—7 P.M.	212 cc.	46 cc.	283 cc.	181 cc.
Aug. 28	4 P.M.—7 P.M.	84 cc.	9 cc.	118 cc.	58 cc.
	7 P.M.—7 A.M.	63 cc.	20 cc.	89 cc.	36 cc.
Aug. 29	7 A.M.—7 P.M.	348 cc.	66 cc.	456 cc.	227 cc.
Sep. 5	7 A.M.—7 P.M.	250 cc.	47 cc.	375 cc.	139 cc.
Sep. 12	7 A.M.—7 P.M.	357 cc.	116 cc.	500 cc.	213 cc.

Cup Evaporimeters. The cup evaporimeters failed several times through accidents, and the record is not complete. Eliminating the manifest errors the record for stations 1 and 2, where these evaporimeters were used, shows the following losses:

Date	Hours	Station 1	Station 2
Aug. 13	6 A. M.—7 P. M.	37 cc.	24.5 cc.
Aug. 21	7 A. M.—7 P. M.	27 cc.	10 cc.
Aug. 28	4 P. M.—7 P. M.	9 cc.	6 cc.
Aug. 29	7 P. M.—7 A. M.	2.5 cc.	2— cc.
	7 A. M.—2 P. M.	23 cc.	7.5 cc.
Sep. 5	7 A. M.—7 P. M.	35.5 cc.	14.5 cc.
Sep. 12	7 A. M.—2 P. M.	13.5 cc.	6 cc

Piche Evaporimeters. The Piche evaporimeters at stations 1 and 2 gave the following total results:

Date	Hours	Station 1	Station 2
Aug. 13	6 A. M.—7 P. M.	.34 cu. in.	.14 cu. in.
	7 P. M.—6 A. M.	.045 cu. in.	.04 cu. in.
Aug. 21	7 A. M.—7 P. M.	.30 cu. in.	.135 cu. in.
Aug. 28	4 P. M.—7 P. M.	.08 cu. in.	.025 cu. in.
	7 P. M.—7 A. M.	.015 cu. in.	.015 cu. in.
Aug. 29	7 A. M.—7 P. M.	.485 cu. in.	.22 cu. in.
Sep. 5	7 A. M.—7 P. M.	.45 cu. in.	.22 cu. in.
Sep. 12	7 A. M.—7 P. M.	.675 cu. in.	.31 cu. in.

The relative humidity of the air varied at the several stations as indicated in the following table:

	August 21				August 29				September 5				September 12			
	Station				Station				Station				Station			
Hour	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
7	.79	.82	.80	.80	.86	.88	.84	.88	.88	.90	.88	.88				
8	.75	.78		.75	.83	.83	.80	.82	.86	.88	.90	.82	.68	.70	.63	.59
9					.74	.78	.72	.75	.82	.84	.75	.78	.54	.56	.55	.63
10	.62	.66	.59	.58	.70	.72	.70	.73	.72	.79	.70	.70	.53	.57	.51	.51
11					.58	.58	.57	.59			.64	.61	.48	.53	.45	.45
12	.56	.62	.51	.57	.50	.54	.50	.47	.59	.63	.58	.58	.48	.51	.42	.44
1	.57	.60			.47	.46	.49	.52	.55	.52	.49	.52	.32		.36	.40
2	.57	.56	.61	.64	.52	.52	.53	.53	.45	.46	.43	.51	.33	.37	.33	.37
3	.66	.67	.61	.67	.49	.54	.52	.58	.44	.46	.38	.48	.32	.38	.35	.38
4	.62	.66	.58	.68	.54	.58	.55	.59	.45	.46	.46	.51	.35	.36	.37	.40
5	.61	.72			.52	.58	.58	.64	.47	.52	.46	.57	.39	.39	.40	.50
6	.72	.72	.68	.78	.59	.63	.66	.73	.54	.57	.64	.65	.41	.47	.43	.47
7	.70	.74	.68	.81	.72	.70	.72	.75	.73	.70	.48	.55	.43	.45	.43	.53

The psychrometer record for August 13th is incomplete, and is omitted.

The foregoing results show clearly that evaporation is much more rapid in the exposed prairie areas than from areas protected by topography or forest.

The relation which meteorological conditions, influenced by topography, bear to evaporation is well illustrated by the results which were obtained at station 1 and represented in part graphically in plates XII and XIII. Each of the figures on these plates presents three curves: The full line (A) represents the amount of evaporation from a Piche evaporimeter, measured in tenths of a cubic inch, the latter forming the ordinates of the curve; the broken line (B) represents the velocity of the wind in miles per hour, the latter forming the ordinates of the curve; and the dotted line (C) represents the temperature in Fahrenheit degrees, the latter also forming the ordinates of the curve.

In all cases the hours of the day between 7 o'clock A. M. and 7 o'clock P. M. form the abscissas of the curves, each space representing one hour.

The numbers 0, 2, 4, 6, 8, 10, 12, and 14 on the left hand side of each figure represent wind-velocity in miles per hour; the corresponding decimals represent evaporation from the Piche evaporimeter measured in tenths of a cubic inch; and the degrees Fahrenheit are indicated on the right hand side of each figure.

A striking relation between evaporation and wind velocity is shown by these figures. While the temperature is in most cases comparatively regular the curves representing wind velocity and amount of evaporation are more or less irregular, but correspond closely to each other in their irregularities. This is especially noticeable in the afternoon when both wind and sun are most effective. The close relation between wind velocity and evaporation is more pronounced as the day advances, and it also became more striking as the dry season advanced and the relative humidity of the air diminished.

An inspection of the relative humidity table for station 1 shows the following variation:

	Minimum	Maximum	Average
August 21	.57	.79	.65
August 29	.47	.86	.62
September 5	.44	.88	.62
September 12	.32	.68	.44

Rains were frequent during the first half of August, but very little rain fell between the foregoing dates.

The curve for September 5th also shows that both wind and temperature must operate together to cause the maximum evaporation, for on this day the wind was quite brisk early in the morning, yet evaporation was slow until the temperature had increased sufficiently to induce great evaporation, the function of the wind evidently being the removal of the vapors as they are formed, — thus making room for more. In the same connection it is interesting to compare the amount of evaporation at night and in the daytime. It will be observed that at night evaporation at the several stations was more nearly the same than in the daytime, for the exposure of the several stations was then more nearly equal, the sun having disappeared and the wind having died down.

The foregoing facts suggest an explanation of the presence of dry prairies on the southwesterly slopes, for these slopes are not only exposed to the prevailing southwesterly winds of summer but also to the "two-o'clock sun" which produces the maximum temperature and the minimum humidity of the air.

The clearness of the sky did not vary sufficiently to bring out any striking results. The record for the several observation days is briefly summarized as follows:

August 13 Hazy.
August 21 Hazy A. M.; cloudy P. M.
August 29 Cloudy A. M.; hazy P. M.
September 5 Clear but quite hazy.
September 12 Clear but somewhat hazy.

The direction of the wind for the same days varied as follows:

August 13 Northwest.
August 21 Mostly southwest.
August 29 Southeast A. M.; south P. M.
September 5 Southeast, then south, then southwest; at 3 o'clock P. M., west; at 5 o'clock, southwest; at 6 o'clock, southeast; and at 7 o'clock northwest.
September 12 Southeast, then southwest, then southeast.

The barometric pressure at station 1 varied as follows (measured in inches):

August 13 28.97 to 28.88 A slight rise and then a gradual fall.
August 21 28.79 to 28.75 A gradual fall.
August 28 28.70 to 28.75 Somewhat irregular.
September 5 28.72 to 28.68 Somewhat irregular.
September 12 28.96 to 28.84 Somewhat irregular.

Relative humidity curves were not included in the figures on plates XII and XIII for fear of causing confusion. These curves may be easily constructed by using the relative humidities recorded in the table as ordinates and the hours of the day as abscissas. For this purpose the lowest line in each figure should be marked respectively .56, .47, .43 and .31 and each vertical space should represent .06. Curves so constructed will correspond quite closely with the evaporation curves, being of course their reverse.

The conclusions reached from these observations may be briefly stated as follows: That evaporation is most rapid from surfaces exposed to the prevailing summer winds and to the afternoon sun, and that both are necessary to cause maximum evaporation; that in rough territory these surfaces are chiefly southwesterly and hence exposed as stated, and this at the time of the day when the relative humidity of the air is the lowest; that the effect of wind upon evaporation is best brought out and is greatest when the temperature is sufficiently high to produce rapid evaporation; that evaporation varies with the direction of the wind and the position of protective barriers such as ridges; and finally that upon all the areas exposed to maximum evaporation a prairie flora. largely xerophytic, is developed, while the mesophytes of the grove and forest develop in our territory only in places sheltered from the chief evaporating agencies.

Similar observations which were made during the same period at Council Bluffs and Omaha confirm these conclusions. A station was established at Council Bluffs, Iowa, (on the east side of the Missouri valley) on a dry prairie ridge northeast of the Ninth Avenue entrance to Fairmount Park, at an altitude of about 140 feet above the bottoms. This station was fully exposed to the south, southwest, west and northwest.

Another station was located at the same elevation near the intersection of Woolworth Avenue and Sixth Street in Omaha, Nebraska. This station was located on the rounded western bluffs on a slope looking northeast, and was well exposed to the north, northeast and southeast. This slope was formerly timbered but is now almost bare. This station was in charge of Mr. Lumir Buresh of the Omaha High School whose patient care and perseverance made the double observations possible, the writer taking the east bluff.

On the 17th of August the observations on the west side were made at another station located in a clearing on the timbered bluffs above Florence, Nebraska, all the readings for that date being made at this station. The Florence station was also about 140 feet above the river valley. All the other west side observations were made at the Woolworth Avenue station.

The work was conducted in the same manner as at Missouri Valley, excepting that no evaporating pans were used.

The relative rate of evaporation on the opposite sides of the valley is shown in the following summary:

		Piche Evaporimeter		Cup Evaporimeter	
Date	Time	Council Bluffs	Omaha	Council Bluffs	Omaha
August 17	7 A.M. to 7 P.M.	.36 cu. in.	.10 cu. in.	43 cc.	24 cc.
August 30	12 M. to 7 P.M.	.41 cu. in.	.24 cu. in.		
September 6	10 A.M. to 7 P.M.	.39 cu. in.	.37 cu. in.	38 cc.	10 cc.
September 13	12 M. to 7 P.M.	.32 cu. in.	.27 cu. in.		

The direction of the wind on the same dates was as follows:

August 17 North and northeast.
August 30 South and southeast.
September 6 North, northeast and northwest.
September 13 Southeast.

The greater relative evaporation on the west side on September 13th was evidently due to the fact that the station was exposed to the southeast wind during the entire day, whereas the Council Bluffs station was sheltered.

The apparent great discrepancy between the Piche and cup evaporimeters on September 6th was evidently due to the circumstance that at the Omaha station the Piche evaporimeter was exposed to the sun while the cup evaporimeter was in the shade during most of the afternoon.

The observations already noted which were made at Ute by Mr David H. Boot, and those made by the writer in the vicinity of the Lakeside Laboratory at Lake Okoboji in the summer of 1909, also confirm the general conclusions based on the observations made at Missouri Valley.

It is now necessary to consider the application of these results to our problem. The prairie areas are uniformly so situated that they are fully exposed to the factors which cause rapid evaporation, namely the sun and the wind. During much of the year they may present conditions quite favorable to plant growth, but there are seasons and there are portions of the year, especially in mid-summer, when evaporation and consequent dessication become so extreme that only those plants which are especially adapted to dry regions can survive. The more or less frequent recurrence of such periods which are fatal to the mesophytes of the forest is sufficient to wipe out or rather prevent the development of a forest flora on those surfaces which are most exposed to evaporation. Forest trees are perennial and must exist through all the varying conditions of succeeding seasons. Any period, no matter how short, which is fatal to trees is sufficient to prevent the development of a forest even though the greater part of each season be favorable to tree-growth, and the failure of the trees of course results in the failure of the minor forest flora which in our territory is essentially mesophytic.

Moreover it should be remembered that trees are tall and lift the transpiring leaf surfaces to a considerable height. In this position the leaves are not only more exposed to the direct rays of the sun, but they are much more exposed to strong winds.

The well-known fact that wind-velocity increases with height above the ground which was demonstrated by Stevenson[14] and has been frequently verified since, increases the danger to taller plants and makes more difficult the development of forest trees. This increased exposure to evaporation at greater heights should also be kept in mind when comparing the results of the observations at Missouri Valley, for evaporation was there determined at, or near the surface of the ground, therefore in positions most favorable to dry areas.

It should not be assumed however that increased evaporation necessarily means greater loss of water by the plant. Experiments which are now being conducted in the plant physiology laboratory in the State University of Iowa indicate that transpiration is stimulated and increased by somewhat greater wind velocity, but that when the velocity is increased beyond a certain maximum, which is variable for different plants, transpiration is diminished, the activity of the plant being evidently checked by the violence of the wind. The increased loss of water at the optimum velocity must not be set down as disadvantageous to the plant, for it merely indicates greater vigor and activity on the part of the plant.

[14] Journal of the Scot. Meteorological Society, New Series, Vol. V, 1880, p. 348. Also cited in Schimper's Plant Geography (English edition), 1903, p. 76.

However a limit must be reached, and moreover where hot, dry winds blow almost constantly, as they do in summer during the daytime in our territory, the loss of water from the unprotected younger structures and the interference with the stomatal apparatus which to some extent controls transpiration, must ultimately result in the elimination of all plants which cannot well resist these conditions.

This limits the flora of these exposed areas largely to xerophytes, and it is a fact especially worthy of note, and one which will be set out in detail in the near future, that the flora of the prairies, especially that of the usually dry mid-summer period, is decidedly xerophytic. This is further emphasized by the similarity of the floras of the prairie and the xerophytic sand-dune areas, the plants of the latter being with very few exceptions identical with those of the dry prairie. That they are xerophytic is revealed in the tufted habit, as illustrated in plate XI, figure 1, the development of large root-systems and the stunting of the exposed tops; the development of thick cutin, deep-seated stomata and strong protective tissues; the production of hairs and scales on the exposed surfaces; and various other adaptations which are recognized as adding to the protection of plants growing on dry surfaces. Hence the structurally protected xerophytes of the prairie persist in exposed places while the mesophytes of the forest fail, and any cause or combination of causes tending to bring about xerophytic conditions will eliminate mesophytes and give the field to the xerophytes of the prairie.

Rainfall should receive attention in connection with evaporation, but it is here given but little prominence as a factor in determining the treelessness of the prairies for the reasons that it is entirely sufficient for forest growth within our territory, as shown by Mr. Stern's table, and indeed it is sufficient throughout the prairie sections of the Mississippi valley, if only properly distributed, and that it cannot be a determining cause because frequently, as illustrated by several of the figures, prairie and forest are in close proximity, upon opposite sides of the same ridge, where they evidently receive the same amount of rain.

The conclusion is therefore inevitable that the question is one of conservation rather than precipitation of moisture, and the claim usually made by meteorologists that forests have no effect on precipitation has no significance in connection with our problem, nor has it any application to the question of the influence of the forest on moisture, for the forest must be considered as a conservator of moisture rather than a rain-maker.

It must be remembered that a tree or any other ordinary plant is quite as much dependent for the possibility of carrying on its functions on the moisture of the air as it is on the moisture of the soil, and any conditions which serve to dissipate the moisture of the air will be fatal to many plants, especially those which are mesophytic, even though sufficient moisture falls upon the soil.

Both the moisture of the air and of the soil will be conserved by protection against evaporation, and this may be accomplished by topography or groves.

The influence of these factors upon the melting of snow should also be considered in this connection, for the retarding of melting by either factor (see plate I, figure 2) results in more complete absorption of the resulting water by the soil and the water is made available for plants during a longer period.

Previous Work

The climatic and topographic factors here especially emphasized as causing the treelessness of the prairies, have received previous attention, both individually and in combination, but the references have been largely general or incidental. For the most part these factors have been given a secondary place, or have been treated as of minor importance, as was done by Whitney (1858, 1876 and 1882), who argued against their effectiveness, declaring (1876) in his comparison of prairie and forest floras, that "by no amount of ingenuity can the peculiarities of the isothermal and isohyetal lines be made to play in with the marked differences of the vegetation."

In a few cases only were these factors held to be collectively the chief cause of the prairie. Dana (1875) concluded (p. 45) "that prairies, forest-regions, and deserts are located by the winds and temperature in connection with the general configuration of the land", and Todd presented a more elaborate argument in a much neglected paper (1878) in which he not only accurately described the striking distribution of the forest areas in western Iowa, but considered forest and prairie in their relation to moisture as influenced by prevailing winds, temperature and topography. He reached the conclusion that "the *fundamental condition of forest-growth is a constant medium humidity of air and soil,*" the prairie of course developing where this condition does not exist. He placed greater stress on the value of moisture retained in the air and soil than on rainfall and closed the paper with this significant suggestion: "Let us therefore, *while not neglecting our pluviometers look more carefully to our hygrometers* in our study of this subject."

But in the great majority of the papers cited in which climatic factors are considered they are given prominence individually, or are represented as merely accessory. It will be most convenient to consider these factors separately though by several authors they were variously combined with other factors.

Rainfall

Of all the climatic factors rainfall has been given the greatest prominence in discussions of the causes of the distribution of forest and prairie.

Cooper (1859) fixed upon a precipitation of 15 inches during the growing season as determining the limit of tree-growth; Shaler (1891) concluded that an annual rainfall of less than 20 inches was fatal to trees; and Powell (1896) fixed the limit at 20 to 40 inches. But Dana (1866) had noted that prairies occur even where the annual rainfall reaches 45 inches, and Whitney (1876, 1882) showed that forests may persist even where the rainfall falls below 20 to 25 inches.

Other authors, while less specific, ascribed the cause of the prairie wholly or chiefly to insufficient rainfall. Among these were Vaughn (1856, 1860), Newberry (1860), Hinrichs (1876) and Hitchcock (1898). Dana (1849) considered dry summers the cause; Schimper (1903) ascribed it to moderate rainfall, dry winters and an early moist summer; Warming (1909) sought it in long winters and hot and dry summers; Marsh (1898) in a want of spring and summer rains; and Gleason (1909) in a low winter rainfall. Several authors recognized drouth as an accessory factor, chiefly in connection with prairie fires. A few writers ventured to deny the importance of this factor, or to give it a secondary place. Among these are Whitney (1876, 1882), Tarr (1896) and the writer (1900).

Rainfall is naturally an important factor in determining the amount of moisture available for the use of plants, and it also influences the rate of evaporation, but it does not explain the characteristic intermingling of prairie and forest in the Mississippi valley, nor the ocurrence of prairie and forest on opposite sides of a sharp ridge, nor the presence of small prairie tracts (barrens or oak-openings) in the heart of wooded areas, for in all these cases the amount of rain falling upon contiguous prairie and forest is the same, and the very unequal amount of available moisture upon the two kinds of surfaces cannot possibly therefore be determined by the amount of precipitation.

Moreover the annual amount of rainfall within the state of Iowa, more than seven-eighths of the surface of which was prairie, is quite sufficient to sustain a forest growth. This is amply demonstrated by the remarkable record of meteorological observations made at Logan in the relatively drier western part of the state by Mr. Glenn H. Stern and his grandparents, which extends over a period of 43 years, from 1867 to 1909 inclusive. A summary of this record[16] is here presented, the rainfall being given in inches for each year.

Annual precipitation of moisture, at Logan, Iowa from 1866 to 1909.

1867 — 27.81	1878 — 46.31	1889 — 29.87	1900 — 31.39
1868 — 29.85	1879 — 33.10	1890 — 34.95	1901 — 30.56
1869 — 44.95	1880 — 27.30	1891 — 35.39	1902 — 40.74
1870 — 25.30	1881 — 56.60	1892 — 35.25	1903 — 30.25
1871 — 28.95	1882 — 37.30	1893 — 22.40	1904 — 24.14
1872 — 32.10	1883 — 39.90	1894 — 16.63	1905 — 30.35
1873 — 43.20	1884 — 36.60	1895 — 26.12	1906 — 38.05
1874 — 28.40	1885 — 40.20	1896 — 43.82	1907 — 22.73
1875 — 42.00	1886 — 23.10	1897 — 26.00	1908 — 28.12
1876 — 28.20	1887 — 23.60	1898 — 24.96	1909 — 43.39
1877 — 45.10	1888 — 34.02	1899 — 31.95	

[16]The record was published in detail by the writer in the report on Harrison and Monona counties, Iowa Geological Survey, vol. XX, 1910.

It will be observed that the maximum annual rainfall (56.60 inches) occurred in 1881, and the minimum (16.63 inches) in 1894, while the average was 33.05 inches. The annual rainfall dropped below 22 inches but once during the 43 years,—in 1894. During that year some of the trees in artificial groves perished, but many more survived together with most of the trees in the native groves of that part of the state. During the remaining years the rainfall was on the whole sufficient and trees suffered, especially in the drier years, only in the exposed situations which are discussed in the preceding part of this paper.

Temperature

While the influence of temperature upon plants is marked, it has not been regarded as the direct cause of the floral peculiarities of the prairie. Dana (1849) early attached some importance to it, and later (1875) considered it in general terms, together with topography and winds. The writer (1900) considered it briefly in relation to injury to trees, and Warming (1909) ascribes the treelessness of the prairie to long winters and hot, dry summers, and to cold nights during the earlier growing season.

Whitney (1876) regarded the factor as of little importance, indeed he says (p. 581) that he is "not aware that this has ever been suggested as having anything to do with the phenomenon in question." We must not forget, however, that while the direct influence of temperature is not great because of its variation within comparatively safe limits during the growing season, the great importance attaching to it in its relation to evaporation makes it one of the most potent of the causes which influence the welfare of plants.

Wind

Wind has been discussed in various relations to this subject. Nutt (1833) seems to have been the only writer who considered the mechanical influence of tornadoes sufficient to cause treelessness on the southern prairies. Phillips (1844) considered wind in conjunction with prairie fires. Dana (1849) refers to ocean winds as a factor, and again (1875) to winds in connection with temperature and topography. McAfee (1876), Fernow (1892), and Baker (1908) placed emphasis upon dry winds and Geikie (1898) referred to the influence of wind-action in general terms. Todd (1878 and 1880) called attention to the exposure of treeless areas to prevailing winds and considered this factor especially in its relation to the relative humidity of air and soil. The writer (1900) also placed especial emphasis upon this factor in its relation to the absence of trees on exposed surfaces. Whitney (1876) however did not consider this factor important, but declared (p. 582) that "if the force of the wind were essentially inimical to the growth of trees we should find them thriving, if anywhere, in the sheltered nooks, and to the leeward of the northwesters, that being the quarter from which the heaviest blasts come." He evidently considered only the mechanical force of winds and did not view the question of wind-influence in its broader aspects. But even the mechanical force of the wind should cause greater damage during the summer when the broader foliage-surfaces are exposed than in winter when most of our trees are stripped of their leaves and hence expose neither their greatest surfaces nor their most tender tissues.

Evaporation

Evaporation has also received some attention in connection with the prairie problem. Engelmann (1862) thought that it chilled the soil and thus prevented the development of a forest flora. More frequently it has been discussed in its relation to the humidity of the air, as by Anders (1882), Whitney (1882), and others. Todd (1878) considered the variable humidity of air and soil of greatest importance, and the writer (1911) has recently discussed the influence of unequal evaporation from exposed and sheltered surfaces in its relation to prairie and forest.

When we consider the influence which evaporation exerts upon the transpiration of plants we can scarcely over-estimate its importance as a factor in our problem. Around it we must group the great climatic factors: rainfall which determines the amount of available moisture, and temperature and wind, which cause or facilitate evaporation together with such local or accessory factors as topography, large bodies of water, character of plant covering, etc., which may influence its rate.

Accessory or Secondary Factors.

Topography

Among the accessory factors none is of greater importance than topography because of its influence upon the conservation of moisture, as has been shown in this paper. Its importance, however, has been variously estimated. Dana (1849 and 1875) considered it together with winds and temperature. Foster (1869) noted its effect upon moisture. Worthen (1866) found prairie on both high and low ground, and Williams (1904) called attention to the fact that in southern Missouri prairies occur at an elevation of 600 to 800 feet, whereas in the northern part they reach an elevation of 1200 feet. White (1870), MacMillan (1892) and Baker (1908) found forests on the south sides of the valleys of streams, but only where the region south of the stream is rough. Macbride (1894 and 1899) reported and illustrated the interesting fact that even in the more heavily forested portions of northeastern Iowa the forests are found chiefly on northern and eastern slopes. Cameron (1897) also noted the abundance of forests on rougher areas, and Todd (1878) discussed the distribution of prairie and forest with reference to topography, and noted the effect of topography on the humidity of the air. The writer (1900) also discussed the effect of topography on winds in their relation to forest growth, and more recently (1911) its influence on evaporation. Local variations in flora are determined in large part by this factor because of its influence upon both evaporation and drainage.

Insufficient Drainage

Standing water in marshes and ponds has frequently been regarded as a cause of the treelessness of prairie. Atwater (1818) and Bourne (1820) early offered this in explanation of the phenomenon, and McGuire (?) (1838) also advocated a swamp origin. Lesquereaux (1857, 1860 and 1866) advanced the opinion that prairies originated in post-glacial lakes and swamps, and Richard Owen (1862) and Worthen (1882) expressed similar views. Engelmann (1862) regarded imperfect drainage as the cause because standing water prevented oxygen from reaching the roots of plants, and Alexander Winchell (1864, 1876) considered the origin lacustrine and the absence of trees due to sourness of the soil. Shaler (1891) objected to the lacustrine origin. Geikie (1898) ascribed it to sediment and wind action.

It is a well-known fact that ordinary trees will not grow on undrained areas, but unfortunately for the application of this as a general cause of the prairie, the latter is frequently found upon old, well-drained surfaces,— indeed typical prairie does not develop upon undrained areas, the plant-formations of the latter being entirely distinct.

The Sea.

The prairie has also been regarded as a plain left by the waters of the receding ocean. This was offered chiefly in explanation of the southern prairies by McGuire (1834) and Desor (1856, 1865). The fact that in the prairie region of the upper Mississippi valley several glacial drift sheets, the fresh-water Aftonian and several terrestrial loesses have been formed since the ocean withdrew is sufficient proof of the inadequacy of this theory.

Geological Formations.

Geological formations were formerly held of great importance in determining the character of a flora, and D. D. Owen expressed this opinion as early as 1852. Whitney (1858) said that prairie was confined to regions underlain by soft sedimentary strata, but we find prairie over the Sioux Quartzite. McGee (1878) in northeastern Iowa found forests restricted to the loess, and (1883) the drift plains timberless, while Howell (1883), more familiar perhaps with the western loess, declared that the loess will not sustain a forest. Pammel (1895) and the writer (1900) also attached importance to geological formations in relation to flora, and later Willard (1902), Upham (1902) and Gleason (1909) connected the origin of the prairies with glacial action. Quite recently (1911), and again in this paper the writer was able to give specific illustrations of the fact that prairie occurs irrespective of geological formations, and the latter can have influence only where they determine topography (as the drift-sheets, etc.) or the physical composition of soils.

Soils

Soil would generally be regarded as the most important factor in determining the distribution of plants, but plant ecologists assign to it a rather subordinate place,— at least within such a territory as the upper Mississippi valley, where the differences in the chemical composition of the mineral constituents are not sufficient to be of material consequence. Within such a territory as that the physical composition of the soil is of greater importance, but even that is likely to determine the quality of individual plants rather than the kinds.

Soil has also received its full share of attention as a cause of the prairie. Jones (1838) considered sand responsible for the barrens, and the soil for the prairie. Newberry (1873) considered the character of soil for holding water as of great importance, and Campbell (1885) placed the adaptation of soils to seeds of trees foremost. Whitney (1862, 1876 and 1882) presented the most elaborate arguments to show that the very fine soil of the prairie caused the failure of trees, and Worthen (1882) agreed with this in part. The American Encyclopedia (1883) presents Whitney's view, while various degrees of importance were attached to the soil by Shaw (1873), Upham (1895), Pammel (1895), Macbride (1896), Davis (1900) and the writer (1900 and 1911). Objections to the fineness of soil as an important factor were made by White (1870), Shaler (1892 and 1896), Tarr (1896) and Marsh (1898), all of whom advocated some other theory. (See Bibliography.)

Attention has already been called to the fact that prairie occurs on all kinds of soils in the upper Mississippi valley, whether alluvial, drift, loess or geest, and therefore the soil-factor is not universal, and does not satisfactorily explain the presence of prairie upon any particular one of its types.

Seed Dispersal

Seed-dispersal has been urged in a few cases as determining the relation of prairie to forest, and Campbell (1886) considered the limits of the latter determined by the accident of seed-dispersal. Alexander Winchell (1864) considered the seeds of plants throughout the region preglacial,[17] and that when the glacier receded the seeds on higher grounds germinated, and the flats, flooded and covered with sediment, remained barren until the lighter seeds of herbs were introduced, and herbs, especially grasses, took possession of these areas forming prairies. Harvey (1908) noted (p. 86) the difficulty of seed germination on the prairie "either because of a dense sod or a lack of soil moisture", and concluded that "the question of non-invasion upon the prairie proper is primarily and initially one of pre-occupation and the inability of seedlings successfully to withstand the extremely severe conditions of the first winter's exposure." Unfortunately for this view many seeds do germinate even on the prairie, broken prairie when allowed to lie fallow usually goes back to the normal prairie condition excepting where the bluegrass invasion has succeeded, and there are in the sections in which prairie predominates many groves in places protected from the dry winds of summer but fully exposed to the cold northwesterly winds of winter. Moreover where shelter would favor the densest sod we find groves most frequently. Preoccupation cannot explain the consistent relative distribution of prairie and forest in the western part of Iowa.

The accident of seed-dispersal no doubt largely determines the grouping of plants in both forest and prairie, but it cannot account for the complete change which takes place in the flora as we pass from the prairie to the forest.

The Bison

The bison, or American buffalo, formerly roamed over the western prairies and plains in countless numbers, and has been regarded as an important cause of the treelessness of the prairie. Aughey (1880) thought that the hardness of the surface, which prevented tree-growth, was due to these millions of buffaloes, and Mayr (1890), Marsh (1898), Gilbert and Brigham (1902) and Channing (1908) expressed the opinion that Indians set fire

[17] On p. 338 he stated: "The drift deposits became the vast granary in which nature preserved her store of seeds through the long rigors of a geological winter",— an utter impossibility!

to the prairie for the purpose of furnishing pasture for the buffalo, but the view is considered not proven by Schimper (1903). Over-grazing by the buffalo has also been offered to the writer privately by several speculators as a cause of the prairie on the well-known ground that overgrazing destroys forests and groves. However, cause and effect are here reversed, for the prairie in all probability made the bison possible.

Prairie Fires

Fire has been considered the cause of the treelessness of prairies more frequently than any other factor. It was so considered in some of the earliest known references. and has received a varying degree of attention to the present time. To those who have seen a prairie fire in all its fury this does not even now seem wholly without reason, for surely no seedlings, and few large trees could withstand the furious onslaught of the flames. Some writers[18] assumed that the prairies had been tree-covered. and that the forests were destroyed by fire, but there is no warrant for this statement. We have in the loess[19] some evidence that there were forests where we now find prairie, but this evidence merely suggests that there were local groves which became exterminated probably through exposure due to change in topography incident to the unequal piling up of loess. There is certainly no evidence that such forests were of wide extent. or that they extended over the flatter prairies.

The probability is that prairie fires were possible because of the condition of the prairie. and that when they consumed the grass and herbs of the prairie they encountered no tree seedlings, except perhaps at the very edges of the groves.

The fire-theory seemed to be supported by the presence of prairie on the drier areas, where it was assumed that fires would be more readily kindled, but such places often have a vegetation so scant that it would furnish but little fuel for the flames, and in the fall and early spring the denser vegetation of the more protected slopes is always sufficiently dry to burn, and hence should have suffered more from fires.

[18] Gleason (1909).

[19] See Journal of Geology, 1899, p. 133, and Proceedings of the Iowa Academy of Sciences, vol. VI, 1899, p. 108.

The following writers gave expression to more or less pronounced views favoring fire as the great cause of the prairie: Wells (1818), Ellsworth (1837), Fendler (1866), White (1868, 1870, 1871), Sternberg (1869), Allen (1870, 1871), Winchell (1880), Redway (1894), Gaskill (1905) and Hopkins (1910), while the following at least mentioned it, or regarded is as an accessory or secondary cause: Nutt (1833) with tornadoes, Western Monthly Magazine (1836), reprint (1838), Phillips (1844) with wind, Swallow (1879), Aughey (1880), Alexander Winchell (1886, 1890, 1894), McGee (1891), Shaler (1892, 1896), Macbride (1894, 1896, 1899, 1900), conditioned on moisture, Upham (1895), Powell (1896), Gow (1899), Davis (1900), Condra (1906), Cook (1908), Baker (1908), and the writer (1900, 1911). The references to burning of prairies for pasture for the bison were mentioned under the preceding head.

A few authors opposed the fire-theory as a fundamental cause, usually in connection with the advocacy of some other cause. Among these may be mentioned: Whitney (1858, 1876), Alexander Winchell (1876), Tarr (1896) and Harvey (1908). Bourne (1820) considered fire as the cause of the barrens but not the general prairies.

The facts which have been regarded as supporting the fire-theory may be briefly summarized as follows:

1. Prairie fires were once extensive, and destructive to aerial parts of plants.

2. Prairies appeared chiefly in drier situations where vegetation would burn more readily, and forests were found mostly along streams.

3. The small, stunted bur-oak shrubs common in the western part of the state have large bench-roots. It was assumed that the tops were periodically burned away and that the large root sent up new shoots, thus forming low shrubs.

While there can be no question as to the extent and destructiveness of prairie fires, they must be looked upon, as stated, rather as an effect than a cause, for nowhere in Iowa or adjacent territory has there been any marked general encroachment of the forest on the prairie when the fires ceased. In much of the territory the rapid settlement and extensive cultivation of the prairies would have prevented any such encroachment, but in the hilly western part of the state, where the surface remained practically undisturbed, there has been only a slight extension of the borders of the grooves. The oldest settlers in that part of the state agree that since the cessation of prairie fires no new groves have appeared except where set out by man, and that the native groves have expanded very little, though they have become denser and where not pastured have developed a dense undergrowth. This latter fact shows that the groves were also periodically swept by fires, and that the fires were not sufficient to destroy the groves.

That prairies appear in drier places has been shown in this paper, but this very fact has often so depauperated the vegetation that it would offer scant fuel for fires. The distribution of native groves along streams is by no means consistent with the view that the streams checked great conflagrations, for sometimes the groves are on one side of a stream, sometimes on the other, and where the stream has not cut a deep channel neither shore is wooded. The distribution of these groves is much more consistent with the causes presented in this paper.

The small bur-oaks have not increased in size in those places where they have remained undisturbed since the cessation of fires, in some cases more than thirty years, and it is evident that fires were not responsible for their condition. These stunted oaks are found invariably in dry, exposed places, and they produce large roots and small tops now just as they did when the fires swept the prairies.

It is evident that fires constituted no more than a local secondary cause, but one of the most conclusive evidences that annual fires were not the prime cause of the prairie is furnished by the prairie openings which are still found in the forested sections of this region, and which were formerly a very striking feature of our upland forests.

These openings differ from the forest not only in the absence of trees, but also in the fact that the minor mesophytic forest flora is also absent and the surface is covered with a typical prairie vegetation. This is especially noteworthy in the smaller areas which are often far remote from the broader prairies and yet develop a typical prairie flora.

These prairie openings differ much in size. Some are mere tongues or extensions of the greater prairie (see plate III, fig. 1), while others are small areas, entirely detached, and often quite remote from the greater prairies. (See plate II, figs. 1 and 2).

They differ also in the character of the soil. They may occur on geest, or drift, or loess, or sand. But whatever differences they may present in these respects they agree in appearing uniformly in rough areas and they have the same flora, a flora identical with that of the drier prairie as is shown in column IV of the table of plants.

The forested areas of this region are located in the rougher sections and these prairie openings are so situated on the tops of the ridges or on the slopes that they are exposed to the two great agents of evaporation herein discussed, namely the "two-o'clock sun" and the prevailing southwesterly summer winds. The character of the topography therefore determines whether the line between the prairie opening and the forest is sharp or whether there is a mingling of the flora of the two types showing a scattering of trees over an area in which prairie plants are also abundant, resulting in the so-called "oak-openings", or "oak-barrens".

The sharpness with which the prairie openings are sometimes defined is illustrated in plate II, figure 2. This is only one of several openings of this kind which cap the narrow ridges which extend to the west and southwest on the convex side of a great bend of the Iowa river six miles above Iowa City. These openings are removed several miles from open prairies yet their flora is that of the dry prairie. Excepting where otherwise stated the plants listed in column IV of the plant list were collected in this locality. In the locality represented in figure 2 the open area, here scarcely more than a rod wide, is covered with a typical unmixed prairie flora. On either side, but especially to the north (the right in the picture) the writer year after year, found an abundance of deep-woods species, such as *Osmunda Claytoniana, Adiantum pedatum, Cypripedium pubescens, Orchis spectabilis,* and others, beginning within a distance of not more than ten or fifteen feet from the margin of the prairie opening. Beyond points from one to four rods from the margin in this direction not a single prairie species could be found.

The absence of trees and the presence of a prairie flora on these areas which are in every way typical prairie areas, cannot be explained on the ground of any other factors thus far considered excepting that of exposure to evaporation. Rainfall is the same upon them and the adjoining slopes; frequently the slopes are the same and affect run-off equally; the underlying formations are the same; excepting for a rather thin veneer of leaf mould formed in the forest the soils are the same, and moreover are as variable in different openings as they are on the general prairies; and general climatic conditions cannot be materially different in such contiguous forest and prairie areas. Furthermore it is inconceivable that fires could have cleared these small areas and kept them cleared year after year without destroying the nearby forest, nor can the tramping of bisons be here considered as a cause.

As stated, these prairie openings are alike in exposure and in flora, and in these particulars they agree also with the general prairie areas. Exposure here periodically produces xerophytic conditions, and the prairie flora, which is more or less xerophytic in its structural adaptions, is alone able to persist.

Sand-Dunes

Further confirmation of the conclusion that the floral conditions of the prairie are not due to fires, soil, etc., is furnished by the sand-dune areas of Iowa and surrounding territory.

While the flora of the sandy areas presents certain special features, by far the greater part of it consists of typical prairie plants, as shown in column VI of the prairie plant list. In this list are included several species which appear as occurring only on sand-dunes, but they are also found on other dry surfaces in other areas than those considered specifically in connection with the list. They are the following, and all but the last show a decided preference for sandy areas:

Apocynum cannabinum var. pubescens (R. Br.) DC.
Astragalus distortus T. & G.
Draba caroliniana Walt.
Euphorbia serpens HBK

Certain other species are listed as appearing both on the sand-dunes and on some of the dry prairie areas, but they also show a more or less decided preference for sandy areas. They are the following:

Carex cephalophora Muell.
Cenchrus carolinianus Walt.
Crotalaria sagittalis L.
Oenothera rhombipetala Nutt.
Polygonum tenue Michx.
Strophostyles pauciflora (Benth.) S. Wats.
Tephrosia virginiana L.
Tradescantia reflexa Raf.
Viola pedata L.

To the foregoing list should be added *Amaranthus blitoides* Wats., and *Cycloloma atriplicifolium* (Spreng.) Coult. The former species occurs in dry places, but in our region appears to be most common in sandy places. The latter species is usually found in sandy places and occurs on both the dune areas, but in the western part of Iowa and the adjacent territory it is found, in common with most of the other species of the last list, on the dry prairie loess ridges. This apparent variation in the habitat of species of this list is not as great as it appears at first sight, for not only are these loess-covered areas xerophytic, but the loess is porous and consists in large part, sometimes more than 70 per cent, of (quartz) sand-dust.

Helianthus petiolaris Nutt. is also common at Muscatine, and is also found in the dry, western part of the state.

Still other species of our general territory, which habitually appear upon sandy areas and only exceptionally upon other dry areas (though none have been found in the particular prairie areas other than dune areas considered in the table), and which are not included in the table of plants, should be added. They are the following:

On the Harrison county dunes:

Desmodium canescens (L) DC.

On the Muscatine and Louisa county dunes:

Androsace occidentalis Pursh.
Aster linariifolius L.
Aster oblongifolius var. rigidulus Gray
Commelina virginica L.

Croton capitatus Michx.
Geranium carolinianum L.
Houstonia minima Beck.
Hypericum gentianoides (L.) BSP.
Opuntia Rafinesquei Engelm.
Sphenopholis obtusata var. lobata (Trin.) Scrib.
Sporobolus neglectus Nash.

Finally the list of plants which seem to be practically restricted to the sandy areas should be presented to complete the record. These plants are not included in the table.

On both the sand-dune areas:

Cyperus Schweinitzii Torr.
Eragrostis pilosa (L.) Beauv.
Paspalum setaceum Michx.
Strophostyles helvola (L.) Britt.

On sand-dunes in Harrison county:

Lespedeza capitata var. longifolia (DC.) T. & G.
Lygodesmia rostrata Gray

On sand-dunes in Muscatine and Louisa counties:

Agrostis hyemalis (Walt.) B. S. P.
Aristida tuberculosa Nutt.
Asclepias amplexicaulis J. E. Smith.
Cristatella Jamesii T. & G.
Croton glandulosus var. septentrionalis Muell. Arg.
Eragrostis pectinacea var. spectabile Gray.
Froelichia floridana (Nutt.) Moq.
Mollugo verticillata L.
Monarda punctata L.
Physostegia virginiana var. arenaria n. var.[20]
Polanisia graveolens Raf.
Polanisia trachysperma T. & G.
Rhus canadensis var. trilobata (Nutt.) Gray.
Sporobolus asper (Michx.) Kunth.

[20]Physostegia virginiana var. arenaria n. var.
This form of this more or less variable species is evidently an ecological variety, differing from the type, which inhabits low grounds, by the narrow linear or lance-oblong very coriaceous pale-green leaves, the thick coriaceous, lance-ovate bracts which are terminated by a short hard cusp, by the very puberulent calyx, bracts and upper part of the flowering stem. This variety is locally common on the sand mound in Muscatine and Louisa counties south of Muscatine, and exhibits its response to the xerophytic surroundings by its more rigid, harsher and more or less reduced leaf and stem structures.

Sporobolus cryptandrus (Torr.) Gray.
Triplasis purpurea (Walt.) Chapm.
Tribulus terrestris L. (Introduced).

The plants in the last list are not always sufficiently abundant to form a conspicuous part of the flora, and are always more or less freely mingled with species which were formerly widely distributed over all types of prairies.

A summary of the flora native to the two Iowa sand-dune areas brings out this relationship in a striking manner, as shown in the following:

Species common to both the sand-dune areas, and also occurring on prairie	31
Species found on the Muscatine sand-dunes and also occurring on prairie	134
Species found on the Harrison county sand-dunes and also occurring on prairie	18
Total number growing on both prairie and sand-dunes	183

Of this number 19 species are more frequent on sandy areas than on ordinary dry prairie.

The species which seem to be restricted to sandy areas in the Iowa sand-dune sections may be grouped as follows:

Species common to both dune areas	4
Species found only on the Muscatine dunes	17
Species found only on the Harrison county dunes	1
Total number of dune species	22

It will thus be seen that in our territory only 22 species seem to be restricted to sandy areas and 27 additional species prefer sand but may occur on ordinary prairie, while 163 species are quite likely to occur equally on either sand or ordinary prairie.

Other sandy areas show a similar preponderance of typical prairie plants on those surfaces which have become more or less stable but where there has been no development of a cementing and binding soil. At Dune Park, Indiana, the writer found 55 such species in one day's search, and other sandy areas show the same result.

Thus Rydberg, in the Flora of the Sand Hills of Nebraska,[21] reports a long list of plants from areas representing various

[21] Contributions from the U. S. National Herbarium, Vol. III, 1895, pp. 133-194.

degrees of fixation and topography, and among those growing in more exposed places 123 species are also more or less common on the prairies of western Iowa. Of the 12 "dry-valley" species (p. 140) 9 are common prairie plants, and 8 of the 27 "blowout" species (p. 139) are of the same type.[22]

In these cases the prairie flora cannot be due to fineness of soil, for it grows here in sand of varying coarseness; rainfall and other general meteorological conditions cannot be responsible, for adjoining surfaces are frequently covered with a mesophytic for-est; and fires and earlier grazing or tramping of bisons are out of question as the dunes frequently present a flora too scant for either cause.

These sandy areas are xerophytic, and the inevitable conclusion is that the prairie flora largely takes possession of them only because it is xerophytic and can exist here as well as on the xerophytic surfaces of ordinary prairie.[23]

[22] That a large part of the flora of sandy areas consists of prairie plants is also confirmed by Gleason's paper on "The Vegetation of the Inland Sand Deposits of Illinois", Bulletin of the Illinois State Laboratory of Natural History, vol. IX, 1910, pp. 23-174, which was received after this paper was written and the greater part of it had been printed. The author lists *Acerates viridiflora* and its varieties, and *Lithospermum Gmelini, Euphorbia corollata*, and *Lespedeza capitata* as characteristic of the blowout basins. All are common prairie plants in Iowa. Of the 31 species listed in the blowsand association (pp. 93-94) those belolnging to the genera *Ambrosia, Cassia, Oenothera* (2 sp.), *Euphorbia* (2 sp.), *Hedeoma, Lepidium, Lespcdeza*, and *Scutellaria*, ten in all, are common prairie types, and those belonging to *Commelina, Cenchrus, Tephrosia, Cycloloma*, and *Festuca* also occur on prairies, though more frequently on sandy areas. The transect across a blowout (p. 101) shows 14 species, of which *Bouteloua hirsuta, Lespedeza capitata, Ambrosia psilostachya, Panicum virgatum, Equisetum laevigatum* and *Koeleria cristata* are typical prairie plants, and *Festuca octoflora* is sometimes found on the prairie. Most of these plants are more common on dry prairies, but extend to prairies of all types.

[23] In order that there may be no misunderstanding as to the scope of this statement attention is called to the fact that in the region here under discussion even the most fertile prairie becomes xerophytic during the prevailing average late-summer conditions, and that frequently areas which are quite wet during a part of the year may be reduced to the same condition at this time. Often the dryness of the air produces a marked effect before the lack of free soil-water has reached the danger point. It

A further confirmation of this fact is furnished by the distribution of the introduced xerophytic weeds which are marked with an asterisk in the list of plants. These plants have become almost equally well-established on both sandy areas and ordinary prairie, and demonstrate that conditions in these two kinds of areas are not dissimilar.

Much emphasis has been placed recently on the succession of floras in sand-dune areas, and a careful study of any such region shows that there is a striking change in the flora as the dune becomes more and more fixed. But a comparison of different areas shows that the emphasis which is usually placed upon certain species in connection with local studies is misleading if any application of the results is extended to wider areas. This is illustrated by a comparative study of the dune areas of Muscatine and Harrison counties at opposite extremities of the state of Iowa. In Harrison county the first plants to appear in blowouts or on new dunes are *Cassia chamaecrista* and *Dalea enneandra,* which are followed very quickly by *Crotalaria sagittalis, Strophostyles helvola, S. Uauciflora,* and such well-marked xerophytes as *Cenchrus caroliniana, Cyperus Schweinitzii, Lygodesmia rostrata,* and *Salsola kali* var. *tenuifolia,* and later by species of *Desmanthus, Desmodium, Lespedeza, Melilotus,* and other xerophytic genera.

In Muscatine and Louisa counties, on the other hand, the pioneer and most effective hold-fast in blowouts and on new dunes is *Tephrosia virginiana,* accompanied or followed by both the common species of *Strophostyles, Cenchrus, Carex cephalophora, Cyperus Schweinitzii, Lithospermum Gmelini, Pentstemon graniliflorus, Polanisia trachysperma,* and finally a long list of other prairie xerophytes.

In the earlier stages the preponderance of individuals of leguminose species is striking, and in such situations they freely develop nitrifying root-tubercules. This is especially true of the Harrison county area where the leguminose plants greatly predominate, and produce great numbers of root-tubercles.

should also be remembered in this connection that the general character of a flora of any region is determined by the least favorable rather than the most favorable periods of the year, especially during the growing season.

Even where the same species occur their relative abundance in different parts of the same larger area, is exceedingly variable, and this is true of both sand-dunes and true prairie. For that reason no effort is made in this paper to indicate associations and other groups of plants, as the same species frequently appear in very different numbers and relative grouping, and different species appear under what seem to be exactly the same circumstances in different areas. The writer ventures to suggest that when our classification of minor ecological groups is perfected we will base them not on individual species, but on ecological types the definition of which will call for much more than the determination of relative numbers of individual species, for these relative numbers do not necessarily indicate fundamental differences in environment or adaptation, but may be fixed by the accident of seed-dispersal. Local detailed studies are of course desirable, but it is not safe to use them as a basis for generalizations in wider areas.

As previously noted the prairie flora of our region varies locally, but within certain very well-marked limits. A large part of that flora is found also upon the sandy areas of the same region. Both the prairies and the sandy areas are exposed to excessive evaporation, and both consequently suffer periodically a lack of available moisture, and this seems to be about all that they have in common excepting the flora, which is xerophytic and hence adapted to these areas, and which represents a consequence of this environment.

Prairie Groves

Still further evidence that the prairie owes its lack of trees to exposure to meterological factors is found in prairie groves, though the fact that trees when planted will grow upon the prairies is generally considered sufficient evidence that the factors which caused the treelessness of the prairies were mainly such as have been eliminated since the advent of the white man.

We have no evidence that the climate of this region has changed materially in recent times. There are fluctuations and variations, but our cycles of dry and wet seasons follow one another much as they probably did long before the white man wrought his changes. The topography of our region has not changed to any marked extent within the same time. Exposure to evaporation,—to sun and wind,—is therefore much the same as when prairie and forest appeared in their normal relation. Why then do trees grow on the prairies of today?

As a matter of fact trees do not always grow well on the prairies. With the exception of the cottonwood individual trees or single rows of trees do not in the long run prosper on the prairies. Larger groves made up of greater numbers of trees set out at one time in a manner which would be impossible by natural seed-dispersal, often thrive well, but even they suffer on their exposed sides, as is illustrated in plate X. Figure 1 illustrates a walnut grove on the south side of a road at Mr. Patrick McGuire's house near George, Iowa. This is the interior of the grove protected from excessive evaporation by the portions of the grove to the south and west. The trees here are prosperous and promise well for the future. Figure 2 illustrates the exposed southwest corner of the same grove, the trees being of the same age throughout. So far as could be determined soil, drainage, topography, etc., were the same, but the interior trees were sheltered by their less-fortunate companions.

Such a grove, if left to its own resources, would in time die out, and during cycles of dry seasons, such as those of 1893, 1894 and 1895, thousands of trees did perish not only where planted singly or in single rows, but also in larger groves, and a large part of the trees set out during such dry years fail completely.

The writer is convinced from observations made during a period of many years that on the prairies man, by his care of artificially planted trees, by cultivation, re-planting and protection, is just able to throw the balance in favor of the trees, and that but for his efforts the trees would again disappear from the greater part of the area which was once prairie.

It is interesting to note that where a grove becomes established, and thus provides the shelter which elsewhere is furnished by topography, the original prairie flora disappears entirely, and its place is taken by a typical mesophytic flora. An excellent illustration of this change is given by the Whiting grove, located near Whiting, Iowa, in the northeast corner of section 25, township 85 north, range 46 west. This grove consists chiefly of soft maple. and was planted in 1865 on the "Whiting ridge," a slight, well-drained swell on the great alluvial plain bordering the Missouri river. This area was covered with a typical prairie flora, evidence of which is still abundant in the vicinity. Within the grove itself the prairie flora has entirely disappeared, cultivation and the light factor probably being in large part responsible, and in its place there appears a typical forest flora consisting of the following plants:

1. *Species with fruits and seeds fleshy or edible.*

   Amphicarpa monoica (L.) Ell. Rare.
   Evonymus atropurpureus Jacq.
   Fragaria virginiana Duches.
   Menispermum canadense L.
   Morus rubra L.
   Psedera quinquefolia (L.) Greene.
   Rhus toxicodendron L.
   Ribes gracile Michx.
   Rubus occidentalis L.
   Vitis vulpina L.
   Zanthoxylum americanum Mill.

2. *Species with fruits bur-like.*

   Arctium minus Bernh. (not native.)
   Galium aparine L.
   Lappula virginiana (L.) Ell.
   Sanicula marilandica Michx.

3. *Species with fruits provided with wings or pappus.*

   Acer negundo L. L
   Eupatorium purpureum L.
   Eupatorium urticaefolium L.
   Fraxinus pennsylvanica var. **lanceolata** (Bookh.) Sarg.
   Lactuca floridana (L.) Gaertn.
   Ulmus americana L.

4. *Species with small light seeds or fruits.*

   Cryptotaenia canadensis L.
   Plantago Rugelii Dec. (Occurring in our territory both on prairie and in open woods.)
   Urtica gracilis Ait.

As the grove was originally planted from seed the possibility of the introduction of other forest plants at the time of planting was reduced to a minimum. Moreover the species are of such character that we can easily account for their later introduction by birds, and other animals, and by wind. The nearest native groves containing these species are several miles away, along the Missouri and Little Sioux rivers. This case, with many others like it, illustrates the effect of shelter on the light-loving, drouth-resisting prairie flora.

Summary of Conclusions

The conclusions for our region may be briefly summarized as follows:

1. Exposure to evaporation as determined by temperature, wind, and topography is the primary cause of the treelessness of the prairies.

2. The prairie flora persists on the exposed areas because it is xerophytic.

3. Rainfall and drainage, while of importance because determining the available supply of water in both soil and air, are not a general, determining cause, both frequently being equal on contiguous forested and prairie areas.

4. Soils and geological formations are of value only in so far as they affect conservation of water; the porosity of the former determining its power of holding moisture, and the latter often determining topography.

5. Prairie fires were an effect rather than a cause, and where acting as a cause were local.

6. Seed-dispersal probably largely accounts for the grouping of plant societies on the prairies, but does not account for the presence of the prairie flora as a whole.

7. Other assumed causes, such as the bison, the sea, etc., are of remote interest and not to be taken into account in any attempt at the explanation of the prairie as a whole.

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The bibliography of the origin of the prairies is very varied both in character and quality. The extent of the discussions also varies greatly. In some cases a mere direct statement of cause is given, in others a more elaborate argument is presented, and between these extremes various intermediate grades occur.

The list here presented is by no means complete, but it will serve as a fair index of the varied treatment which the subject has received.

In order that historic sequence and relation may be better presented the references are arranged chronologically, and in connection with each one a brief statement suggesting the author's conclusion is presented. It should not be inferred however that these suggestions always fully and clearly set forth the views of the respective authors, and the papers themselves should be consulted.

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1866—**Worthen, A. H.**—Geological Survey of Illinois, vol. I, pp. 9-10.—(Reprinted in Economic Geology of Illinois, vol. I, 1882, pp. 7-8.) Topography of the prairie.

—**Lesquereaux, Leo.**—On the Origin and Formation of Prairies. Geological Survey of Illinois, vol. I, pp. 238-254. Lake beds.

—**Dana, James D.**—On the Origin of the Prairies.—Am. Journal of Science and Arts, 2nd series, vol. XL, pp. 293-304. Prevalence of moisture.

—**Fendler, A.**—On Prairies.—Am. Journal of Science and Arts, 2nd series, vol. XLI, pp. 154 et seq. Fires.

1868—**White, C. A.**—The Lakes of Iowa.—Past and Present.—American Naturalist, vol. II, pp. 143-155. Not great lakes, but fire.

1869—**Foster, J. W.**—The Mississippi Valley: its Physical Geography. The origin of prairies, pp. 71-140. Moisture, pp. 71, 109. Not peat growth, p. 73. Not texture of soil, p. 76. Not annual burnings, p. 76.

—**Sternberg, Dr. G. M.**—The Plains of Kansas.—American Naturalist, vol. III, p. 162. Fire.

1870—**White, C. A.**—Geological Survey of Iowa, vol. I, pp. 131-133, and p. 363. Not soils, but fire.

—**White, C. A.**—Geological Survey of Iowa, vol. II. Timber on south side of east and west streams, p. 80. Fires, p. 161.

—**Allen, J. A.**—The Flora of the Prairies.—American Naturalist, vol. IV, Fires, p. 584.

1871—**Allen, J. A.**—The Fauna of the Prairies.—American Naturalist, vol. V, pp. 4-9. Fires.

—**White, C. A.**—Prairie Fires.—American Naturalist, vol. V, 1871, pp. 68-70. Describes prairie fires.

1873—**Newberry, J. S.**—Origin of the Prairies.—Geological Survey of Ohio, vol. I, part 1, pp. 26-31. Alternately too wet and too dry. Deficiency of precipitated moisture. Rainfall and soil.

—**Shaw, James.**—Geological Survey of Illinois, vol. V. Origin of the prairies, pp. 10-14. Discusses various causes, but concludes that soils are most potent. Also topography and flora of prairie in reports on Jo Daviess (p. 26), Ogle (p. 106), Bureau (p. 172) and Henry (p. 192) counties. These are reprinted in Worthen's Economic Geology of Illinois, vol. III, 1882, on pp. 21, 106, 167 and 185, respectively.

—**Winchell, Alexander.**—Prairies and Their Treelessness. Sketches of Creation, pp. 264-272. Lacustrine.

1874—**Marsh, George P.**—Man and Nature, 2nd ed. (See Marsh, 1898).

1875—**Andreas' Atlas of Iowa.**—Fire, pp. 344, 388, 410. Chiefly based on White's report (1870).

—**Broadhead, G. C.**—Geological Survey of Illinois, vol. VI. Topography and flora of the prairie discussed in reports on Fayette (p. 477), Montgomery (p. 490), Effingham (p. 520), Moultrie (p. 530), Macon (pp. 534, 536), and Piatt (p. 541) counties. Reprints in Worthen's Economic Geology of Illinois, vol. III, 1882, on pp. 137, 149, 175-176, 185, 190 and 194-195, respectively.

—**Dana, James D.**—Manual of Geology, 2nd edition, p. 45. Same as 1st edition, 1863, p. 46.

1876—**Winchell, Alexander.**—Treelessness of Prairies.—In Cochrane's Centennial History of Mason County (Illinois). Origin lacustrine, p. 70.

—**Whitney, J. D.**—Plain, Prairie and Forest.—American Naturalist, vol. X, pp. 577-588, and 656-667.—Not rainfall, nor fires, nor wind, but fineness of soil.

—**McAfee, H. H.**—Proceedings of the American Forestry Association. Southwest drying winds, p. 555.

—**Hinrichs, Gustavus.**—First Annual Report of Iowa Weather Station. Report of the Iowa State Agricultural Society, p. 286. Greatest forest surface where most rain.

1878—**McGee, W. J.**—Proceedings of the American Association for the Advancement of Science, 1st series, vol. XXVII. Loess usually covered with timber, drift with grasses, p. 198 (reprint p. 5.)

—**Todd, James E.**—Notes on the Distribution of Timber in Southwestern Iowa, with inferences concerning the Origin of Prairies. —American Naturalist, vol. XII, pp. 91-96. Variable humidity of air and soil.

1879—**Swallow, G. C.**—Prairie and Timber.—In Switzler's History of Missouri, pp. 528-529. Prairie when surface emerged from water. Fire checked forest.

1880—**Winchell, N. H.**—Eighth Annual Report of the Geological and Natural History Survey of Minnesota. Fires, p. 96. List of prairie plants, p. 97.

—**Todd, J. E.**—Notes on the Distribution of Timber in Southwestern Iowa, with Inferences concerning the Origin of Prairies.—Brief abstract, Proceedings of the Iowa Academy of Sciences for 1875-1880, p. 14. Variation in humidity of air and soil. Published in full in American Naturalist, 1878.

—**Aughey, Samuel.**—The Physical Geography and Geology of Nebraska. Fires, p. 42. Hard surface due to tramping of "millions of buffalo and other wild animals."

1881—**Hilton, H. R.** —The Rainfall in its Relation to Kansas Farming.—Transactions of the Kansas Academy of Science for 1879 and '80, vol. VII. Buffaloes, prairie fires, hot winds, p. 42.

1882—**Anders, J. M.**—Forests—Their Influence Upon Climate and Rainfall. American Naturalist, vol. XVI, pp. 19-30. (Review in Popular Science Monthly, vol. 21, p. 562). Discusses relation of forest and moisture.

—**Whitney, J. D.**—The Climatic Changes of Later Geological Times. —Memoirs of the Museum of Comparative Zoology, vol. VII, part II. Rainfall, fine soil, etc., pp. 166-183.

—**Worthen, A. H.**—Economic Geology of Illinois, vol. III, pp. 9-11. Excessive moisture in part. Fine soil. Topography and plants are also discussed in county reports, reprinted from Shaw (1873) and Broadhead (1875).

1883—**American Encyclopedia.**—Prairie, vol. XIII, p. 802. Finely comminuted soil.

—**Howell, Thomas J.**—The Geological Distribution of North American Forests.—Popular Science Monthly, vol. 23, pp. 517-524. "Loess is not capable of sustaining forest-growths for any length of time." Geological.

—**McGee, W. J.**—The Geological Distribution of Forests.—Popular Science Monthly, vol. 24, p. 115. Drift plains timberless, loess covered with trees.

1886—**Campbell, John T.**—Causes of Forest Rotation.—American Naturalist, vol. XX, pp. 521-527, and 851-856. Fires.

—**Winchell, Alexander**—Walks and Talks in the Geological Field. 1st ed. Prairies of lacustriue origin and kept treeless by fires.

1890—**Mayr, H.**—Die Waldungen von Nordamerika—(Quoted by Schimper (1903), p. 593). Prairies at first forested, but forests destroyed by Indians for buffalo pastures.

—**Tarr, Ralph S. and McMurry, Frank M.**—Geographies, Second Book. Probably once wooded, but forest destroyed by fires set to frighten bison, etc.

—**Winchell, Alexander**—Walks and Talks in the Geological Field,—2nd ed. Same as first (1886).

1891—**Call. R. E.**—Annual Reports of the Geological Survey of Arkansas, vol. II. Not difference in drainage, pp. 72, 73. Forest encroaching on prairie, p. 149.

—**McGee, W. J.**—Pleistocene History of Northeastern Iowa.—United States Geological Survey, vol. XI. Fires pp. 208, 297. Geological (prairie on drift). Inequality in rainfall, p. 297.

1892—**Shaler, N. S.**—The Origin and Nature of Soils. Report U. S. Geological Survey for 1891. Neither fineness of soil nor great lakes (p. 323), but dry seasons, and then fires.

—**Fernow, B. E.**—Report of the Chief of the Division of Forestry for 1891. Dry hot and cold winds are bane of trees, p. 207.

—**MacMillan, Conway**—The Metaspermae of the Minnesota Valley.—Geological and Natural History Survey of Minnesota, Botanical Series, vol. I. Along Minnesota valley trees are scant or absent on north bluffs.

1894—**Macbride, Thomas H.**—Trees of Allamakee County (Iowa)—Iowa Geological Survey, vol. IV, pp. 115-116. Fires only one of the factors, conditioned on moisture.

—**Redway, J. W.**—The Treeless Plains of the United States.—Geographical Journal, vol. III. Quoted by Warming (1909), p. 353. Fires.

—**Winchell, Alexander**—Walks and Talks in the Geological Field. 3rd edition, revised by Frederick Starr.—Same as second edition (1890).

1895—**Pammel, L. H.**—Trees of Boone County (Iowa).—Iowa Geological Survey, vol. V. Soil and geological formations, p. 233.

—**Upham, Warren**—The Glacial Lake Agassiz. Monographs of the U. S. Geological Survey, vol. XXV. Fires, pp. 46, 604. Rainfall, p. 605. Prairie plants, pp. 606-610.

—**Bush, B. F.**—Notes on the Mound Flora of Atchison County, Missouri. Sixth Annual Report of the Missouri Botanical Garden, pp. 121-134. Prairie flora of the loess hills.

1896—**Moore, Willis L.**—Some Climatic Features of the Arid Regions. U. S. Department of Agriculture, Weather Bureau. Relative humidity for U. S. Maximum winds for plains region.

—**Shaler, N. S.**—Aspects of the Earth. Not fineness of soil, p. 286. Partly drouth and partly fire, p. 288.

—**Macbride, Thomas H.**—Notes on Forest Distribution in Iowa.—Proceedings of the Iowa Academy of Sciences, vol. III, pp. 96-101. Fires and nature of soil.

—**Powell, J. W.**—The Physiography of the United States. Rainfall, pp. 70, 71.

—**Tarr, Ralph S.**—Elementary Physical Geography.—Neither compactness of soil nor fires proven sufficient, p. 257. Not dryness, p. 351.

1897—**Cameron, John E.**—Forest Trees of Delaware County (Iowa)—Iowa Geological Survey, vol. VIII. Timber on rougher areas, p. 193.

1897-8—**Shimek, B.**—The Flora of the Sioux Quartzite in Iowa. Proceedings of the Iowa Academy of Science, part I, vol. IV, 1897, pp. 72-81; part II, vol. V, 1898, pp. 28, 31. Lists of prairie plants.

1898—**Geikie, James**—Earth Sculpture, p. 337. Aqueous sedimentation, or wind action, or both.

—**Marsh, George P.**—The Earth as Modified by Human Action. Not fineness of soil, p. 339. Climatic conditions, especially want of spring and summer rains. Eastward, fires. Pasturage of the buffalo. In Wisconsin and Ohio cleared by primitive people and forest renewal prevented by fires and grazing. This is a revised edition of Man and Nature, published in 1863 and 1874.

—**Hitchcock, A. S.**—Ecological Plant Geography of Kansas.—Transactions of the St. Louis Academy of Science, vol. VIII, pp. 55-69.—Rainfall, p. 56.—Plant lists.

1899—**Macbride, Thomas H.**—Forestry Notes for Humboldt County (Iowa).—Iowa Geological Survey, vol. IX, pp. 148-149.—Fires rather than soil. Influenced by moisture.

—**Gow, James E.**—Forest trees of Adair County (Iowa).—Proceedings of Iowa Academy of Sciences vol. VI, pp. 56-63.—Fires, p. 61.

1900—**Macbride, Thomas H.**—Forestry Notes for Dickinson and Osceola Counties (Iowa),—Iowa Geological Survey, vol. X, pp. 228-239. Fires, etc., p. 230.

—**Macbride, Thomas H.**—Forestry Notes for Dubuque County (Iowa). —Iowa Geological Survey, vol. X. Fires, p. 624.

—**Davis, William M.**—In Mill's International Geography, p. 739. Prairie fires, fineness of soil, lack of rainfall. Not due to common cause.

—**Pound, Roscoe and Clements, Frederic E.**—The Phytogeography of Nebraska. The Prairie-grass formation, pp. 348-350. Characteristic plants.

—**Shimek, B.**—The Distribution of Forest Trees.—Proceedings of the Iowa Academy of Sciences, vol. VII, pp. 47-59. Chief cause exposure to wind. Accessory causes, fire, excess of moisture, lack of moisture, temperature, geological formations and soils.

—**Shimek, B.**—The Flora of Lyon County (Iowa).—Iowa Geological Survey, vol. X, pp. 157-184. Exposure, pp. 160 and 163. Lists of prairie plants.

1901—**Haddock, William J.**—The Prairies of Iowa. Fires, p. 56.

—**Thornber, John J.**—The Prairie-Grass Formation in Region I.—Botanical Survey of Nebraska, no. V, pp. 29-143. Ecological factors and plant lists.

1902—**Adams, Charles C.**—Postglacial origin and Migration of the Life of the Northeastern United States.—Journal of Geography, vol. I. Life of the prairie, p. 35, etc.

—**Pammel, L. H.**—Preliminary Notes on the Flora of Western Iowa, etc.—Proceedings of the Iowa Academy of Sciences, vol IX. pp. 152-180. Ecologic conditions of prairies. Lists of prairie plants.

—**Willard, Daniel E.**—The Story of the Prairies, or the Landscape Geology of North Dakota. Portions from lakes, etc.

—**Upham, Warren.**—Review of Willard's Story of the Prairies. Am. Geologist, vol. XXX. Suggests geologic origin of prairies.

—**Williams, Walter.**—The State of Missouri.—Prairie in southern part of state 600-800 feet above the sea; in northwestern part 1200 feet.

—**Gilbert, Grove K., and Brigham, Albert P.**—An Introduction to Physical Geography.—Fires by Indians to maintain pasturage for buffaloes, pp. 163 and 324.

—**Gaskill, Alfred.**—Why Prairies are Treeless.—Read before the Society of American Foresters, February 23, 1905. Review in Science, vol. XXII, N. S., pp. 55-56, 1905. Fires.

1906—**Squires, Walter S.**—The passing of the Prairie Flora.—Plant World, vol. 9, pp. 162-164.

—**Condra, George E.**—Georgraphy of Nebraska.—Overgrazing, fires and occasional drouths, p. 92.

1907—**Parrish, Randall.**—The Great Plains.—Prairie fauna, pp. 25-27.

1908—**Baker, H. P.**—Native and Planted Timber in Iowa.—Forest Service Circular 154, U. S. Department of Agriculture. Drying winds, p. 7. Prairie fires, dry winds and less rainfall in western Iowa, p. 8.

—**Cook, O. F.**—Change of Vegetation on the South Texas Prairies.—Bureau of Plant Industry, circular no. 14, U. S. Department of Agriculture. Fires chiefly, also overgrazing and early Indian agriculture, pp. 1-5.

—**Harvey, L. H.**—Floral Succession in the Prairie-grass Formation of Southeastern South Dakota.—The Botanical Gazette, vol. XLVI. Geological pp. 84 and 297. Climatic, p. 297. Prairie plant lists.

—**Channing, Edward.**—Students' History of the United States.—Indians burned grass to provide fields for buffaloes or bisons, p. 13.

1909—**Gleason, Henry A.**—Some Unsolved Problems of the Prairies.—Bulletin of the Torrey Botanical Club, vol. 36, pp. 265-271. Low winter rainfall, p. 267. Geological causes, p. 268.

—**Warming, Eugen.**—Oecology of Plants, English translation. Long severe winters; hot and dry summers; low atmospheric humidity; p. 285.

1910—**Hopkins, Cyril I.**—Soil Fertility and Permanent Agriculture. Fires, p. 78.

1911—**Shimek, B.**—Botanical Report (on Harrison and Monona counties, Iowa).—Iowa Geological Survey, vol. XX, 1910 (issued February, 1911), pp. 426-474. The present paper is an elaboration of this.

The following ecological papers are also of interest in this connection:

1898—**Pound, Roscoe and Clements, Frederic E.**—The Vegetation Regions of the Prairie Province.—Botanical Gazette, vol. XXV, pp. 381-394.

1899—**Cowles, Henry C.**—The Ecological Relations of the Vegetation on the Sand Dunes of Lake Michigan.—Botanical Gazette, vol. XXVII, pp. 95-202 and 281-391.

1900—**Pound, Roscoe and Clements, Frederic E.**—The Phytogeography of Nebraska.

1901—**Thornber, John J.**—The Prairie-Grass Formation in Region I.—University of Nebraska Botanical Survey of Nebraska, pp. 29-143.

—**Cowles, Henry C.**—The Physiographic Ecology of Chicago and Vicinity.—Botanical Gazette, vol. XXXI, pp. 73-108; 145-182.

1903—**MacDougal, Daniel T.**—Some Aspects of Desert Vegetation.—Contributions from the New York Botanical Garden, no. 46.

—**Transeau, Edgar N.**—On the Geographic Distribution and Ecological relations of the Bog Plant Societies of Northern America. —Botanical Gazette, vol. XXXVI, pp. 401-420.

—**Schimper, S. W.**—Plant Geography upon a Physiological Basis.—pp. 593-598, etc.

1904—**Clements, Frederic E.**—The Development and Structure of Vegetation.—University of Nebraska, Botanical Survey of Nebraska, VII.

1905—**Transeau, E. N.**—Forests of Eastern America.—Am. Naturalist, vol. 39, pp. 875-898.

1906—**Bray, William L.**—Distribution and Adaptation of the Vegetation of Texas.—Bulletin of the University of Texas, no. 82.

—**Livingston, B. E.**—The Relation of Desert Plants to Soil Moisture and to Evaporation. No. 50, Carnegie Institution.

1907—**Daniels, Francis P.**—The Flora of Columbia, Missouri, and Vicinity.—The University of Missouri Studies, vol I.

—**Hart, C. A. and Gleason, Henry A.**—On the Biology of the Sand Areas of Illinois.—Bulletin of the Illinois State Laboratory of Natural History, vol. VII, pp. 135-273.

—**Livingston, B. E.**—Evaporation and Plant Development.—The Plant World, vol. 10.

1908—**Harvey, L. H.**—Floral Succession in Prairie-Grass Formation of Southeastern South Dakota.—Botanical Gazette, vol. XLVI, pp. 81-108; 277-298.

—**Livingston, B. E.**—Evaporation and Plant Habitats.—The Plant World, vol. 11.

—**Livingston, B. E.**—Evaporation and Centers of Plant Distribution. —The Plant World, vol. 11, pp. 106-112.

1909—**Gleason, Henry A.**—The Vegetational History of a River Dune.—Trans. of the Illinois State Academy of Science, vol. II, pp. 19-26.

—**Olsson-Seffer, Pehr.**—Hydrodynamic Factors Influencing Plant-Life on Sandy Sea-Shores.—The New Phytologist, vol. VIII, pp. 37-51.

—**Yapp, R. H.**—On Stratification in the Vegetation of a Marsh, and its Relations to Evaporation and Temperature.—Annals of Botany, vol. XXIII, pp. 275-319.

—**Shaw, Charles H.**—Present Problems in Plant Ecology.—The American Naturalist, vol. XLIII, pp. 420-431.

—**Gleason, Henry A.**—Some Unsolved Problems of the Prairies.—Bulletin of the Torrey Botanical Club, vol. XXXVI, pp. 265-271.

—**Olsson-Seffer, Pehr.**—Relation of Soil and Vegetation on Sandy Sea Shores.—Botanical Gazette, vol. XLVII, pp. 85-126.

—**Warming, E.**—Oecology of Plants. Pp. 270-271, 285-286, etc.

1910—**Dachnowski, Alfred.**—Physiologically Arid Habitats and Drought Resistance in Plants.—Botanical Gazette, vol. XLIX, pp. 325-339.

—**Gleason, Henry A.**—The Vegetation of the Inland Sand Deposits of Illinois.—Bulletin of the Illinois State Laboratory of Natural History, vol. IX, pp. 23-174.

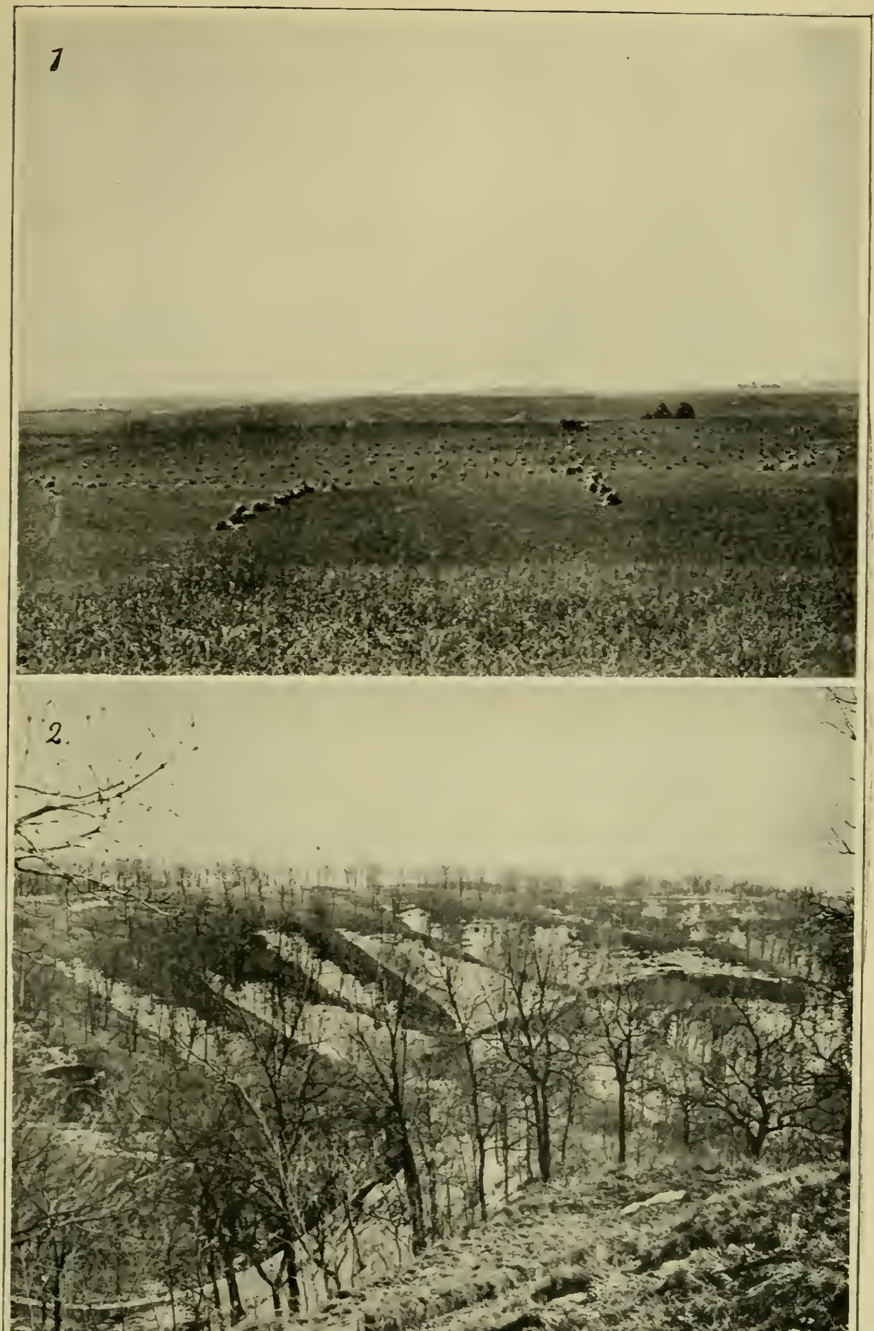

PLATE I—1 Prairie west of Lake Okoboji. 2 Snow between loess prairie ridges, Council Bluffs.

PLATE II—Prairie openings in wooded regions. 1 Near Reno, Minn. 2 North of Iowa City.

PLATE III—Prairie and wooded areas. 1 Lyon county, looking east. 2 Hamburg, Iowa, looking north.

PLATE IV—Opposite bluffs of the Missouri. 1 Wooded bluffs above Florence, Neb., looking north. 2 Prairie bluffs above Missouri Valley, Iowa, looking north.

PLATE V—Prairie ridges. 1 Sheltered ravines with buroaks, looking south from Murray Hill. 2 Looking southeast, in Sec. 15. T. 84 N. R. XLIV W.

PLATE VI—Opposite sides of valley north of Turin. 1 Looking southeast at exposed prairie side. 2 Looking southwest from same point toward sheltered wooded side.

PLATE VII—Missouri Valley, Iowa. 1 Looking north along exposed loess bluffs. 2 Looking northeast from the top of (1) into Snyders Hollow.

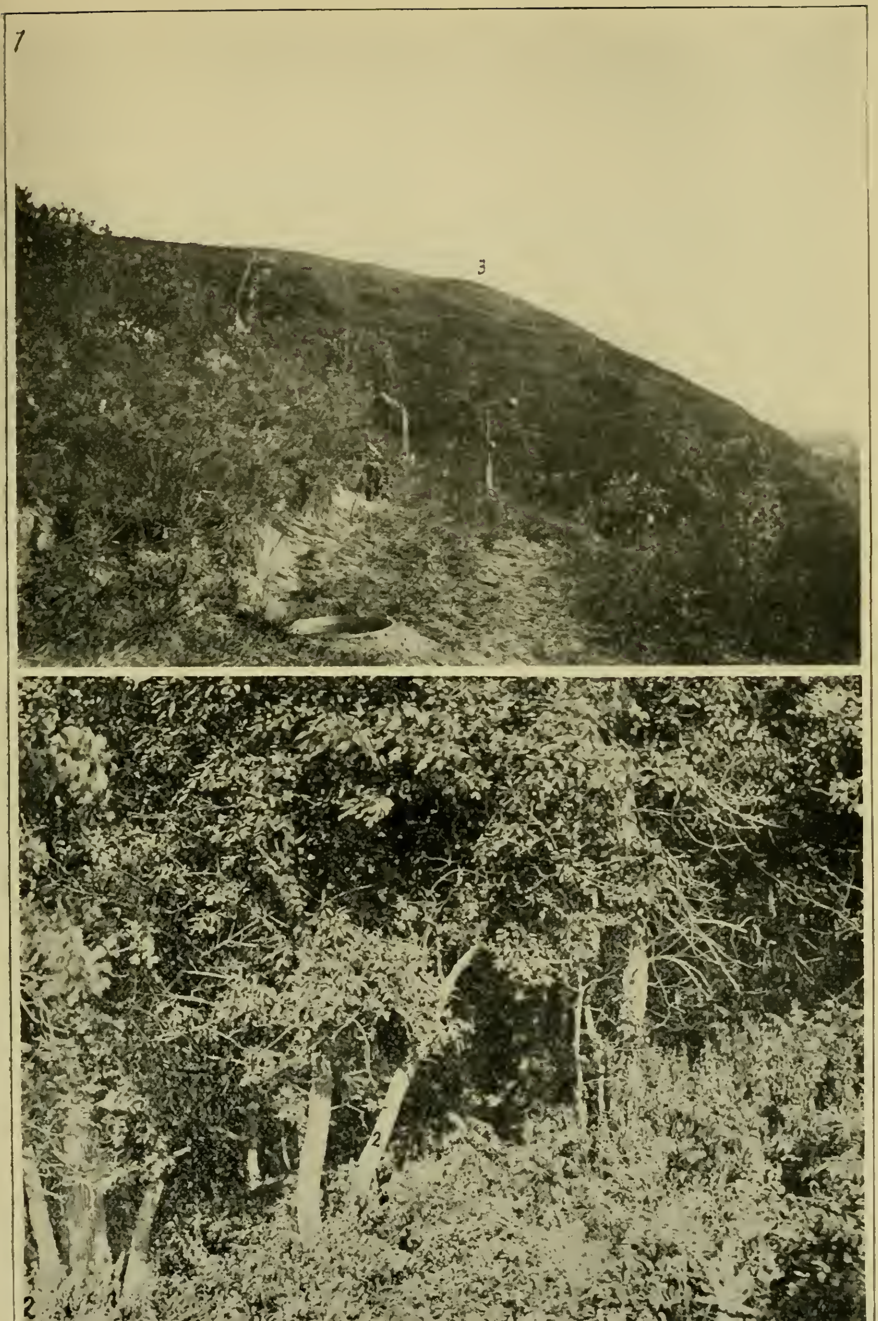

PLATE VIII—Meteorological stations, Missouri Valley. (1 Looking south across stations (1) and (3). 2 Looking east toward station (2) in grove in line with buroak marked (2).

PLATE IX—Meteorological stations, Missouri Valley. 1 Looking east toward stations (1) and (3). 2 Looking east of south toward station (4).

PLATE X—McGuire's walnut grove near George, Lyon county, Iowa. 1 Looking east. Thriving trees to right, sheltered. 2 Looking east at exposed southwest corner of same grove.

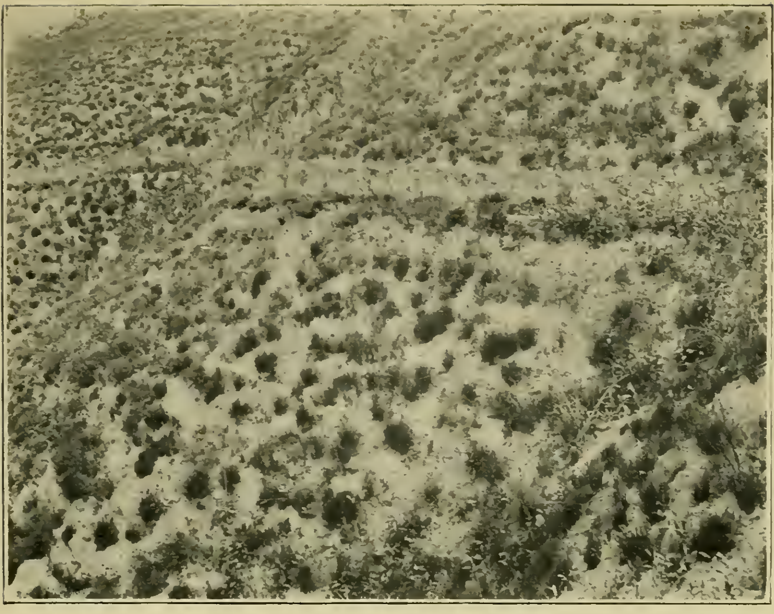

PLATE XI—Xerophytic areas. 1 Prairie loess bluff, Council Bluffs. 2 Sand-dune near Blair bridge, Harrison county, Iowa.

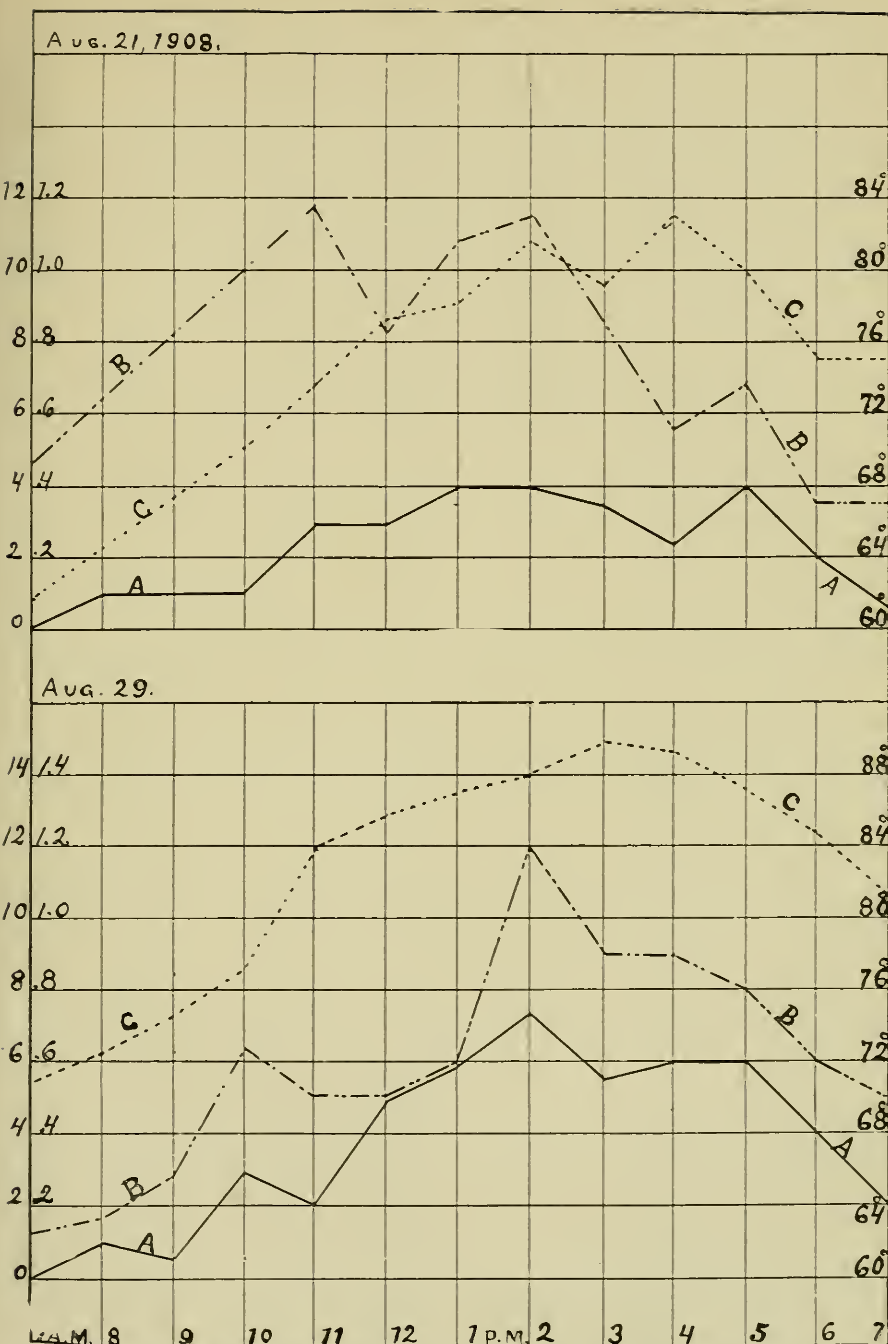

PLATE XII—Meteorological curves showing: a Evaporation from Piche evaporimiter in tenths of a cubic inch; b Wind velocity in miles per hour; and c Temperature Fahrenheit. For every hour of the day from 7 A. M. to 7 P. M. 1 For August 21, 1908. 2 For August 29, 1908.

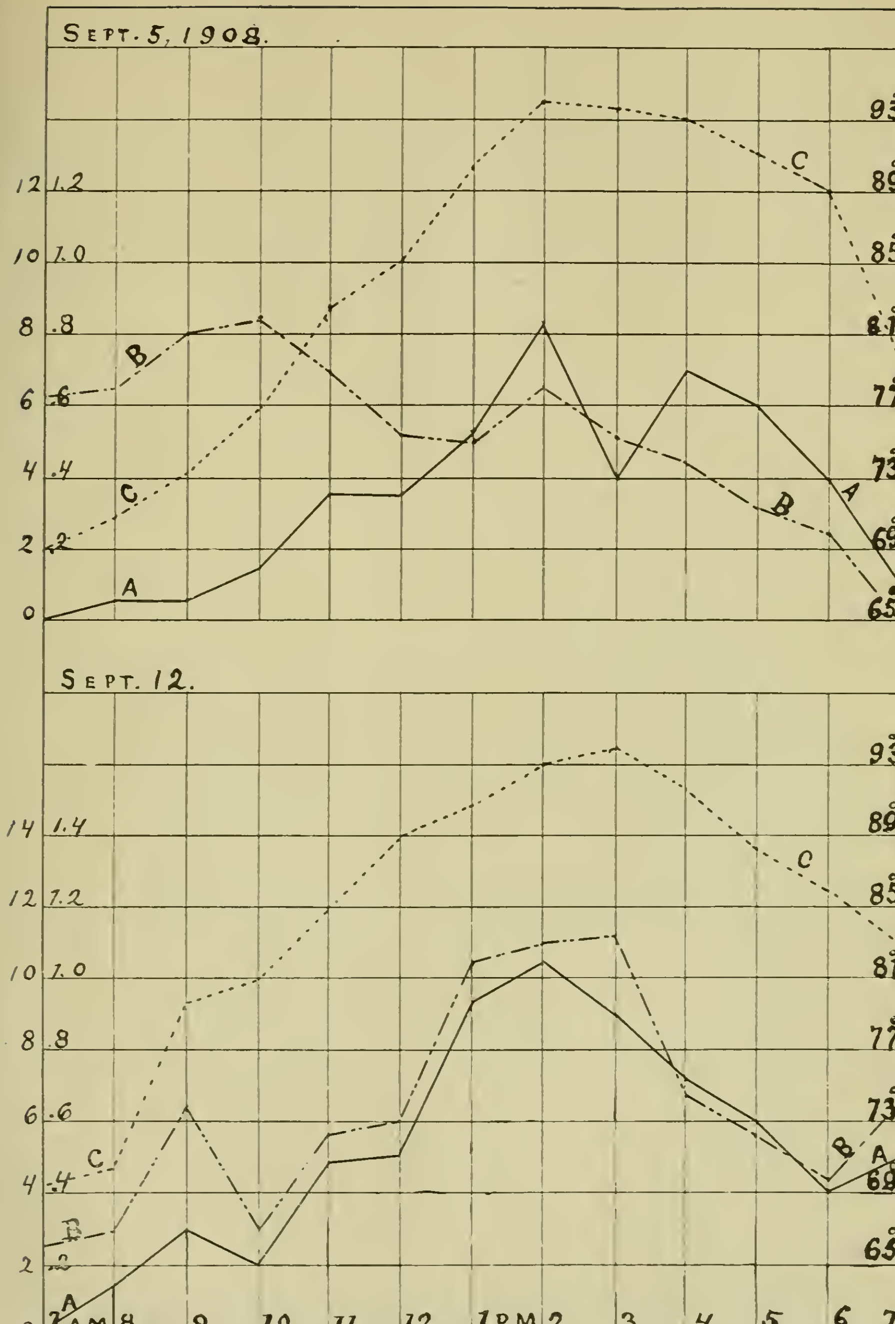

PLATE XIII—Same as plate XII. 1 For September 5, 1908. 2 For September 12, 1908.

PLATE XI rift.

PLATE XIV—Map of Iowa, Showing Original Forest Area and the border of the lobe of the Wisconsin Drift.

CORRECTIONS AND ADDITIONS.

P. 172.—Substitute "rough Kansan" for "Wisconsin moraine" in 8th line from bottom.

P. 174.—Substitute "Kansan" for "Wisconsin" in 8th line from top.

P. 223.—In 5th line from bottom, in footnote, insert "and" after "cusp".

P. 226.—In 19th line from top write "**pauciflora**" instead of "**Uauciflora**".

Omit the following letters from the table of plants, pp. 174-184:

H in column III opposite **Ambrosia trifida integrifolia, Anemone patens Wolfgangiana, Artemisia dracunculoides, Aster laevis,** and **Ceanothus ovatus pubescens.**

J in column II opposite **Aster laevis** and **Chenopodium leptophyllum.**

L in column II opposite **Prenanthes racemosa.**

Substitute M for J in column VI opposite **Pycnanthemum pilosum.**

Insert the following letters in the table:

cL in column II opposite **Artemisia dracunculoides, Bouteloua hirsuta,** and **Cirsium altissimum.**

c in column II opposite **Astragalus canadensis,** and in column III opposite **Cirsium discolor.**

cJ in column V, and cM in column VI opposite **OEnothera rhombipetala.**

Insert the following in table:

OEnothera fruticosa hirsuta Nutt., dJ in column II and dM in column VI.

NEW SERIES NO. 44 MAY 18, 1912

BULLETIN OF THE STATE UNIVERSITY OF IOWA

Bulletin from the Laboratories of Natural History

VOLUME VI NUMBER 3

CONTENTS

Published by the University
Iowa City, Iowa

ISSUED TWENTY-ONE TIMES DURING THE ACADEMIC YEAR; MONTHLY FROM OCTOBER TO JANUARY, WEEKLY FROM FEBRUARY TO JUNE. ENTERED AT THE POST OFFICE IN IOWA CITY AS SECOND CLASS MAIL MATTER

IN THE SERIES OF RESEARCH BULLETINS OF THE UNIVERSITY

BULLETIN

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CONTENTS

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A REPORT ON SOME RECENT COLLECTIONS OF FOSSIL COLEOPTERA FROM THE MIOCENE SHALES OF FLORISSANT.

H. F. Wickham

Within the past five or six years, the historic locality of Florissant, Colorado, has been revisited several times by parties under the direction of Professor T. D. A. Cockerell, of the University of Colorado, for the purpose of making fresh collections of the fossil insects abounding in the shales of the ancient lake bed. These expeditions have been successful in bringing to light a great number of hitherto unknown species, and in securing additional specimens of many forms already known. Some of the material has been worked up by Professor Cockerell himself, other portions by Professor Brues and Mr. Beutenmueller, while most of the Coleoptera have at length come into my hands for study. A good share of these were transmitted directly by Professor Cockerell, others came through the American Museum of Natural History. I have also had some specimens from the Peabody Museum and am now engaged in finishing a report on the collection of Florissant Coleoptera belonging to the United States National Museum. The new species from the last named source will be published elsewhere, but I have made an occasional note upon them in the present paper and have also referred to a few of the names which are still in manuscript. It is my hope to publish tables of some of the genera when all of the collections are finished, and the intention is to get out a list in which the Florissant beetle fauna will be shown as nearly in its entirety as possible. This seems the more desirable since Dr. Scudder was interrupted in his work by ill health and had only begun the non-Rhynchophorous series.

Until the remainder of the collections in hand are studied, it is scarcely worth while to make any extended remarks on the peculiarities of this Miocene fauna. Dr. Scudder has already called attention to some of the most striking characteristics of beetle life on the old lake shore, but it will probably be necessary to modify his conclusions regarding relative prevalence of certain families. The remarkable preponderance of Rhynchophora which he noted seems well sustained in recent collections, and the development of the Rhynchitidæ, a family of this series, is even more pronounced than he had judged. The Rhynchophora were undoubtedly a dominant type of beetle during the Miocene times. None of the other groups approach them in richness of species or individuals. They had already developed specialized rostral and scale structures, as shown by the remains from Florissant. It is interesting to note that the so-called seed weevils, the Bruchidæ, had also a strikingly strong representation in this region, seven species being described in the present paper, and another, of a more specialized type, being figured and described in manuscript. These seven species show varying modifications of the antennæ and indicate that the femoral dentation so well developed in recent forms had already made some progress in the Tertiary. The wood boring Bostrychids, *Protapate* and *Xylobiops* are also well along in development of the peculiar sculpture of the group to which they belong.

I must confess that I have not been able to find the affinities with the Central American fauna that Dr. Scudder seemed to suspect. Time after time, I have compared the species of certain genera with their Mexican or Central American representatives, but have nearly always found them more closely related to those of the United States. Even the European fauna does not seem to have been any more closely approximated than our own, and when I have been unable to assign a beetle to one of our native genera it has almost always been necessary to erect a new genus for its accommodation. The case of *Paussopsis*, as showing a possible striking affinity to the African or European fauna is not so convincing as it might be. I am not at all sure that this beetle belongs to the Paussidæ, though for the present I follow Professor Cockerell in the assumption that it does.

Such characters as the expanded tarsi of the males in Carabidæ, Staphylinidæ and water beetles had already made their appearance in the Tertiary forms. Bizarre structures of any description are somewhat conspicuously lacking. I do not see that there is any well marked difference in the average size of the recent beetles of given genera when compared with their presumed relatives of the Miocene rocks, though an occasional specimen has been assigned to one genus or another as a large or small exponent thereof. No really large family or series of families seems to be entirely wanting, unless it be the Pselaphidæ or the Histeridæ, of which latter Dr. Scudder mentions seeing a specimen though none is described in any of his papers. I have seen nothing that can possibly belong there, in spite of the fact that the genus *Saprinus* is today a common inhabitant of lake shores and the texture of the exoskeleton is such that there would be no doubt of its preservation as a fossil if deposited in the mud at one of the periods of shale formation. Small coleoptera of all families are extremely few in the collections though this may perhaps mean that they have been overlooked by field investigators. Thus, no Trichopterygidæ, Pselaphidæ or Scydmænidæ have been described, nor have I seen any. In the Clavicorn families now well represented along the forested shores of inland waters nearly all of the smaller forms seem to have been undeveloped or to have been lost after their entombment.

All of the drawings are from camera lucida figures by the author, except those of *Protapate* and *Macrodactylus* which are free hand. No structures have been "restored" but in case of such sculpturing as lines of fine punctures the courses of these lines have been indicated without attempting to reproduce each individual point. Attention has been called in the text to all such diagramatic representation and it is always accompanied by a detail figure on a larger scale or by a definite verbal description.

Arranged by families, the species herein reported upon are as follows:

CARABIDÆ.

Trechus fractus n. sp.
Amara cockerelli n. sp.
Amara danæ *Scudd.*

DYTISCIDÆ.

Cœlambus miocenus n. sp.
Agabus charon n. sp.

SILPHIDÆ.

Miosilpha necrophiloides n. sp.

PAUSSIDÆ.

Paussopsis secunda n. sp.

STAPHYLINIDÆ.

Quedius mortuus n. sp.
Quedius chamberlini *Scudd.*
Staphylinus lesleyi *Scudd.*
Leptacinus leidyi *Scudd.*
Tachinus sommatus *Scudd.*
Tachyporus nigripennis *Scudd.*

Boletobius funditus *Scudd.*
Mycetoporus demersus *Scudd.*
Bledius osborni *Scudd.*
Deleaster grandiceps n. sp.

COCCINELLIDÆ.

Adalia subversa *Scudd.*

EROTYLIDÆ.

Tritoma submersa n. sp.
Tritoma materna n. sp.

COLYDIIDÆ.

Phlœonemites miocenus n. sp.

DERMESTIDÆ.

Dermestes tertiarius n. sp.
Orphilus dubius n. sp.

NITIDULIDÆ.

Amartus petrefactus n. sp.

BYRRHIDÆ.

Nosotetocus vespertinus *Scudd.*

PARNIDÆ.

Dryops tenuior n. sp.
Lutrochites lecontei n. sp.

BUPRESTIDÆ.

Anthaxia exhumata *Wickh.*
Melanophila cockerellæ n. sp.
Melanophila handlirschi n. sp.
Acmæodera schaefferi n. sp.
Acmæodera abyssa n. sp.

LAMPYRIDÆ.

Pyropyga prima n. sp.

MALACHIDÆ.

Eudasytites listriformis n. sp.
Trichochrous miocenus n. sp.

BOSTRYCHIDÆ.

Protapate contorta n. sp.
Xylobiops lacustre n. sp.

SCARABÆIDÆ.

Atænius patescens *Scudd.*
Aphodius aboriginalis n. sp.
Aphodius restructus n. sp.
Aphodius shoshonis n. sp.
Aphodius laminicola *Wickh.*
Serica antediluviana n. sp.
Macrodactylus pluto n. sp.
Macrodactylus propheticus n. sp.
Diplotaxis simplicipes n. sp.
Diplotaxis aurora *Wickh.*

CERAMBYCIDÆ.

Leptura petrorum n. sp.

CHRYSOMELIDÆ.

Donacia primæva n. sp.
Crioceridea dubia n. sp.
Metachroma florissantensis n. sp.

BRUCHIDÆ.

Bruchus henshawi n. sp.
Bruchus exhumatus n. sp.
Bruchus bowditchi n. sp.
Bruchus florissantensis n. sp.
Bruchus scudderi n. sp.
Bruchus haywardi n. sp.
Bruchus osborni n. sp.

TENEBRIONIDÆ.

Platydema antiquorum n. sp.

MORDELLIDÆ.

Mordellistena florissantensis n. sp.

MELOIDÆ.

Nemognatha exsecta n. sp.

RHYNCHITIDÆ.

Docirhynchus ibis n. sp.

CURCULIONIDÆ.

Pachybaris rudis n. sp.

TRECHUS *Clairv.*

T. FRACTUS n. sp. (Plate III, Fig. 1.) Form moderately elongate. Head rather large, not constricted posteriorly, mandibles strong, about as long as the rest of the head. Antennæ broken, but the few remaining joints rather stout. Prothorax trapeziform, much broader at apex and strongly narrowed to the base, sides almost straight, front coxæ narrowly separated by the prosternum. Elytra without humeral angles, broadest a little in front of the middle, apices broken, striæ, as shown through the abdomen, fine. Length, 7.00 mm.

Station number and collector not specified. The type and only known specimen was received directly from Professor Cockerell and is in the Museum of the University of Colorado.

This insect has given me a good deal of trouble to place. It reminds one of the slender Platyni of the *larvalis* group, and is also similar to some of the European Anophthalmi. The lack of a strongly defined neck has led me to prefer *Trechus* as a final disposition, in preference to *Platynus,* but I cannot say that I am very well satisfied with the assignment.

AMARA *Bonelli.*

A. COCKERELLI n. sp. (Plate I, Fig. 1.) Intermediate in size between *A. powellii,* and *A. danæ,* from these shales, but in form more like *A. revocata.* A species is indicated in which the prothorax was narrower behind as in the recent subgenus *Cyrtonotus,* this segment being broadest well in front of the middle, whence the sides are arcuate to the anterior angles, which are not prominent, posteriorly they are nearly straight and only slightly sinuate to the base, thoracic disk without distinct sculpture except a strong median line. Head as broad at base as the prothoracic apex. Eyes rather small and anterior as in all of the species described by Dr. Scudder. Elytra with finely impressed narrow striæ, apparently impunctate and about equally distinct to the lateral margins, scutellar stria free at tip and moderately long. Legs and antennæ wanting. Length, 9.25 mm.; of elytron, 5.50 mm. Width of elytra, 3.75 mm.

Station number 11 or 12. One specimen, showing obverse and reverse, with the collection numbers 70 and 191. The type is in the Museum of the University of Colorado. It was collected by Professor Cockerell, for whom it is named.

This fossil seems undoubtedly distinct from any of Dr. Scudder's species and like them is doubtfully a true representative of the genus. Except for the great difference in size, I should have referred it to *A. revocata,* the figure of which it fairly closely resembles, especially in the form of the prothorax.

A. DANÆ SCUDD. Station number 13. A fine paired specimen from this place was collected by S. A. Rohwer.

CŒLAMBUS *Thoms.*

C. MIOCENUS n. sp. (Plate II, Figs. 1 to 6.) Form scarcely elongate for this genus, tapering towards both ends. Head large, antennæ not well preserved but sufficiently well shown to indicate that they were rather stout. Prothorax possibly not complete at the sides but in general tapering from about the base to the apex. Elytra broadest a little in front of the middle, the length of each a little more than twice the breadth. Entire upper surface with a fine alutaceous sculpture, visible only under high magnification. Under side better preserved than the upper and much more roughly sculptured, the punctuation being strongly pronounced and coarse, the punctures circular and separated generally by much less than their own diameters. In front of the middle coxæ, these punctures are comparatively fine but behind them, on the sternal pieces and especially on the coxal plates they are large, taking into account the size of the insect. The abdomen is about equally coarsely but somewhat less strongly punctured, toward the base, but much more finely on the last two segments. Legs rather slender, the anterior and middle tarsi somewhat dilated. Length, 3.75 mm. Width across both elytra at broadest point, 2.40 mm.

Station number 14. One beautiful paired specimen, collected by Geo. N. Rohwer. The type is in the American Museum of Natural History.

I refer this insect to *Cœlambus* without the least hesitation, the shape, sculpture, and structural features all point to the same conclusion. It seems to have had more likeness to *C. medialis* than to any other of our recent North American species, but was more finely punctured above.

AGABUS *Leach.*

A. CHARON n. sp. (Plate IV, Fig. 1.) Form almost regularly elliptical, broadest about the middle of the body length. Head large, and, as preserved, longer than the prothorax when viewed from beneath, about equal to it when seen from above, no distinct sculpture aside from a fine alutaceous roughening which also covers the upper surfaces of the prothorax and elytra. Prothorax short, about three times as broad as long in dorsal view, sides nearly straight or slightly arcuate, convergent from base to apex. Elytra at base not quite continuing the prothoracic outline, conjointly nearly one and one-fourth times as long as broad, without striation or evidence of coarse punctures. Legs rather short. Length from front of head to elytral apex, 8.25 mm.; of elytra, 6.00 mm. Width across both elytra at widest point, about 4.75 mm.

Station number 14. One paired specimen, collected by Mrs. W. P. Cockerell or S. A. Rohwer. The type is in the Museum of the University of Colorado.

This insect probably belongs with *Agabus,* judging from the form, size, short legs, and such of the ventral sclerites as can be made out. It is, of course, possible that it should form a separate genus, but no characters are apparent upon which to base a division. It is readily distinguished from the fossil *A. florissan-*

tensis by the much smaller size, which is only about three-fourths that of the latter species.

MIOSILPHA n. gen.

Form of *Silpha*, for example *S. lapponica*, but differs in having the middle coxæ quite closely approximate or possibly contiguous. The front coxæ are transverse, the cavities confluent, hind coxæ also transverse and contiguous. The flanks of the prothorax are inflexed and the elytra have a wide inflexed margin. Antennæ apparently ten jointed, with a four jointed club, but it is possible that there were eleven joints. The type and only known species is described below.

M. NECROPHILOIDES n. sp. (Plate I, Figs. 4, 5, 6.) Moderately elongate in form. Head short, distinctly and strongly but not especially coarsely punctured above and beneath, closely on the vertex, less so on the occiput, and sparsely on the front. Eye rounded, small as seen from above. Antenna apparently ten jointed, the first joint long and stout, second small, third as long as the next two, fourth, fifth and sixth subequal, seventh, eighth, ninth, and tenth forming a moderately strong club which is somewhat shorter than all the joints from the second to the sixth inclusive. Prothorax distorted but approximately twice as wide as long, upper surface distinctly but sparsely punctured, a little more coarsely and closely towards the sides. Scutellum finely punctured, triangular. Elytra nearly parallel sided, not notably differing, in conjoint width, from the prothorax, the surface of each with nine sharp, fine, nearly equidistant striæ, which nearly attain the elytral apices, their bottoms apparently finely indistinctly punctate, interstitial spaces broad, a little convex, probably each with a few coarse punctures, though this appearance may perhaps be due to the structure of the stone. Front tibia carinate, the others not distinct. Underside of prothorax moderately finely, quite sparsely punctured, that of the meso and metathorax still more finely; on all of these, and on the abdomen, the punctuation is coarser at the sides, the middle abdominal region being almost smooth. Length to apex of extended abdomen, 9.00 mm.; of elytra, 3.50 mm.

Station number 14. There are two paired specimens, collected by Mrs. W. P. Cockerell. The type is in the Museum of the University of Colorado, the cotype in the American Museum of Natural History.

This very interesting insect seems without doubt to be a Silphid. I should place it in the tribe Silphini, with which it agrees in having transverse anterior coxæ, with trochantins, the cavities confluent and open behind, the hind coxæ simple and contiguous. The exposed abdomen and ten jointed antennæ ally it to *Necrophorus* in which, however, the club is capitate while in *Miosilpha* it is long and not very compact as in *Silpha* and

Necrophilus. The contiguous or closely approximate middle coxæ separate it at once from *Silpha,* but in this respect it is similar to *Necrophilus,* which genus it also closely resembles in sculpture and in the carination of the tibiæ. It is, in fact, about like a *Necrophilus* with ten jointed antennæ, truncate elytra, and elongate abdomen, the last character probably being exaggerated by maceration. If we should attempt to incorporate it in the table of genera in the LeConte and Horn "Classification" it might be placed after *Necrophorus* from which it differs by the characters already given. It may be worth while to call attention to the fact that it seems an osculant form between *Necrophorus* and *Silpha,* two genera which are readily distinguishable at the present day, and that it combines the coxal structure of the forms with long elytra (represented today by *Necrophilus* and *Pelates*) with the short elytra of the two genera mentioned above.

PAUSSOPSIS *Ckll.*

P. SECUNDA n. sp. (Plate I, Figs. 8, 9.) Form moderately elongate, subparallel. Head longer than the prothorax. Eye large, circular. Antennæ hardly clavate but thick, basal joint a little longer than the three succeeding, second smallest, those following are subequal among themselves except the last which is larger and apparently rounded at the tip. The vertex and occipital region are closely but finely punctured, the frontal region more finely and less closely. Prothorax shown partly in side view, and, as preserved, much wider than long, distinctly margined behind, the outline regular, surface smooth and shining, (probably polished in life) with extremely fine, microscopic, widely dispersed punctures. Elytra subparallel at sides, bluntly pointed at tip, surface scarcely visibly sculptured but with some indications of extremely fine lines of punctures. Length, 6.25 mm.

Station number 14. One specimen, collected by Geo. N. Rohwer. The type is in the Museum of the University of Colorado.

This seems to be congeneric with *P. nearctica* Ckll., with which it agrees in most of the specific details as well, but *P. secunda* is a little larger, the antennæ, judging from the figure, less clavate and the head punctured. If *Paussopsis* really belongs to the Paussidæ, it must be considered a very generalized form, since neither the antennæ, the head, nor the prothorax exhibit any development of the peculiar distortions common among recent species in that family.

QUEDIUS *Steph.*

Q. MORTUUS n. sp. (Plate I, Fig. 2.) Form elongate, parallel. Head long, rather narrow, tapering behind the eyes which are large but not very prominent. Antennæ wanting. Prothorax wider than the head, but about equal in length and breadth, apex narrower than the base which is rounded, sides nearly regularly arcuate. Scutellum large, subtriangular. Elytra conjointly but little wider than the prothorax, sinuately truncate at apices, their combined width slightly exceeding their length. Abdomen nearly as broad as the elytra, strongly margined, only the basal three segments remaining. Legs wanting. Length of fragment, 11.45 mm.; from front of head to elytral apex, 7.60 mm.; of elytra, 2.80 mm. Width of prothorax, 2.80 mm.; of elytra, about 3.00 mm.

Station number 14. Collected by S. A. Rohwer. The type and only specimen is in the American Museum of Natural History.

This appears to be a *Quedius* of the *explanatus* type and is of similar size. The sculpture of the entire upper surface is very fine and seems scarcely more than an alutaceous roughening of the integuments. In life, the insect probably reached a length of about 15 mm.

Q. CHAMBERLINI *Scudd.* Station number 17. One paired specimen, collected by S. A. Rohwer.

STAPHYLINUS *Linn.*

S. LESLEYI *Scudd.* Station number 13B. One paired specimen, collected by Geo. N. Rohwer.

LEPTACINUS *Erichs.*

L. LEIDYI *Scudd.* One fine specimen, without citation of station or collector.

TACHINUS *Grav.*

T. SOMMATUS *Scudd.* Station number 14. One specimen. Station number 17. One specimen, collected by Mrs. W. P. Cockerell.

TACHYPORUS *Grav.*

T. NIGRIPENNIS *Scudd.* Station number 17. One specimen, collected by Mrs. W. P. Cockerell.

Boletobius *Leach.*

B. funditus *Scudd.* Station number 17. One specimen, collected by Mrs. W. P. Cockerell.

Mycetoporus *Mann.*

M. demersus *Scudd.* Station number 14. One specimen, collected by Mrs. W. P. Cockerell.

Bledius *Leach.*

B. osborni *Scudd.* Station number 14. One specimen, collected by Mrs. W. P. Cockerell.

Deleaster *Erichs.*

D. grandiceps n. sp. (Plate I, Fig. 3.) Form similar to that of the recent Colorado species, *D. trimaculatus.* Head larger than the prothorax, eyes prominent, antennæ incrassate distally but with the joints not distinct. Prothorax distorted, narrower than the head and somewhat constricted in front of the base which is subequal to the apex, the sides protuberant. Elytra much broader at base than the prothorax, each apparently with a large rounded light spot in front of the middle. The entire upper surface is simply finely scabrous, but traces of punctures show that a better preserved specimen might indicate another type of sculpture. Length of fragment, 7.25 mm.

Station number 14. A single specimen, collected by Geo. N. Rohwer. The type is in the Museum of the University of Colorado.

This was a larger species than the one with which is has been compared and was probably not strictly congeneric, though of the same general type. In *D. trimaculatus* the elytra are darker at the apex and in the scutellar region, but have no well defined light spots.

Adalia *Muls.*

A. subversa *Scudd.* A specimen sent directly from Professor Cockerell is referred here. It is of the same size and form as Dr. Scudder's example and of a similar light color, preserved in dorsal view, and shows the insect to have been a member of the group Coccinellæ to which *Adalia* belongs. The coxal lines of the first ventral are well exhibited. The antenna is moderately long and gradually clavate as in the recent *A. bipunctata.* Since Dr. Scudder made his identification practically upon facies alone, it is interesting to have it verified by the discovery of this better specimen.

Station number 14. Collector not specified.

TRITOMA *Fabr.*

T. SUBMERSA n. sp. (Plate III. Figs. 2. 3.) Form rather short for this genus. Head large, broader than long, eyes not discernible in their entire outline, but enough shows to indicate that they were of good size. Antennæ mutilated but fragments of both remain, showing the basal joints to have been slender and the club to be composed of three broad joints, similar among themselves. Prothoracic width equal to double the median length, hind angles a little rounded, anterior angles a little acute, sides margined. The greatest width is slightly in front of the base, whence the sides taper with slight arcuation to the apex. Scutellum small but distinct, triangular. Elytra two and two-thirds times the length of the prothoracic median line, conjointly noticeably broader than the prothorax, pointed at the apex, exterior and sutural margins with a rather fine bead. Legs wanting. No distinct sculpture can be made out on the specimen, but the elytra show faint signs of striæ. Length, 2.50 mm.

Station number 14. One specimen, collector not specified. The type is in the Museum of the University of Colorado.

Though rather small for this genus, the specimen seems to belong to the Erotylidæ and appears more closely allied to *Tritoma* than to any other genus that I know. At any rate there is no basis for generic separation.

T. MATERNA n. sp. (Plate II. Figs. 7. 8.) Form rather short, resembling that of the recent *T. humeralis*. Head comparatively a little larger than that of the species cited, the sculpture, (except a few scattered fine punctures), eye and articulations of the antennæ effaced. Prothorax short, not much arched in profile. Elytra cuneiform in side view, about three and one-half times as long as the prothorax and a little more than twice as long as high. Legs short, tibiæ expanded towards the tips and flattened. Length, 4.85 mm.; of elytron, 3.55 mm.

Station number 14. One fine paired specimen, collected by S. A. Rohwer. The type is in the Museum of the University of Colorado.

This beetle is strikingly like the recent *T. humeralis* in outline and has the same leg construction as far as can be seen, except that the hind tarsi are perhaps a trifle longer in proportion to their tibiæ in the fossil. The sculpture seems to have been finer, the prothorax with very sparse punctuation, the elytra with rows of fine distant punctures.

PHLŒONEMITES n. gen.

This name is proposed for a fossil similar to the recent *Phlœonemus catenulatus* in form, size and elytral sculpture, but differing in having the antennal club much more gradually formed and the prothorax without sharp raised lines. The type and only known species is *P. miocenus*, described below.

P. MIOCENUS n. sp. (Plate II, Figs. 9, 10, 11.) Form somewhat obscured through the breaking of the margins, but not much more elongate than that of *Phlœonemus catenulatus*. Head narrower than the prothorax, shape destroyed through the obliteration of the margin, vertex strongly and closely punctured. Eyes indistinguishable. Antennæ showing only fragmentary portions, the club of one is intact and is formed of two joints, the three preceding joints successively narrower as the head is approached. Prothorax with the sides damaged, upper surface strongly sculptured with close set circular punctures. Elytra a little over three times as long as the prothorax and conjointly about two-thirds as wide as long, broadest about the middle, not strongly tapering in either direction but becoming somewhat suddenly conjointly rounded at the apex. Sculpture composed of a sutural and submarginal and three deep, smooth, discal grooves, between which are double series of elongate punctures, the punctures of each row separated by a transverse raised line, the lines and punctures of each row of a double series alternating with those of its fellows, as shown in the detail drawing. Length, 4.25 mm.

Station number 13. One specimen, collected by Mrs. W. P. Cockerell. The type is in the Museum of the University of Colorado.

The specimen is one received directly from Professor Cockerell, and I believe it is undoubtedly a reverse, in which case the head and thorax are granulate (a common structure in the Colydiidæ), the elytra with submarginal, sutural and three discal costæ, each elytron with four double series of elongate tubercles as in *Phlœonemus catenulatus*. The club of the antenna is so gradually formed that it might about as well be called three jointed as two jointed.

DERMESTES *Linn.*

D. TERTIARIUS n. sp. (Plate V, Figs. 1, 2.) Form moderately elongate. Head wanting. Prothorax crushed, but the remains show it to have been broader at base than at apex, the base slightly prominent at middle but not lobed, the apex weakly arcuately emarginate. Elytra not striate, subparallel to behind the middle, thence tapering to the apices which are bluntly pointed. Abdominal segments subequal, except the first which is longer. The entire surface of the prothorax and elytra is finely, regularly, and rather closely punctured, the punctures bearing moderately long hairs. Length, from front of pronotum to apex of abdomen, 7.50 mm.

Station number 14. One paired specimen collected by Mrs. W. P. Cockerell. The type is in the American Museum of Natural History.

In the absence of head and legs, the generic assignment is open to some doubt, but what can be seen of the form, sculpture, and vestiture points to the above reference. This insect is much larger than *Attagenus sopitus* Scudd., the only Dermestide thus far known from the Florissant shales.

ORPHILUS *Erichs.*

O. DUBIUS n. sp. (Plate I, Fig. 7.) Similar in form to the recent *O. ater*, and of about the same size. The sculpture is either much finer or else poorly preserved, and the surface of the prothorax and elytra is nearly smooth. The head is not visible, presumably covered by the front margin of the prothorax. Length, 3.00 mm. Width, 2.05 mm.

Stations number 14 and 14B. Two specimens, collected by Mrs. W. P. Cockerell. The type is in the Museum of the University of Colorado, the cotype in the American Museum of Natural History.

The reference is based on the form and size of the specimen, and must be considered provisional. The appearance is entirely that of *Orphilus*, with the punctuation slightly developed.

AMARTUS *Lec.*

A. PETREFACTUS n. sp. (Plate II, Figs. 12, 13.) Form a little more elongate than in the recent *A. rufipes* and *A. tinctus*. Head, exclusive of the mandibles, as long as the prothorax but much less broad. Eyes not definable. Antennæ eleven jointed, first joint large and thick, third long, club gradually formed as usual in the tribe Brachypterini. Prothorax distorted but evidently narrowed anteriorly and with rounded sides, about two and two-fifths times as broad as long. Elytra showing only along one edge, not displaying any characters of interest. Abdomen somewhat displaced but showing that the segments near the base are short. Length, 3.85 mm.

Station number 14. One specimen, collector not specified, which is considered the type and is in the Museum of the University of Colorado. Another example, referred here with little doubt, comes from Station number 17 and was collected by Mrs. Cockerell.

This insect goes very well with *Amartus*, which genus is now represented on our Pacific coast. The formation of the antennal club does not permit of its reference to the Carpophilini, to which it has a superficial resemblance. About the only structural character of importance that can be made out on the underside is the shape of the front coxæ which are shown to be transverse and narrowly separated by the prosternum.

Nosotetocus *Scudd.*

N. vespertinus *Scudd.* Station number 14. One specimen, collected by S. A. Rohwer. This shows the upper surface and indicates that the elytra were punctured in rows as suspected by Dr. Scudder.

Dryops *Oliv.*

D. tenuior n. sp. (Plate III, Fig. 4.) Resembles *D. eruptus* from the Florissant shales but is smaller and more slender. Head with microscopic scattered punctuation. Eye small. Prothorax nearly straight in front, sinuate behind, rather broader proportionately than in the recent *D. lithophilus,* front angle produced beneath and partly covering the eye as in that species, surface finely, microscopically, sparsely punctured, a little more coarsely than the head. Scutellum small. Elytra mutilated at the tip, sides subparallel, surface marked with rows of indistinct moderate-sized elongate punctures. Legs long, claw-joints swollen. Length, 4.15 mm.

Station number 14. One paired specimen, collected by Mrs. W. P. Cockerell. The type is in the Museum of the University of Colorado.

This seems to be a good *Dryops* by all the visible characters and in any event is closely related to that genus. The sketch shows the outline and the courses of the elytral rows of punctures as far as they can readily be distinguished.

Lutrochites n. gen.

This name is proposed for a fossil insect of nearly the shape and size of the recent *Lutrochus luteus* and of a similar velutine appearance. It differs in the strongly longitudinally striate head and somewhat in the punctuation as well. It is impossible to be sure of the family affinities, but I have placed it here provisionally. The type is *L. lecontei,* described below.

L. lecontei n. sp. (Plate V, Fig. 4.) Form short and broad. Head with the outline somewhat broken and the exterior margins of the eyes damaged, but these organs were large. The vertex has about thirteen strong and nearly equidistant longitudinal striæ. Prothorax distinctly broader than long, widest at base, sides more or less arcuate to the apex, surface distinctly punctured, the punctures well separated but not distant, a little stronger near the sides. Elytra about two and two-thirds times as long as the median prothoracic line, sides subparallel anteriorly, posteriorly arcuately narrowing to the apices which, separately, are acute, conjointly they were perhaps sharply rounding. The elytral sculpture consists of a fine, confused punctuation, but, like the whole upper surface of the body, the wing covers have a velutine appearance. Length, 2.65 mm. Width, 1.75 mm.

Station number 14. One specimen, collected by Mrs. W. P. Cockerell. The type is in the American Museum of Natural History.

This species has been very troublesome to place. It seems best assigned in the position here given and if it should occur again in collections from these shales will readily be known by the peculiar sculpture.

ANTHAXIA *Esch.*

A. EXHUMATA *Wickh.* Station number 14. A paired specimen in rather poor condition and a little smaller than my type was collected by Geo. N. Rohwer.

MELANOPHILA *Esch.*

M. COCKERELLÆ n. sp. (Plate III, Fig. 5.) Form only moderately elongate, subparallel at sides. Head much broader than long, reticulately sculptured, similarly to the prothorax but a little more finely. Prothorax damaged in front but about one and three-quarters times as broad as long, the apparently undamaged side straight, surface reticulate as in the recent *M. consputa, M. intrusa* or *M. æneola.* Elytra apparently finely scabrously punctate not pointed nor truncate but moderately conjointly rounded at the apex. Legs wanting. Length from front of head to abdominal apex, 10.70 mm.; of elytra, 5.85 mm. Width across middle of elytra, 3.90 mm.

Station number 14. Two specimens, the collector of the type not specified, of the co-type, Mrs. W. P. Cockerell. The type is in the Museum of the University of Colorado, the co-type in the American Museum of Natural History.

This insect resembles (by description) none of the known Florissant Buprestidæ. It is much larger than *Anthaxia exhumata* and much smaller than *Chrysobothris haydeni.* While of about the same size as *C. gahani,* that species must be very differently proportioned, since Professor Cockerell gives the length of the elytra as about 8.00 mm., as against 5.85 mm. in the present insect. Compared with recent forms, it was probably most like *M. intrusa* in general appearance. The generic reference is based on the size, form and sculpture, all of which are matched in recent species of *Melanophila* in my collection. The cotype is slightly smaller than the type, but otherwise does not differ. It shows the large eye with straight inner border common to recent Melanophilæ and particularly noticeable in *M. acuminata* and *M. atropurpurea.*

M. HANDLIRSCHI n. sp. (Plate III, Fig. 6.) Form elongate, subparallel, but broadest behind the middle of the elytra. Head long, surface extremely closely and quite finely punctured, the punctures crowded so much as to have lost, in great part, their circular outline. Eyes moderate in size, long, inner edges straight. Prothorax broader than the head, the posterior edge indistinguishable so that no comparisons can be made with the length, surface reticulately sculptured about as in *M. cockerellæ*. Elytra long, tapering strongly from behind the middle to the apices which are obliquely truncate from the suture and sharply acuminate, sculpture a rather fine confused punctuation tending to form transverse rugosities as in *M. fulvoguttata*. Front and middle femora and middle tibia rather slender, remainder of legs wanting. Length, from front of head to elytral apices, 14.25 mm.; of elytron, 9.25 mm. Greatest width across both elytra in position as preserved, 5.50 mm.

Station number 13B. One fine paired specimen, collected by S. A. Rohwer. The type is in the American Museum of Natural History.

This seems to be a good *Melanophila*. It is so different in the form of the body and of the elytral apices as to separate at sight from *M. cockerellæ*. The size will distinguish it from all the other known Florissant Buprestidæ except *Chrysobothris haydeni*, which is described by Scudder as having rounded eyes and broad-tipped, impunctate elytra.

I name this species for Dr. Anton Handlirsch of Vienna, Austria.

Acmæodera *Esch.*

A. schaefferi n. sp. (Plate III, Fig. 7.) Form moderately elongate. Head not distinctly separable from the prothorax, the latter broadest near the base, finely scabrous and hairy. Elytron strongly sinuate externally and sharply pointed at the tip, surface scabrous and hairy, apparently a little more coarsely than the prothorax. Legs wanting. Length, from front of head to elytral apex, 8.00 mm.; of elytron, 5.90 mm. Width of elytron at the postmedian bulge, 1.30 mm.

Station number 14. One specimen, collected by Mrs. W. P. Cockerell. The type is in the Museum of the University of Colorado.

This is well preserved as to the left elytron and has the characteristic look of an *Acmæodera*. It differs from all of our species with which I am acquainted in the finer sculpture and the lack of serrations near the elytral apex. It may be that this species and *A. abyssa* are congeneric but not strictly referable to the genus in which I have placed them.

The beetle is named after Chas. Schaeffer, of the Museum of the Brooklyn Institute.

A. ABYSSA n. sp. (Plate IV, Fig. 2.) Form rather stout. Head and prothorax not showing any details of sculpture other than a fine scabrosity. But one elytron remains entire, which is strongly sinuate externally and blunt at the tip, the surface scabrous, probably from the sculpture showing through. Legs wanting. Length, from front of head to tip of abdomen, 7.75 mm.; of elytron, 5.50 mm. Width of elytron at postmedian bulge, 1.25 mm.

Station number 17. One specimen, collector not specified. The type is in the Museum of the University of Colorado.

The specimen lies on its back, so as to present a ventral view. It differs from *A. schaefferi* in the shape of the elytron and in the generally stouter form, and I think is undoubtedly distinct. The front of the prosternum shows at the middle and is rather faintly arcuately prominent. On account of distortion, I have not attempted to describe the thoracic outline.

PYROPYGA *Motsch.*

P. PRIMA n. sp. (Plate V, Fig. 3.) Form about like that of the recent *P. decipiens*, the prothorax covering the head in a similar manner but the upper cephalic outline shows through the expanded front margin of the pronotum. Antennæ and eyes not definable, elytra about two and one-half times the length of the prothorax. Sculpture of entire upper surface obscure. Abdomen banded as shown in the figure. Length, from front margin of prothorax to the abdominal tip, 5.60 mm.; of elytra, 3.60 mm.

Station number 14. One speçimen, collected by Mrs. W. P. Cockerell. The type is in the Museum of the University of Colorado.

This looks like the recent species of *Pyropyga* and I have no doubt that it belongs in the near vicinity of the genus.

EUDASYTITES n. gen.

This name is proposed to accommodate a species belonging to the Malachidæ and probably to the tribe Dasytini. Lacking antennæ and legs, a closer determination cannot be made at present. The genus may be considered a magazine for the reception of the type, *E. listriformis*, described below, and such other fossil forms of the same general nature as show affinities too obscure to be made out with certainty. It should be made up of fossil Dasytini of a slender build and coarse sculpture, with vestiture inconspicuous or wanting.

E. LISTRIFORMIS n. sp. (Plate II, Fig. 14.) Form elongate, probably subparallel in life but by pressure the elytra are spread and the abdomen is distended. Head small, rather narrow. Antennæ wanting. Eyes not definable. Prothorax nearly twice as wide as long, somewhat distorted so that one side is about straight while the other is arcuate. Elytra broken at tip but showing a good part of their surface which is strongly sculptured with moderately large subconfluent punctures tending to form transverse rugæ. Abdomen with six visible segments, nearly smooth, sternal thoracic pieces finely and sparsely punctured, a little more coarsely and closely on the prothoracic flanks. Length, 3.50 mm.

Station number 14. One specimen, collected by S. A. Rohwer. The type is in the American Museum of Natural History.

There seems to be no reason for doubt as to the family affinities of this beetle, but students of the Malachidæ will know the difficulty of closer classification in the absence of all appendages.

Trichochrous *Motsch.*

T. miocenus n. sp. (Plate V, Fig. 5.) Form rather elongate. Head and prothorax much distorted and with the sculpture obliterated. Elytra covered somewhat sparsely with slender short hairs and with well defined regular series of longer stouter hairs, which, in their prostrate fossil condition, give the appearance of striation, as shown in the figure. Length, 5.00 mm. Width, 2.65 mm.

Station number 17. One specimen, collected by Mrs. W. P. Cockerell. The type is in the Museum of the University of Colorado.

The vestiture of this beetle is arranged about as in the recent *T. seriellus*, common in Wyoming and Utah.

Protapate n. gen.

Related to *Apatides* Casey, but differs in the eyes being relatively much larger when viewed from above, the intervening separating space being only about equal to the transverse ocular diameter. Prothorax apparently without recurved hooked processes and differently sculptured, as will be seen from the following description of the typical and only known species.

P. contorta n. sp. (Plate II, Fig. 15.) Preserved in dorsal view, the elytra somewhat twisted and partially overlapping, the prothorax also distorted. The specimen is a reverse, but I describe the markings as shown thereon, adding the interpretation at the close of the diagnosis. Head transversely quadrate, eyes transversely elliptical, relatively large, separated by about one long diameter. Front finely granulate, vertex finely longitudinally rugose for its entire width. Prothorax distorted, but longer than high (or broad, it is not possible to tell from the condition of the specimen whether we see the entire disk, but I believe it is in part profile), closely, strongly, and rather regularly granulate, the granules rounded, replaced on an area occupying the anterior dorsal portion by a considerable group of deep, large punctures disposed in about five diagonal series.

Elytra obtuse at tip, other details of outline not definable, ornamented with granules similar to those of the prothorax, arranged in about fifteen fairly well-defined series, which, however, become confused near the apex. These granules are separated in the series by much less than their own diameters, but the interserial spaces are a little wider as a rule. Femora moderate, the remaining parts of the legs wanting. Length, 14.50 mm.; of head, 2.25 mm.; of prothorax, near upper margin, 4.75 mm.; of elytron, 8.85 mm. Width of head, 3.25 mm.; of flattened elytron, near middle, 3.50 mm. Height of prothorax, 3.75 mm.

Florissant, Colorado, collected by Mrs. C. Hill. The holotype is in the Peabody Museum of Yale University.

Since the specimen is a reverse, the granules, of course, represent punctures, and vice versa. We have indicated, then, an insect of about the size of the recent *Apatides fortis* Lec., the anterior margin of the prothorax similarly strongly, sharply asperate, the head rugose in like manner and the elytra deeply, strongly, seriately punctured in the same way, the little mammillæ seen at the bottom of some of these punctures being represented in the fossil by small pits at the apices of the granules. But in *P. contorta* the principal discal prothoracic area, with most of the sides and posterior portions, are strongly punctate instead of being granulate or asperate, reproducing on a larger scale and with some difference of detail the sculpture of those parts in *Micrapate dinoderoides*. What little can be seen of the legs, agrees with the corresponding structures in *A. fortis*. While the generic characters set forth are not in themselves of any great importance, it is probable that the insect was not a true *Apatides*, and it has seemed better to separate it.

XYLOBIOPS *Casey*.

X. LACUSTRE n. sp. (Plate V, Fig. 6.) Form moderately elongate. Head long, eyes and antennæ not definable. Prothorax projecting over the head, the front margin somewhat produced, surface roughened, anterior declivity with about four transverse rows of asperities. Elytra declivous and pointed at apex, a moderate sized sharp tooth near the top of the declivity, disk punctate with close rows of circular somewhat approximate punctures. Legs wanting. Length from front of prothoracic margin to elytral tip, 5.35 mm.

Station number 14. One specimen, collected by S. A. Rohwer. The type is in the American Museum of Natural History.

There seems no reason to doubt that this insect is properly placed, although the prothoracic margin is a little more produced anteriorly and the transverse rows of asperities are more regular than in our recent species of *Xylobiops*. In the characters noted, our insect comes nearer to *Dinoderus*, and this would be the alternate reference. It looks like a *Dinoderus* with the elytra of a *Xylobiops*. The genera are fairly closely related.

ATÆNIUS *Harold*.

A. PATESCENS *Scudd.* (Plate VI, Figs. 4, 5.) A specimen of an Aphodiide agreeing with this species in size and what can be seen of the sculpture, exhibits the tarsal and tibial structures of the middle and hind legs very well. The opportunity of figuring the distal parts of these legs seems worth improving and drawings to show the tibial spurs and the proportions of the tarsal joints are offered herewith.

APHODIUS *Illiger*.

A. ABORIGINALIS n. sp. (Plate VI, Fig. 1.) Form stout, somewhat as in the recent *A. fimetarius* but probably a little shorter. Head and prothorax distorted, practically impunctate but the head is granulate or scabrous on the clypeal region. Scutellum short. Elytra with moderately strong and rather wide striæ which are fairly distinctly and closely but not strongly punctate. Length to tip of elytra which are broken at the apices, 5.75 mm.; when complete, probably 6.50 mm.

Station number 17. One paired specimen, collected by Mrs. W. P. Cockerell. The type is in the Museum of the University of Colorado.

This is readily known from all the other Florissant species, except *A. laminicola* which is nearly half as large again, by its greater size and wider striæ, in conjunction with the almost complete lack of cephalic and thoracic sculpture.

A. RESTRUCTUS n. sp. (Plate VI, Fig. 2.) Form similar to that of the recent *A. granarius*, as far as can be determined in the condition of the specimen. Clypeus damaged anteriorly so that the shape of the front margin is not determinable with certainty, the surface with shallow punctures but probably not rugose. Top of head with a few scattered small punctures. Prothorax narrowed anteriorly but the sides are too much distorted to describe, the disk very sparsely and finely punctured along the middle, somewhat more closely and coarsely towards the sides but without any tendency to a transverse arrangement. Scutellum short. Elytra finely, sharply, and not very deeply striate, the striæ impunctate. Length, 3.50 mm.

Station number and collector are not cited, but the specimen was taken by one of the parties under the direction of Professor Cockerell. The type is in the Museum of the University of Colorado.

This is smaller than *Atænius patescens* and has a different punctuation. The simple elytral striæ, with the size, will separate it immediately from *Aphodius florissantensis* and the impunctate elytra will differentiate it from *A. granarioides*. I have placed with the type, a second specimen collected at Station 17B by Mrs. W. P. Cockerell.

A. SHOSHONIS n. sp. (Plate VI, Fig. 3.) Form stout, nearly parallel sided. Head short, clypeus broadly rounded anteriorly, without emargination. Prothorax about one and three-fifths times as broad as long, sides subparallel from the base to beyond the middle, thence arcuate to the apex. Front angles obtuse but well defined, hind angles obtuse and not prominent. Scutellum moderate. Elytra, separately, nearly twice as long as wide, with strong, fine, sharp striæ, which seem to be impunctate. Legs not in very good preservation, the armature of the front tibiæ being indefinite and all the spurs gone except those of the hind leg which seem to be slender and equal. The hind tibia and tarsus are fairly well shown and are quite slender. Length, 2.95 mm.

Station number 17. Collector not specified, but the insect was secured by one of the parties under direction of Professor Cockerell. The type is in the Museum of the University of Colorado.

I place this insect in *Aphodius* and feel sure that it belongs in that genus in its broad sense at any rate. The clypeus is of a type uncommon in *Aphodius* proper, but resembles that of some species of *Ægidia*. The legs, however, seem too slender to permit of association with this latter genus. I have not attempted to describe the sculpture of the head and prothorax, since the specimen is too thoroughly carbonized to permit this character to be made out.

A. LAMINICOLA *Wickh.* Station number 14. A good specimen was collected here by Mrs. W. P. Cockerell. It offers no characters additional to those given elsewhere.

SERICA *Mac Leay.*

S. ANTEDILUVIANA n. sp. (Plate VI, Fig. 6.) Form, viewed in profile, only moderately stout for this genus. Head fairly large. Prothorax short, about one and a half times as high as long, no definite sculpture visible on either of these parts. Elytra nearly smooth but with some evidence of the presence of shallow striæ. Abdomen finely alutaceous. Legs stout, fore tibia with three well marked teeth, the upper one the weakest. Hind tarsi long. Length, 6.10 mm.

Station number 14. One paired specimen collected by Mrs. W. P. Cockerell; another single example from the same source is referred here with some doubt. The type is in the Museum of the University of Colorado.

The above short description sets forth the principal characters, as far as they can be made out, of a beetle which I think may be well placed with *Serica*. However, all of our native species of *Serica*, so far as I know them, have but two teeth on the fore tibiæ; the fossil agrees more closely with the allied genus *Diazus* in having three. The body form is more like that of *Serica*, and I prefer to so place the specimen. The present species is smaller than the average in the genus, but is of almost exactly the same size as the recent *S. trociformis*, and is also closely approximated in this respect by a new form in my collection, from Buena Vista, Colorado.

Macrodactylus *Latr.*

M. PLUTO n. sp. (Plate VI, Figs. 7, 8.) Preserved in dorsal view and showing parts of the middle and hind legs, the front legs and antennæ lacking. Head, across the eyes, a little broader than long, closely and roughly punctured over nearly the entire surface, the vertex more finely, a narrow occipital space about smooth, clypeus truncate and barely emarginate in front. Prothorax more finely and sparsely punctate than the head, narrowed at base and apex, strongly angulate about the middle. Elytra broader in front of the middle, not covering the tip of the abdomen, with faint indications of longitudinal striæ and apparently finely punctured as well. Tibiæ (middle and hind) about straight, broader at tip, posterior tarsi long, the first joint about twice the length of the tibial spurs. Length, total, about 12 mm.; of head, 2.00 mm.; of prothorax, 2.85 mm.; of elytron, 6.75 mm.; of hind tibia, 3.00 mm.; of hind tarsus, about 4.50 mm. Width of head, 2.65 mm.; of prothorax, 4.10 mm.; of one elytron, 2.85 mm.

Station number 13. One specimen, with reverse, collected by Walter Reed, while a member of the expedition to Florissant, under the leadership of Professor Cockerell, in March, 1911. The type is in the Museum of the University of Colorado.

The generic reference is made on the strength of the shape of the prothorax, the sculpture of the head and body, the small eyes, and the long tarsi. In the broad pronotum, this specimen resembles some of the Mexican species, but this part must undoubtedly have been flattened and spread out by pressure. A shred of some foreign matter lying along the end of the right hind tibia bears a deceptive resemblance to an extremely elongate spur, but I believe the structure to be properly described above. Additional specimens of the insect have since been found in the collection of the United States National Museum, one of them displaying the left antenna. This organ is figured, and will be seen to differ in no important respect from the recent forms, as far as can be made out from the rather indistinctly shown articulations. This is the only fossil Scarabæid thus far known to me in which the antenna can be seen.

M. PROPHETICUS n. sp. Form generally similar to that of *M. pluto*, but a little more elongate. It is a considerably larger species with a relatively smaller prothorax, widest about the middle, sides not at all angulate but curving almost regularly to the apex and base which are subequal. The elytra can barely be made out through the overlying abdomen (the specimen being preserved in ventral view) which they do not cover, nearly the whole of two segments being exposed beyond their apices. Middle and hind legs spiny or with stout hairs. Length, 18.35 mm.; of head, 1.35 mm.; of prothorax, 3.40 mm.; of hind femur, about 4.35 mm.; of hind tibia, the same; of hind tarsus including the claws, 6.75 mm. Width of prothorax, 4.75 mm.; across elytra, about 7.25 mm.

Station number 14. Collector not specified. The type specimen comes directly from Professor Cockerell, with the collection number 168, and is in the Museum of the University of Colorado.

I see no reason for doubting that this is congeneric with *M. pluto*, which it sufficiently resembles to obviate the need of a figure. The two species differ in size and in the shape of the prothorax. The sculpture does not show in *M. propheticus*, but it was probably fine or it would be likely to leave some imprint on the stone.

DIPLOTAXIS *Kirby.*

D.(?) SIMPLICIPES n. sp. (Plate VI, Fig. 9.) Form moderately robust. Head short, anterior outline nearly semicircular. Eye small. Prothorax about twice as broad as long (measured along the median line) sides strongly and regularly arcuate. Elytra about three and three-fourths times as long as the prothorax (the latter measured as before) with the striæ of fine but not at all closely placed punctures, these striæ becoming confluent towards the apex as shown in the figure. Legs short, the front one, as drawn, not entirely free from the matrix so as to appear smaller than it really is, the middle and hind tibiæ roughened about as in *Diplotaxis*, but not ridged. Length, about 10.25 mm.; of elytron, 7.25 mm.; of middle tibia, 1.75 mm.; of middle femur, 1.80 mm. Width of prothorax about 3.70 mm.

Station number 13B. One specimen, received directly from Professor Cockerell. The type is in the Museum of the University of Colorado.

The specimen shows the underside, as far as the trunk is concerned, but the elytron is twisted so as to exhibit the upper surface. In the drawing, the punctures are a little too close together, but answer the purpose intended, in showing the courses of the striæ.

D. AURORA *Wickh.* Station number 13. One paired specimen of a wing cover in rather imperfect condition, was collected by Professor Cockerell. A prothorax, with the front legs still attached, was taken at Station 17 by Geo. N. Rohwer, and may represent the same species.

LEPTURA *Serv.*

L. PETRORUM n. sp. (Plate VIII, Fig. 2.) Form rather elongate but the outlines of the body are partly obscured by the spread wings. Head long, muzzle produced, eyes not defined, sculpture obliterated. Antennæ long and slender, the apices wanting but in their completeness they must have reached nearly to the elytral tips. Prothorax, in side view, strongly tapering to the apex, arched above and below, the sculpture indistinct but there is some evidence of irregular punctuation. Elytron very strongly tapering to the tip, which is excavate and pointed on one side. Legs moderately slender. Length from front of head to elytral apex, 11.85 mm.; of elytron, 9.65 mm. Height of prothorax at base, 3.00 mm.

Station number 14. One specimen collected by Mrs. W. P. Cockerell. The type is in the Museum of the University of Colorado.

The generic reference is to be understood in the broad sense, since the recent genera of Lepturæ separate upon characters which would only exceptionally be visible in fossils. The present species is easily separable from *L. ponderosissima* by its different build and from *L. antecurrens* by having much longer antennæ and sharp elytral tips. I have given the two names last mentioned to Florissant fossils belonging to the collection of the United States National Museum, and while they will presumably appear in print shortly they are as yet unpublished.

DONACIA *Fabr.*

D. PRIMÆVA n. sp. (Plate IV, Fig. 3.) Form rather slender. Head wanting. Prothorax crushed and distorted, the visible sculpture consisting of feathery or dendritic lines which I believe to be adventitious. Elytra tapering and not truncate at tip, marked with moderate sized punctures in striæ, the striæ showing evidences of extensive confluence at their tips, as in recent Donaciæ. Scutellar stria strong and moderately long. The strial punctures are finer towards the elytral apices, distinctly but not strongly elongate and separated in each stria by spaces about equal to their own long diameters. In some parts they are a little closer together. Legs of moderate length, the fore and hind femora (the middle ones being wanting) moderately swollen but without signs of dentation, front tarsus not palmate. Length of fragment, from apex of prothorax to that of the elytra 8.00 mm.; of elytron, 6.30 mm.

Station number 14. One paired specimen, collected by S. A. Rohwer. The type is in the American Museum of Natural History.

My idea of this *Donacia* is that it was of the general type of the recent *D. emarginata,* that is to say a form of moderate specialization as compared with the broad, flat, long-legged *proxima* on one side and the convex, short-legged *rufa* on the other. I think there can be no doubt as to the correctness of the generic reference. The front femur, described above, shows on only one stone and is not figured in the drawing which is made from the other slab.

Crioceridea n. gen.

This name is proposed for a Chrysomelid of doubtful affinities, apparently related in build to *Crioceris*, but differing in several points, especially in the finer sculpture and in the longer second antennal joint. It differs from *Lema* in the same features and also in having a distinct scutellar stria, sharing this last character with *Crioceris*.

C. dubia n. sp. (Plate V, Figs. 7, 8.) Form hardly elongate. Head a little shorter than the prothorax and without visible sculpture. Eye large, circular. Antennæ rather elongate, the two of apparently different thickness, probably on account of one showing on the flat, the other on the edge. In the wider one the breadth is about as in the recent *Crioceris asparagi* (or a little less) the joints beyond the middle are shortened in the same way. Prothorax distinctly broader than long, not sculptured. Elytra a little more than three times the length of the prothoracic median line, conjointly much wider than the prothorax, apices rounded, sculpture of lines of fine, well-separated punctures which fade out posteriorly except at the sides. The courses of some of these lines are indicated on the figure, but as the markings are not preserved over the whole disk the drawing shows them in fragmentary condition. Legs wanting, except one belonging to the front or middle pair which is rather slender. Length to elytral tip, 5.50 mm.

Station number 17. One specimen, collected by Geo. N. Rohwer. The type is in the Museum of the University of Colorado.

This insect looks very much like *Lema evanescens* but is more finely punctured and has a distinct scutellar stria.

METACHROMA *Lec.*

M. FLORISSANTENSIS n. sp. (Plate V, Fig. 9.) Form moderately elongate, probably about as in the recent *M. californicum.* Head and prothorax very poorly preserved, not showing the sculpture nor fully maintaining the original shape. Antennæ long and slender, reaching to near the middle of the elytra. Elytra somewhat overlapping along the suture but not sufficiently to seriously obscure the punctuation which is rather fine and arranged in nearly regular striæ, fading towards the apex as in recent species of this genus. Length from front of prothorax, as preserved, to abdominal apex, 5.25 mm. In life, with the head normally extended, it probably reached a length of about 1 mm. more.

Station number 13B. One specimen, collector not specified. The type was received directly from Professor Cockerell and is in the Museum of the University of Colorado.

There is little doubt in my mind as to the correctness of the identification. The first stria, outside of the scutellar, has been partly obliterated by the overlap, otherwise the sculpture is strikingly like that of *M. californicum.*

BRUCHUS *Linn.*

B. HENSHAWI n. sp. (Plate VII, Figs. 1, 14.) Form moderately robust but less so than in *B. dormescens.* Head of normal size, finely and closely punctured, somewhat more coarsely on the front. Eye a little smaller than in most of the recent species with which I am acquainted. Antenna reaching about to the prothoracic hind angle, incrassate towards the tip but not strongly nor rapidly, the joints not serrate so that the outline is nearly even. Prothorax rather finely punctured, the punctures circular, larger than those of the head, rather distant except near the sides where they are considerably closer together. Hind angles rounded, median lobe not well marked. Elytra overlapping somewhat so that the exact shape is doubtful, but each seems to have been marked with nine striæ, the outer stria incurved at the humerus. The striæ are not deep but are strongly uniseriately punctate, the punctures rounded and rather closely approximate though not confluent, wider than the striæ, as shown in the detail figure, interspaces broad, flat, strongly and rather closely obliquely rugose. Abdomen poorly preserved, the sculpture not definable. Hind leg, the only one visible, showing a moderate post-median femoral tooth, tibia slightly curved and apparently carinate. Length, 4.15 mm.

Station number 14. A single specimen, collector not specified. The type is in the American Museum of Natural History.

Easily distinguished from all of the other known Florissant Bruchidæ, except *Bruchus dormescens,* by the form, and from that species by having simple antennæ, those of *B. dormescens* being strongly pectinate. In punctuation, it is different from any of the others. The specimen is in reverse, so that the punctures and striæ above described appear as granules and ridges.

Named for Dr. Samuel Henshaw of Cambridge, Massachusetts.

B. EXHUMATUS n. sp. (Plate VII, Figs. 2, 10.) Preserved as a reverse, in dorsal view, lacking the legs, front of the head and antennæ, but in good condition as concerns the elytral sculpture and structure. Eyes large, separated by less than their own width, emarginate anteriorly, the space between them apparently finely alutaceous but without well defined punctuation. Prothorax short, broader behind, the more perfect side about straight near the hind angle but broadly and regularly arcuate anteriorly, front margin slightly projecting at middle, hind margin with fairly well defined lobe, which, however, is split in the center so as to obscure the exact shape, the entire thoracic surface alutaceous like the head and in addition with low scattered granulations which represent shallow punctures. Elytra subparallel but broadest near the humeri, broadly separately rounded at apices, each with ten fine sharp subequidistant carinæ (representing striæ), these carinæ somewhat catenate as if the striæ had been marked with elongate but not very well defined punctures. The fourth and fifth striæ are shorter than the others, much as in the recent *B. discoideus*, which, however, was not resembled in form nor in general sculptural characters. Interspaces flat and finely alutaceous. Tip of abdomen wanting, probably owing to an imperfection in the stone. Length, from front of eyes to tip of elytra, 4.35 mm.; of prothorax, 1.10 mm.; of elytron, 2.90 mm. Width of prothorax, 1.50 mm.; of one elytron, behind humerus, 1.30 mm.

Florissant, Colorado, March, 1911, collected by Professor Cockerell. The type and only known specimen is in the Museum of the University of Colorado.

Aside from the characters given in the foregoing diagnosis, it may be noted that a pronotal carina on the fossil indicates that this part was marked with a distinct median groove in the living insect. The scutellum is not defined. In form, *B. exhumatus* probably approached the recent *B. protractus* Horn, from the southwestern states. It was a considerably smaller insect than Scudder's *Spermophagus vivificatus* from the Florissant shales, and if his figure is correct the elytra are differently striate. A specimen in the collection of the United States National Museum shows the antennæ nicely, and indicates that these organs were weakly serrate as in most of the recent North American species. This has furnished the basis for the figure given.

B. BOWDITCHI n. sp. (Plate VII, Figs. 6, 13.) Form elongate, similar to that of *B. exhumatus* from these shales. Head moderately large, sculpture indistinct but apparently of moderate sized circular closely placed shallow punctures. Eyes rather small. Antenna more slender than usual in this genus, the apical joints wanting, the median ones about equal in length and breadth, subserrate. Prothorax about three-fifths as long as wide, broadest behind the middle, tapering with nearly straight sides to the apex which is much narrower than the base, all the angles rounded or indistinct, surface with shallow but distinct close-set circular punctures which are more crowded at the sides, no sign of median groove or carina. Elytra long, about three times the length of the prothorax, finely striato-punctate, the punctures elliptical, moderately strong, wider than the striæ, those of each series separated by less than their own long diameters, as a rule, though in places they are more widely spaced. Both striæ and punctures are stronger near the elytral bases, becoming so weak near the apices that I have not been able to trace them with certainty in that region. Legs wanting. Length, about 6.00 mm.

Station number 17. One specimen collected by S. A. Rohwer. The type is in the Museum of the University of Colorado.

This is most like *B. exhumatus* but is distinguishable from it by the more slender antennæ and the stronger punctuation.

Named for Fred C. Bowditch of Brookline, Massachusetts.

B. FLORISSANTENSIS n. sp. (Plate VII, Fig. 3.) Form only moderately elongate, less so than in *B. bowditchi*, from which species it is separated chiefly by the body proportions. Head finely sculptured with small circular shallow closely placed punctures. Eye large. Antenna rather long and slender, similar to *B. bowditchi.* Prothorax with shallow but distinct small circular punctures (but considerably larger than those of the head) moderately closely placed on the disk, more crowded at the sides and much sparser on the prothoracic flanks. Elytra distinctly less than three times the length of the prothorax, surface with fine sharp striæ with elongate rather strong punctures separated in each series by a little less than their own long diameters. The striæ and punctures become weaker towards the tip, as in *B. bowditchi*, so that I have not attempted to figure their terminations. Hind femora large and swollen, tibiæ strongly arcuate. Length, 4.00 mm.

Station number 13. One paired specimen, in side view, collected by S. A. Rohwer. The type is in the Museum of the University of Colorado.

Resembles *B. bowditchi* very closely and I only separate it on account of the relatively much shorter elytra, although the punctuation, especially on the prothorax, is distinctly stronger. The femoral region is not sufficiently well defined to enable me to be sure of the absence of a tooth, but none can be made out.

I might have referred either this species or *B. bowditchi* to *Spermophagus vivificatus* Scudd., if it were not for the description of the antennæ in the last named species, where the joints beyond the fourth are said to be much longer than broad, and are so represented in the figure. In the two species of *Bruchus* the elytra are longer, in proportion to the prothorax, than in the figure of the *Spermophagus*.

B. SCUDDERI n. sp. (Plate VII, Figs. 7, 8, 11.) Form moderately elongate and more parallel than usual. Head mutilated, but showing signs of very shallow inconspicuous punctuation. Antenna exhibiting the seven proximal joints which are rather strongly serrate, the second joint shorter than the third, the fourth and fifth successively a little longer. The width of all the visible joints is nearly the same, and is about equal to the length of the fourth. The prothorax is distorted to such an extent that I do not care to describe the shape, but it seems to have had no distinct basal lobe and the apex is truncate. The punctuation (relatively to the other fossil Bruchids of Florissant) is strong and moderately coarse, the punctures circular and closely crowded or even occasionally subconfluent towards the sides, more widely spaced and finer along the middle, so as to give the effect of a nearly smooth median line when viewed under a low power. Elytra nearly three times as long as the prothorax, the striæ deep but narrow, with nearly rounded or slightly elongate punctures which are separated by about their transverse diameters. Under surface distinctly and rather strongly punctate over the entire thoracic region, the abdomen much more finely. Hind femur swollen but not visibly toothed, the tibia rather strongly curved and carinate, or possibly bicarinate. Length, 3.90 mm.

Station number 14. One paired specimen, collected by S. A. Rohwer. The type is in the Museum of the University of Colorado.

Easily recognized, among the Florissant forms, by the elongate elytra with strong, sharp, rather finely punctate striæ, the moderately strongly serrate antennæ, and the strong prothoracic punctuation.

It is named for the late Dr. Samuel Hubbard Scudder.

B. HAYWARDI n. sp. (Plate VII, Figs. 4, 5, 12.) Form only moderately elongate. Head weakly, finely and sparsely punctured, the punctuation visible only under high power. Eyes not definable. Antennæ long, the joints scarcely subserrate, those beyond the fourth distinctly longer than broad, the whole antenna very slender for the genus. Prothorax broad just in front of the base, sides narrowing rapidly to the apex which is truncate, basal lobe rather strong. Pronotal disk with small irregular scattered rather weak punctures, circular or slightly elongate, finer towards the sides, no evidence of median line. Elytra about two and a half times as long as the prothorax, tips rounded and not covering the abdomen, each with ten fine, sharp, scarcely visibly punctate striæ, the punctures longitudinal. Middle coxæ closely approximate, hind coxæ more widely separated, intercoxal process triangular. Middle femur rather slender, hind femora strongly swollen but not visibly toothed, their tibiæ arcuate and carinate. Length, 4.65 mm.

Represented by three specimens, one paired and considered as the type from Station number 14, collected by Geo. N. Rohwer; one dorsal view (single) from Station number 17, collected by Mrs. Cockerell; and one single (side view) from the same source. The description and all the figures are made from the type, which is in the Museum of the University of Colorado.

It is easily distinguished from all of the other Florissant species of *Bruchus,* except *B. osborni,* by the slender antennæ and fine sculpture, and from that insect by the truncate thoracic apex, stronger punctuation and more pronounced basal lobe.

The species is named after the late Roland Hayward of Milton, Massachusetts.

B. OSBORNI n. sp. (Plate VII, Fig. 9.) Form moderately elongate. Head not visible, covered by the thorax. Antennæ long and slender, the joints beyond the second much longer than broad. Prothorax rounded at base and apex but without a strong basal lobe, surface with extremely fine and widely spaced punctures, which, however, are fairly deep. Scutellum rather large for this genus. Elytra about two and one-half times as long as the prothorax, finely, sharply striate, the strial punctures scarcely visible except at the base where they are very fine, slightly elongate and close together. The interspaces are flat and show a well marked longitudinal aciculation, probably due to the impress of a coating of hairs. Legs wanting. Length, from front of prothorax to the tip of the elytra, 4.45 mm.

Station number 17. Collected by Mrs. W. P. Cockerell. The type is in the Museum of the University of Colorado.

Represented by a single specimen in beautiful condition as regards the characters of the upper surface. It is sufficiently differentiated from all of the other Florissant species by the shape and punctuation of the prothorax. The nearest ally seems to be *B. haywardi,* and the description of that insect should be consulted for additional differential features. The antennæ are represented as slightly too slender in the drawing.

Named for Dr. Henry Fairfield Osborn.

PLATYDEMA *Lap.*

P. ANTIQUORUM n. sp. (Plate IV, Fig. 4.) Form moderately robust. Head much narrower than the prothorax, distinctly broader than long.

Eyes transverse, moderate in size. Antennæ slightly incrassate towards the tips, eleven-jointed, first joint rather large, second small, third a little longer than the fourth, the remaining joints more distinctly broadened, forming the club. Prothorax arcuately emarginate anteriorly, basal margin sinuate, sides arcuately tapering to apex but somewhat imperfectly preserved. As near as can be judged from the condition of the specimen the pronotum was about two and one-fourth times as wide as long. Elytra about three times as long as the prothorax and rather broad, overlapping along the suture in the specimen so that their conjoint width is not properly shown. In places there are signs of striæ marked with rows of very fine punctures as shown in the figure. Legs wanting. Length, 8.00 mm. Width across both elytra, 4.35 mm.

Station number 17. One paired specimen, collector not specified. The type is in the Museum of the University of Colorado.

This insect must have been much like our recent *P. ruficorne* in build and probably had a similar but finer sculpture. The antennæ are comparatively somewhat broader at base in the fossil and the third joint is less distinctly elongate, but neither of these characters have more than specific value. The genus is well represented in the United States and Central America by species of varying form, size and color. One other, *P. bethunei*, is known from the Florissant shales, and is readily distinguished from *P. antiquorum* by being much larger and of more elongate form.

Mordellistena *Costa*.

M. florissantensis n. sp. (Plate II, Fig. 16.) Preserved in profile. Head large. Prothorax as long as high, the dorsum slightly arched. Elytra two and a half times as long as the prothorax and nearly four times as long as wide, scarcely tapering to the tips which are blunt and rounded. Abdomen, as preserved, projecting far beyond the elytral apices, the extreme end pointed but without a distinct style. Length from front of head to apex of abdomen, 3.35 mm.

Station number 13. Collected by S. A. Rohwer. The type and only known specimen is in the Museum of the University of Colorado.

Easily distinguished from *Mordella lapidicola*, the only Florissant species of the family yet described, by the much smaller size of the present insect. I place it in *Mordellistena,* rather than in *Mordella*, partly because of its minuteness, since the tibiæ and tarsi are not well enough preserved for the exact demonstration of the oblique ridges characterizing the former genus, in case of their existence. There seems, however, to be two short ridges on the face of the first joint of the hind tarsus. The entire body and the elytra show traces of fine hairs like those of recent species of Mordellidæ.

Nemognatha *Illiger.*

N. exsecta n. sp. (Plate V, Fig. 10.) Preserved in part profile. Form rather slender. Head moderate in size, hind angles pronounced, but rounded, surface finely punctulate, eye of normal size, elliptical in outline, antennæ long, only the median or ultramedian joints preserved, these distinctly longer than wide. Maxillary processes longer than the head and prothorax together. Prothorax tapering a little anteriorly, the surface moderately coarsely cribrately punctured. Elytral punctuation shallow. Middle leg slender, the others wanting. Length, 7.00 mm.

Station number 14. One paired specimen, collected by Mrs. W. P. Cockerell. The type is in the Museum of the University of Colorado.

Only one Meloide, *Gnathium œtatis,* has thus far been described from the Florissant shales. It is a little smaller than *N. exsecta* and has the prothorax sculptured only with very faint transverse rugæ. The present species had a thoracic punctuation similar to that of our recent *N. vittigera* or *N. cribricollis.* In addition to the type, cited above, a second specimen, from Station number 13B, collected by Geo. N. Rohwer, has been met with in the material received directly from Professor Cockerell. This does not show the sculpture as well as the type, and exhibits only the bases of the maxillary processes, but is assigned here without much doubt.

Docirhynchus *Scudd.*

D. ibis n. sp. (Plate VIII, Fig. 1.) Form similar to that of *D. culex* from the Florissant shales. Head small and rather deeply sunken in the prothorax. Eye transversely elliptical. Genal and gular regions with about eight equidistant striæ visible in side view. Beak very long, a little curved, scarcely tapering and not dilated at the apex, a strong lateral stria or carina extending nearly the whole length. Antennæ not well enough preserved to show the jointing in sufficient detail for description, but they are inserted near the middle of the beak and have a slender, three jointed club. Neither the head nor beak show more than a very faint punctuation under the magnification of six or eight diameters. Prothorax about four-fifths as long as high, subtriangular in profile, dorsal line regularly and rather strongly arched, surface finely, sparsely punctured, and with a coarser transverse verrucose sculpture in addition. Elytra incomplete at apex, but more than twice as long as the prothorax, with longitudinal rows of circular punctures, not very regularly spaced but those of each series are ordinarily separated by about their own diameters or less. Legs long, hairy, femora not toothed, the appearance of a denticle on the front femur being due to an imperfection of the margin. Tarsi short, the front joint of the hind ones nearly as long as the remaining three. Abdomen and thoracic sternites nearly smooth, pygidium exposed. Length from front of head to abdominal apex, 7.00 mm.; of beak, 6.75 mm.

Station number not specified. One specimen, collected by Geo. N. Rohwer. The type is in the Museum of the University of Colorado.

This insect forms part of a sending received directly from Professor Cockerell. It is undoubtedly a *Docirhynchus* and is nearest *D. culex,* but is about two-thirds as long again and has a rostrum of relatively greater length. It is like nothing else from the Florissant shales and is interesting as adding another species to the already large number of Rhynchitidæ from that region.

Pachybaris *Lec.*

P. rudis n. sp. (Plate II, Fig. 17.) Preserved as a reverse, in profile. Form short, stout, the dorsal outline more convex than in the recent *P. porosus.* Head with fine granules irregularly disposed above the eye but on the beak arranged in longitudinal series with rather distinct intervening carinæ. Eye distorted, squarish, in life probably nearly round. Antennæ wanting. Prothorax short, closely covered with rather large granules, some of which show a faint median indentation which may be the mark of a hair. Elytra displaying only a portion of the lateral disk, showing four sharply elevated narrow carinæ, broken by shallow notches into a series of elevations which are much longer than wide, the spaces between the carinæ not less than three times as wide as the ridges, their bottoms broken by rather distant transverse impressions into oblong spaces, but hair marks are not certainly visible. Underside of meso and metathorax granulate similarly to that of the prothorax, of abdomen much more sparsely so. Abdominal ventral surface ascending, the first and second segments long, the dividing suture indistinct, third and fourth short, subequal, fifth about equal to the two preceding, the sutures of these last three segments sharp and distinct. Legs wanting or obscured. Length, excluding beak, 3.45 mm. Height at middle, 2.20 mm.; the other body proportions may be approximated by reference to the figure.

Collected at Florissant by a party in charge of Professor Cockerell, in March, 1911. The type is in the Museum of the University of Colorado.

Remembering that the specimen is a reverse, we should have in life an insect of the form and size of *P. porosus,* with irregularly punctured head, the beak longitudinally striatopunctate in like manner, the prothorax, with the sides of the meso and metathorax marked with large crowded punctures, the abdomen punctate somewhat more finely and sparsely. The elytral sculpture would consist of deep narrow striæ, each with a row of well marked longitudinally elongate punctures at bottom, the interstitial spaces much wider than the striæ and each with a row of large oblong punctures. It does not closely approximate any of the Barini described by Dr. Scudder, but seems to go well into the genus to which I have referred it since it shows so many of the features of *P. porosus*.

Explanation of Plates.

Plate I.

1. Amara cockerelli n. sp.
2. Quedius mortuus n. sp.
3. Deleaster grandiceps n. sp.
4. Miosilpha necrophiloides n. sp.
5. Miosilpha necrophiloides.
6. Miosilpha necrophiloides, detail of antenna.
7. Orphilus dubius n. sp.
8. Paussopsis secunda n. sp.
9. Paussopsis secunda, detail of antenna.

Plate II.

1. Cœlambus miocenus n. sp.
2. Cœlambus miocenus.
3. Cœlambus miocenus, antenna, in part.
4. Cœlambus miocenus, front tarsus, in part.
5. Cœlambus miocenus, middle tarsus, in part.
6. Cœlambus miocenus, hind tibia and tarsus.
7. Tritoma materna n. sp.
8. Tritoma materna, hind leg.
9. Phlœonemites miocenus n. sp.
10. Phlœonemites miocenus, apex of antenna.
11. Phlœonemites miocenus, elytral sculpture.
12. Amartus petrefactus n. sp.
13. Amartus petrefactus, antenna.
14. Eudasytites listriformis n. sp.
15. Protapate contorta n. sp.
16. Mordellistena florissantensis n. sp.
17. Pachybaris rudis n. sp.

Plate III.

1. Trechus fractus n. sp.
2. Tritoma submersa n. sp.
3. Tritoma submersa, apex of antenna.
4. Dryops tenuior n. sp.
5. Melanophila cockerellæ n. sp.
6. Melanophila handlirschi n. sp.
7. Acmæodera schaefferi n. sp.

Plate IV.

1. Agabus charon n. sp.
2. Acmæodera abyssa n. sp.
3. Donacia primæva n. sp.
4. Platydema antiquorum n. sp.

Plate V.

1. Dermestes tertiarius n. sp.
2. Dermestes tertiarius, detail of elytral vestiture.
3. Pyropyga prima n. sp.
4. Lutrochites lecontei n. sp.
5. Trichochrous miocenus n. sp.
6. Xylobiops lacustre n. sp.
7. Crioceridea dubia n. sp.
8. Crioceridea dubia, antenna, in part.
9. Metachroma florissantensis n. sp.
10. Nemognatha exsecta n. sp.

Plate VI.

1. Aphodius aboriginalis n. sp.
2. Aphodius restructus n. sp.
3. Aphodius shoshonis n. sp.
4. Atænius patescens *Scudd.*, middle leg.
5. Atænius patescens, hind leg.
6. Serica antediluviana n. sp.
7. Macrodactylus pluto n. sp.
8. Macrodactylus pluto, antenna.
9. Diplotaxis (?) simplicipes n. sp.

Plate VII.

1. Bruchus henshawi n. sp.
2. Bruchus exhumatus n. sp.
3. Bruchus florissantensis n. sp.
4. Bruchus haywardi n. sp.
5. Bruchus haywardi.
6. Bruchus bowditchi n. sp.
7. Bruchus scudderi n. sp.
8. Bruchus scudderi.
9. Bruchus osborni n. sp.
10. Bruchus exhumatus, antenna.
11. Bruchus scudderi, antenna.
12. Bruchus haywardi, antenna.
13. Bruchus bowditchi, antenna.
14. Bruchus henshawi, elytral punctuation.

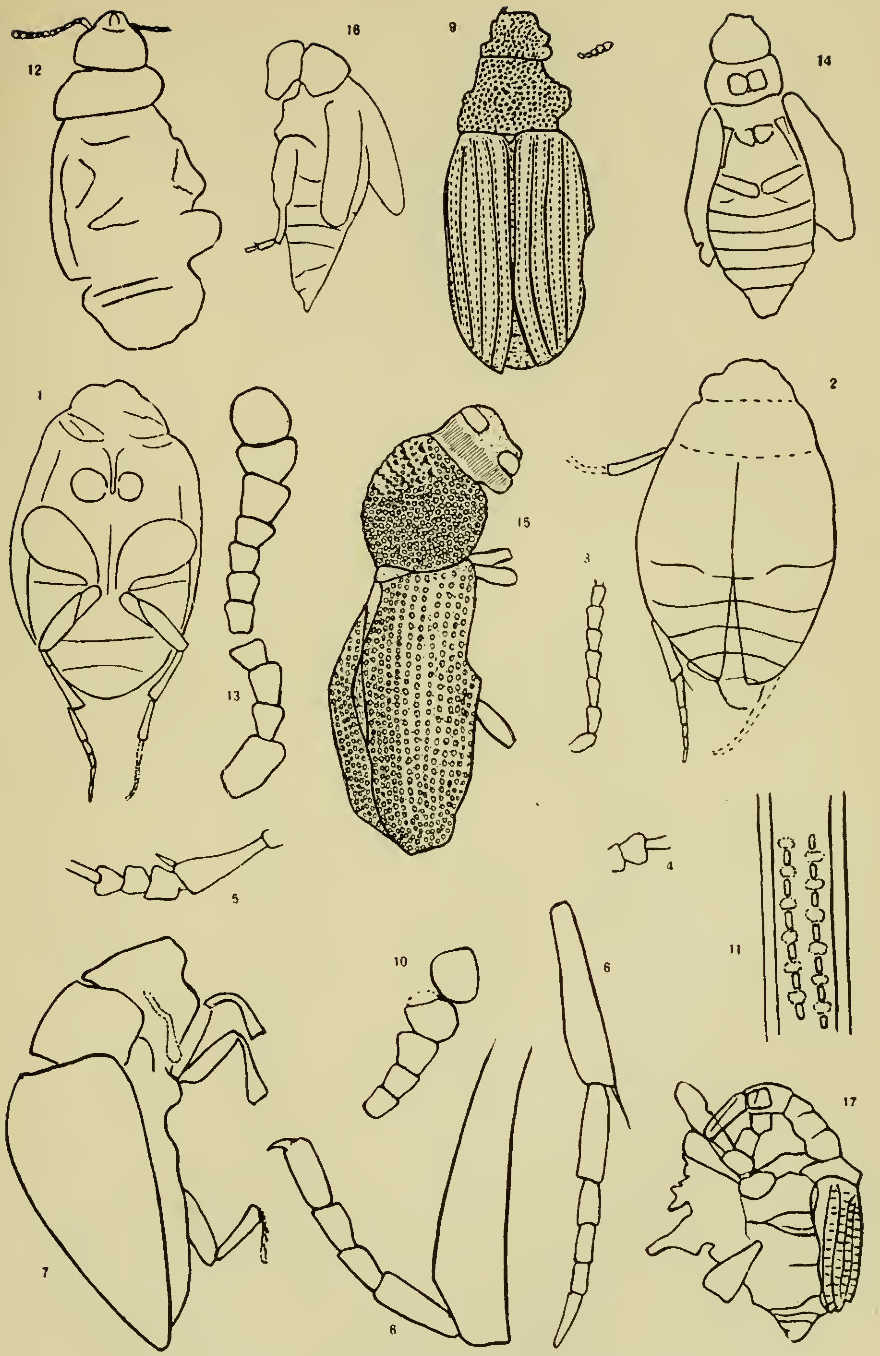
Plate VIII.

1. Docirhynchus ibis n. sp.
2. Leptura petrorum n. sp.

Plate I

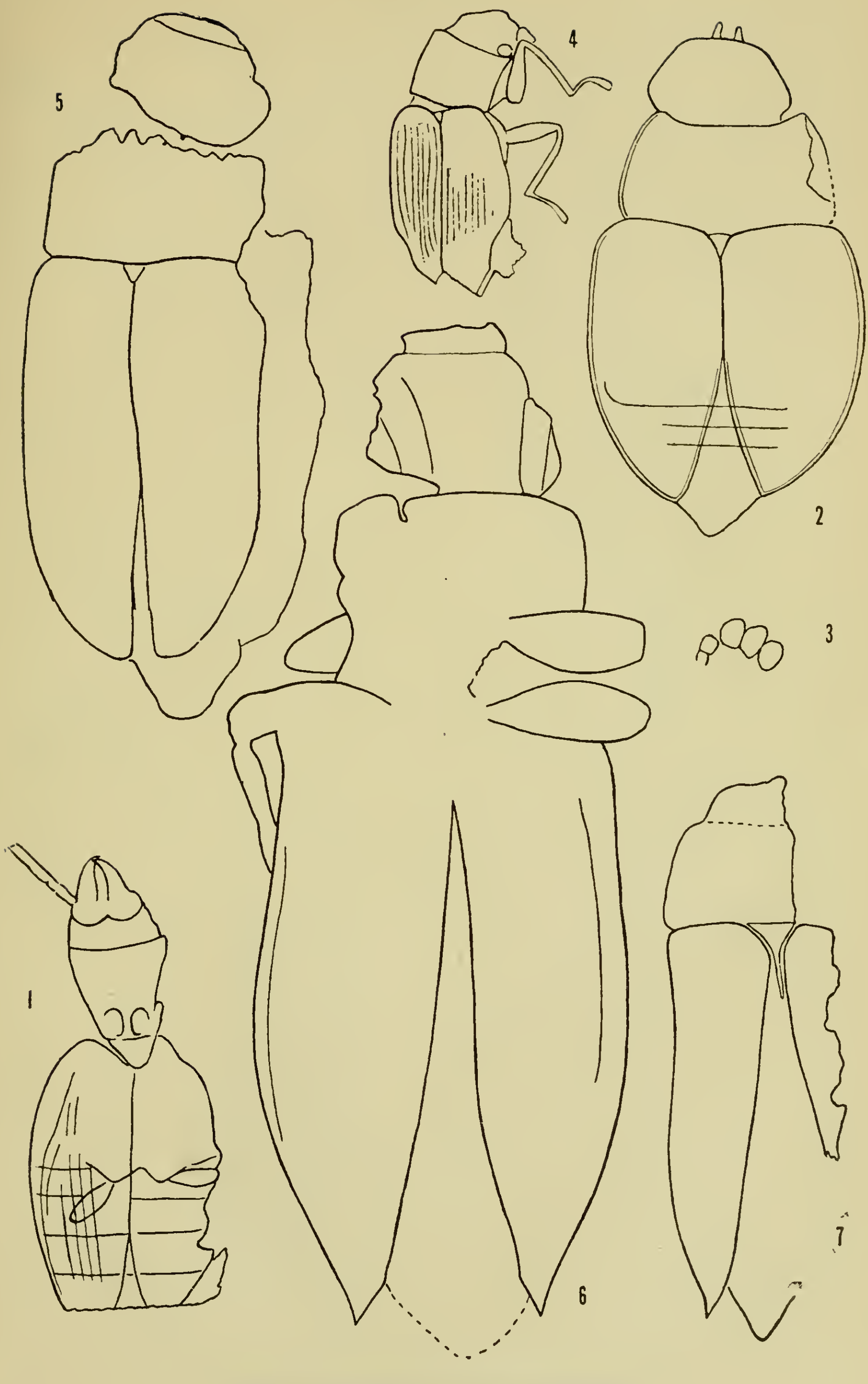
Fossil Coleoptera from Florissant

Plate II



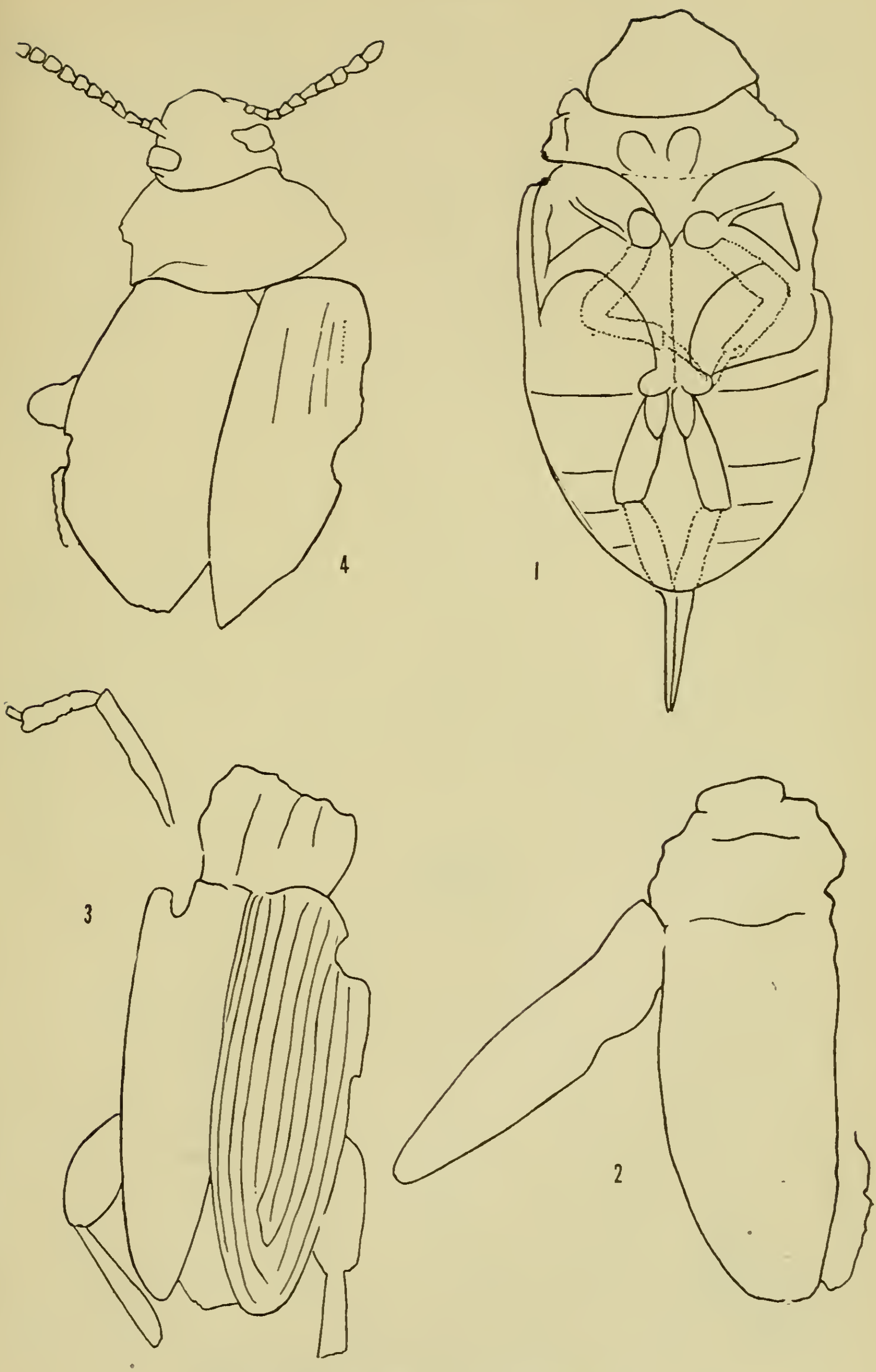
Fossil Coleoptera from Florissant

Plate III



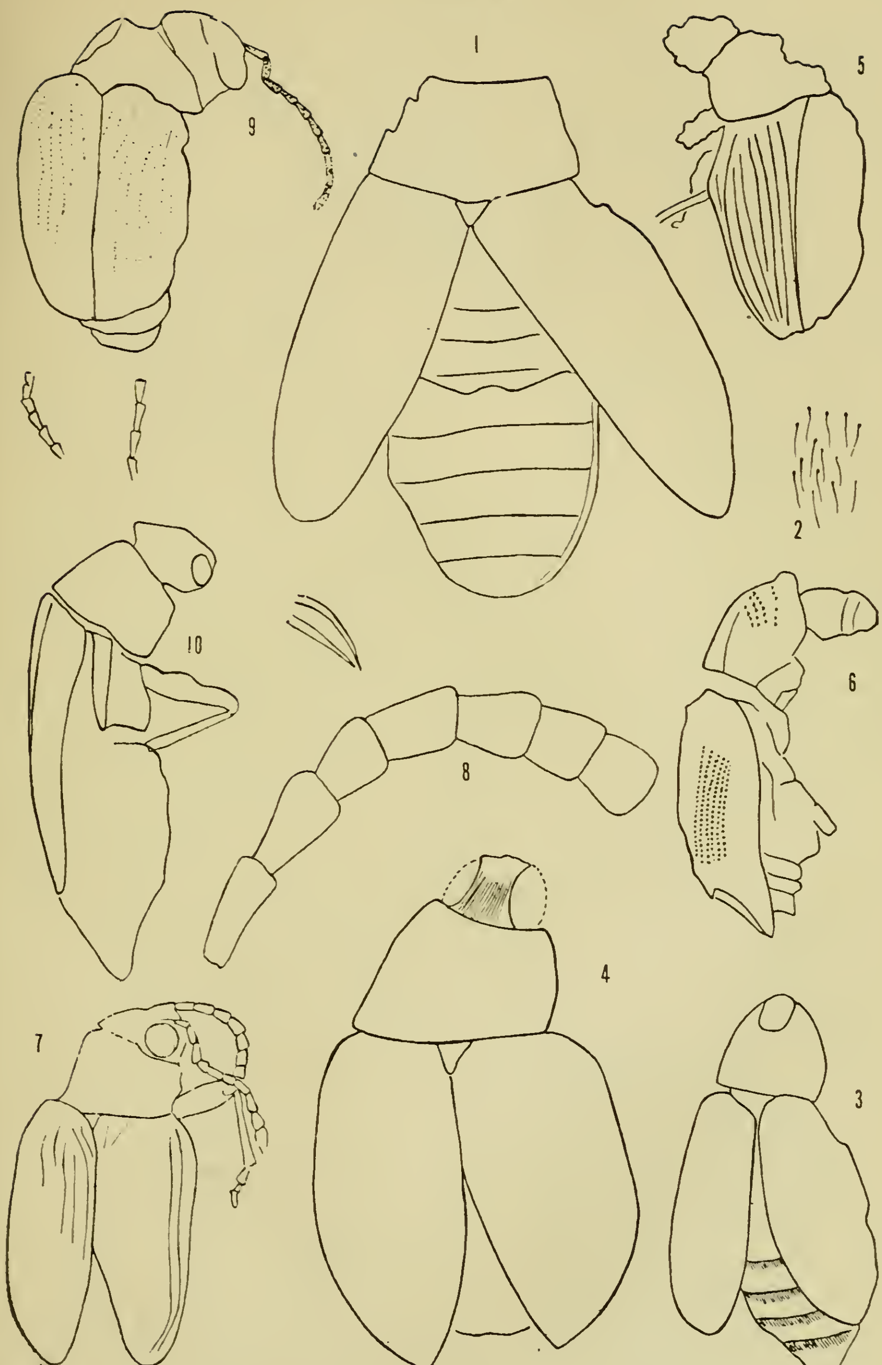
Fossil Coleoptera from Florissant

Plate IV



Fossil Coleoptera from Florissant

Plate V

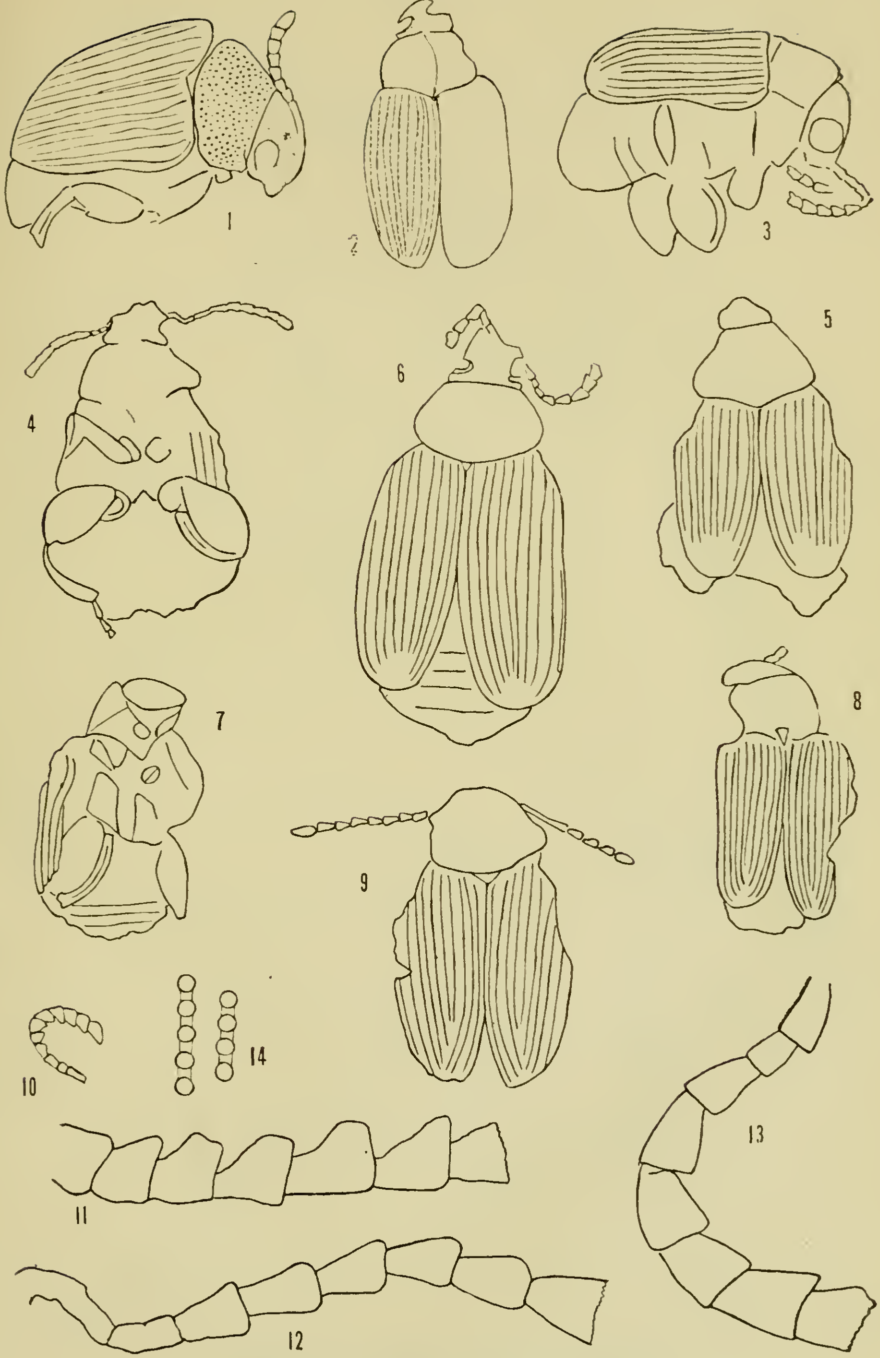


Fossil Coleoptera from Florissant

Plate VI

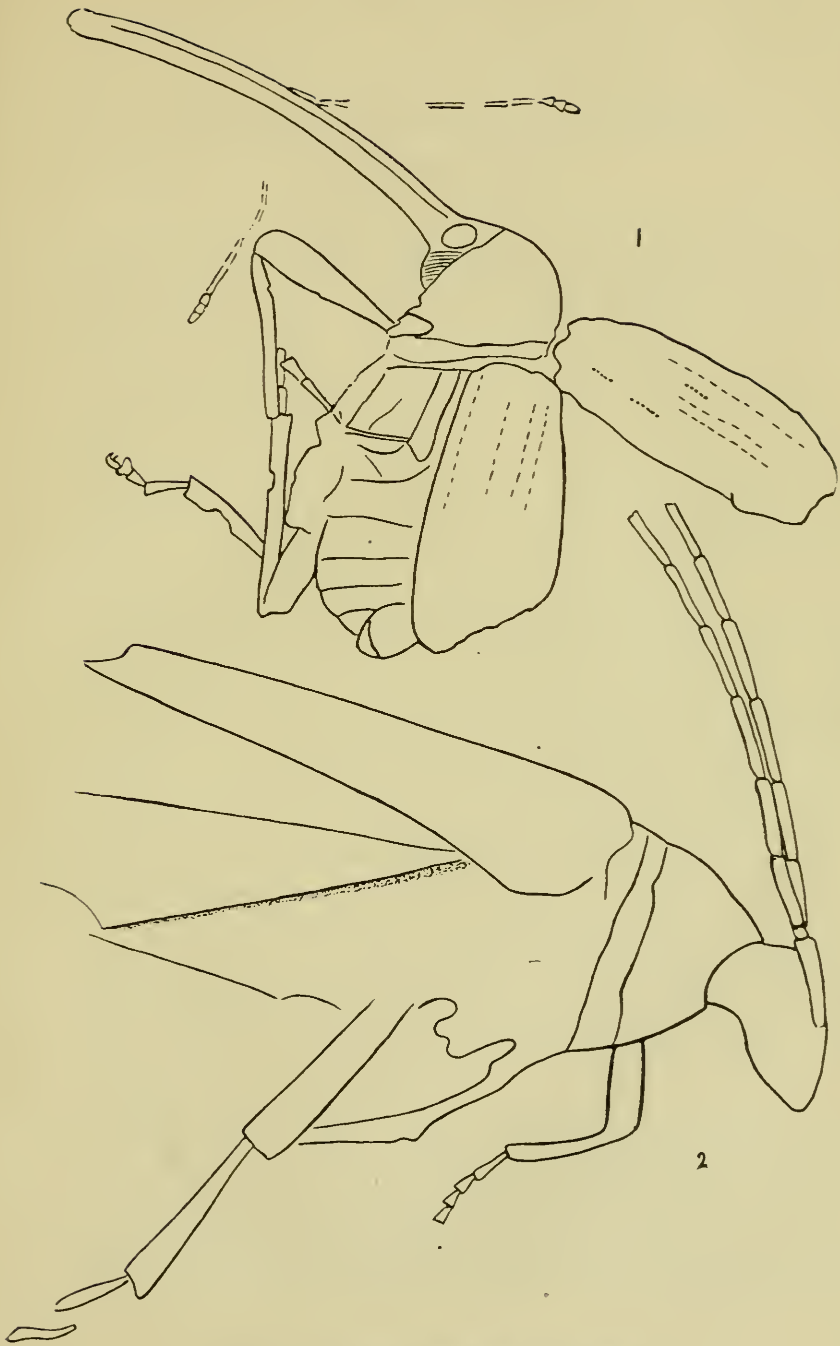
Fossil Coleoptera from Florissant

Plate VII



Fossil Coleoptera from Florissant

PLATE VIII



FOSSIL COLEOPTERA FROM FLORISSANT

NOTES ON NEW ENGLAND HYDROIDS.

C. McLean Fraser

The few notes I have to offer on the New England Hydroids would scarcely be worth publishing as a separate paper were it not that the district is visited by so many zoologists every summer and any information concerning the fauna should hence be made available for reference as soon as possible.

While taking advantage of the privileges offered by the U. S. Bureau of Fisheries at the Woods Hole station, I had a chance to get somewhat acquainted with the hydroid fauna. As the "Fishhawk" was not in commission during the summer, no deep sea dredging was done and hence the collecting had to be restricted to shore, pile and surface collecting, together with some work with the dredge or tangle in shallow waters.

Only 47 species were obtained, but among these were five that up to that time had not been reported from this region. These five species were: *Eudendrium vaginatum, Campanularia raridentata, Lovenella clausa, Filellum expansum* and *Sertularia stookeyi*. One of these, *Eudendrium vaginatum* has not been reported from the eastern coast of North America hitherto, the other four have been reported from other points along the coast. The gonosome of *Filellum expansum*, a widely-spread form, was found for the first time. The gonosome of *Clytia minuta*, a species reported only from Woods Hole, was found for the first time also. The gonosome of *Clytia edwardsi*, which I found at Departure Bay, Vancouver Island, had not been found at Woods Hole, although the original description was made from specimens obtained here; many colonies with the gonosome present were obtained during the summer.

Later in the summer, I visited the laboratory at South Harpswell, Me., for a week. Unfortunately, the weather was stormy for a large portion of the time at my disposal there, so that I had little chance to get acquainted with the region. From the few observations I was able to make, it struck me that the colonies of the species I did find, appeared to be in such good condition, and showed the particular characteristics of the species so well. Almost all the colonies seemed to be equally serviceable for examination; one did not have to look over much material to find a specimen for diagnosis. This may be due to the fact that the locality is so close to the deep waters of the ocean and is not befouled as shallow water so often is. I obtained only 14 species, but of these three had not previously been reported from the region. These were *Bougainvillia carolinensis, Eudendrium vaginatum* and *Campanularia calceolifera.* These have all been obtained from the Woods Hole region, but one of them, *Eudendrium vaginatum,* not until I had collected it a couple of weeks previous.

A report on these species from Woods Hole and South Harpswell, with observations on some other forms already reported, make up the material for this paper. Many of the species are described in full in a paper on "Some Beaufort Hydroids", which is being published by the U. S. Bureau of Fisheries, but the work is not far enough advanced to be able to give any page references.

The figures, the drawings for which were made by my wife, show a magnification of about eighteen diameters.

I wish to express my obligation to the U. S. Bureau of Fisheries for the facilities it afforded at Woods Hole and to Professors Kingsley and Neal for the benefit I derived from my sojourn at the laboratory at South Harpswell. The facilities for the study of hydroids afforded at the State University of Iowa, have made it possible for me to attempt much work this year, but these facilities would lose much of their value were it not for the assistance that Professor C. C. Nutting is always ready and willing to give. I cannot acknowledge too often my obligation to him for the interest he has taken in all this systematic work.

GEMMARIA GEMMOSA *McCrady.*

Gemmaria gemmosa was found in abundance at several points, but the most suitable place for collecting it was just outside the entrance to the eel-pond, where masses of serpulid tubes could be picked up readily, over a good sized area. These masses were coated with the brick-red *Membranipora;* over much of this *Membranipora, Gemmaria* could be found. Reference has been made in my Beaufort paper to the confusion there has been in the synonymy of this species. It has occurred to me that possibly the specimen referred to by Murbach,[1] as being much like *G. gemmosa* (*Cornyitis agassizii*), was *G. costata* Gegenbaur, as this species differs from *G. gemmosa* in the points that he mentions. Since they are so much alike in their structure and their habitat, it is quite possible that *G. costata* has traveled north as well as *G. gemmosa*.

Bougainvillia carolinensis (*McCrady*).

Verrill gives the range of this species from Charleston, S. C., to Vineyard Sound and as far as I can make out, no record has since been made of its appearance farther north than this. On the other hand, the range of *B. superciliaris* is said to extend from Newport, R. I., to the Bay of Fundy and possibly to Greenland. Unless specimens are in good condition, it is difficult to distinguish the one from the other as the tentacles, and in some cases the whole hydranths, disintegrate rapidly. Specimens of *Bougainvillia* were found at Basin Cove, South Harpswell, in which the medusa buds were not far enough developed to use for diagnosis, but all the other characters agree with those given for *B. carolinensis*, as distinct from *B. superciliaris*, hence I have little doubt that the specimens belong to the former species. This would extend the range for *B. carolinensis* to the north of Cape Cod. There is little evidence to show that Cape Cod is a dividing point for hydroid fauna to such an extent as it is said to be in some other groups of marine animals, but I hope to have more to say on that matter at some later date.

Calyptospadix cerulea *Clarke*.

In a paper written two years ago,[2] C. W. Hargitt refers to this species which at that time appeared to be rare. The first Woods Hole specimens were observed on the piles of the U. S. B. F. wharf in 1908, and the following year other specimens were obtained at Wareham by Mr. Vinal Edwards.

Mr. Edwards kindly informed me exactly where the Wareham specimens were obtained, and on August 7 I had an opportunity to visit the locality. I had no trouble in finding specimens; in fact they were in such abundance that no one who had ever collected hydroids could fail to observe them. The colonies formed an encircling mass on almost every pile of the bridge over the river where the main current was flowing, for several inches near low tide mark. On that day the tide was particularly favorable, so that in many cases the colonies were exposed.

If, as Dr. Hargitt supposes, this hydroid has been recently introduced, the conditions at the Wareham bridge must be particularly favorable, to produce such numerous colonies in such a short time. It may be, however,

[1] Hydroids from Woods Hole. Mass. Quarterly Journal of Microscopical Science, Vol. 42, pt. 3. New Series, 1899, p. 355, footnote.

[2] New and little known Hydroids of Woods Hole. Biol. Bull., Vol. XVII, No. 6, p. 371.

that they are seasonal as many hydroids are, and that his previous collecting had never been at a suitable time. The date in which I found these fine colonies was practically the same as the date he mentions (Aug. 10), two years previous.

Eudendrium carneum *Clarke*.

This species has been reported from the Woods Hole region several times but all such reports agree in stating that it was rare. Apparently it has now become well established in the region as last season it was quite plentiful even on the piles of the U. S. B. F. wharf, where it appeared in close proximity to specimens of *Eudendrium ramosum*, the species of *Eudendrium* that has been predominant for some time. At Beaufort the two species were found growing side by side in many localities in the same way. It will be interesting to find out if they will continue to live side by side, or if the one will crowd the other out. They are both rather lusty species and would appear to have almost equal chances to survive. At Woods Hole evidently *E. carneum* is the invader. It remains to be seen how extensive the invasion may be.

Eudendrium vaginatum *Allman*.[3]

I believe this species has not been reported from the Atlantic Coast of North America, though it is not unnatural that it should appear, as it has been reported from Europe and from the west coast of North America. Many species that have been so reported are found on the west side of the Atlantic.

Fine specimens of male colonies were found at Basin Cove, South Harpswell, at the old tide mill site. Other specimens without gonophores were obtained in some material dredged in Quicks Hole at a depth of about 10 fathoms. The extensive annulation and the characteristic shape of the hydranth were sufficient for identification.

Tubularia crocea (*Agassiz*).

Tubularia crocea is most plentiful at Woods Hole, at Vineyard Haven and at other places in the vicinity, where at the end of June and early in July it is in a flourishing condition, with the actinules still contained in the bud attached to the hydranth body, or already liberated so that the new colony is begun. Soon after this, the "heads" are all lost and nothing remains but the twisted stalks of the colonies, with possibly many young colonies, just starting to grow, attached to various points on the hydrorhiza or even on the lower part of the stems.

When I reached South Harpswell, after the middle of August, no such degeneration was apparent in the specimens in that locality. The colonies

[3] Eudendrium vaginatum Allman. Ann. and Mag. of Nat. Hist., 3rd ser. XI, 1863, p. 10.

were as fresh as the Woods Hole colonies were in June. I have heard it stated that the Maine forms do not lose their ''heads'' during the year, or at least that whole colonies do not appear to degenerate at the same time. If this is true, it would be an interesting point to investigate the cause of the difference.

Campanularia angulata *Hincks.*

This species has been reported from Woods Hole and it appears to be widely distributed in the region. No specimens were found that were not attached to eelgrass, but some may be found almost anywhere in the vicinity where eelgrass grows. The best specimens found last summer were growing in Little Harbor. These bore gonophores on the stolon, corresponding exactly with those described and figured by Hincks.[4]

Some specimens obtained at Wareham on Aug. 7 were provided with long terminal tendrils, like those figured by Hincks. This is probably a seasonal conditions, as many other species, e.g. *Obelia commissuralis,* become attenuated and give out tendrils after the generative products have been liberated. The tendrils of *C. angulata* are broader and more ribbon-like than those of *O. commissuralis* and other campanularian forms.

Campanularia calceolifera *Hincks.*

Specimens of this species were found at Basin Cove, South Harpswell, at the old tide mill site. This is the first time this species has been observed or recorded in the Casco Bay region, or at any point north of Cape Cod on the west side of the Atlantic. As it was first described in Britain, it probably came across the ocean by way of the Arctic regions; hence in getting to Woods Hole, where the species is plentiful, it must have passed Casco Bay, but up until this time it has been missed by collectors. The colonies presented no features that are not found in typical forms.

? Campanularia raridentata *Alder.*

Verrill, in his Checklist,[5] gives this species with an interrogation mark, but I have not seen any references to it in any other of his papers, or in any other West Atlantic Coast papers, for that matter; at any rate, I think it has not been reported from the Woods Hole region. Some excellent specimens, the best I have seen, were obtained by dredging about half way between Knobska Point and Falmouth Heights in five fathoms of water. They were growing on a piece of dead twig. Though I have found several of these specimens on the Pacific Coast and at Beaufort on the Atlantic Coast, I have not been able to find any gonosome, hence the generic name is still only provisional.

[4] British Hydroid Zoophytes, 1868, p. 170, pl. XXXIV, fig. 1.

[5] Verrill, A. E. Preliminary checklist of the marine Invertebrates of the Atlantic Coast, 1879, p. 16.

Clytia edwardsi (*Nutting*).

In his Woods Hole hydroid paper, Nutting described this species,[6] but as he did not find the gonosome, he put it in the genus *Campanularia*. In material obtained at Departure Bay, Vancouver Island, I found what I took to be the same species with the gonosome present. This I figured and described last year.[7] The finding of the gonosome made it necessary to change the species from the genus *Campanularia*, where it was placed provisionally, to the genus *Clytia*. Last summer I was fortunate enough to obtain specimens of this species, at Fay's wharf and off Penzance, that had gonophores perfectly agreeing with the gonophores of the Departure Bay specimens. This corroborates very satisfactorily the diagnosis of the Departure Bay specimens.

Clytia minuta (*Nutting*).

As *Campanularia minuta*, the trophosome of this species was described by Nutting.[8] He did not find the gonosome. Many specimens were obtained last summer, growing on *Eudendrium* stems on the piles of the bridge at the entrance to Lagoon Pond, Vineyard Haven, and on *Tubularia* at Fay's Wharf, Woods Hole. The finding of the gonosome of the species necessitates the placing of the species in the genus *Clytia*.

The species has a very characteristic mode of growth. The stems and pedicels are usually very long and slender and as the branches and pedicels leave the stem they turn abruptly upwards side by side with the main stem. Consequently, though the colony may reach a height of 2 cm. or more, the spread is insignificant, yet so many colonies grow close together that at first glance one would not observe the extreme slenderness of the colony. Annulation is carried to the extreme in many colonies as there is scarcely any part of the stem, branch or pedicel that is not annulated or at least wavy in outline. In other colonies this is not so marked but even here there are few stretches of any length that are entirely uniform. The hydrotheca reminds one somewhat of that of *Clytia johnstoni* Alder, or more especially of such specimens as Agassiz has figured as *Clytia bicophora*,[9] and in some stages of the growth of the colony it resembles the colony of that species. The hydrotheca, however, is smaller in *C. minuta* and there are usually but eight teeth present, while *C. johnstoni* has as many as twelve.

The gonangium bears a strong resemblance to the gonangium of *C. johnstoni*. It grows either from stolon or from the main stem. It is oval or obvate in shape and has corrugations similar to that of *C. johnstoni*.

[6] Hydroids of the Woods Hole region, 1901, p. 346, fig. 28.

[7] Hydroids of the West Coast of North America, 1911, p. 34, pl. III, figs. 1, 2.

[8] Hydroids of the Woods Hole Region, 1901, p. 345, fig. 27.

[9] Contributions to the Natural History of U. S., vol. IV, pl. XXIX, fig. 6.

Calycella pygmæa *Hincks.*

Under the name *Calycella nuttingi*,[10] Hargitt has described a small species of *Calycella*. I have found specimens that answer to his description and measurements but I see no reason for considering them different from Hincks' *Calycella pygmæa*.[11] Verrill reported *C. pygmæa* from Fishers Island Sound. Conn., and from Casco Bay, Me. This is probably the same species that I have obtained and also that Hargitt has collected. There is a difference of opinion as to whether *C. pygmæa* can be considered as specifically distinct from *C. syringa* and it will not help matters to introduce into the question still another species that seem to agree in all respects with at least one of these.

Lovenella clausa (*Loven*).

Two species of *Lovenella* have been reported from the New England Coast. Verrill reported *Lovenella* (*Calycella*) *producta* (Sars) from deep water off the Maine Coast,[12] Nutting reported *Lovenella grandis*[13] from Newport Harbor, and this was later reported from Woods Hole by Hargitt.[14]

Last summer Mr. Vinal Edwards gave me some surface tow to look over, and in some of this marked "Woods Hole, Feb. 21, 1902," I found a fragment of a colony of *Lovenella clausa*. I found specimens of this species at Beaufort and in my Beaufort paper have shown that the species which Clarke described as *Lovenella gracilis* from Chesapeake Bay,[15] is the same species *Lovenella clausa*. The three species are easily distinguished. *L. clausa* has 8 pieces in the operculum, *L. grandis* has 10 and *L. producta* 12 or more. There are other differences in mode of growth, etc., but the opercular character is constant and is readily recognized.

Filellum expansum *Levinsen.*

The species, *Filellum expansum*, is a very cosmopolitan form, being found in many waters of the Northern Hemisphere. Though it has not previously been reported from Woods Hole, it is distributed all along the coast, as I have found it from Canso, N. S., to Beaufort, N. C. The hydrothecæ are quite minute and when, as is often the case, they are distributed at rather distant intervals along the stolon, they may easily be overlooked. When one has once recognized them, they are so characteristic that they can

[10] New and little known hydroids of Woods Hole. Biol. Bull., vol. XVII, no. 6, 1909, p. 378.

[11] cf. Ann. and Mag. Nat. Hist., 4th ser. XIII, 1874, p. 149, pl. VII, fig. 15.

[12] Results of recent dredging expeditions on the Coast of New England. Amer. Jour. of Science and Arts, Vol. VII, 1874, p. 413.

[13] Hydroids of the Woods Hole Region, 1901, p. 354.

[14] Biol. Bull., No. 2, 1908, p. 112.

[15] Hydroids from Chesapeake Bay. Mem. Boston Soc. Nat. Hist., Vol. III, 1881, p. 139, pl. IX, figs. 25-39.

never again be passed over unnoticed. Another point regarding the hydrothecæ may help to account for their being overlooked. This is the fact that instead of being of a colorless transparency as hydrothecæ usually are, they are of a delicate blue-green color, quite similar in tint to many of the blue-green algae.

The gonosome of species of Lafœidæ is characterized by the massing together of the gonophores with many of the hydrothecæ. This mass has been called the ''Coppinia'' mass so often that the word ''Coppinia'' has come to have a definite significance although it was first used in error. So much is this the case that it seems as though we might use it regularly now without the quotation marks. Bonnevie has found the coppinia mass of several species and figured them; among them, the species, *Filellum serpens,* which is nearly allied to *F. expansum,* but I believe no one has discovered the coppinia mass of the latter species. I was fortunate enough to obtain some excellent specimens of this species, growing over *Eudendrium* on the piles of the bridge at the entrance of Lagoon Pond at Vineyard Haven. Many of the colonies had the gonosome present. The number of the hydrothecæ in the mass varied from about 20 to 80, arranged so closely that in most cases the stolon could not be seen. Intermingled with these were the much less numerous gonophores of a regular spherical sporosac type; the female with few ova present, four seeming to be the usual number, and the male much smaller than the female. The largest mass was 2 mm. long, and surrounded the *Eudendrium* for the whole length. These colonies with the gonosome were obtained on June 26.

In a recent paper Kramp has the following paragraph as a footnote:[16] ''*Filellum? expansum* Levinsen was set up under the reservation that 'it is quite possible that they (the tubes) will prove to belong to a species of the genus *Folliculina* or of a nearly related genus.' This species is found in great numbers on leaves of *Delesseria* and such like from the Danmark Expedition. I have often seen it with the two ciliated lobes characteristic of *Folliculina* stretched out of the tubes, so that the reference to the genus *Folliculina* is certain. Levinsen has asked me to communicate this here.''

I cannot reconcile this statement with the facts as I have observed them. It scarcely seems probable that the specimens I have found belong to a different group to those that Levinsen described. The form is so characteristic and shows perfect agreement. Yet I have found the coppinia mass, both male and female, entirely agreeing with the nature of the coppinia in the genus *Filellum.* Moreover, though in the majority of cases the zooid, if present, is withdrawn into the basal portion of the tube, in some cases it is extended and shows the regular hydranth form. None were extended enough to show plainly the exact number of tentacles. I have seen nothing of the 'two ciliated lobes' nor can I believe they are present in any specimen I have. In fact, there is nothing to indicate that the specimens are hydrozoan but everything to indicate that they are hydroid.

[16] Kramp, P. Report on the Hydroids collected by the Danmark Expedition at North-East Greenland, 1911, p. 374.

If the specimens described by Levinsen were bryozoan there must be an instance here of a greater resemblance in the two groups than any yet found.

Sertularia stookeyi *Nutting.*

The species of the genus *Sertularia*, as this genus is defined by Nutting, in his monograph,[17] are confined largely to the tropical seas. The outstanding exception along the American shore of the Atlantic is *Sertularia pumila* Linnæus, which is abundant along the New England Coast and the Canadian coasts to the northward. *Sertularia cornicina* (McCrady) has been found quite commonly in the Woods Hole region but appears to be more at home farther south. Hargitt has reported *Sertularia versluysi* Nutting,[18] but it was found on sargassum that may have come in from far south. The stolon-like outgrowths that he mentions were common enough on specimens found at Beaufort, and are probably seasonal as the terminal outgrowths of *Obelia commissuralis* and *Campanularia angulata*, previously referred to in the note on *C. angulata*.

Sertularia stookeyi Nutting is a tropical or sub-tropical form and was the commonest species of all the Sertularidæ in the material obtained at Beaufort. Some specimens were obtained in Vineyard Sound outside of Tarpaulin Cove at a depth of 7 or 8 fathoms. They were growing on fucus and on old stems of *Thuiaria argentea*, in company with colonies of *Sertularia cornicina*. *Thuiaria argentea* is the common shallow water *Thuiaria* of the New England coast and is not a Gulf weed form, consequently it would appear that this species has become definitely located in the region and is not a transient as *Sertularia versluysi* may have been. It is the most delicate looking species in the North American waters but it is possible that it has a greater degree of adaptability than some of the more lusty species.

[17] American Hydroids, Part II, The Sertularidæ, 1904, p. 49.
[18] Biol. Bull., vol. XIV, no. 2, 1908, p. 112.

Explanation of Plate.

Fig. 1. Clytia minuta. Full-grown colony.

Figs. 2-5. Young colonies.

Figs. 6, 7. Gonophores.

Fig. 8. Filellum expansum. A coppinia mass.

Plate I

New England Hydroids

NOTES ON CLERIDÆ FROM NORTH AND CENTRAL AMERICA.

H. F. Wickham and A. B. Wolcott

The following paper is, in effect, a catalogue of the species of this family contained in the collection of the senior author and is intended as a contribution to the exact knowledge of the distribution of the Cleridæ on the North American continent. A few biological notes, based on field experience, are added, which may be of service as indicating where these insects are to be sought or expected, and the dates of occurrence should also be of some value. Because of the numerous types contained in the collection, it has been thought best to note their presence for the guidance of systematists who, at some future time, may wish to locate them for study.

All of the exact records, that is to say those referring to localities by city or county, are taken directly from specimens in this collection. Those referring to states alone are inserted to show the general distribution of the species and are furnished by the junior author from notes gathered from the literature and from the study of specimens in his own collections or those sent him for examination. It has not seemed advisable to take up the space which would be required in the citation of the original collector for every specimen catalogued in the body of the work, but the following list of the principal contributors and the localities noted for the Cleridæ coming from them will serve the purpose.

Chas. Liebeck, Philadelphia, and the nearby parts of New Jersey; George Ehrmann, Allegheny County, Pennsylvania; G. W. Caffrey, Bethlehem, Pennsylvania; Chas. Dury, Cincinnati, Ohio; Frederick Knab, Chicopee, West Springfield and Mt. Tom, Massachusetts; Fred. C. Bowditch, Brookline and Marion, Massachusetts; Clarence M. Weed, Durham, New Hampshire; S. A. Shaw, Hampton, New Hampshire; Percy G. Bolster, Mt. Katahdin and Old Orchard, Maine; W. H. Harrington, Ottawa, Ontario; R. J. Crew, Toronto, Ontario; John D. Evans, Sudbury, Ontario; Wm.

S. Marshall, Dane County, Wisconsin; Dayton Stoner, Ada, Minnesota; C. W. Strumberg, Galesburg, Illinois; W. Knaus, McPherson, Kansas; F. F. Crevecœur, Onaga, Kansas; E. A. Popenoe, Riley County, Kansas; F. H. Snow, Douglas County, Kansas, Magdalena Mountains, New Mexico, San Bernardino Ranch and Oak Creek, Arizona; Richard Oertel, Malcolm, Nebraska; Moritz Schuster, St. Louis, Missouri; A. H. Manee, Southern Pines, North Carolina; H. P. Loding, Mobile and adjacent district, Alabama; E. P. VanDuzee, Muskoka, Ontario, and Crescent City, Tampa and Estero, Florida; C. Schaeffer, two species from Brownsville, Texas; G. Birkmann, Fedor, Texas; Frank B. Armstrong, Cameron County, Texas, August and September; T. D. A. Cockerell, Mesilla and Las Cruces, New Mexico; B. Shimek, Escondido, Highrolls and Tularosa, New Mexico; E. J. Oslar, Poncha Springs and Durango, Colorado; C. P. Gillette, Fort Collins, Lamar and Trinidad, Colorado; R. A. Cooley, Montana, all points listed except Kalispell; Norman Criddle, Aweme, Manitoba; A. W. Hanham, Winnipeg, Manitoba, and Goldstream, Vancouver Island; Geo. W. Taylor, Nanaimo, Vancouver Island; E. P. Venables, Vernon, British Columbia; Everett R. Ryan, Salem, Oregon; A. B. Cordley, Corvallis, Oregon; H. C. Fall, Pomona, California; A. Fenyes, Pasadena, Palm Springs and Ahwahnee, California; Max Albright, Soldiers Home, California; E. C. Van Dyke, Los Angeles County, California; Chas. Fuchs, St. Helena, California, and San Jose del Cabo, Lower California; Chas. L. Smith, Jalapa, Mexico. The junior author has sent specimens from Heyworth and Bloomington, Illinois. and from Brownsville, Texas. The senior author has made three trips to Mexico, and, with the exception of the Jalapa material, has himself secured all of the beetles herein listed from that country. He has also worked for many years in various parts of the United States and Canada and is to be credited as collector of all the species mentioned from Iowa City, Iowa; Bayfield, Wisconsin; McCook, Nebraska; Devil's Lake and Williston, North Dakota; Kalispell, Montana; Cœur d' Alene and Priest River, Idaho; Huntington, Oregon; Spokane, Leavenworth and Tacoma, Washington; Victoria, Vancouver Island; Sisson, Dunsmuir, Tehachapi, Truckee, Bodie, Bridgeport, Independence, Colton, Yuma, Salton, and The Needles, California;

Carson City, Elko and Reno, Nevada; St. George, Chadburn's Ranch, Provo, Parowan, Marysvale, Milford, City Creek Canyon and Salt Lake City, Utah; Winslow, Williams, Flagstaff, Bright Angel Camp, Seligman, Peach Springs, Tucson, Pinal Mountains, Santa Rita Mountains and Nogales, Arizona; Albuquerque, Coolidge, Gallup, Cloudcroft, and Deming, New Mexico; El Paso, Marfa, Alpine, Del Rio, Alice, San Antonio, and Dallas, Texas; Little Rock, Arkansas; Atoka and South McAlester, Indian Territory. He also took most of the species listed as coming from Brownsville, though it will be noted that some of them came from other sources.

The arrangement of the genera and species is in accordance with the views of the junior author, who is responsible also for some changes of name and synonymy. He has written the descriptions of the new species and varieties which will be found in their appropriate places. The biological notes, unless otherwise credited, are contributed by the senior author.

Family CLERIDÆ.

Subfamily Clerinæ.

Tribe I. Tillini.

Monophylla *Spinola*.

M. substriata *Wolc.* St. George, Utah. (TYPE). Doubtfully distinct from *M. californica* Fall, which occurs from southern Oregon through California to Lower California, Arizona and Costa Rica.

M. pallipes *Schaeff.* Texas, Brownsville and Alice, June and July.

M. terminata *Say.* Camden Co., New Jersey, July 6; Jeannette, Pennsylvania; Onaga, Kansas; Iowa City, Iowa, April 15; Brownsville and Columbus, Texas, July. Known also from Georgia, Virginia, West Virginia, Maryland, District of Columbia, New York, New Jersey, Massachusetts, Ohio, Indiana, Illinois, Missouri, Louisiana and Arizona. Mr. Frost writes that W. S. Fisher has bred it from Honey Locust.

Callotillus *Wolcott*.

C. eburneocinctus *Wolc.* Key West, Florida, June. (TYPE).

Tillus *Olivier.*

T. collaris *Spin.* Mobile, Alabama, May 17, collected on Chinquapin by H. P. Loding. Also known from Georgia, Ohio, Texas, Mexico and perhaps Guatemala.

T. elegans *Er.* (*occidentalis* Gorh.) Brownsville, Texas, June; Mesilla, New Mexico, August 12. My two specimens are quite different in appearance, the one from Brownsville being uniformly dark above excepting the humeral spot and transverse band, while the Mesilla example is black only behind the band, the whole upper surface anterior thereto being testaceous with the exception of the spots and the band which are light colored as in the other and of a similar eburneous gloss. The insect occurs as well in Arizona, Lower California, Mexico, Guatemala, Nicaragua and Peru.

Cymatodera *Gray.*

The species of this genus are comparatively rare and are ordinarily taken by beating trees or bushes of various kinds, seldom occurring on flowers though occasionally resting under bark. It is unusual to take more than one or two examples from a single plant. They are strongly attracted by lights and may be found in the mornings about the doors of buildings where they have crawled in after having been drawn by the illumination. Partially dead branches yield them more freely than healthy vegetation. The genus is well represented in the arid districts of our southwest.

C. puncticollis *Bland.* Yuma, Arizona, August 24. The known distribution extends from Western Texas through New Mexico to California and down the Peninsula.

C. turbata *Horn.* Uvalde, Texas, June 19; Tepehuanes, Durango, Mexico, August. In both instances, the specimens were found under decaying leaves of *Opuntia.*

C. delicatula *Fall.* Tepehuanes, Durango, Mexico, August. Described from Lower California.

C. usta *Lec.* Las Cruces, New Mexico. Known from Texas, Arizona, and perhaps California, Mexico and Guatemala.

C. duplicata *Wolc.* Toluca, Mexico, (TYPE). The co-type comes from the city of Mexico, where it was found at rest in an umbrella in one of the stores on the Zocalo.

C. isabellæ *Wolc.* St. George, Utah, July. (TYPE).

C. tuta *Wolc.* Escondido, New Mexico, August 30. (TYPE). High-rolls, New Mexico. Occurs in Nevada at Yerington.

C. torosa *Wolc.* Albuquerque, New Mexico. (TYPE).

C. SOROR *Wolc.* Nogales, Arizona, August. (TYPE).

C. LONGICORNIS *Lec.* Santa Fe, New Mexico, July. Occurs also in Utah.

C. BRUNNEA *Melsh.* Southern Pines, North Carolina, August; Tucson, Arizona. Also known from New Jersey, District of Columbia, New Hampshire, Pennsylvania, Ohio, Iowa, Missouri and Texas.

C. BICOLOR *Say.* Chicopee, Massachusetts; Onaga, Kansas; Heyworth, Illinois; Iowa City, Iowa, March 29 and various dates in May. Here it is found occasionally running about in the house but has seldom been met with out of doors. Other state records are Georgia, New York, New Jersey, Maine, Pennsylvania, Ohio, Indiana, Wisconsin, Texas, and Ontario, Canada.

C. ÆMULA *Wolc.* Santa Rita Mountains, Arizona. (TYPE).

C. BIPUNCTATA *Gorh.* Jalapa, Mexico. Also known from Oaxaca and perhaps from Costa Rica.

C. INORNATA *Say.* Atoka, Indian Territory; Onaga, Kansas; Galesburg, Illinois; Iowa City, Iowa; Allegheny, Pennsylvania; several of the foregoing bear dates, all of which are for June. Occurs also in Louisiana, Georgia, District of Columbia, New Jersey, Maine, Indiana, Michigan, Wisconsin, Missouri and Canada.

C. GROSSA *Gorh.* Cuernavaca, Morelos, Mexico. It is known also from Jalapa in the Mexican state of Vera Cruz.

C. WICKHAMI *Wolc.* Mexico City, Mexico. (TYPE).

C. MOROSA *Lec.* Santa Fe, New Mexico, July; a doubtful specimen is in my collection from Arizona. Found in Colorado, Arizona, California and Mexico.

C. UMBRINA *Fall.* Bright Angel Camp, Arizona, on the edge of the Grand Canyon, July; Albuquerque, New Mexico; Salida, Colorado, July 6. It inhabits California, as well.

C. DISCOIDALIS *Chev.* Jalapa, state of Vera Cruz, Mexico.

C. SANTAROSÆ *Schaeff.* A somewhat doubtfully identified specimen is in my cabinet from Mesilla, New Mexico. Otherwise, it is known from Lower California.

C. ÆTHIOPS *Wolc.* El Paso, Texas, July, (TYPE, male); Tucson, Arizona, July, (CO-TYPE, female, this being misprinted "male" in the original description).

C. COMANS *Wolc.* St. George, Utah, July, (TYPE); Salton, California, 265 feet below sea level, August; Peach Springs, Arizona. Occurs also in Nevada. The specimens from St. George were secured by beating thick clumps of desert shrubs on the flats near the Virgin River, those from Salton were concealed about the roots of weeds in a little draw leading down to the Salton Sea.

C. TEXANA *Gorh.* Burnet County, Texas.

C. UNDULATA *Say.* Iowa City, Iowa, Oct. 7; Independence, Iowa; Onaga, Kansas, June 26 and July 16; Malcolm, Nebraska, July 17; Crescent City, Florida, April. Known to occur in North Carolina, Maryland, District of Columbia, New Jersey, Pennsylvania, Ohio, Indiana, Illinois, Wisconsin, Arkansas, Texas and Arizona. Mr. C. A. Frost writes that it has been bred from *Ampelopsis quinquefolia* by H. B. Kirk.

C. BALTEATA *Lec.* Brownsville, Harwood and New Braunfels, Texas, July. Lives in Mississippi, Alabama and California.

C. ANGUSTATA *Spin.* Los Angeles County, California. Found also in Mexico.

C. OVIPENNIS *Lec.* Los Angeles County and Tehachapi, California. Known from New Mexico and Arizona, and perhaps from Missouri, though the locality label for the last specimen may be in error.

Tribe II. **Clerini.**

PRIOCERA *Kirby.*

P. CASTANEA *Newm.* Heyworth, Illinois; Allegheny, Pennsylvania; Spring Hill, Alabama, May 17. Distributed through Florida, North and South Carolina, Ohio, Indiana, Michigan, Kansas and Canada.

DERESTENUS *Chevr.*

D. FURCATUS *Schaeff.* Brownsville, Texas, July 10.

THANASIMUS *Latreille.*

T. TRIFASCIATUS *Say.* Bayfield, Wisconsin. Known from Vermont, Pennsylvania and Canada.

T. DUBIUS *Fabr.* Durham, New Hampshire; Chicopee, Massachusetts; Mt. Katahdin, Maine, 5000 feet, June 29. Known to occur in Louisiana, New York, Vermont, Pennsylvania, Indiana, Michigan, Minnesota, Canada and Mexico.

T. UNDATULUS *Say.* Livingston, Montana, July 14. Found in New Hampshire, Minnesota, Colorado, New Mexico and Ontario.

T. UNDATULUS var. NUBILUS *Klug.* Sudbury, Ontario; Bayfield, Wisconsin; Kalispell, Montana, June 15; Leadville, Colorado, July; Priest River, Idaho, June. Widely distributed in Tennessee, New York, New Hampshire, Vermont, Maine, Wisconsin, Michigan, Minnesota, South Dakota, Nebraska, Kansas, New Mexico, Alaska, Northwest Territories and the Hudson's Bay region.

T. NIGRIVENTRIS *Lec.* Buena Vista, Leadville and Salida, Colorado; Cloudcroft and Gallup, New Mexico; Flagstaff, Arizona; Truckee and Sisson, California; Spokane, Washington; Cœur d' Alene, Idaho; Vernon, British Columbia. All of the dates on the foregoing specimens are for July and August. The beetles are common running in the sunshine on the trunks of cut pines and other conifers, and are frequently seen in lumber yards and about saw mills. They take to flight readily and are often found in company with *T. nubilus* which has similar habits. Other records of locality are Ontario, Wisconsin, Michigan, South Dakota, Nebraska, Utah, Wyoming, Oregon, Vancouver Island, California, Mexico and Guatemala.

ADELPHOCLERUS *Wolcott.*

A. NITIDUS *Wolc.* Jalapa, state of Vera Cruz, Mexico, (COTYPE). Several specimens were collected at that point a few years ago by Mr. Chas. L. Smith.

ENOCLERUS *Gahan.*

E. THORACICUS *Oliv.* Chicopee, Mass.; Southern Pines, North Carolina, April 24; Estero, Florida, May 6; Mobile, Alabama, April 14; Durham, New Hampshire; Ridgeway, Ontario. It is known to occur also in Louisiana, Georgia, District of Columbia, New Jersey, Rhode Island, New York, Pennsylvania, Ohio, Indiana, Illinois, Michigan, Texas, California and Mexico.

E. THORACICUS var. PALLIPES *Wolc.* n. var. Resembles the ordinary form of the species, but differs in having the legs pale yellow. This gives it a very different aspect, but no other differential characters are apparent. It is represented by specimens from Lincoln, Nebraska; Onaga, Kansas, and Iowa City, Iowa. The dates indicate that it appears in June.

E. OCREATUS *Horn.* Salida, Colorado; Flagstaff, Arizona. Both captures were made in July, the specimens being taken from cut pines. The species is also found in Nebraska, Kansas and New Mexico.

E. HUMERALIS *Schaeff.* Vernon, British Columbia. Recorded from California and Arizona.

E. NIGRIFRONS *Say.* Marion, Massachusetts, June; Muskoka, Ontario, July; Tumblin Gap, Alabama. Other records are District of Columbia, New York, New Jersey, Pennsylvania, Indiana, Illinois, Nebraska, and the Lake Superior region.

E. QUADRIGUTTATUS *Oliv.* Iowa City, Iowa, April 5; Hampton, New Hampshire, May 18; Malcolm, Nebraska, June 4. It is recorded from Ontario, Maine, Vermont, Rhode Island, Massachusetts, New York, New Jersey, Pennsylvania, Ohio, Indiana, Illinois, Wisconsin, Michigan, Minnesota, Kansas, Missouri, Georgia, New Mexico, Arizona, California and Mexico.

E. QUADRIGUTTATUS var. RUFIVENTRIS *Spin.* Mt. Katahdin, Maine, 5000 feet, June 29; Toronto, Canada, same date. It is known from Vermont, New York, Wisconsin, Michigan, Kansas, California and Mexico.

E. ROSMARUS *Say.* Iowa City, Iowa, June 29; Atoka, Indian Territory, June 14; Little Rock, Arkansas, May. Inhabits also Louisiana, Florida, Georgia, Virginia, District of Columbia, Maryland, New York, New Jersey, Massachusetts, Pennsylvania, Ohio, Kentucky, Indiana, Illinois, Nebraska, Missouri and Kansas. In my experience, this occurs on flowers.

E. BOMBYCINUS *Chev.* Cuernavaca in Morelos and Tepehuanes in Durango, Mexico, July and August. This is a flower loving species like the last, and was taken in some abundance in sweepings on heavily overgrown hillsides.

E. EXIMIUS *Mann.* Nanaimo, Vancouver Island, May 8; Salem, Oregon; Pasadena and Soldiers Home, Los Angeles County, California.

E. MUTTKOWSKII *Wolc.* Bayfield, Wisconsin, where two specimens were found running on a fence made chiefly of poplar logs. The type of this species was labelled merely "Wis." Dr. Muttkowski took a specimen at Prescott, Pierce County, Wisconsin, between July 13 and 19, 1910. The color of the abdomen of this fresh specimen is red, (not yellow, as in the evidently faded type) and the apical ventral segment is piceous. In my examples, the abdomen is red throughout.

E. SPINOLÆ *Lec.* Alpine and Marfa, Texas, June and July; Shady Run in the Pinal Mountains, Arizona, July; Wallace County, Kansas, July; Tepehuanes, Durango, Mexico. This showy beetle sometimes occurs in large numbers in the flowers of various yuccas and related plants in the warm desert regions of the southwest. It is known to occur in New Mexico and California, as well as in the states noted above, and a doubtful record is extant for Kentucky.

E. MŒSTUS *Klug.* Colorado Springs, Salida and Ouray, Colorado, July; Coolidge, New Mexico; Flagstaff and Bright Angel Camp, Arizona, June and July. Sometimes abundant running in the sunshine on cut trunks of conifers or hiding in the dying foliage. I have never seen it on flowers and the habits are suggestive of *Thanasimus* rather than of *Enoclerus.* It has a wide range and is known from several states other than those named above, namely South Dakota, Wyoming, Nebraska, Montana, Washington, Oregon and California, extending south into Mexico.

E. SPHEGEUS *Fabr.* Olympia, Leavenworth and San Juan Island, Washington; The Dalles, Oregon; Priest River, Idaho; Sisson, Truckee, Tehachapi and Bridgeport, California; Leadville, Colorado; Williams, Arizona; Goldstream, British Columbia, October. With the exception of the last record, practically all of the dates are in July and August, when this insect may be found under conditions similar to those indicated for *E. mœstus*. It is of equally wide range, being found in South Dakota, Nebraska, Wyoming, Utah, New Mexico and Mexico as well as in the places already noted.

E. JOUTELI *Leng.* Southern Pines, North Carolina, June 4. This species has only recently been described from a single specimen taken on top of Screamer Mountain, Rabun County, Georgia, 3500 feet, June 15. Mr. Manee sent me one with the note that it was unique in his collection. To me, the insect looks more like *E. viduus* than like *E. sphegeus*, to which latter species it has been compared by Mr. Leng, in fact it is remarkably similar to the specimen that I have as *viduus* from Alpine, Texas. In the Texas specimen the hind femora are not orange, though slightly tinged at base, the size of the insect is less and the color more purplish.

E. VIDUUS *Klug.* Alpine, Texas, June. A single beautiful specimen found in sweepings. It was already known from Mexico.

E. ICHNEUMONEUS *Fabr.* New York City; Riley County, Kansas, October 27. It is known as well from Iowa, Indiana, Illinois, Wisconsin, Arkansas, Georgia, Florida, Virginia, Maryland, District of Columbia, Pennsylvania, Ohio and Ontario.

E. ACERBUS *Wolc.* Elko, Nevada, (TYPE). It also inhabits Utah.

E. BIMACULATUS *Skinner.* Carr Canyon, Huachuca Mts., Arizona, August, (COTYPE).

E. OPIFEX *Gorh.* Alpine, Texas, June and August, in sweepings. Otherwise recorded from Mexico, Guatemala and Nicaragua.

E. LATEFASCIATUS *Wolc.* Rio Balsas, Guerrero, Mexico. (TYPE).

E. QUADRISIGNATUS *Say.* New Braunfels and Brownsville, Texas, June, July and August; South McAlester, Indian Territory, June. Occurs also in Georgia, North Carolina, New Jersey, Pennsylvania, Ohio, Indiana, Illinois, Kansas, Colorado, Arizona, California, Lower California and Mexico. In the west, this species occurs on yuccas.

E. QUADRISIGNATUS var. LATECINCTUS *Lec.* San Jose del Cabo, Lower California; Yuma and Soldiers Home, California; Cameron County, Texas, August. Dr. Leconte gives the locality as "Colorado River and Sonora," probably in the vicinity of Yuma.

E. VULNERATUS *Klug.* Cuernavaca, Morelos, Mexico.

E. LUNATUS *Klug.* Glassboro, New Jersey, July; New Braunfels and Harris County, Texas, May; Estero and Tampa, Florida, May; Southern Pines, North Carolina, June; Riley County, Kansas, July; Orchard, Alabama, May. Widely distributed, being found as well in Georgia, Virginia, Maryland, New York, Pennsylvania and Missouri.

E. DECUSSATUS *Klug.* Cuernavaca, Morelos, Mexico. The variety *ornatus* Spin., occurs in Arizona.

E. ANALIS *Lec.* Onaga, Kansas, June; Alpine, Texas, July; Luna, New Mexico, August; Lamar, Colorado, September; Winslow, Arizona. Known also from Ohio. It is a flower loving insect, like *Trichodes.*

E. CORDIFER *Lec.* Powderville, Montana, July 29; Alpine and Marfa, Texas, June and July; Colorado Springs, Colorado, June. This also is a flower loving form, and is known, in addition to the above localities, from Kansas, Nebraska and New Mexico.

E. LÆTUS *Klug.* (*abruptus* Lec.) Del Rio, Alpine and Brownsville, Texas; Peach Springs, Seligman, Winslow and Santa Rita Mountains, Arizona; Chadburn's Ranch, and Parowan, Utah. Another flower loving species, feeding exposed and easily frightened. It is found also in New Mexico, California and Mexico.

E. COCCINEUS *Schklg.* Trinidad and Colorado Springs, June, Poncha Springs, July, Colorado; Roswell and Luna, New Mexico, August; Marfa, Texas, July. This species is quite generally confused with the preceding but is quite distinct and is known from Minnesota, Nebraska, Kansas, and Mexico in addition to the localities cited above. Its habits are the same as those of *E. lætus.*

E. PALMI *Schaeff.* Williams, Arizona, July; Gallup, New Mexico. It is known from no other states than these.

E. CRABRONARIUS *Spin.* Brownsville, Texas, June. Reported from Texas only.

TRICHODES *Herbst.*

All of the North American species of *Trichodes* seem to have similar habits in the adult state, being found in flowers, more especially in those which bloom in heads like the Compositæ and Umbelliferæ. They are at least fairly active and fly on slight alarm, without being as swift as the species of *Enoclerus* or *Thanasimus.* Their bright colors make them quite conspicuous and they form one of the striking features of collections made in the mountain region of the west. Some of them occur in considerable abundance.

T. ORESTERUS *Wolc.* Alpine, Marfa and Pecos, Texas, June and July.

T. ILLUSTRIS *Horn.* San Bernardino Ranch, Santa Rita Mountains and Tucson, Arizona, those from the last two places occurring from late August to early September.

T. SIMULATOR *Horn.* Albuquerque and Embudo, New Mexico, on golden rod in September; Parowan, Utah, August. Known to occur as well in Arizona and Wyoming.

T. BIBALTEATUS *Lec.* New Braunfels, Alpine and Del Rio, Texas, June. The two specimens from the last named locality are yellow instead of red. The species is known also from Arizona and a specimen in the collection of Warren Knaus is labelled "Pa."

T. NEXUS *Wolc.* San Jose del Cabo, Lower California, (COTYPE).

T. ORNATUS *Say.* Colorado Springs, Buena Vista, Leadville, Breckenridge, Poncha Springs, Ouray, Georgetown, Durango, South Park and Denver, Colorado; Lamb's Canyon, Fort Douglas and City Creek Canyon, near Salt Lake City, Utah; Reno, Nevada; Kalispell and Lo Lo, Montana; Nanaimo and Victoria, Vancouver Island; Leavenworth, Spokane, Tacoma, Ellensburgh and Centralia, Wash.; Salem, Huntington, The Dalles and Cayuse, Oregon; Kaweah, Sierra Nevada above Independence, Bubb's Creek, Truckee, Sisson and Dunsmuir, California; Flagstaff and Bright Angel Camp, Arizona. The dates run all through the summer, but the species is abundant in July and August. Records are also extant from South Dakota, Nebraska, Idaho, Wyoming, New Mexico, Alberta and British Columbia.

T. ORNATUS var. TENELLUS *Lec.* Kaweah, California; Albany, Oregon. Known also from Utah, Colorado, Nevada, and New Mexico.

T. NUTTALLI *Kirby.* Waldoboro and Old Orchard, Maine; Buffalo, New York; Toronto and Port Hope, Ontario; Bayfield, Wisconsin; Evanston, Illinois; Iowa City, Iowa; Williston, North Dakota; Golden, Colorado; Aweme and Winnipeg, Manitoba. It is recorded also from Florida, Louisiana, Vermont, Massachusetts, Pennsylvania, Michigan, Indiana, Missouri, Kansas, Nebraska, South Dakota and Minnesota.

T. APIVORUS *Germ.* Crescent City, Florida, April; Southern Pines, North Carolina, June; Spring Hill, Alabama, July. It is known to occur in Virginia, District of Columbia, New York, New Jersey, Massachusetts, Nebraska, Texas, New Mexico and Canada.

T. APIVORUS var. INTERRUPTUS *Lec.* Mt. Tom, Massachusetts; Webster, New Hampshire; Holiday, Pennsylvania; DaCosta, New Jersey. Recorded also from Florida, Alabama, Virginia, Illinois and Texas.

AULICUS *Spinola.*

A. NERO *Spin.* Alpine, Texas, July and August; Luna, New Mexico, August; Palm Springs, California, June. This insect rests on the stems of tall grasses, in which position it is quite conspicuous. Besides the above recorded distribution, it inhabits Nevada and Lower California.

A. MONTICOLA *Gorh.* Alpine, Texas, August; Santa Rita Mountains, Arizona, September. Its habits are the same as those of the preceding species. Its range extends into Mexico.

XENOCLERUS *Schklg.*

X. EDWARDSII *Horn.* Tucson, Arizona, August 24; this fine species occurs occasionally among the branches of the palo verde and other small desert trees on the hills about the town, and is only moderately alert. It is known as well from California and the Peninsula.

Tribe III. **Hydnocerini.**

HYDNOCERA *Newm.*

H. UNIFASCIATA *Say.* Atoka, Indian Territory, June; Southern Pines, North Carolina, May and June, the specimen of later date having no cross-band; Bloomington, Illinois, July; New Mexico. Other records are Alabama, District of Columbia, New York, New Jersey, Massachusetts, Pennsylvania, Ohio, Indiana, Nebraska, Colorado, Texas and Arizona.

H. RUFIPES *Newm.* Chuchula, March 29, and Oak Grove, Alabama; it is recorded from Florida and Arkansas. The Chuchula specimen, received from Mr. Loding, is marked as having been collected on oak.

H. DUBIA *Wolc.* n. sp. Very similar to the blue variety of *humeralis* in size, form and color. Rather robust, black, moderately clothed with short, pale grayish pubescence. Head and thorax with slight greenish tinge, finely densely punctate and asperulate. Antennæ pale testaceous, apical joint and the palpi pale piceous. Elytra fully covering the abdomen, blue black, closely subcribrately punctate, sculpture more dense towards the tip, sides slightly narrowing towards the apices which are separately obliquely rounded, strongly serrate and but slightly dehiscent at the suture. Legs black, anterior and middle tibiæ (the latter more or less infuscate), knees, and tarsi of all the legs pale testaceous. Length, 4.00 mm.

Devil's Lake, North Dakota, June 6, (TYPE).

Represented by a single male specimen which differs from the blue form of *H. humeralis* as follows:— Subopaque, more densely pubescent, head and pronotum more finely but roughly punctured, prothorax proportionately longer, the sides more broadly but less strongly dilated, the disk not less densely punctured than the flanks and the elytral apices obliquely rounded.

The form of the thorax is very similar to that of *H. pubescens*, but it is longer and narrower at the apex. The finely, densely punctured area at about apical third of elytra, which is present in many species, is entirely wanting in *H. dubia*, the pubescence clothing this portion is without distinct lateral direction.

H. MEXICANA *Wolc.* Tepehuanes, Durango, August, (TYPE).

H. SUBFASCIATA *Lec.* Coolidge, New Mexico; Williams and Flagstaff, Arizona, July; Buena Vista, Colorado, July; Provo, Utah, May; Bodie, California, July. Frequently common, particularly on young pine trees. It is known also from Wyoming, Montana, Kansas, Nebraska and Texas.

H. SUBFASCIATA var. FRATERNA *Wolc.* n. var. Differs from the typical form by the upper surface being brilliantly metallic, the head, base of prothorax and elytra more densely punctate and the post-median pubescent fascia much less evident. The legs are pale testaceous, more or less infuscate, the femora, apices excepted, black.

Chatham, Massachusetts, (COTYPES).

Described from six specimens from Chatham, Massachusetts, July 14, 1907, collected and presented by Mr. C. A. Frost. Four specimens remain in the Wolcott collection.

H. PUBESCENS *Lec.* Onaga and Lawrence, Kansas, May, June and August; South McAlester, Indian Territory, June; Point Isabel, Brownsville and Dallas, Texas, July; Volga, South Dakota. Known as well from Illinois, Nebraska, Colorado, Montana and New Mexico.

H. FUCHSII *Schaeff.* Santa Rita Mountains, Arizona, September. It occurs also in New Mexico.

H. SUPERBA *Wolc.* Tepehuanes, Durango, Mexico, (TYPE).

H. GORHAMI *Wolc.* Cuernavaca, Morelos, Mexico, (TYPE). Quite abundant in sweepings on open hillsides overgrown with thickets of low shrubs and weeds.

H. HUMERALIS *Say.* Williston, North Dakota, June; Brookings, South Dakota; Ada, Minnesota, July; Dane County, Wisconsin, June; Lee, New Hampshire; Aweme, Manitoba, May; McCook, Nebraska; Colorado Springs, June, and Fort Collins, Colorado; occurs also in Florida, Georgia, North Carolina, Virginia, Maryland, District of Columbia, New Jersey, New York, Massachusetts, Pennsylvania, Kentucky, Ohio, Indiana, Illinois, Michigan, Kansas, Missouri, Montana, Texas, Arizona, California and perhaps Mexico. The foregoing notes refer to the typical form, the blue variety is contained in the collection from Kalispell, Montana, June; Provo, Nephi and City Creek Canyon, Utah; Fort Collins and Ouray, Colorado, July; Williston, North Dakota, June; Ada, Minnesota, July; Dane County, Wisconsin, June; Durham, New Hampshire; Aweme and Winnipeg, Manitoba, May; Ottawa, Canada. It is found also in New York, New Jersey, Maryland, Massachusetts, Maine, Pennsylvania, Ohio, Indiana, Illinois, Michigan, Nebraska, Kansas, Texas and New Mexico.

H. HÆMATICA *Gorh.* Cuernavaca, Morelos, Mexico. This was common with *H. gorhami*, being even more plentiful than that species. The type locality is Mexico, (Puebla and Cuernavaca).

H. LECONTEI *Wolc.* (new name for *H. subœnea* Lec., not Spinola). This name is here proposed for the species identified and described as *H. subœnea* by LeConte (Ann. Lyc. Nat. Hist., N. Y. V, 1849, p. 26) which is quite different from the true *subœnea* of Spinola (Mon. Cler. II, 1844, p. 51). The latter appears to be very rare, if my identification of it is correct, and is known to me from Massachusetts only. On the other hand, *H. lecontei* is common and widespread, as will be shown by the following records. Old Orchard, Maine, June 23; Durham, New Hampshire; Chicopee, Massachusetts; Aweme, Manitoba, June; Greeley, Georgetown, Colorado Springs, Ouray and Salida, Colorado, June and July; Fort Douglas, Utah; Bodie and Soldiers Home, California; Flagstaff, Arizona, July; Magdalena Mountains and Cloudcroft, New Mexico. It is found also in New York, New Jersey, Vermont, Ohio, Nebraska, Montana and the Lake Superior region. The existing Illinois record is founded upon an erroneous identification. In the semi-arid regions of the west, this is the most abundant *Hydnocera* and may be beaten from various shrubs.

H. TRICOLOR *Schaeff.* Cameron County, Texas, September. The type locality is Brownsville, in this county.

H. WICKHAMI *Wolc.* Santa Rita Mountains, Arizona, September, (TYPE).

H. BIMACULATA *Wolc.* Amedee, California, July, (TYPE).

H. ASPERA *Wolc.* Cuernavaca, Morelos, Mexico, (TYPE).

H. SINGULARIS *Wolc.* n. sp. Elongate, feebly shining, æneous black, moderately densely clothed with short pale pubescence, antennæ and a large subscutellar spot pale yellowish, legs black, knees and anterior and middle tibiæ and tarsi testaceous, posterior tibiæ and tarsi piceous brown. Head, including the prominent eyes, as wide as the elytra, rather coarsely rugosely punctate, front feebly impressed. Prothorax slightly wider than long, punctuation same as that of the head, lateral foveæ neither very large nor strongly impressed, sides broadly and rather feebly dilated at apical two-fifths, nearly straight and feebly convergent posteriorly. Elytra shorter than the abdomen, moderately finely and very densely punctate, post-scutellar region depressed, humeri distinct, sides parallel, apices obliquely truncate, dehiscent at the suture, lateral margin posteriorly and sutural angle very finely serrate, the truncature nonserrate. In color, the elytra are less æneous than the other dark parts of the body, and are marked with a large, testaceous, common post-scutellar maculation which gives off a ramus bordering the scutellum and reaching the base. Legs clothed with long erect whitish hairs. Length, 4.50 mm.

Southern Pines, North Carolina, August 10, (TYPE).

This is described from a unique specimen, collected by A. H. Manee. It is totally unlike any of the other known species in coloration and differs in form and sculpture from all of those with truncate elytra.

H. KNAUSII *Wickh.* McPherson, Kansas, (TYPE). Also known from Brownsville, Texas.

H. OMOGERA *Horn.* Cameron County, September, Brownsville, July, Texas. Known also from Arizona and Lower California.

H. DISCOIDEA *Lec.* Yuma and Amedee, California, August; Las Cruces, April, and Albuquerque, New Mexico; Winslow and Tucson, Arizona; St. George and Chadburn's Ranch, Utah, July. This is a true desert species and is to be beaten from various shrubs. It extends into Mexico and Lower California.

H. SCABRA *Lec.* Tehachapi, California; Spokane, Washington; Nephi, Utah, June. It is known as well from Kansas, Colorado, Idaho, New Mexico and Arizona.

H. PYGMÆA *Wolc.* n. sp. Form of *H. scabra*, densely clothed with short, semirecumbent pubescence and sparse, erect, fine, whitish hairs. Head black with bluish tinge, finely rugosely punctate, about one-fourth wider than the prothorax, front feebly biimpressed, eyes large, prominent, antennæ pale testaceous, club slightly darker, palpi piceous. Prothorax black with bluish tinge, slightly wider than long, subapical constriction strong, sides broadly not very strongly dilated before the middle, posteriorly compressed, straight and subparallel to the base, subapical transverse impressed line feeble at middle, distinct at sides, basal transverse impressed line nearly obsolete, basal margin elevated, sculpture similar to that of the head, disk with longitudinal area finely, sparsely punctate. Elytra æneous black, scarcely wider at base than the head, slightly shorter than the abdomen, humeri moderately prominent, sides subparallel to apical two-fifths, thence rather strongly narrowing to the apices which are separately obtusely rounded and dehiscent at the suture, lateral margins behind the middle and apices distinctly serrate, punctuation moderately coarse and dense, the individual punctures somewhat confluent, pubescence nearly uniform, at apical two-fifths slightly longer and directed laterally but scarcely more dense and not at all conspicuous. Legs black, knees, anterior and middle tibiæ (the latter more or less infuscate) and tarsi of all the legs pale testaceous. Body beneath and legs moderately clothed with long whitish hairs, the abdomen rather sparsely pubescent. Length, 2.80 mm.

Independence, California, July 17, (TYPE); Bridgeport, California, 6465 feet, July 12 to 15, (COTYPE).

Represented by one specimen from each of the above localities. Allied to *H. scabra* but differs from that species by having somewhat less densely, more smoothly punctured elytra, and in lacking the distinct postmedian elytral pubescent band.

H. PEDALIS *Lec.* Onaga, Kansas; Malcolm, Nebraska, May; Colorado. It is found also in New Jersey, Ohio, Illinois, Wisconsin, Missouri and Arizona.

H. SPINOLÆ *Wolc.* Cuernavaca, Morelos, Mexico, (TYPE).

H. BITUBERCULATA *Chevr.* Jalapa, in the state of Vera Cruz, Mexico.

H. NIGRESCENS *Schaeff.* Southern Pines, North Carolina. This is the type locality.

H. NIVEIFASCIA *Schaeff.* Cuernavaca, Morelos, Mexico. Known from Arizona.

H. LONGA *Lec.* Alpine, Texas, July. Also known from Arizona.

H. FALLAX *Wolc.* Colorado Springs, June, (TYPE).

H. AFFILIATA *Fall.* Colton, California.

H. LATERALIS *Gorh.* Brownsville, Texas, July. Known from Panama.

H. SUTURALIS *Klug.* Tampa, Florida, May. It is probable that the species recorded under this name from Mexico, Panama and Guatemala will prove distinct.

H. VERTICALIS *Say.* Chicopee, Massachusetts, May; New York City, July; Allegheny County, Pennsylvania; Dane County, Wisconsin, June; Iowa City, Iowa; Toronto, Ontario, June. This is widely distributed in Florida, District of Columbia, New Jersey, New Hampshire, Vermont, Ohio, Indiana, Illinois, Michigan, Kansas and Texas.

H. PALLIPENNIS *Say.* Webster, New Hampshire; West Springfield, Massachusetts, July; Oswego, July, New Baltimore, August, New York; Southern Pines, North Carolina, June; Sparta, Wisconsin, August; Iowa City, Iowa. This species has also a wide range through Louisiana, Alabama, District of Columbia, New Jersey, Maine, Ohio, Pennsylvania, Indiana, Illinois, Michigan, Nebraska, Kansas, Missouri, Colorado and Ontario.

H. TRICONDYLÆ *Lec.* Onaga, Kansas, June 19. It is found as well in Illinois, Nebraska and Colorado.

H. LONGICOLLIS *Ziegl.* Onaga, Kansas, May 23; Hampton, New Hampshire, June 28; other known localities are District of Columbia, New York, New Jersey, Massachusetts, Pennsylvania, Ohio, Indiana, Illinois, Michigan, Wisconsin, Iowa, Nebraska, Texas and Ontario.

H. TABIDA *Lec.* Southern Pines, North Carolina, Chicago, Illinois, and Iowa City, Iowa, June; Douglas County, Kansas. This beetle is found in sweepings on low meadows and ranges through Alabama, District of Columbia, New Jersey, New Hampshire, Pennsylvania, Ohio, Indiana, Michigan, Wisconsin, Nebraska and Ontario.

H. ÆGRA *Newm.* Crescent City, Florida, April. It has been taken on Tybee Island, Georgia, by Mr. Wenzel.

ZENODOSUS *Wolcott.*

Z. SANGUINEUS *Say.* Iowa City, Iowa, March, April, May and September; Toronto, Ontario. I find this beautiful little beetle running in the house, probably being bred from sticks fallen from trees and bushes in the yard and thrown into the cellar for kindling. It is widespread in distribution, as will be shown by the list of additional localities, namely, Georgia, West Virginia, District of Columbia, New Jersey, New York, Rhode Island, Massachusetts, New Hampshire, Maine, Pennsylvania, Ohio, Indiana, Illinois, Michigan, Wisconsin, Nebraska, Kansas and Colorado.

EURYCRANUS *Blanchard.*

E. PULCHELLUS *Wolc.* San Angel, Federal District, Mexico, August, (TYPE). The unique specimen was found resting on a composite flower growing on the hills above San Angel, a few miles above Mexico City. But two species are known to occur on the American continent, the other, *E. viridiæneus* Gorh., being recorded from Guatemala.

Subfamily CORYNETINÆ.

Tribe IV. **Enopliini.**

Group 1. *Phyllobænides.*

PHYLLOBÆNUS *Spinola.*

P. DISLOCATUS *Say.* Onaga, Kansas; Iowa City, Iowa, August. This seems to be rather rare, but is found over a wide range of territory. The records give Georgia, District of Columbia, New York, New Jersey, New Hampshire, Massachusetts, Maine, Pennsylvania, Ohio, Indiana, Illinois, Michigan, Wisconsin, Kansas, Ontario and Texas.

ELLIPOTOMA *Spinola.*

E. LATICORNIS *Say.* Marion and Brookline, Massachusetts. Known from North Carolina, District of Columbia, New York, Maine, Canada, Pennsylvania, Ohio and Illinois.

Group 2. *Enopliides.*

PYTICERA *Spinola.*

P. HUMERALIS *Horn.* Oak Creek Canyon, Arizona. Extends into New Mexico and Mexico.

P. QUADRIPUNCTATA *Say.* Fedor, Texas. Also known from Ohio, Indiana and Arkansas.

P. QUADRIPUNCTATA var. QUADRINOTATA *Hald.* Fedor, Texas. It is recorded from no other state.

CHARIESSA *Perty.*

C. VESTITA *Chevr.* Brownsville, Texas, July. These fine beetles were found running during the daytime on posts in the village. Their contrasting blue backs and clear red legs made them very conspicuous. They were much less alert than the species of *Enoclerus* and *Thanasimus.* Other known records are Mexico, Guatemala, Nicaragua, Panama and Brazil.

C. ELEGANS *Horn.* Corvallis, Oregon; St. Helena, Napa County, California. It extends into Texas and possibly into Mexico.

C. PILOSA *Forst.* St. Louis, Missouri; Iowa City, Iowa, June 19; Bayfield, Wisconsin; South McAlester, Indian Territory, June; Bethlehem, Pennsylvania; Marion, Massachusetts. It has a wide range, occurring also in Florida, Georgia, District of Columbia, New Jersey, New York, Rhode Island, Kentucky, Ohio, Indiana, Illinois, Nebraska, Arkansas, Texas and Canada. Mr. C. A. Frost writes that it was bred from elm by H. B. Kirk.

C. PILOSA var. MARGINATA *Say.* (*onusta* Say). Hampton, New Hampshire, July 3. This too is widespread and is known from the District of Columbia, New Jersey, New York, Pennsylvania, Maine, Kentucky, Ohio, Indiana, Illinois, Kansas, Texas and Canada.

C. TEXANA *Wolc.* Texas, probably New Braunfels. No record exists for other states.

PELONIUM *Spinola.*

P. LEUCOPHÆUM *Klug.* (*vetustum* Spin.) Allegheny County, Pennsylvania. It is found also in Louisiana, Alabama, Florida, District of Columbia, New Jersey, Illinois, Missouri, Kansas, Texas, Lower California and Mexico.

P. MACULICOLLE *Schaeff.* Brownsville, Texas, June and August.

GALERUCLERUS *Gahan.*

G. OCULATUS *Say.* New York City; Camden County, New Jersey; Cincinnati, Ohio. It is known as well from Louisiana, Alabama, Florida, Georgia, District of Columbia, Massachusetts, Pennsylvania, Indiana, Kansas and Texas.

G. MIXTUS *Lec.* Brownsville and Columbus, Texas, July and August; Cincinnati, Ohio; Atoka, Indian Territory, June. It is recorded from Maryland, District of Columbia, Kentucky, Louisiana and Colorado. It is often beaten from thick clumps of vines.

ORTHOPLEURA *Spinola.*

O. DAMICORNIS *Fabr.* Onaga, Kansas, April, May and June; Iowa City, Iowa; St. Louis, Missouri; Fort Lee, New York. This insect is the most variable in size of any beetle that I know. It has a wide range over Cuba, Florida, Georgia, District of Columbia, New Jersey, Pennsylvania, Ohio, Indiana, Illinois, Michigan, Louisiana, Texas, Lower California and Mexico.

Tribe V. **Corynetini.**

LEBASIELLA *Spinola.*

L. MACULICOLLIS *Lec.* Pomona, Pasadena, Mount Lowe, Soldiers Home and Ahwahnee, California.

NECROBIA *Olivier.*

The three North American species of this genus are frequent upon dry carrion, and since they are readily transported and easily maintain themselves for some time under varying climatic conditions they are likely to be found almost anywhere within our limits. For this reason, it does not seem worth while to record the numerous localities represented.

N. RUFIPES *Fabr.* This species was brought to Iowa City some years ago, in a collection of natural history specimens from Cuba, and was fairly common about the Museum for a long time. It seems to have died out, however.

N. RUFICOLLIS *Fabr.*

N. VIOLACEA *Linn.* The habits of the last two are practically the same as in *N. rufipes.*

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CONTENTS

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FOSSIL COLEOPTERA FROM THE WILSON RANCH NEAR FLORISSANT, COLORADO

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The present report gives the results of a study of the collections made by myself at Florissant, during the summer of 1912. It is a part of a series of papers intended to make known the Coleopterous life of that region during the Miocene times and, including those characterized in a memoir now printing by the United States National Museum, brings up the number of beetles described from these shales to 377 species. Even now, the subject is by no means exhausted since the material on hand, consisting largely of the unworked portions of the Scudder collections, includes about a thousand unidentified specimens, which will certainly furnish at least 200 novelties, possibly even more.

The old lake at Florissant covered a good deal of ground. It is known to have been over nine miles long and about two miles across, with irregular outlines. The shales occur in layers of varying depth, interspersed with deposits of other character, the whole, in places, reaching a thickness of about forty or fifty feet. Presumably this deposition must have extended over a considerable period of time and it is reasonable to suppose that dust showers and mud flows took place at different seasons so we are not surprised to find that collections made at the various points where exposures occur show some tendency to be unlike in detail. The early explorations were made with no attempt to indicate the exact points from which specimens were taken and it was largely for the sake of remedying this neglect that Professor Cockerell undertook to number each station at which his parties worked—the idea being that if the beds were laid down at periods widely differing in geological time the faunæ of the various stations would yield some evidence to that effect. The beetles that he has sent me for study seem to show that the differences are not greater than we might expect in collections made at varying seasons or under diverse shore environments. As indicating what may be found in a single limited area, I subjoin a list of the Coleoptera from my collection. These, with the exception of perhaps half a dozen specimens which came from a point a few feet higher up, were all taken out of a single excavation not more than six feet in depth and perhaps twenty feet in length upon the side of a hill on Mr. George W. Wilson's ranch.

CARABIDÆ.

Calosoma emmonsi *Scudd.*
Bembidium florissantensis n. sp.
Tachys haywardi n. sp.
Amara powellii *Scudd.*
Platynus florissantensis n. sp.

DYTISCIDÆ.

Agabus florissantensis *Wickh.*
Cœlambus miocenus *Wickh.*

HYDROPHILIDÆ.

Hydrobius titan n. sp.
Creniphilites miocenus n. sp.

SILPHIDÆ.

Hydnobius tibialis n. sp.

STAPHYLINIDÆ.

Atheta florissantensis n. sp.
Heterothops conticens (?) *Scudd.*
Quedius chamberlini *Scudd.*
Leptacinus leidyi *Scudd.*
maclurei *Scudd.*
Stenus morsei *Scudd.*
Lathrobium antediluvianum n. sp.
Pæderus adumbratus n. sp.
Tachyporus nigripennis *Scudd.*
Boletobius stygis *Scudd.*
funditus *Scudd.*
Mycetoporus demersus *Scudd.*
Bledius soli *Scudd.*
Platystethus archetypus *Scudd.*
Oxytelus subapterus n. sp.
Homalium antiquorum n. sp.

COLYDIIDÆ.

Cicones oblongopunctata n. sp.

MYCETOPHAGIDÆ.

Mycetophagus willistoni n. sp.
exterminatus n. sp.

NITIDULIDÆ.

Colastus pygidialis n. sp.
Cychramites hirtus n. sp.

LATHRIDIIDÆ.

Corticaria petrefacta n. sp.

BYRRHIDÆ.

Nosotetocus vespertinus *Scudd.*

DASCYLLIDÆ.

Ectopria laticollis n. sp.

MALACHIDÆ.

Eudasytites listriformis *Wickh.*

CLERIDÆ.

Hydnocera wolcotti n. sp.

PTINIDÆ.

Vrilletta tenuistriata n. sp.

BOSTRYCHIDÆ.

Xylobiops lacustre *Wickh.*
Dinoderus cuneicollis n. sp.

SCARABÆIDÆ.

Aphodius granarioides *Wickh.*
aboriginalis *Wickh.*
præemptor n. sp.
laminicola *Wickh.*
Atænius patescens *Scudd.*

CERAMBYCIDÆ.

Protoncideres primus n. sp.

CHRYSOMELIDÆ.

Lema evanescens *Wickh.*
Crioceridea dubia *Wickh.*
Crytocephalus miocenus n. sp.

BRUCHIDÆ.

Bruchus scudderi *Wickh.*
haywardi *Wickh.*
exhumatus *Wickh.*

Bruchus florissantensis (?) *Wickh.*
wilsoni n. sp.
succintus n. sp.

PYTHIDÆ.

Pythoceropsis singularis n. sp.

MORDELLIDÆ.

Mordella lapidicola *Wickh.*
Mordellistena smithiana n. sp.

RHYNCHITIDÆ.

Auletes florissantensis n. sp.
Isothea alleni *Scudd.*
Trypanorhynchus exilis n. sp.
minutissimus n. sp.
obliquus n. sp.
Docirhynchus culex *Scudd.*
terebrans *Scudd.*
Toxorhynchus minusculus *Scudd.*

OTIORHYNCHIDÆ.

Evopes veneratus *Scudd.*

CURCULIONIDÆ.

Sitones exitiorum *Scudd.*
Geralophus antiquarius *Scudd.*
lassatus *Scudd.*
pumiceus (?) *Scudd.*
Anthonomus corruptus *Scudd.*
Anthonomus evigilatus *Scudd.*
debilitatus *Scudd.*
primordius *Scudd.*
Orchestes languidulus *Scudd.*
Rhysosternum longirostre *Scudd.*
Acalles exhumatus n. sp.
Cryptorhynchus kerri *Scudd.*
falli (?) *Wickh.*
Ceuthorhynchus clausus *Scudd.*
duratus (?) *Scudd.*
Baris imperfecta *Scudd.*
florissantensis n. sp.
cremastorhynchoides n. sp.
Centrinus obnuptus *Scudd.*
vulcanicus *Wickh.*
Balaninus minusculus (?) *Scudd.*
florissantensis n. sp.

CALANDRIDÆ.

Scyphophorus lævis *Scudd.*
Cossonus gabbii *Scudd.*

SCOLYTIDÆ.

Xyleborites longipennis n. sp.
Hylesinus extractus *Scudd.*
Hylastes americanus n. sp.
Hylurgops piger n. sp.

ANTHRIBIDÆ.

Brachytarsus (?) dubius n. sp.

An examination of the list shows it to contain ninety-five species of which forty are here described as new. Most of these novelties are so distinct as to offer no question as to their validity, and as many of them belong to families not studied by Dr. Scudder they may yet be found among the material collected by him at his chief station on Fossil Stump Hill, distant something over four miles by road. The preponderance of Rhynchophora is exhibited here as in all the other collections, this group furnishing thirty-eight species. The occurrence of four new Rhynchitids is noteworthy as indicating in a striking manner the great development of this family at Florissant during the Miocene, while the discovery of three new Scolytids helps to remove a deficiency in what is today a numerous group. The Bruchidæ or seed-weevils have supplied two more novelties; it is evident that the family was numerically stronger than today. Another Chrysomelid has been added to the scanty representation hitherto known from Florissant. Three families, the Pythidæ, Cleridæ and Mycetophagidæ until now containing no named species from these shales, are added. Staphylinidæ maintain their normal abundance, with a good quota of new things, and the two Hydrophilidæ found are now described for the first time. The Elateridæ and Lampyridæ have not been studied and hence do not appear in the catalogue.

The rather high percentage of small insects contained in the present collection is due in part to the special effort expended in looking over the split shales with a hand lens. This was done on account of a suspicion on my part that general collectors might have missed a good share of the little beetles because of an interest in more conspicuous things. It may be worth mentioning that a stroll along the beach of Lake Superior after a favorable night wind would show a much more striking assemblage of beetles, as far as size and structure are concerned, than seems to have been present about the shores of the ancient Lake Florissant.

As in previous papers, the illustrations are from camera lucida drawings. The figure of *Protoncideres primus* is free hand, the insect being too large for the microscope. The types of the new species remain in my collection.

BEMBIDIUM *Latr.*

B. FLORISSANTENSIS n. sp. (Plate V, Fig. 1.) Form elongate, subparallel. Head moderate, eyes not strongly prominent, antennæ slender. Prothorax broadest near the apex, sides arcuate and sinuate posteriorly, hind angles right or slightly prominent. Elytral subparallel at sides for most of their length, apices conjointly rounded, each elytron about three and one-half times as long as wide, finely striate, the striæ scarcely or not punctate, the interspaces, at least towards the margins, finely punctate. Legs wanting. Length, 6.10 mm. Width, 2.20 mm.

By the elongate form and differently shaped prothorax, this insect is readily distinguished from either of the fossil species described from Florissant by Scudder. It is not possible to place it in its correct position in relation to the enormous number of recent species of *Bembidium*.

TACHYS *Schaum.*

T. HAYWARDI n. sp. (Plate I, Fig. 1.) Form scarcely elongate for this genus. Head of moderate size, eyes normal, antennæ wanting, front finely punctured. Prothorax broader than the head, about one and two-fifths times as broad as long, widest slightly in front of the middle, median line indicated but not deep, base a little narrower than the apex, sides nearly regularly arcuate, not sinuate, angles not prominent, thoracic disk punctulate, basal and marginal beads fine. Scutellum small. Elytra much wider than the prothorax, sides rather strongly rounded, apices pointed, surface scarcely perceptibly striate except that one elytron shows a trace of a stria near the outer tip which may represent the strong groove found in that position in many of the recent species. Legs wanting. Length, 2.85 mm.

This seems to answer very well to the characteristic appearance and small size of the genus *Tachys,* and is the first species described from the Florissant Tertiaries. I do not feel that it is safe to try to indicate its relationships with the numerous modern forms. The name is given in memory of my friend, Roland Hayward, whose paper on *Tachys* is a most helpful contribution.

PLATYNUS Bon.

P. FLORISSANTENSIS n. sp. (Plate I, Fig. 2.) Form similar to that of the recent *P. melanarius.* Head of moderate size, antennæ slender, extending back to the basal third of the elytra, eyes not well defined. Prothorax strongly and regularly rounded on the sides, the width equal to a little less than twice the length of the median line, base not well defined so that the hind angles cannot be made out, but they are apparently rounded into the sides and base, or at least extremely indistinct. Elytra about equal in length to one and one-half times their conjoint width, very finely striate and with no visible interstitial sculpture though the striæ themselves show indications of being finely punctate. Legs wanting, excepting a portion of one of the hind pair which shows nothing of importance. Length, from front of head to elytral apex, 8.85 mm.

Compared with recent species, this would remind one of *P. placidus* by the fine striæ and of *P. melanarius* by the size and form. It does not resemble the fossil *P. tartareus* of these shales.

HYDROBIUS *Leach.*

H. TITAN n. sp. (Plate II, Figs. 4, 5.) Form more narrowed anteriorly and posteriorly than in the recent *H. fuscipes.* Head of moderate size, finely and closely punctate over the entire upper surface. Palpi with the terminal joint larger than the one preceding. Prothorax narrowed anteriorly, the sides rather regularly arcuate to the base which is the widest part, angles distinct, sculpture similar to that of the head but a little less pronounced. Elytra broadest about the middle, very finely punctate over the whole surface and showing signs of striæ which appear to have been indistinctly punctured. Legs moderately slender, the tibiæ with markings indicating rows of spines as in *H. fuscipes.* Abdominal segments subequal in length, finely punctate. Length, 10.00 mm.; of elytra, 5.75 mm.

At first sight, I had supposed this insect would turn out to be a *Tropisternus,* but an examination of the sterna and feet indicate its position as a member of the tribe *Hydrobiini,* where it seems to go well with *Hydrobius,* a genus showing considerable diversity in form and size. The tarsi are not flattened nor distinctly ciliate, and the metasternum is not prolonged into a spine. As far as they can be made out, the plates of the under surface of the body are strikingly like those of *H. fuscipes.* The only Florissant species with which it can be compared in facies is *Tropisternus vanus,* which differs not only in being smaller, but by the elytra being two and a half times the length of the median prothoracic line, while in *H. titan* they are about three and a half times the length. The specific name refers to the exceptional size of the fossil species.

H. PRISCONATATOR *Wickh.* (Plate II, Figs. 1, 2, 3.) The original description of this species was unaccompanied by a figure. I take the present opportunity to offer sketches showing both under and upper surfaces, the drawings being made from the type. A renewed study of the specimen shows that the elytral striæ are indistinctly punctate.

CRENIPHILITES n. gen.

Form similar to that of the modern species of *Creniphilus,* but perhaps a little more oblong. Metasternum considerably more elongate. Antennæ not in very good condition, but the basal club-joint is larger and the terminal one smaller than in the recent members of that genus. The type is *C. orpheus,* described below.

C. ORPHEUS n. sp. (Plate IV, Figs. 1, 2, 3.) Form elongate oval. Head rather small, outline subcontinuous with the curve of the prothoracic sides, eye moderate. Antennæ with basal joints not defined, club four-jointed, the first and last of these smaller than the intermediate ones. Prothorax much broader posteriorly, width equal to about twice the length, widest across the base, sides feebly arcuate, sculpture not visible. Elytra subcontinuous in outline with the prothorax (in the dorsal view, which is the better preserved), broadest at about their middle, sculpture apparently a fine, alutaceous roughening, no visible punctuation nor striation. Legs short and small. Front coxæ rounded, contiguous, middle coxæ oblique and nearly or quite contiguous, metasternum carinate along the median line. Length, 3.00 mm.

The size and form are those of some of our common species of *Creniphilus,* but the characters specified above seem to warrant the formation of a new genus for the reception of the fossil.

Hydnobius *Schmidt.*

H. tibialis n. sp. (Plate II, Figs. 6, 7.) Form moderately elongate. Head large, probably exaggerated in apparent size on account of abnormal extrusion. Antennæ with most of the basal portion concealed but showing the distal seven joints, the last five of which form a club. The basal club-joint (probably the seventh antennal joint) is longer than the one succeeding but smaller than the presumed ninth. The terminal three joints form by far the largest part of the club. The prothorax is shown from beneath, partly in side view, the coxæ large, globular or nearly so, angulate externally. Middle coxæ oblique. Elytra showing only one outer edge, with a small portion of the disk, sculpture scarcely evident except some slight traces of striation. Legs rather short and stout, the tibiæ all carinate externally, the number of carinæ apparently three. Middle and hind tarsi five-jointed. Length, 3.60 mm.

This seems to go into the genus *Hydnobius* without violating any of the essential characters and agrees especially in the structure of the antennæ and tarsi. The tibiæ of the recent *H. matthewsi* and *H. latidens* show the same carinate effect as those of the fossil. Modern forms of *Hydnobius* are known from Europe and from both the Atlantic and Pacific slopes of North America.

Atheta *Thoms.*

A. (?) florissantensis n. sp. (Plate III, Fig. 1.) Form rather broad for the genus, probably exaggerated by flattening. Head, in outline, rounded, eye small, oval. Antenna distinctly clavate, the apical joints much broader than the basal, but the articulations are not well defined. If directed backwards, the antenna would slightly pass the thoracic base. Prothorax broad, narrowed anteriorly. Elytra a little longer than the head and prothorax together, truncate at tip. Abdomen gently tapering, obtuse at apex. Legs wanting. Length, over all, 2.50 mm.

All of the Staphylinidæ described by Scudder are much larger than this one. I include it in *Atheta* merely for convenience. It is not strictly identifiable generically on account of the loss of the legs, but may be presumed to go into the same group of

Aleocharini as *Atheta,* which genus is well represented in North America today. The impressions on the pro- and mesothorax probably have to do with the coxæ, but I have not felt safe in describing them as such.

Lathrobium *Grav.*

L. antediluvianum n. sp. (Plate III, Figs. 2, 3.) Form rather stout for this genus. Head much larger than the prothorax, almost regularly elliptical in outline, sculpture not distinct, but there seems to be indications of coarse scattered punctures. Eyes small, elliptical, anterior in position. Antennæ only about as long as the head, first joint long, the others short, second and third longer than those following, eleventh (possibly through decomposition) subtruncate at the tip. Prothorax narrow, subelliptical, sculpture indistinct. Elytra short, only a little longer than the prothorax, sculpture not defined. Abdomen badly decomposed, but the form is evidently nearly parallel to the vicinity of the apex. Legs short and stout, the tibiæ broad. Length, 9.60 mm.

As far as appearance goes, except for the structure of the antennæ and legs, this might be a *Cryptobium.* It seems to go better in *Lathrobium,* in the wide sense, but is not especially like any of our recent forms. The short elytra recall those of *L. brevipenne,* which, however, has the hind angles of the head less rounded.

Pæderus *Grav.*

P. adumbratus n. sp. (Plate IV, Figs. 4, 5.) Form elongate. Head smaller than usual in this genus, antennæ proportionately longer than in most of the Florissant fossil Staphylinidæ, second joint not reduced. Prothorax pyriform in outline, strongly narrowed behind. Elytra one-third longer than the prothorax, truncate apically. Abdomen one-fourth longer than the remainder of the body. Legs rather slender, but short, the tibiæ not at all expanded. Length, from front of prothorax to abdominal apex, 4.65 mm.

This is about the size of the recent species which passes in collections as *P. littorarius* Grav., but the fossil seems to be more slender and to have a rather smaller head. As in the other Florissant Staphylinidæ, the legs are short compared with presumed generic representatives of recent times. The difference in the breadth of the right and left antennæ, as shown in the sketch, is probably due to their varying position in reference to the normal plane.

OXYTELUS *Grav.*

O. SUBAPTERUS n. sp. (Plate III, Figs. 4, 5.) Form more elongate than in most of the recent species. Head finely punctured, large, not wider than the prothorax but considerably longer, eyes small, moderately prominent, posterior in position, mandibles projecting and prominent. Antennæ, if directed backwards, reaching almost to the prothoracic hind angles, not geniculate, feebly incrassate to apex, first joint large, second small, third longer than the fourth. Prothorax strongly narrowed posteriorly, about one and two-fifths times broader than long, widest near the apex, sides regularly and feebly arcuate, apex a little advanced at middle, base approximately straight, surface sculpture similar to that of the head but a little coarser, apparently faintly grooved on each side of the middle. Elytra narrowed at base, wider behind, apices separately somewhat rounded, sculpture scarcely visible excepting a line at about the external fourth, which may represent the former line of flexure on the flanks. Abdomen a little longer than the remainder of the body, sides imperfect. Legs short and slender, the tibiæ simple, showing no spines nor processes. Length over all, 7.95 mm.

Except in the tibial structure, this seems a good *Oxytelus*. The spines, of course, may have been lost, but their absence and the want of any modification in the shape of the front pair leads me to think that eventually it may be necessary to separate the fossil as the type of a new genus. The size is greater than that of any of our recent North American species, but not excessively so when allowance has been made for probable abnormal elongation of the abdomen by maceration. The name refers to the assumed reduction of the hind wings, as indicated by the narrowed humeri.

HOMALIUM *Grav.*

H. ANTIQUORUM n. sp. (Plate V, Fig. 2.) Form elongate. Head strongly exserted, probably unnaturally so, the surface finely sculptured, eye nearly circular. Prothorax wider than the head, apparently not much narrowed posteriorly, the surface minutely roughened like the head. Elytra showing only along one side, where two rows of small rounded punctures are visible, the interstitial areas alutaceous. Sclerites of the meso- and metathoracic underside irregularly and (for so small an insect) not very finely punctate, abdominal sculpture apparently only an alutaceous roughening. Hind leg, the only one showing, rather short. Length, from front of head to abdominal apex, very nearly 2.00 mm.

One specimen, lying partly upon the side, so as to expose most of the under surface. The generic assignment is made in the wide sense. The form, sculpture, and such structural characters as can be made out lead to the above determination. The genus is a very large one and is well distributed.

Cicones *Curt.*

C. oblongopunctata n. sp. (Plate III, Figs. 6, 7.) Form a little more elongate than in the recent *C. marginalis*. Head moderately large, front with low, irregular granulations, more pronounced in the median area, antennæ, judging from that on the left, which is a little better preserved, with rather slender stem, of which the joints are hardly definable with certainty, and a rounded solid club. Prothorax a little less than one and a half times as broad as long, sides regularly arcuate, serrate, base and apex nearly equal, front angles prominent, surface granulate, more coarsely and closely on the disk, a distinct transverse sub-basal line. Elytra with regular rows of transverse punctures, these rows extending to the tip though not so shown on the figure since the imperfect preservation of the apical portion does not admit of their accurate delineation. Under surface coarsely sculptured. Legs short. Length, 3.60 mm.

This beetle, undoubtedly a Colydiid, agrees well with *Cicones* in the (apparently) open front coxal cavities, the antennal structure, the presence of a deep, well-defined antennal groove along the edge of the eye, the proportions of the abdominal segments and the sculpture of the upper surface. The only possible basis of separation would be on the apparent lack, in the fossil, of elytral setæ. However, I do not feel justified in erecting a new genus upon so uncertain a foundation. The two modern North American species of *Cicones* are found upon the Atlantic slope.

Mycetophagus *Hellw.*

M. willistoni n. sp. (Plate IV, Figs. 6, 7, 8.) Form only moderately elongate, subparallel. Head, as preserved, sunken well into the prothorax, eyes not defined. Antennæ short, gradually clavate, the basal joints not distinguishable, median joints small, transverse, club, at its widest part, three times as broad as the sub-basal portion of the antenna, last joint pointed at apex. Prothorax nearly twice as broad as long, apex not much narrowed, sides arcuate, more strongly in front and with the appearance of a marginal bead. Entire thoracic disk finely, sparsely, but distinctly punctured. Scutellum small, transverse. Elytra, at base, about as broad as the prothorax, conjointly rounded at tip, each elytron about two and a half times as long as broad. Sculpture of fine punctures, arranged in striæ, with a few other punctures of similar size scattered in the interstices. Legs, as far as shown, moderate, roughened above, possibly from hair impressions. Metasternum punctured, abdominal segments finely alutaceous. Length, 3.40 mm. Width, across the middle of elytra, 2.00 mm.

By all the characters of the underside, this insect seems to go very well into the Mycetophagidæ. The antennæ are of a type shown in some of the recent North American species of *Mycetophagus* (*Tritoma* of the recent European catalogues and of Casey), though relatively a little shorter. The general average of characters shown, the build, sculpture, and so on, would seem to ally it most closely to the recent *T. notatula* of Casey, from British Columbia and the Northwest Territories. I have named it after Dr. S. W. Williston, in recognition of the high services he has rendered in entomology and palæontology.

M. EXTERMINATUS n. sp. (Plate IV, Figs. 9, 10.) Form elongate. Head moderately large, much broader than long, punctuation close, distinct, and moderately coarse. Eyes rounded, not large. Antennæ not showing the basal joints, but terminated by a large three-jointed club, the joint immediately preceding being a little more than half the width of the club. Prothorax broader than the head but very short, about one and two-thirds times as wide as long, sides rather feebly rounded, base arcuate, about equal to the apex, surface finely punctate. Elytra subparallel at sides, conjointly rather sharply rounded at apex, length equal to one and two-thirds times their combined width, surface with rather fine, scattered, irregular punctuation and traces of fine striæ. Length, as preserved, 5.40 mm., in life probably a little less since the head and abdomen are apparently unnaturally distended.

Probably not a true *Mycetophagus*, though belonging to the same family. In form it is similar to the recent *M. pluriguttatus* but is differently punctured, the sculpture of the pronotum and elytra being less pronounced in the fossil. The antennæ have a wider club than any of the modern forms that I know. There is no evidence of hairy vestiture.

COLASTUS *Erichs.*

C. PYGIDIALIS n. sp. (Plate I, Fig. 3.) Form elongate, entire upper surface roughened, apparently scabro-punctuate, most strongly on the elytra, less so on the pronotum, and still more finely on the head and the exposed abdominal segments. Head incomplete in outline. Prothorax about one and one-half times as wide as long, the apex subtruncate, sides not much rounded. Scutellum of moderate size. Elytra about twice as long as the prothorax, exposing two full segments of the abdomen, the last of which is much the longer and is marked by a strong longitudinal median groove. Length, 2.80 mm.

One specimen, showing both obverse and reverse. It is slightly more elongate than the modern species of *Colastus* with which

I am acquainted, but goes well into the genus by the general facies and by the structure of the underside. In North America, *Colastus* is represented today by a few species which, in the aggregate, range from the Atlantic to the Pacific.

CYCHRAMITES n. gen.

Form similar to *Cychramus* (*C. adustus*). The scutellum is smaller and the last dorsal segment of the abdomen is differently formed. The type is *C. hirtus,* described below.

C. HIRTUS n. sp. (Plate I, Fig. 4.) Form sub-elliptical. Head large, finely punctate. Prothoracic width equal to three times the length of the median line, pronotum broadest across the base, strongly narrowing anteriorly, sides regularly arcuate, apex emarginate, front angles acute, surface a little more distinctly punctate than the head and with a covering of fine hairs. Elytra at base as wide as the prothorax, their apices separately broadly rounded and finely margined. Surface not striate but with a fine punctuation and covered with hairs. Apex of abdomen exposed, the dorsum of the terminal segment closely, evenly, but not very coarsely nor deeply punctured. Legs wanting. Length, 3.25 mm. Greatest width, 2.10 mm.

This seems to be a Nitidulid, similar to the recent species of *Cychramus,* but I do not like definitely to refer it there, and have consequently followed the prevalent custom of founding a magazine genus for its reception. The form of the terminal dorsal abdominal segment may be seen by reference to the figure.

CORTICARIA *Marsh.*

C. PETREFACTA n. sp. (Plate V, Fig. 3.) Form only moderately elongate. Head narrower than the prothorax, distinctly, and relatively rather coarsely, moderately densely punctured. Prothorax punctured a little less coarsely and more sparsely than the head, about one and four-fifths times as broad as long, apex narrower than the base, the sides feebly arcuate. Elytra broadest a little behind the middle, apices pointed, the sculpture consisting of a fine, rather irregular punctuation without sign of strial arrangement. Antennæ and legs wanting. Length, from front of head to elytral tip, 3.30 mm.

This may not be a true *Corticaria,* though the form of the body and the type of sculpture point to that reference. It is above the average size of existing species of the genus, approaching most nearly to the common *C. pubescens* of Europe and America, which reaches a length of 3.00 mm.

ECTOPRIA *Lec.*

E. LATICOLLIS n. sp. (Plate III, Fig. 8.) Form, allowing for flattening, similar to that of the recent *E. nervosa.* The head is somewhat damaged, the front outline broken, but the eyes are of moderate size and the antennæ, only one of which is preserved, are filiform, though the poor state of preservation precludes any description of the individual joints. Prothorax short, deeply emarginate in front, anterior angles sharp, base bisinuate. Scutellum small. Elytra, at base, about the same width as the prothorax, approximately one-fourth longer than their conjoint basal width. Sculpture of the entire upper surface minute and with a covering of fine hairs. Length, 3.85 mm.

It seems that the Dascyllidæ offer the best family agreement with this fossil, and it is placed provisionally in *Ectopria* since the proportions of the body, the antenna and the coxal structures correspond fairly well. The Dascyllidæ would seldom make satisfactory fossils, their fragility renders perfect preservation unlikely, and the generic characters rest largely upon structures which would scarcely ever be in condition for study.

HYDNOCERA *Newm.*

H. WOLCOTTI n. sp. (Plate IV, Fig. 11.) Form rather stout. Head short and broad, and, including the eyes, probably a little wider than the prothorax, sculpture extremely minute, consisting only of a fine alutaceous roughening. Antennæ not well preserved, but the club seems fairly distinct. Prothorax very broad, about one and a half times as wide as long, the sides not entirely perfect but evidently narrowing to the base, a strong transverse anterior impressed line, surface similar to that of the head. Scutellum moderate, triangular. Elytra much shorter than the abdomen, not striate, but strongly sparsely punctate towards the apices which are somewhat narrowed and separately rounded as well as distinctly beaded. Abdomen exposing at least four segments behind the elytral tips, sutures strongly sinuate, projecting backwards at middle. The dorsal ventral segments are without any well defined sculpture. Legs stout. Length, 5.35 mm.

Not particularly closely related to any of the numerous living North and Central American species with which I am acquainted. The exposed portion of the abdomen seems excessively long, but this is doubtless due in part to maceration before fossilization. The prothorax is like that of *H. pubescens* in the deep anterior impression, but is relatively broader and of different shape. The margined or beaded elytra recall those of *H. longicollis* or *H. tabida,* but are differently sculptured. The restriction of the punctures to the apical region is not so complete in any modern *Hydnocera* that I know, though in some of them this portion is much more strongly or densely punctured than the remainder of the elytra. In view of the wide range of abdominal exposure and of thoracic outline within this genus, I do not feel justified in separating the fossil generically on the basis of these characters. I take pleasure in dedicating this, the first fossil *Hydnocera,* to my friend A. B. Wolcott, of the Field Museum of Natural History.

Vrilletta *Lec.*

V. tenuistriata n. sp. (Plate IV, Fig. 12.) Form rather stout. Head, prothorax, elytra, and abdomen minutely punctulate or alutaceous. Eye of moderate size, elliptical in outline. Antennæ wanting. Prothorax, in side view, cuneiform, dorsal arch rather strong. Elytra overlapping in such a way as to somewhat obscure the outline, but they were evidently long enough to completely cover the abdomen, the surface with fine, deep, apparently impunctate striæ, which, so far as they can be traced, run together at the apex in the same manner as in the recent *V. laurentina,* epipleural lobe strong and with at least one stria. Abdomen with the second segment longer than the third or fourth, and but slightly shorter than the fifth. The sharp edge, which in life fits against the elytron, shows in the fossil as a longitudinal carina, on account of the accidental abdominal deflection. Legs rather short. Length, 5.55 mm.

The entire structure of this insect indicates a close relationship to *Vrilletta.* The form is the same, the general sculpture is very similar, the abdominal segmental proportions agree and so does the length of the legs, as far as shown. In size, the present species is almost identical with *V. laurentina,* but in the fine elytral striation it comes closer to *V. plumbea.* In the fossil, the head is incomplete anteriorly and is so represented in the figure. Six species of the genus *Vrilletta* are found in North America today, all belonging to the Pacific coast fauna excepting *V. laurentina* which occurs near Toronto, Canada.

Dinoderus *Steph.*

D. cuneicollis n. sp. (Plate II, Fig. 8.) Form stout. Head much smaller than the prothorax, rather roughly granulate. Prothorax, in side view, cuneate, the back strongly arched, surface granulate and with rather ill-defined transverse rows of asperities across the anterior half. Elytra with the dorsum moderately arched, the disk with three or four somewhat indistinct costæ, between which the surface is roughened. Legs and antennæ lacking. Length, 2.75 mm.

Resembles in size and general appearance the insect described by Scudder under the name *Hylesinus extractus.* The present species has a different prothoracic outline and the elytra are relatively shorter in comparison with the length of the pronotum. It is much smaller than *Xylobiops lacustre* from the Florissant shales. The genus *Dinoderus* is widely distributed, and is well represented in North America. The insect in hand would go near to the recent *D. punctatus* by its sculpture, but it is differently proportioned.

Aphodius *Ill.*

A. PRÆEMPTOR n. sp. (Plate VI, Figs. 1, 2.) Form moderately elongate, subparallel. Head incomplete, the anterior margin being injured on that slab which shows the dorsal view, but judging from the ventral aspect the sides of the clypeus are nearly straight and convergent to the apex which is truncate and without teeth or prominent angles. Prothorax with moderately arcuate sides, disk scarcely punctured, a few shallow punctures laterally. Scutellum short. Elytra injured at base but apparently about as wide as the prothorax, finely striate, the striæ not very deep and only finely punctate, the punctures longitudinal. Legs stout, tibiæ too much injured to show the teeth distinctly. Mesosternum not carinate. Length, 5.65 mm.

Easily distinguished from any of the other Florissant species of *Aphodius* of similar size by the type of elytral striation and punctuation. It would come near the fossil *A. aboriginalis.* The subjoined table will serve as a guide to the identification of the species thus far known from these shales.

- Size very small (under 3.00 mm.). Form stout, elytral striæ deep, fine, and apparently impunctate; (2.95 mm.). *shoshonis.*
- Size greater (3.50 mm. or more).
  - Size moderate (3.50 to 6.50 mm.).
    - Elytral striæ duplicate, impunctured; (5.25 mm.). *florissantensis.*
    - Elytral striæ simple, punctate or not.
      - Much smaller (3.50 mm.); striæ impunctate. *restructus.*
      - Larger (over 5.00 mm.); striæ punctate.
        - Thoracic disk distinctly punctate. Elytral striæ sharp, well impressed, with rounded punctures; (6.25 mm.). *granarioides.*
        - Thoracic disk nearly impunctate. Elytral striæ wide, fairly distinctly punctate; (6.50 mm.). *aboriginalis.*
        - Thoracic disk with rather indistinct scattered punctures. Elytral striæ sharp, narrow, with fine elongate punctures; (5.65 mm.). *praeemptor.*
  - Size very large. Elytral striæ fine, not closely punctured; (9.25 to 10.00 mm.). *laminicola.*

Protoncideres n. gen.

Form of *Oncideres,* to which it seems related. Prothorax unarmed at sides. Antennæ very long, (in what is presumed to be the male), about two and one-half times the body length. Front legs not elongate. Type, *P. primus,* described below.

P. primus n. sp. (Plate V, Fig. 4.) Preserved in ventral view. Form rather short and broad, subparallel. Head large, antennal tubercles pronounced, antennæ exhibiting only eight of the joints but these reach nearly twice the length of the entire body; first joint large, obconical, second very small, third a little more than twice as long as the first and equal to the fifth, fourth a trifle shorter, sixth and seventh each about as long as the fifth, eighth probably incomplete, the remainder wanting. The first and second joints are strongly punctate, the punctures distinctly transverse and tending to form series in that direction, third joint more finely punctured, the remainder apparently only finely roughened like the greater part of the body surface. Prothorax without spines, under surface finely transversely rugose, about as in the recent *Monohammus scutellatus.* Elytra not quite reaching the tip of the abdomen, (which was probably distended a little by maceration), apices rounded, the surface punctate towards the base but not strongly nor closely. Both inner and outer edges are apparently finely margined, the former being in the shape of a sutural bead, the latter probably the epipleura. Legs moderate or rather short, the pairs subequal in length, femora about as long as the tibiæ, the former not strongly clavate, the latter about straight and with no expansions nor teeth. Tarsi obscure. Length, 19.25 mm.

Comparisons with a large number of Cerambycidæ from North America, Europe and other parts of the world, give no clue to any very close relationships with this fossil. It seems, by the large head and immarginate prothorax, to be a Lamiide. The elongate antennæ suggest the Acanthoderini or Monohammini, but the lack of spine or tubercle upon the thoracic sides is uncommon in these groups. If it were not for the fact that the anterior legs are not elongate in my specimen (which, judging by the antennæ, is a male) it might be considered near *Ptychodes,* but so far as the visible characters permit the formation of an opinion, I think it best to place the insect between *Saperda* and *Oncideres.*

Cryptocephalus *Geoff.*

C. miocenus n. sp. (Plate V, Fig. 5.) Form fairly stout. Head bent up, but as it is shown from the under side it displays no features of interest. Antennæ visible only at the base, slender. Elytra conjointly a little more than four-fifths as wide as long, strongly and deeply punctatostriate. Length, 4.65 mm.

The Chrysomelidæ seem to have been rather rare at Florissant and this is the first *Cryptocephalus* to be recorded from these shales. Of course the generic reference is to be understood in the broad sense of the term, since there is no way of separating most fossils by the characters used in defining modern genera split off from *Cryptocephalus* as understood by its author. The prominence of the head, judging from the appearance of the under surface, is due to flattening and pressure. Cryptocephalid characters are seen in the form, texture, and sculpture of the body, the small rounded anterior coxæ well separated by the prosternum, the widely distant hind coxæ, the short intermediate abdominal segments with arcuate sutures, and the filiform antenna.

Bruchus *Linn.*

B. succintus n. sp. (Plate V, Fig. 6.) Preserved in side view. Form rather stout. Head finely but distinctly and closely punctate, more finely on the occiput, antennæ wanting, except three or four of the median joints which are hardly serrate. Prothorax with close, deep, rounded punctures of moderate size, becoming subconfluent in places, these punctures very much larger than those of the head. Elytra badly broken at apex, epipleural lobe strong, disk punctured and striate, the striæ narrow, moderately deep, much stronger at base, marked at their bottoms with single rows of close, slightly elongate punctures, interspaces distinctly punctate. Hind coxal region strongly and closely but not coarsely punctured, the sternal plates very sparsely, the abdomen scarcely visibly punctulate. Hind femur only moderately swollen and not showing teeth, the tibia nearly straight. Length, from front of head to tip of abdomen, 3.50 mm.

Easily distinguished from any of the other described Florissant species by the small size, strong punctuation, and comparatively slender hind femora. The above measurement is that of the type, other specimens run as small as 2.25 mm.

B. wilsoni n. sp. (Plate V, Figs. 7, 8, 9.) Form rather short and stout. Head small, eye large, front moderately strongly, closely punctured, antennæ slender, about as long as the elytra, not serrate. Prothorax injured, but what remains shows it to have been broad, the sides apparently nearly straight to near the apex, thence very suddenly narrowed. Disk with moderately deep, rounded punctures, not very closely nor regularly placed, the median area being less punctured than the lateral, base hardly lobed, nearly straight or only a little curved. Elytra rather more than three times the prothoracic length, nearly smooth excepting that each is marked with fine, narrow, regular, impunctate striæ. Abdomen, as preserved, considerably exceeding the elytral apices. Hind femora strongly swollen, each apparently with a good-sized tooth, though this structure is indistinct, hind tibiæ much arcuate. Length, 3.25 mm.; of elytron, 2.00 mm.

A considerably smaller species than most of those hitherto recorded from Florissant. It seems nearest *B. osborni* in antennal, thoracic, and sculptural characters, but that species is much larger. The measurements given for *B. wilsoni* are those of the type, others are as small as 2.65 mm. It is named for George W. Wilson of Florissant, to whom I am indebted for many favors which materially assisted me in the investigation of the fossil insect fauna.

For the purpose of more readily distinguishing the Florissant species of *Bruchus,* I subjoin the following table.

Antennæ strongly serrate; (3.75 mm.). *dormescens.*
Antennæ weakly or moderately serrate.
  Larger (4.35 mm.). Thoracic punctures shallow. *exhumatus.*
  Smaller (3.90 mm.). Thoracic punctures strong. *scudderi.*
Antennæ not serrate.
  Elytral striæ with strong rounded punctures; (4.15 mm.). *henshawi.*
  Elytral strial punctures weaker, elongate.
    Large species (6.00 mm.). *bowditchi.*
    Smaller species.
      Prothoracic punctuation moderately close; (4.00 mm.). *florissantensis.*
      Prothoracic punctuation strong, deep, becoming subconfluent in places; (2.25 to 3.50 mm.). *succintus.*
      Prothoracic punctuation very fine and sparse.
        Thoracic apex truncate. Punctuation stronger; (4.65 mm.). *haywardi.*
        Thoracic apex rounded. Punctuation finer; (4.45 mm.). *osborni.*
  Elytral striæ impunctate; (2.65 to 3.25 mm.). *wilsoni.*

Pythoceropsis n. gen.

Form similar to that of the recent genus *Lecontia.* Anterior coxæ round, separated by the prosternum, middle coxæ slightly transverse and apparently only a little separated, their inner edges obscured by the anterior femora which have been folded back. Posterior coxæ transverse, extending to the sides of the body, contiguous on the median line, intercoxal process short. Antennæ not clubbed, but slender at the apex, first joint large, second much smaller, third elongate, fourth fifth, sixth, and seventh subequal among themselves and each shorter than the third; the eighth, ninth, tenth and eleventh are much shorter than those preceding, the eleventh probably damaged at the apex. The type is *P. singularis,* described below.

P. SINGULARIS n. sp. (Plate I, Figs. 5, 6.) Body elongate, form subparallel. Head of moderate size, anterior margin not defined, eyes, seen from below, small and coarsely granulated. Antennæ equal in length to about one and one-third times the width of the head, slender, if directed backward they would reach slightly beyond the elytral base, apex not incrassate. Gular region transversely corrugated. Prothorax not sufficiently perfect to show the outline distinctly, the underside is plainly but not coarsely punctured, more sparsely upon the middle than on the flanks. Mesosternum strongly and closely punctured, its side-pieces more finely and sparsely. Metasternum long, apparently finely grooved along the middle line, the punctuation extremely fine, that of the side-pieces more distinct. Elytron a little less than three times as long as wide, narrowing behind the middle, apex bluntly pointed, sculpture consisting of close, regular, distinct, rounded punctures of moderate size, not arranged in striæ although there is some tendency to linear series, a faint indication of two discal flat costæ as shown in the sketch. Abdomen with five free segments, the one before the last a little shorter than the others, the entire abdominal ventral surface with fine but distinct scattered punctures. Legs, as far as shown, of moderate length. Length, 12.65 mm.; of elytron, 9.00 mm. Greatest width of elytron, 3.20 mm.

This insect is of great interest, as it introduces into the Florissant Miocene fauna a family not hitherto recognized as one of its constituents. In my mind, there is no doubt of the Pythid affinities. The antenna is of a type found in different genera of the heteromerous series, the reduction in length of the distal joints being the most striking feature. It is remarkable how closely the sculpture of the underside follows that of *Pytho americanus* and *Boros unicolor,* while the elytral sculpture is similar to that of the latter species. No one of our three common genera of North American Pythini is followed consistently in all characters. To me, the insect has the underside of *Lecontia* or *Boros* with the antennæ of *Pytho* and may be regarded as a synthetic type.

The type specimen is an underside, but the elytron (shown separately on the plate, to save space, though in reality it projects out at a wide angle as indicated by the stub in the drawing) is twisted so as to exhibit the upper surface.

MORDELLISTENA *Costa.*

M. SMITHIANA n. sp. (Plate IV, Fig. 13.) Preserved in side view. Form a little broad, well tapering, anal style moderate in length. Elytra narrowing to apex, not sharply pointed, the length a little more than four times the breadth. Sculpture of entire body extremely fine, scarcely visible.

Legs wanting, except a small portion of one of the hind pair which shows no characters of importance. Length, exclusive of style, 3.40 mm.; of anal style, about .80 mm. Height, 1.55 mm.

On account of its small size, this is referred to *Mordellistena*. Compared with the fossil *M. florissantensis,* the present species has a distinctly differentiated moderately long anal style and relatively longer elytra. The name is given in memory of the late John B. Smith, whose Synopsis of the Mordellidæ is well and favorably known.

Auletes *Schönh.*

A. florissantensis n. sp. (Plate VI, Fig. 3.) Form rather slender and elongate for this genus. Head narrower than the prothorax, eyes not distinctly definable but evidently small, antennæ showing only a few of the median joints which are rather slender. The cephalic punctuation is strong and close, except on the occiput. Prothorax distorted by pressure, the sides damaged so that their outline cannot be determined, punctuation perceptibly less strong than that of the head but very close. The front coxæ are overlapped a little in the specimen, in life they were evidently contiguous. Meso- and metasterna, with their side-pieces, strongly and closely punctured, middle coxæ contiguous. Elytra rather coarsely and closely punctured, the discal punctures not in striæ, but showing some indication of leaving a smooth longitudinal discal line and a stria is evident along the outer margin. Abdominal segments subequal, punctured at sides, nearly smooth along the middle. Legs slender and rather short for this family. Length, from the base of the beak to the elytral apex, 4.75 mm.

Unfortunately the beak is destroyed in my only specimen. The insect is an undoubted Rhynchitid and is a much better exponent of *Auletes* than the fossil *A. wymani* referred here by Scudder. Recent species of this genus are found from Massachusetts to British Columbia.

Trypanorhynchus *Scudd.*

T. minutissimus n. sp. (Plate VI, Fig. 4.) Form moderately elongate. Head full, very minutely sculptured in front, eye small and nearly circular, behind it a fan-shaped figure of about thirteen fine rugæ. Rostrum straight, about equal in length to the dorsal line of the prothorax, striate and carinate. Prothorax very little arched along the back, anterior side margin about straight, surface closely and, for such a small insect, moderately coarsely punctate. Elytra more finely sculptured than the prothorax, punctures rounded, subseriate in arrangement at base but completely confused apically. Underside of body much smoother than the upper, particularly upon the abdomen, which is barely visibly punctate. Legs lacking, except one fore femur which is of moderate length and stoutness. Length, from front margin of prothorax to elytral tip, 2.65 mm.; of rostrum, about .80 mm.

This is referred to *Trypanorhynchus* since it seems to go better in that genus than in any of the others described by Dr. Scudder. It is smaller than any of the species placed there by him, but would come nearest *T. sedatus,* though easily distinguished by the corrugate head of the specimen in hand. It looks like the figure of *Apion exanimale* from these shales, but from the description I judge the elytra of that species to be impunctate.

T. EXILIS n. sp. (Plate VII, Fig. 2.) Form rather slender, back not strongly arched. Head without noticeable striations, eye subelliptical, beak a little longer than the prothorax, nearly straight, antennæ not visible. Prothorax short and, as preserved, higher than long, the surface with strong, large, irregular punctures, much more evident on the sides than on the disk and becoming confluent laterally so as to form rugæ. Elytra not striate but with rows of moderately deep, well separated, rounded punctures, smaller than those of the prothorax. Legs rather short. Length, 2.60 mm.

Resembles *T. minutissimus* quite closely but that species has the prothorax more regularly, closely and finely punctured, the elytral punctuation is also closer and better defined. The fan-shaped striate area, so well shown in *T. minutissimus,* is absent from the head of the present species.

T. OBLIQUUS n. sp. (Plate VII, Fig. 1.) Form, in profile, rather elongate, back regularly but not strongly arched. Head small, higher than long, the sides, behind the eyes, strongly and regularly transversely striate, eye elliptical, oblique, the long axis nearly parallel to the forehead which is very finely punctulate, occiput more strongly punctured and with some trace of rugosity. Beak well defined at base, arising suddenly from the head, long, almost straight, strongly striate, carinate and punctured. Antennæ inserted at about basal third, straight, proximal and medial joints slender, elongate, club three-jointed, moderately broad, the joints slightly obscured but apparently subequal in length. Prothorax distinctly punctured, the punctures mostly well separated but tending to form transverse rugæ, the fore part of the disk a little smoother. Elytra distinctly punctate at base, the remainder of the surface sculpture obscure or obliterated except that faint striæ are indicated as shown in the figure. Legs moderately long, tarsi obscure. Abdominal segments subequal. Length, excluding rostrum, 6.10 mm.; of beak, 3.30 mm.; of antennæ, 1.90 mm.

This fine beetle, about the size of *Rhynchites subterraneus,* differs from that species and from the recent members of the genus (as far as they are known to me) in having elliptical oblique eyes. Chiefly on account of this character, I have placed it in *Trypanorhynchus,* near *T. depratus* from which it is at once distinguishable by the relatively longer beak in *T. obliquus.*

ACALLES *Schönh.*

A. EXHUMATUS n. sp. (Plate VII, Fig. 3.) The specimen is preserved in such a position as to present chiefly a dorsal view. Form moderately elongate and not very robust, recalling the recent *A. porosus* but with a differently shaped prothorax. Head not distinguishable. Prothorax broadest at base, strongly narrowed anteriorly, the sides little if at all arcuate, surface rather coarsely and very closely granulate, the granules rounded and with a slight tendency to form longitudinal or radiating series, a distinct median line present. Elytra with series of elevated rounded granules, effaced over a great part of the surface but where present they are fairly regularly spaced, separated by distances somewhat greater than their own diameters. The courses of these series can be traced sufficiently well to indicate that they were extensively confluent near the tip, the discal rows enclosed, as usual in the Rhynchophora. Length, 6.25 mm.

Some doubt must attach to this generic identification, which is made chiefly upon facies. Nothing similar seems to have been described by Dr. Scudder, the nearest approach to it being his *Rhysosternum æternabile,* in which the thoracic punctures form distinct rugæ. I assume that in my specimen the sculpture is in reverse, and that the granules represent punctures.

BARIS *Germ.*

B. FLORISSANTENSIS n. sp. (Plate VI, Figs. 6, 7, 8.) Form rather stout. Head mostly concealed, except the rostrum which is short, only slightly curved, and punctate near the base, eye elliptical and transverse. Prothorax with close, deep, rounded punctuation, about uniform over the entire disk. Elytra striate, the striæ with distinctly elongate, well-impressed but not very regularly spaced punctures, the interstitial areas broad, nearly flat, with transverse alternating grooves and ridges, representing a further development of the type of punctuation seen in the recent *B. transversa.* The elytra overlap along the suture, confusing the arrangement of the striæ, but those of the disk are seen to be disposed very much as in *B. transversa.* Legs, as far as shown, rather finely and somewhat rugosely punctured, only the femora visible. Length, 4.75 mm.

One specimen, showing obverse and reverse. This species is readily distinguished from most of the other Florissant fossil representatives of the genus by its size, in which respect it is approached only by *B. schucherti* and *B. cremastorhynchoides*. From both of these, it may be distinguished by the distinct transverse sculpture of the interstrial spaces. It approaches the recent *B. transversa* in several features, and like that species has a distinct humeral callus, but this is more strongly punctured in the fossil.

B. CREMASTORHYNCHOIDES n. sp. (Plate VI, Fig. 5.) Form rather elongate and but slightly arched above. Head finely and distinctly but not very deeply punctured, the punctures separated by less than their own diameters. Eye, not shown in the figure, moderately large, transverse. Beak not defined. Prothorax more coarsely and deeply punctured than the head. Elytra punctured in rows, the puncta circular and deep, ordinarily separated by a little less than their own diameters, interspaces nearly flat and not hairy nor punctate. Under surface of meso- and metathorax sculptured similarly to the prothoracic disk, but somewhat less closely, ventral segments much smoother, scarcely visibly punctate, the first and second segments long, the next two short, first suture strongly sinuate at sides, second and third bent at tips. Legs short but not distinct enough for description. Length, 4.60 mm.

This insect is strikingly like *Cremastorhynchus stabilis*, described from the Florissant shales, which has been placed in the Anthonomini by Dr. Scudder. The present species differs essentially in having the abdominal segments very unequal in length. It seems best placed in the Barini, but is most likely not a true *Baris* in the restricted sense, the form being more nearly that of *Limnobaris*.

CENTRINUS *Schönh.*

C. VULCANICUS *Wickh.* (Plate VII, Figs. 4, 5.) A fine specimen of the insect described by me as *Dorytomus vulcanicus* (Bull. Amer. Mus. Nat. Hist., XXXI, p. 48, pl. IV, fig. 1) indicates the propriety of removing it from *Dorytomus*. The appearance of a strong tooth on the front femur of the original example is illusory, though this character was the chief one upon which the generic reference was made. A new figure and details are given herewith, showing some features not to be made out in the first example studied. It will be noted that in the gradually formed club, the antennal structure is similar to that figured by Dr. Scudder for his *C. obnuptus*. Compared with recent forms in my cabinet, it seems closest to *C.* (*Odontocorynus*) *denticornis*.

C. OBNUPTUS *Scudd.* (Plate VII, Fig. 6.) A fine example of this insect is contained in the collection and offers an opportunity for a figure showing some additional details.

Balaninus *Germ.*

B. florissantensis n. sp. (Plate VI, Fig. 9.) Form stout. Head small, finely punctured, eye elliptical, transverse. Rostrum heavy, very minutely and quite closely punctulate, nearly straight, except near the tip where it is very faintly arcuate. Antennæ not well defined, but the point of insertion is about two-thirds from the base. Prothorax, in side view, about twice as high as long, dorsum strongly arched, surface regularly punctate, the punctures round and close-set. Elytra with well defined striæ of rather approximate elongate punctures. Legs stout, but not especially short, the thighs unarmed. Length, allowing for the breaking of the elytral apex, about 4.00 mm.

This seems distinct from any of the rather numerous species of *Balaninus* already known from Florissant. In size it is near *B. femoratus* and *B. minusculus*. From the former it differs in having a longer beak, differently shaped femora, and elliptical instead of circular eyes. From the latter it may at once be told by the nearly straight rostrum and coarse elytral sculpture. It looks a great deal like *Dorytomus williamsi*, but that species is said to have toothed femora. The elytral lines, in my figure, show simply the courses of the striæ and not their punctuation.

Xyleborites n. gen.

Form similar to the recent *Xyleborus pubescens* but more elongate, the prothorax shorter as compared with the elytra, the thoracic sculpture finer and nearly uniform, eye sub-elliptical. These characters are, of course, not in themselves generic, but they indicate a probable diversity of structure from the modern species of *Xyleborus*. The type is *X. longipennis*, described below.

X. longipennis n. sp. (Plate VII, Fig. 7.) Form elongate. Head large, the surface finely roughened or asperate, eye subelliptical, antennæ not showing. Prothorax cuneiform, in side view, dorsal arch broken, the front lateral margin bisinuate, surface finely, evenly asperate, not perceptibly more so anteriorly. Elytra imperfect at apex but at least two and a half times the prothoracic length, striatopunctate, the punctures well separated, rounded or slightly longitudinal, the interspaces very finely transversely rugose. Legs stout, the middle tibia, the only one well shown, longitudinally carinate. Length, as preserved, 2.25 mm.

I cannot place this insect in *Xyleborus* without giving too much latitude to the presumed generic facies. At first sight it looks like some Xylebori or Pityophthori but the prothorax is relatively too short. The best course seems to be its separation by the suggestion of a provisional genus.

HYLASTES *Erichs.*

H. AMERICANUS n. sp. (Plate VI, Fig. 10.) Form only moderately elongate for this genus. Head finely scabrous, eye not defined, antenna showing well the sub-spherical club. Prothorax, in side view, not much arcuate on the dorsal line, the surface regularly sculptured with fairly deep, rounded, approximate punctures of moderate size. Elytra about twice as long as the prothorax, punctate in striæ, the punctures sub-transverse, moderately close-set and deep. Abdomen punctured, but less strongly than the elytra. Legs short, the tibiæ moderately expanded. Length, 4.50 mm.

This seems fairly close in appearance to the recent *H. cavernosus.* The tibiæ are not well enough preserved to show the toothing if it were present. The genus is well distributed and contains a moderate number of species.

HYLURGOPS *Lec.*

H. PIGER n. sp. (Plate VII, Fig. 8.) Form stout. Head rather finely punctato-scabrous, eyes and antennæ not definable. Prothorax with the dorsum only slightly arched, the surface very closely sculptured with deep rounded punctures, more or less confluent on the disk but hardly so near the flanks. Elytra about two and one-third times the length of the prothorax, with well-marked striæ, each of which is beset with a row of large, deep, approximate, rounded punctures. There is some evidence that these striæ are set off in pairs by the elevation of the alternate intervals. Underside of abdomen and thorax distinctly punctured, the former much more strongly. Legs short, tibiæ broad. Length, 3.45 mm.

The generic assignment is made upon the facies. The elytral sculpture is strikingly like that of the recent *H. subcostulatus,* from California and Arizona, this species being matched almost exactly in size as well by the fossil.

BRACHYTARSUS *Schönh.*

B. (?) DUBIUS n. sp. (Plate IV, Fig. 14.) Form about as in the recent common *B. variegatus,* the prothorax a little more rounded at the sides. Head not visible. Pronotum closely and regularly sculptured with moderate sized, rather shallow, round punctures. Elytra punctatostriate, the punctures elongate but not very deep. Length, 2.90 mm.

Characters for exact classification are not available, and the assignment is made chiefly upon facies. Compared with *B. variegatus,* the fossil has the prothorax much more regularly and closely punctate, somewhat as in the European *Aræocerus fasciculatus.* The elytral striæ are fine and the punctures very decidedly elongate.

Explanation of Plates.

Plate I.

1. Tachys haywardi n. sp.
2. Platynus florissantensis n. sp.
3. Colastus pygidialis n. sp.
4. Cychramites hirtus n. sp.
5. Pythoceropsis singularis n. sp.
6. Pythoceropsis singularis, elytron.

Plate II.

1. Hydrobius prisconatator Wickh., underside.
2. Hydrobius prisconatator, upper side.
3. Hydrobius prisconatator, antenna.
4. Hydrobius titan n. sp.
5. Hydrobius titan, underside.
6. Hydnobius tibialis n. sp.
7. Hydnobius tibialis, antenna.
8. Dinoderus cuneicollis n. sp.

Plate III.

1. Atheta florissantensis n. sp.
2. Lathrobium antediluvianum n. sp.
3. Lathrobium antediluvianum, antenna.
4. Oxytelus subapterus n. sp.
5. Oxytelus subapterus, antenna.
6. Cicones oblongopunctata n. sp.
7. Cicones oblongopunctata, underside.
8. Ectopria laticollis n. sp.

Plate IV.

1. Creniphilites orpheus n. sp.
2. Creniphilites orpheus, underside.
3. Creniphilites orpheus, antenna.
4. Pæderus adumbratus n. sp.
5. Pæderus adumbratus, head and antennæ.
6. Mycetophagus willistoni n. sp.
7. Mycetophagus willistoni, underside.
8. Mycetophagus willistoni, antenna.
9. Mycetophagus exterminatus n. sp.
10. Mycetophagus exterminatus, antenna.
11. Hydnocera wolcotti n. sp.
12. Vrilletta tenuistriata n. sp.
13. Mordellistena smithiana n. sp.
14. Brachytarsus (?) dubius n. sp.

Plate V.

1. Bembidium florissantensis n. sp.
2. Homalium antiquorum n. sp.
3. Corticaria petrefacta n. sp.
4. Protoncideres primus n. sp.
5. Cryptocephalus miocenus n. sp.
6. Bruchus succintus n. sp.
7. Bruchus wilsoni n. sp.
8. Bruchus wilsoni, antenna.
9. Bruchus wilsoni, thoracic punctuation.

Plate VI.

1. Aphodius præemptor n. sp.
2. Aphodius præemptor, underside.
3. Auletes florissantensis n. sp.
4. Trypanorhynchus minutissimus n. sp.
5. Baris cremastorhynchoides n. sp.
6. Baris florissantensis n. sp.
7. Baris florissantensis, elytral sculpture.
8. Baris florissantensis, thoracic punctuation.
9. Balaninus florissantensis n. sp.
10. Hylastes americanus n. sp.

Plate VII.

1. Trypanorhynchus obliquus n. sp.
2. Trypanorhynchus exilis n. sp.
3. Acalles exhumatus n. sp.
4. Centrinus vulcanicus Wickh.
5. Centrinus vulcanicus, eye, beak and antenna.
6. Centrinus obnuptus Scudd.
7. Xyleborites longipennis n. sp.
8. Hylurgops piger n. sp.

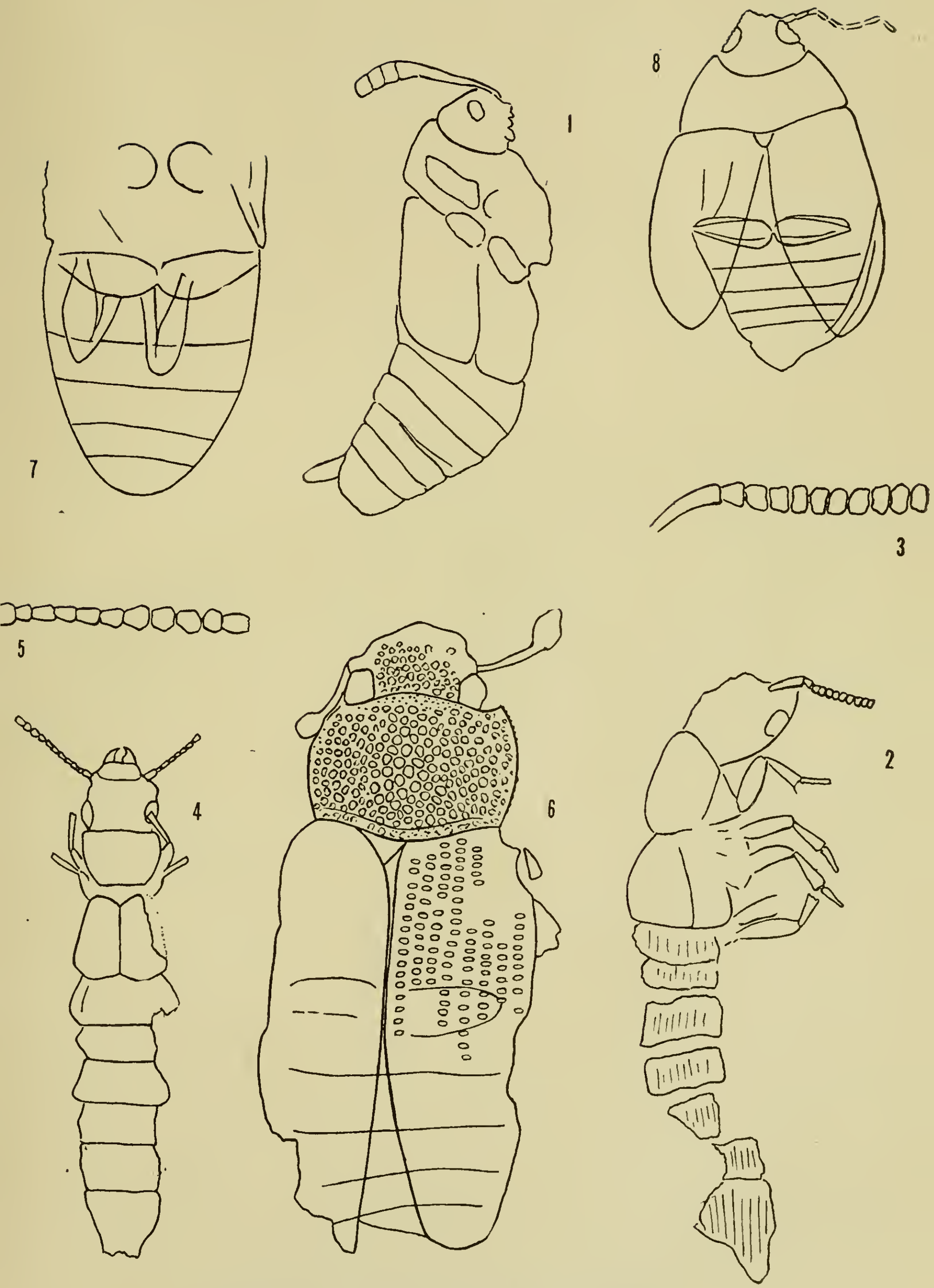
PLATE I

FOSSIL COLEOPTERA FROM FLORISSANT

PLATE II

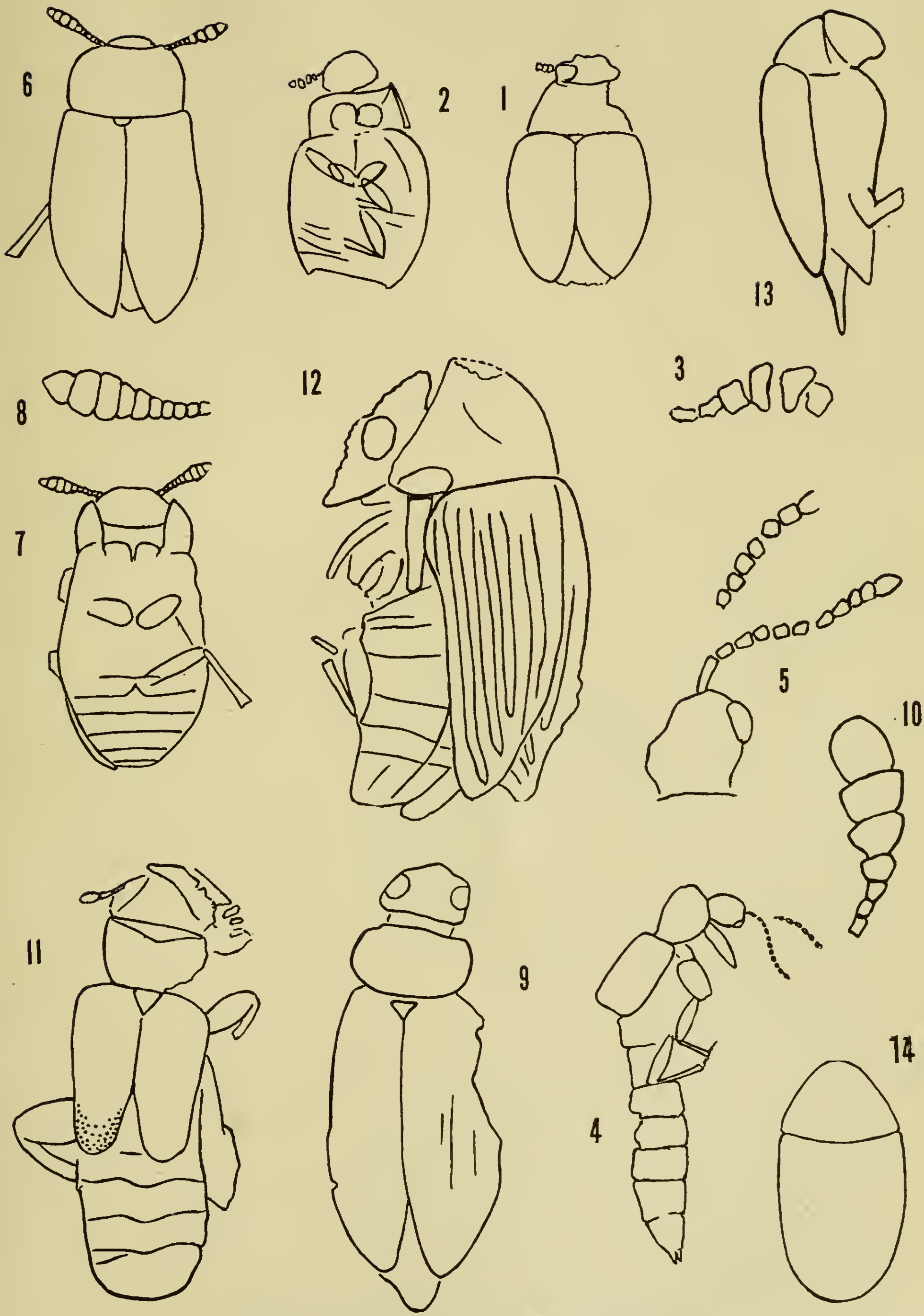
VI—4—3 FOSSIL COLEOPTERA FROM FLORISSANT

PLATE III



FOSSIL COLEOPTERA FROM FLORISSANT

PLATE IV



FOSSIL COLEOPTERA FROM FLORISSANT

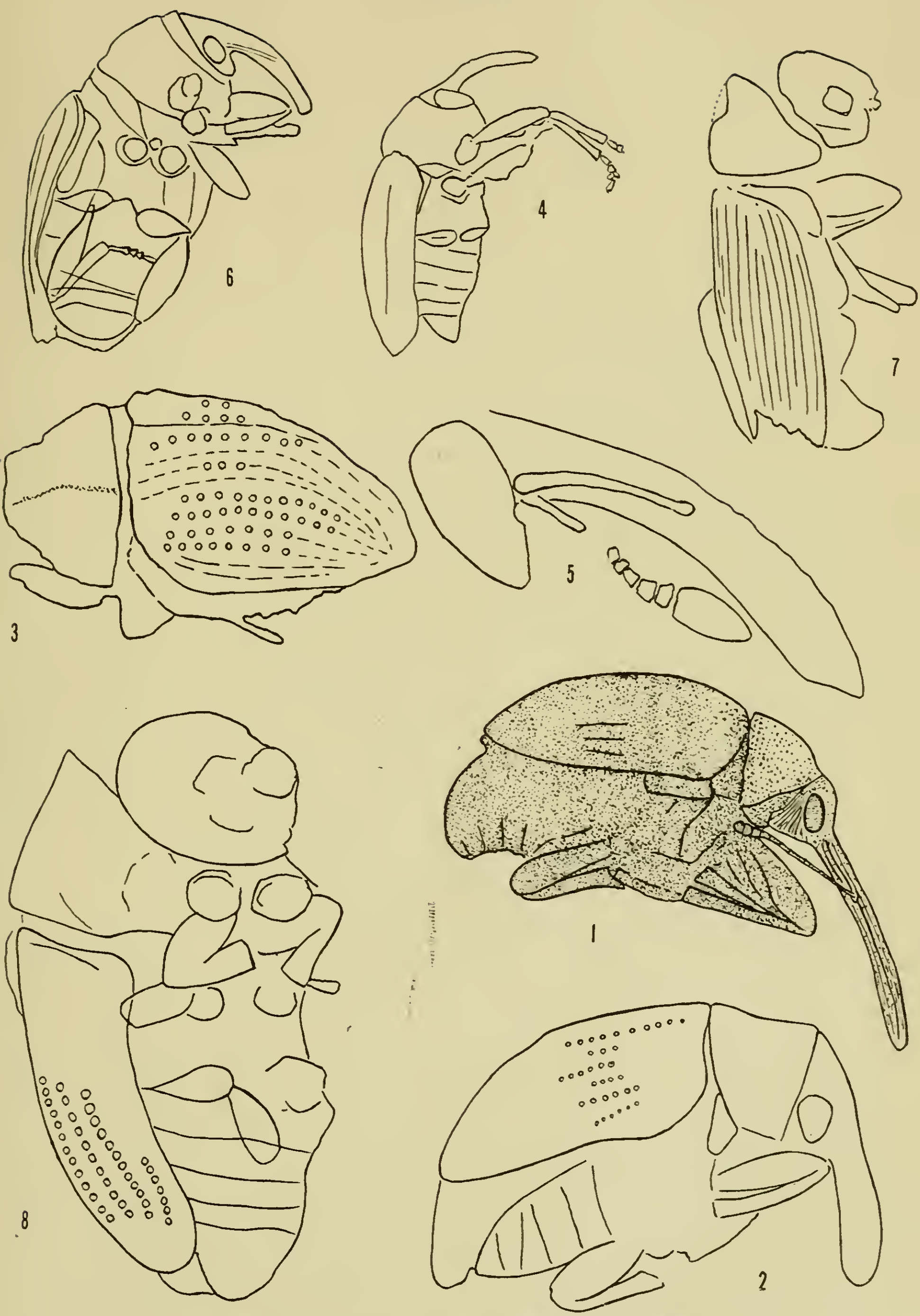
PLATE V

FOSSIL COLEOPTERA FROM FLORISSANT

PLATE VI

FOSSIL COLEOPTERA FROM FLORISSANT

PLATE VII



FOSSIL COLEOPTERA FROM FLORISSANT

A NEW SUCCINEA*

B. SHIMEK

SUCCINEA WITTERI, n. s.—Plate I, figures I-V.

Shell: Ovate-conic, rather heavy for a species of this genus; whorls $3\frac{1}{2}$, somewhat rounded, but more or less flattened below the suture, forming a slight shoulder, or even constricted by a shallow spiral groove which leaves the shoulder a low ridge following the suture, this being most prominent on the body-whorl; the spire is elevated, and on account of the flattening of the whorls, quite regularly conical, forming a third or more of the length of the shell; body-whorl relatively large, but not greatly expanded, its upper contour being distinctly flattened; aperture ovate, broadly rounded below, acute above, its columellar margin somewhat incurved by an indistinct columellar fold; the peristome sharp, very oblique to the axis of the shell in side view, and in this view usually slightly sigmoid; the surface is covered with distinct lines of growth which are more or less unequal, and crossed by irregular, unequal and interrupted spiral grooves which are especially prominent on the body-whorl; the color is a distinct yellow, deeper at the apex, sometimes approaching orange; the dimensions of the 18 shells, figured in the same order on the plate, are as follows (in millimeters) :

Length, ...	17.0	17.0	16.5	16.5	16.0	16.0	17.5	17.0	17.0
Width, ...	10.0	9.0	10.0	9.0	9.0	9.5	10.0	9.5	9.5
Aperture, length, ...	11.5	10.5	11.0	10.0	10.5	11.0	11.5	11.5	11.0
Aperture, width, ...	6.5	6.0	6.5	6.5	6.5	6.5	6.5	6.5	6.5

Length, ...	17.0	16.5	17.0	16.5	16.0	16.0	16.0	16.0	15.0
Width, ...	9.5	9.0	9.0	9.0	10.0	8.5	8.5	9.0	8.0
Aperture, length, ...	11.0	11.5	11.0	11.5	11.0	11.0	11.0	11.0	10.0
Aperture, width, ...	6.0	6.5	6.5	6.5	6.0	6.5	5.5	6.0	5.0

Jaw: Strongly arcuate, the ends rounded and enlarged, the convex margin somewhat wavy, the concave margin with a single blunt central projection. (See fig. IV.)

*Preprints of this paper were distributed March 6, 1913.

Radula: The radula shows 1 row of central teeth, and 9 rows of lateral and 19 rows of marginal teeth on each side. The outer one of the two side cusps of the laterals is quite uniformly larger. (See fig. V.)

Its nearest relative in the upper Mississippi valley is *S. avara* from which it differs by its larger size, the more flattened body-whorl, the distinct spiral grooves, the blunt and enlarged ends of the jaw, and the nine rows of lateral teeth of the radula, each lateral with the outer side cusp larger. It is nearer *S. ovalis* in size, but differs in being less inflated, with flattened and spirally marked body-whorl, and with a simpler jaw of the *S. avara* type. It also equals *S. retusa* in size but is more oblique, spirally marked, and with a higher spire.

The specific name is given in honor of the late Professor F. M. Witter of Muscatine, who devoted many years to the study of Iowa mollusks.

Distribution and habits: The species has been collected by the writer for many years in the vicinity of Iowa City, Iowa, where it is locally common. Some years ago specimens were sent out under the name of *S. avara var. vermeta.* The species is gregarious on muddy borders of the Iowa river. Where the mud has been recently exposed, and is still quite soft, numerous individuals may be found creeping about, sometimes reaching the water's edge.

The types which are figured were selected from two sets: the first six on the plate and in the table of dimensions are from a set which was collected at the town of Coralville, near Iowa City, and the remaining twelve specimens were collected in Iowa City,—in both cases along the Iowa river. The jaw and radula were taken from the Coralville specimens.

The types are in the writer's collection, and cotypes have been deposited in the zoological museum of the State University of Iowa, the National Museum, and the Philadelphia Academy of Natural Sciences.

EXPLANATION OF PLATE I

I. SUCCINEA WITTERI n. s.
Six shells showing three views. Coralville, Iowa.

II-III. SUCCINEA WITTERI n. s.
Twelve shells showing three views. Iowa City, Iowa.

IV. SUCCINEA WITTERI n. s.,—jaw.

V. SUCCINEA WITTERI n. s.,—teeth from radula.
- a. Central.
- b. First lateral.
- c. First marginal. The tenth and eleventh rows from the central, which usually form the first and second rows of marginals, often have some teeth with but one lateral cusp (hence like laterals) and some with two lateral cusps of the usual inner marginal type.
- d. Seventh marginal, showing three lateral cusps.

For comparison the following species of *Succinea*, occurring in Iowa, are figured on the plate:

VI. *Succinea ovalis* Say. Three views. Iowa City, Iowa.

VII. *Succinea retusa* Lea. Three views. Iowa City, Iowa.

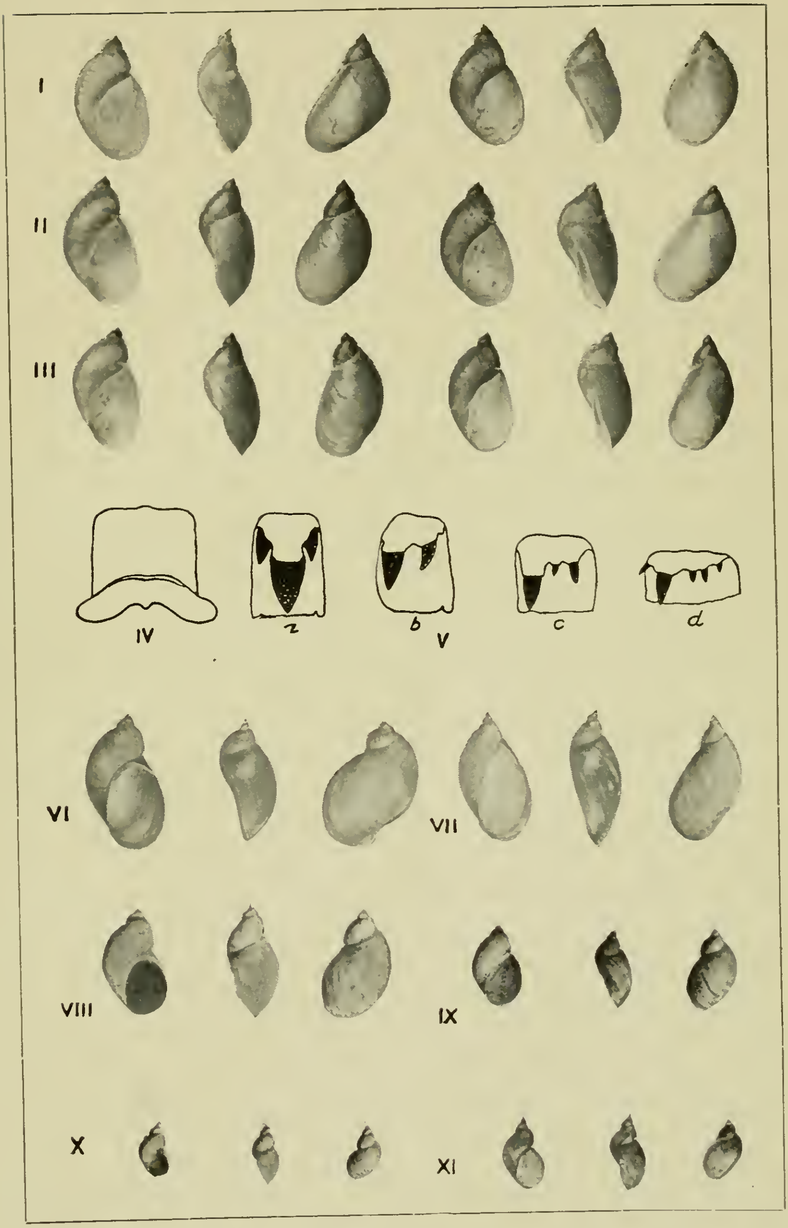
VIII. *Succinea ovalis* Say. Three views of a variety from yellow loess. Iowa City, Iowa.

IX. *Succinea grosvenorii* Lea. Three views. Hamburg, Iowa.

X. *Succinea avara* Say. Fossil, from yellow loess. Iowa City, Iowa.

XI. *Succinea avara* Say. Modern, Rock Rapids, Iowa.

PLATE I



IOWA SPECIES OF SUCCINEA

AN ARTIFICIAL PRAIRIE*

B. SHIMEK

Seven-eighths of the area of the State of Iowa and large portions of surrounding states were originally covered with prairie. The greater part of this area has been completely transformed by cultivation and the prairie flora has disappeared excepting along highways and the right of way of railways, and in certain rougher parts of the state which are not cultivated.

The original prairie was here with all its peculiarities when the white man came, and it had probably long existed in the condition in which he found it. There is no record of its cause or origin excepting as we find it in the forces and phenomena of the natural world, and these have been so variously interpreted that the origin of the prairies has been ascribed to a variety of causes.†

The writer has contended§ that evaporation as influenced by exposure to temperature and wind, and by relative humidity, was the chief and most universal cause of the treelessness of the prairie, the forest plants failing in exposed places because they are mesophytic, while the prairie plants are able to hold their own in such places because they are structurally adapted to existence under conditions which are, at least during a part of the summer, decidedly xerophytic.

An interesting bit of evidence supporting this view is furnished by a strip of prairie bordering a highway near Homestead, Iowa, which differs from ordinary prairie in that it has been developed within the memory of men now living and under conditions which make it essentially an artificial, man-made prairie. It is not of great extent, but extent of area does not form a measure of the prairie, the latter being marked by only one consistent feature, the flora.

*This paper was presented in substance before the Botanical Society of America at Cleveland, O., December, 1912.

†See the writer's paper on "The Prairies" in this volume, pp. 169-240, 1911.

§The Prairies, *ibid.*

The entire area here discussed lies within the holdings of the Amana Community, a religio-communistic society whose settlement is popularly known as the "Colony" or "Colonies". Two of the seven towns belonging to the community, namely Homestead and Amana, are connected by the wagon-road which is here discussed. Homestead lies about one and one-half miles south of the Iowa river. The territory north of the town is more or less broken and the highest parts traversed by the road in question rise to an altitude of about 150 feet above the river. The region between Homestead and the river is densely forested excepting in the immediate vicinity of the town, and the present owners, who were the original settlers and who are practical conservationists, have maintained a large part of the forest in its primitive condition for nearly 60 years. The road was cut through this forest in about the year 1856 for the purpose of connecting Homestead and Amana. It follows a general northerly course, but like many of the earlier ridge-roads it zigzags more or less, bending somewhat toward the east, with its southerly part well exposed toward the southwest. For a short distance above Homestead the road is not bordered by woods, but for at least one and one-third miles north of the open part it lies wholly within the forest, which here extends quite to the river. It is to this portion of the road which is closely bordered by a dense forest that attention is specially directed. The altitude of this part of the road varies from about 100 to 150 feet above the river. Its width is 66 feet and it has been kept clear to the full width for many years in a manner very characteristic of the methodical and industrious owners.

The flora covering this road-strip was originally the typical flora of the forest such as now appears in the bordering woods, but this has been completely replaced by a typical prairie flora which borders the roadway throughout its length. The bordering prairie strips on either side vary up to 30 feet in width and are illustrated in part by figure 1, plate I.

The accompanying list of plants, which were collected on the cleared but otherwise undisturbed portions of the road strip, contains 72 species of flowering plants of which 13 are monocotyledonous,—mostly grasses. Of the total number only 6 species (those marked *) also occur less frequently in woods, but usually in rather open places. Four of these species were here found on both the prairie strips and in the bordering forest; the two remaining species, *Gentiana flavida* and *Silene stellata,* also occur sometimes in the woods of this general region but were not observed in the vicinity of the road. The greater part of the list, 66 species, is made up of characteristic prairie plants which are wholly wanting in the adjoining forest, and which could not have been a part of the flora which originally covered the road-strip. Very few weeds were introduced with this prairie flora and these are largely restricted to the immediate border of the road-bed. Some years ago small portions of the roadside were not cleared for some time and the forest flora rapidly advanced, producing bordering thickets. The vanguard of such an advance usually consists of *Corylus americana, Rhus glabra, Populus tremuloides, Quercus macrocarpa, Crataegus Margaretta, Rubus allegheniensis,* and other hardy trees and shrubs, among which the smaller herbs soon appear. Individual specimens of these trees and shrubs are scattered along the prairie border in some places, but they are kept in check by the periodic clearing of the roadside.

A comparison of the flora of this prairie strip with that of the adjoining forest brings out in a striking manner the difference between these floras. An examination of the forest list shows 86 species of vascular plants of which 6 are pteridophytes, and 17 monocotyledones. The dicotyledonous plants are almost equally divided between herbs and woody plants. Of this list 9 species (those marked *) also occur on the prairie. Of the latter number 5 were here not found on the prairie border but occur on prairies elsewhere. The greater part of the list, 77 species, is made up of species which are characteristic of the forest and undoubtedly represent the bulk of the flora which originally covered the road-strip.

The source of the introduced prairie flora is probably to be sought in the prairie which originally covered the territory south of the forest here discussed, the remnants of the flora of which are still preserved along the Chicago, Rock Island and Pacific Railway, and elsewhere. Another prairie area is located on the bottomlands north of the river, but this probably contributed very little to the introduced flora of the road-strip.

The manner of introduction is suggested by a review of the habitual methods of seed dispersal of the introduced species. Of these species 32 produce seeds or fruits easily carried by the wind and 33 have seeds or fruits which may be readily driven by wind along the surface of snow, or with sand and dust. Seven species are usually distributed by animals, the fruits of three being used for food, and four producing hooks or spines. Many of the seeds were probably also brought in on wagon-wheels, horses' hoofs, etc.

Once introduced, this flora has been able to hold its own because its members are essentially xerophytes. The larger trees and shrubs which would make possible the advance of the forest have been removed artificially; the smaller forest flora, being mesophytic, can not exist in the strip thus exposed to wind and sun; and the prairie flora has become established simply because its structural adaptations give it greater powers of resistance to fluctuations in the relative humidity of the air.

These structural adaptations are of the usual type, but perhaps the most striking are shown in the leaf characters. The leaves of the prairie plants usually have reduced surfaces, being small or frequently variously cut, their texture is more or less coriaceous, and they are frequently covered with hairs, scales or spines. The difference in these characters between prairie and forest plants is often illustrated in species of the same genus, as is shown in figure 2, plate I. This figure illustrates the leaves of species of eight genera. In each case (a) represents a leaf of the forest species and (b) a leaf of the prairie species belonging to the same genus. All but four of the species figured were obtained on the prairie border or in the adjoining woods, but these four species are found in nearby territory. Thus *Viola pedatifida,* while absent from the prairie border, is abundant on the prairie north of the river. Its place along the road seems to be taken by *Viola pedata. Erigeron philadelphicus* and *Phlox divaricata* were not observed in the woods near the road, but both occur in more remote portions of the same forest. *Lobelia syphilitica* belongs to the swamp rather than the forest, but it is found in wet places in the surrounding forest and is also introduced for comparison.

The leaves of these species differ not only in form and size but also in texture, those of the prairie being harsher and more coriaceous. The usual differences in microscopic structure are also strikingly shown, but these need not be discussed here.

The fact that prairie plants are essentially xerophytes is well established, and explains the possibility of their continued existence in exposed situations. That exposure brought about artificially should result in the development of this xerophytic flora in a narrow strip extending through a deep forest seems especially worthy of note, and further confirms the previous conclusion that exposure is the primary cause of the existence of treeless prairies. So long as this strip is kept clear of shrubs and trees it will continue to produce a prairie flora. If neglected much of it will probably revert to forest, though it is very probable that where the prairie turf has become well established it would resist the advance of the forest.

The following lists of plants give a comparative view of the floras of the prairie strip and the adjacent forest. The lists are based on many collections made at various times.

Prairie Plants

Dicotyledones

Achillea millefolium L.
Ambrosia artemisiifolia L.
Amorpha canescens Pursh
Anemone cylindrica Gray
Autennaria plantaginifolia (L.) Rich.
Artemisia caudata Michx.
Asclepias syriaca L.
Asclepias tuberosa L.
Asclepias verticillata L.
Aster laevis L.
Aster multiflorus exiguus Fern.
Baptisia leucantha T. & G.
Brauneria pallida (Nutt.) Britt.
Cassia chamaecrista L.
Ceanothus americanus L.
Cirsium discolor (Muhl.) Spreng.
Coreopsis palmata Nutt.
Desmodium canadense (L.) DC.
Erigeron ramosus (Walt.) BSP.
Euphorbia corollata L.
*Fragaria virginiana Duches.
*Gentiana flavida Gray
Helianthemum majus BSP.
Helianthus scaberrimus Ell.
Heuchera hispida Pursh
Hypericum cistifolium Lam.
Krigia amplexicaulis Nutt.
Kuhnia eupatoroides corymbulosa T. & G.
Lactuca canadensis L.
Lepachys pinnata (Vent.) T. & G.
Lespedeza capitata Michx.
Liatris pycnostachya Michx.
Liatris scariosa Willd.
Linum sulcatum Rid.
Lithospermum canescens (Michx.) Lam.
Lobelia spicata Lam.
Monarda mollis L.
Œnothera serrulata Nutt.
Parthenium integrifolium L.
Phlox pilosa L.
Physalis pubescens L.
*Potentilla canadensis L.
Pycnanthemum flexuosum (Walt.) BSP.
*Rhus glabra L.
Rudbeckia hirta L.
Ruellia ciliosa Pursh

Salix humilis Marsh.
Scutellaria parvula Michx.
Silene antirrhina L.
*Silene stellata (L.) Ait. f.
Silphium integrifolium Michx.
Silphium laciniatum L.
Solidago canadensis L.
Solidago nemoralis Ait.
Solidago rigida L.
Verbena angustifolia Michx.
*Veronica virginica L.
Viola pedata L.
Zizia aurea (L.) Koch.

Monocotyledones

Agropyron Smithii Ryd.
Andropogon furcatus Muhl.
Andropogon scoparius Michx.
Elymus canadensis L.
Hordeum jubatum L.
Hypoxis hirsuta (L.) Cov.
Kœleria cristata (L.) Pers.
Panicum Scribnerianum Nash
Panicum virgatum L.
Poa pratensis L.
Sorghastrum nutans (L.) Nash
Stipa spartea Trin.
Tradescantia bracteata Small

Forest Plants

Dicotyledones

Herbs

Actaea alba (L.) Mill.
Actaea rubra (Ait.) Willd.
Agrimonia gryposepala Wallr.
Agrimonia striata Michx.
Anemone quinquefolia L.
Anemone virginiana L.
Anemonella thalictroides (L.) Spach
Aralia racemosa L.
Aster Drummondii Lindl.
Circaea lutetiana L.
Cryptotaenia canadensis (L.) DC.
Desmodium grandiflorum (Walt.) DC.
*Dodecatheon Meadia L.
*Fragaria virginiana Duches.
Galium aparine L.
Galium triflorum Michx.
Geranium maculatum L.
Geum canadense Jacq.
Hepatica acutiloba DC.
Hydrophyllum virginianum L.
Osmorrhiza longistyla (Torr.) DC.
Phryma leptostachya L.
Podophyllum peltatum L.
Polemonium reptans L.
*Potentilla canadensis L.
Pyrola elliptica Nutt.
Ranunculus abortivus L.
Sanguinaria canadensis L.
Sanicula marilandica L.
Solidago ulmifolia Muhl.
Triosteum perfoliatum L.
*Veronica virginica L.
Viola cucullata Ait.
Viola pubescens Ait.

Woody Plants

Carya ovata (Mill.) K. Koch
Celastrus scandens L.
Celtis occidentalis L.
Cornus paniculata L'Hér.
Corylus americana Walt.
Crataegus Margaretta Ashe
Crataegus mollis (T. & G.) Scheele
Menispermum canadense L.
Populus tremuloides Michx.
Prunus americana Marsh.
Prunus serotina Ehrh.
Prunus virginiana L.
Psedera quinquefolia (L.) Greene
Pyrus ioensis (Wood) Britt.
Quercus alba L.

Quercus macrocarpa Michx.
Quercus rubra L.
Quercus velutina Lam.
Rhamnus lanceolata Pursh
*Rhus glabra L.
*Rhus toxicodendron L.
Ribes gracile Michx.
Rosa blanda Ait.
Rubus allegheniensis Porter
*Rubus occidentalis L.
Sambucus canadensis L.
Tilia americana L.
Ulmus americana L.
Ulmus fulva Michx.
Viburnum lentago L.
*Vitis vulpina L.

Monocotyledones

Arisaema dracontium (L.) Schott
Arisaema triphyllum (L.) Schott
Carex rosea Schk.
Cypripedium parviflorum pubescens (Willd.) Kn.
Cypripedium hirsutum Mill.
Dioscorea villosa L.
Hystrix patula Moench.
Liparis lilliifolia (L.) Rich.
Orchis spectabilis L.
Panicum Porterianum Nash
Polygonatum commutatum (R. & S.) Dietr.
Smilax ecirrhata (Eng.) Wats.
Smilax herbacea L.
Smilax hispida Muhl.
Smilacina racemosa (L.) Desf.
*Smilacina stellata (L.) Desf.
Uvularia grandiflora Sm.

Pteridophyta

Adiantum pedatum L.
Aspleniium filix-foemina (L.) Bernh.
Botrychium virginianum (L.) Sw.
Cystopteris fragilis (L.) Bernh.
Osmunda Claytoniana L.
Pteris aquilina L.

Explanation of Plate I

FIG. I—A portion of the Homestead road, looking north, showing the prairie border especially well on the east side.

FIG. II—Leaves of prairie and forest plants.

1. *Smilacina.*
   - a. S. racemosa (L.) Desf.
   - b. S. stellata (L.) Desf.
2. *Solidago.*
   - a. S. ulmifolia Muhl.
   - b. S. nemoralis Ait.
3. *Panicum.*
   - a. P. Porterianum Nash
   - b. P. Scribnerianum Nash
4. *Viola.*
   - a. V. cucullata Ait.
   - b. V. pedatifida G. Don.
5. *Aster.*
   - a. A. Drummondii Lindl.
   - b. A. multiflorus var. exiguus Fern.
6. *Erigeron.*
   - a. E. philadelphicus L.
   - b. E. ramosus (Walt.) BSP.
7. *Lobelia.*
   - a. L. siphilitica L.
   - b. L. spicata Lam.
8. *Phlox.*
   - a. P. divaricata L.
   - b. P. pilosa L.

PLATE I

FIGURE 1

HOMESTEAD ROAD WITH PRAIRIE BORDERS

FIGURE 2

COMPARISON OF LEAVES OF FOREST AND PRAIRIE PLANTS OF SAME GENUS

A LONG-STALKED ELODEA FLOWER

ROBERT B. WYLIE

The submersed seed plants are of peculiar interest to the botanist. Obviously descendants of land plants, they offer many ingenious modifications in relation to their adopted habitat. More remotely they were probably derived from some primitive aquatic stock, but all evidences of such ancestry are lost in the multitudinous structures elsewhere associated with land plants. In the life history of each of these aquatic flowering plants there must have been a terrestrial life of sufficient duration to permit the evolution of a dominant sporophyte, the development of heterospory, and the attainment of the seed habit, together with a relatively high degree of floral development. The possession of such structures and habits in common with land plants would argue that our aquatic phenogams are removed but a little from the land.

Most so-called "water-plants" are only nominally aquatic, living merely rooted in shallow water or partly submersed. The marginal vegetation of every lake affords numerous examples. A few plants, on the other hand, have solved the problems of existence entirely beneath the surface of the water and are truly aquatic since they carry out their whole life history while completely submersed. A fine example is seen in *Ceratophyllum demersum* L. which is pollinated beneath the surface, so may flourish at considerable depths. In West Okoboji Lake in northwestern Iowa this form has been found growing at a depth of nearly thirty feet and is one of the most successful plants in these waters. Zostera and Phyllospadix are marine genera of similar habit.

An extensive intermediate group includes seed plants that live beneath the surface of the water, but which must bring their flowers to the air if cross pollination is to be effected. Such plants are truly amphibious, though in the reverse sense of the term, since they vegetate in water and seek the air only for aid in reproduction. Vegetatively they are aquatics, but in their floral habits are still essentially land plants. It must not be assumed, however, that they have retained unmodified their former habits of pollination. While some of them are possibly anemophilous in the simpler sense of the term, others have specialized flowers and employ the surface film of water in most ingenious ways to aid in the transfer of pollen. Nor should the members of the hydro-anemophilous group be looked upon as transitional to the subsurface habit of pollination. On the contrary they probably represent a distinct specialization, with structures and habits intimately related to pollination at the surface of the water. Conspicuous examples are seen in *Vallisneria* and *Elodea,* while less highly specialized forms are found in certain species of *Myriophyllum* and *Potamogeton.*

The submersed plant that brings its flowers to the surface of the water for pollination accomplishes this in one of three ways, or, in the dioecious forms, there may be a combination of two of these methods;—

1. *By elongation of the floral axis.* This is the simplest and probably in general the most primitive plan since it might be developed gradually as plants pushed out into deeper water. Examples are seen in *Myriophyllum spicatum* L., several species of *Potamogeton,* and in the pistillate flower of *Vallisneria spiralis* L.

2. *By detachment of flowers from the plant.* This leaves the flowers free to float to the surface of the water. Obviously this plan may be employed for staminate flowers only, and is therefore always associated with some other plan for the pistillate flower which must retain connection with the plant until the seeds are matured. Well known examples are the staminate flowers of *Elodea* and *Vallisneria spiralis* L.

3. *By elongation of the flowers.* This plan is the most highly specialized of the three, involving as it does the radical modification of the floral parts in order to bring the stamens and stigmas to the surface of the water. In *Elodea* the epigynous pistillate flower may be one thousand times as long as wide. The perfect flowers of *Heteranthera dubia* (Jacq.) MacM., though hypogynous, attain to a marked degree of elongation in their upward stretch toward the surface of the water.

Another alternative suggests itself, namely, self-pollination beneath the surface of the water, but this seems seldom to occur.

It may be that the wide spread dioecism in aquatic plants, evidently recently acquired in some of them, is to avoid this dilemma. The writer has recently made a careful study of the perfect flowers of *Heteranthera dubia* (Jacq.) MacM. and finds them to be regularly cleistogamous. Whether deeply submersed, the more favorable condition for vegetative growth, or near enough to the surface to permit the flowers to open in air, fertilization seems to take place uniformly before the flowers open.

In the genus *Elodea* the flowers are generally functionally monosporangiate though rudiments of the suppressed parts are regularly present. The pistillate flower reaches the surface of the water, if not too deeply submersed, through the elongation of that portion of the epigynous flower above the ovary,—the "tubus calicis" of the older writers,—i. e., it employs the principle of flower elongation.

The staminate flower of our common species of *Elodea* reaches the surface by detachment. Each remains until fully developed attached to the plant within the globose spathe. At maturity the pedicil weakens and presently the flower is released, rises rapidly the the surface and there sheds its pollen on the water. The surface film of water has much to do with the floating of the pollen and the general events of pollination in this plant.[1]

During the summer of 1909, in connection with work at the Macbride Lakeside Laboratory on Lake Okoboji in northwestern Iowa, the writer noted an unusual form of staminate flower on the Elodea plants of that locality. The flowers were in striking contrast to those of the common species in that they were carried to the surface of the water on a long slender axis instead of remaining sessile and detaching at maturity (Fig. 1). Detachment was subsequent to the shedding of the pollen, and was often long delayed. It was interesting to encounter a pollen bearing flower of Elodea employing the plan of axis elongation instead of detachment, and to note within the one genus the occurrence of the three possible modes of surface attainment.

The staminate flowers of several South American species of *Elodea* are reported to behave similarly. Caspary[2] describes certain species, among these, *Elodea chilensis* Casp. and *E. calli-*

[1] Wylie, Robert B., The Morphology of Elodea canadensis, Bot. Gazette, 37: 1-22, 1904, pp. 11-13.

[2] Caspary, R., Die Hydrillen. Jahrb. f. wiss. Bot., 1: 377-513, 1858, pp. 469-472.

trichioides Casp., as having a filiform axis to the staminate flower, but no similar structures seem to have been noted among our members of this genus. Accordingly the plants above noted were studied with care, and observations were continued through the two succeeding summers.

The plants under discussion were large and vigorous, and flourished abundantly in the north end of East Okoboji lake, at times completely dominating certain areas. Every one of the hundreds of staminate flowers examined displayed the same trait, seeming to point to a distinct strain of these plants in that locality. During the summer of 1910 these plants were found in the same place and also at another point in the lake four miles distant. The low water prevailing in these lakes during the summer of 1911 greatly altered the number and distribution of water plants but the form in question was fairly abundant. The associated pistillate plants, whose flowers closely resemble those of the common species, were abundant and set seeds regularly. In all this time the other form, *E. canadensis* Michx. was not noted in the waters of these connected lakes.

The lower portion of the spathe of these pollen bearing flowers is early constricted (Fig. 3), and might resemble in a superficial way the condition described as "spathe peduncled" by Rydberg[3] in his description of *Philotria linearis* Rydb. and *P. Planchonii* (Casp.) Rydb., though the spathe of our form is strictly sessile. The outer end of the spathe expands abruptly into a flattened two-cleft circular portion which loosely invests the body of the flower which is pedicillate within the spathe.

At maturity the axis elongates rapidly, pushing the flower out of the spathe (Fig. 2), and outward into the water when its buoyancy carries it upward toward the surface. The degree of elongation of the axis is related in a general way to depth of its insertion. Those borne near the surface may be but two or three centimeters in length, while those in deeper water show extreme elongation. Specimens were measured in 1911 28 cm. long and no doubt this did not represent the extreme of elongation.

The staminate flower is thus carried up on a slender whitish thread which resembles in a superficial way the "floral tube" of the pistillate flower. In Caspary's descriptions the same term, "tubus calicis," is applied to both of these elongated structures.

[3] Rydberg, P. A., Flora of North America.

While the habits of these two flowers are biological equivalents, and the parts concerned outwardly similar, they are morphologically unlike and in no sense homologous. The "tubus calicis" of the pistillate flower includes that complex of parts above the ovary of the epigynous flower, while that of the staminate flower is simply the stem or axis. The greater efficiency of the latter is probably due to its stem character and the relative simplicity of stem elongation compared with flower elongation.

The rapid elongation of the peduncle of the staminate flower is due to the lengthening of cells previously much contracted. These cells may increase to twenty-five times their former length,—this accompanied by a slight decrease in diameter. Some stalks elongated over 20 cm. on plants left over night in a collecting case,—the flowers being pushed out through the tangle of plants in the vasculum.

The flower maturing naturally in the water has usually, during the hours of sunshine at least, a bubble tugging at its apex. Frequent experiment failed, however, to dislodge a bubble in such a way as to carry any of the pollen to the surface. It seems that the pollen is shed only when the flower itself reaches the surface of the water.

In quiet waters the flowers may remain attached to the plant for some time after the pollen is shed. But in more open waters their release is hastened by wave action, the axis breaking at its most slender part within the spathe at the base. In 1909, when the plants were noted most abundantly, the detached staminate flowers formed extensive windrows at the margins of open water where thousands of them might be seen tangled together by their long trailing stalks. In no case was an unopen flower noted among these and they were free from all except floating pollen.

Biologically it is of interest to note the occurrence of the three possible flower-forms within the one genus, and the association of two distinct types of staminate flowers with a pistillate flower that is quite constant throughout the genus. While the pistillate flower might also have developed an elongated scape, as in Vallisneria, the vegetative habits of the plant have not made this necessary. Elodea plants are small leaved and thrive near the surface of the water,—a habit that is favored through its anchorage by means of long roots. Vallisneria, on the other hand, has long leaves arising from a short stem at the bottom of the pond, and may flourish in waters of a yard or more in depth. Its flowers are thus compelled to rise through a considerable distance, requiring a scape, while those of Elodea, borne nearer the surface, reach the air by flower elongation.

These two types of staminate flowers in the genus *Elodea* suggest independent lines of evolution in the efforts, so to speak, of this plant to overcome the difficulties of cross pollination as a submersed plant. The sessile flower, which comes to nothing unless detached, is probably the simpler and agrees in structure with the pistillate flower which is always sessile. Detachment was made easy through the reduction of mechanical tissues characteristic of submersed plants, while buoyancy was secured by means of the air-spaces so freely developed in plants of such habitat. The other, or long peduncled pollen bearing flower, seems here to represent the derived condition, though this habit is certainly primitive in other genera. Its advantages, if any, are not obvious; on the other hand no disadvantages are suggested since detachment is possible at any degree of axis-elongation.

A couple of years ago the writer published[4] a brief description of this form with the suggestion that it be called *Elodea iowensis* in case it could not well be included in any of the recognized species. Further study of the plant has only made more uncertain any other disposition of it, and accordingly a tentative description is outlined as follows;—

Elodea ioensis nov. sp.
(Plates I and II)

Polygamo-dioecious water plant. Stems slender 2-10 dm. long; leaves in 3's oblong lanceolate to oblong linear, 8-14 mm. long, 2-3.5 mm. broad, abruptly pointed, finely serrate; spathe of staminate flower sessile, constricted at base into a tubular stalk-like portion 5-10 mm. long, outer expanded portion 6-8 mm. long, 4 mm. broad, flattened, and two cleft; staminate flower long-pedicelled, the axis at maturity 3-20 cm. in length, often detaching after elongation, body oval 3 mm. long; sepals oval, 4 mm. long and strongly recurved in open flower; petals linear-lanceolate, long acuminate, obtuse, ¼ mm. wide, abruptly expanded near base, and shorter than the sepals; stamens 9; anthers oblong, 2.5-3 mm. long, subsessile; inner triad of stamens standing much higher than outer; branched rudimentary stigma prominent; spathe of pistillate flower linear, 10-15 mm. long; hypanthium-tube slender, 3-15 cm. long; sepals oval, 2 mm. long; petals obovate, delicate; stigmas 3, linear, 3 mm. long; staminodia 3, slender.

East Okoboji Lake, Dickinson County, Iowa, 1909.

[4] Wylie, Robert B., The Staminate Flower of Elodea. Proc. Iowa Acad. Sci., 18: 80-82, 1911.

It seems to differ markedly from described North American species in the possession of this long peduncled staminate flower. But as this axis does not elongate conspicuously until a few hours before the flower opens, the suggestion naturally arises that it may have been overlooked elsewhere and the description based on immature material. Under this assumption one is lead to compare it with *Elodea Planchonii* Casp. (*Philotria Planchonii* [Casp.] Rydb.) which is described as having a short pedicelled staminate flower, but a comparison of these forms shows many other points of difference.

Elodea Planchonii Casp. Based on description of *Philotria Planchonii* (Casp.) Rydb.	Elodea ioensis
Leaves 7-15x1-2 mm.	Leaves 8-14x2-3.5 mm.
Staminate flower short-pedicelled.	Staminate flowers long-pedicelled.
-Pedicel ————————.	-Pedicel 5-25 cm. long.
-Spathe peduncled.	-Spathe sessile, contracted at base.
-Sepals elliptic, 5 mm. long.	-Sepals oval, 4 mm. long.
-Petals lacking.	-Petals present, linear-lanceolate, long-acuminate, etc.
-Anthers 3-4 mm. long.	-Anthers, 2.5-3 mm. long.
Pistillate flower, tube 3-5 cm. long.	Pistillate flower, tube 3-15 cm. long.
-Sepals linear, 3 mm. long.	-Sepals oval, 2 mm. long.
-Petals linear, 3 mm. long.	-Petals obovate, 2 mm. long.
-Stamens none.	-Sterile stamens, 3.

Figs. 5 and 6 illustrate fundamental differences between the staminate flower of this form and that of *Elodea canadensis* Michx. at corresponding stages of development; at any later stage the contrasts would be more marked. Minor differences in form of petals and sepals for both flowers occur, and of course there can be no agreement with the hermaphrodite form of *E. canadensis* Michx.

Comparison with the South American species credited with long stalked staminate flowers is difficult from the descriptions since the same term "tubus calicis" is applied to the elongated portions of both pistillate and staminate flowers, though it is highly improbable that they are structurally identical. However, in summarizing the characters of *Elodea chilensis* Casp. Caspary[5] says, "Männliche Blüthe, wie die weibliche mit sehr langer Röhre des Kelches, 8-48‴ lang. Die männliche Blüthe

[5] Loc. cit., p. 470.

scheint sich nicht lozulösen. Die Spatha der männlichen Blüthe ist lineal-cylindrisch.'' The slender spathe would seem to be a point in evidence also of the homology of these structures,—in which case there can be no agreement with our form. But assuming the term ''tubus calicis'' of these descriptions relates to the peduncle of the staminate flower there are many points of difference between any of them and the Okoboji plant. In addition, the wide geographical separation,—in opposite hemispheres, —would suggest caution in correlating these forms, though Caspary[6] refers to at least three species that are dioecious and may have peduncled staminate flowers (*Elodea chilensis* Casp., *Elodea callitrichiodes* Casp., and *Elodea Najas* Casp.) that offer similarities to the form in question.

The occurrence of the plant under discussion in the waters of the Okoboji lakes suggests two alternatives;—Either, (1) that it is a form of local development, with perhaps a limited range, or, (2) that it belongs to a species of possibly wide distribution to the west and northwest of the Mississippi basin which has not yet been clearly identified nor fully described.

Favoring the former view is the considerable depth of these Okoboji lakes (over 100 feet in places), thus pointing to a probably constant body of water since the last glacial invasion,—the lakes having been formed in part at least by the Wisconsin ice-sheet. These quiet waters, through thousands of years, having at all times shallower margins favoring the growth of such plants, would have made ready the stage for possible mutations.

Favoring the latter alternative, which to the writer seems probable, is the relative inconspicuousness of the flowers suggesting that this form might easily have escaped the casual observer. In its younger stages it is not strikingly different from the common species, while in its maturity the flower resembles the pistillate flower in a general way. Of course no skilled collector would be deceived, but when one recalls the relative inaccessibility of these plants to the pedestrian collectors, and the greater interest of most pioneer workers in the more conspicuous land plants, one is inclined to the view that this form may be found more generally in the lakes to the west and northwest as these are studied more thoroughly.

[6] Loc. cit., 469-477.

vi—4—5

Explanation of Plates

The abbreviations employed in describing figures are as follows: stg, stigma; st, stamen; sp, spathe; p, petal, and s, sepal.

Plate I

Fig. 1. Open staminate flower attached to plant.

Fig. 2. Mature staminate flower enclosed within the spathe.

Fig. 3. Staminate flower emerging from spathe.

Fig. 4. Detached and empty staminate flower floating on water with elongated axis trailing.

Plate II

Fig. 5. Median longitudinal section through mature staminate flower of *Elodea ioensis* still enclosed by spathe.

Fig. 6. A similar section through staminate flower of *Elodea canadensis* Michx. at a stage of development corresponding to that shown in Fig. 5.

Fig. 7. Open flower of *Elodea ioensis*.

Fig. 8. Leaf of *Elodea ioensis*.

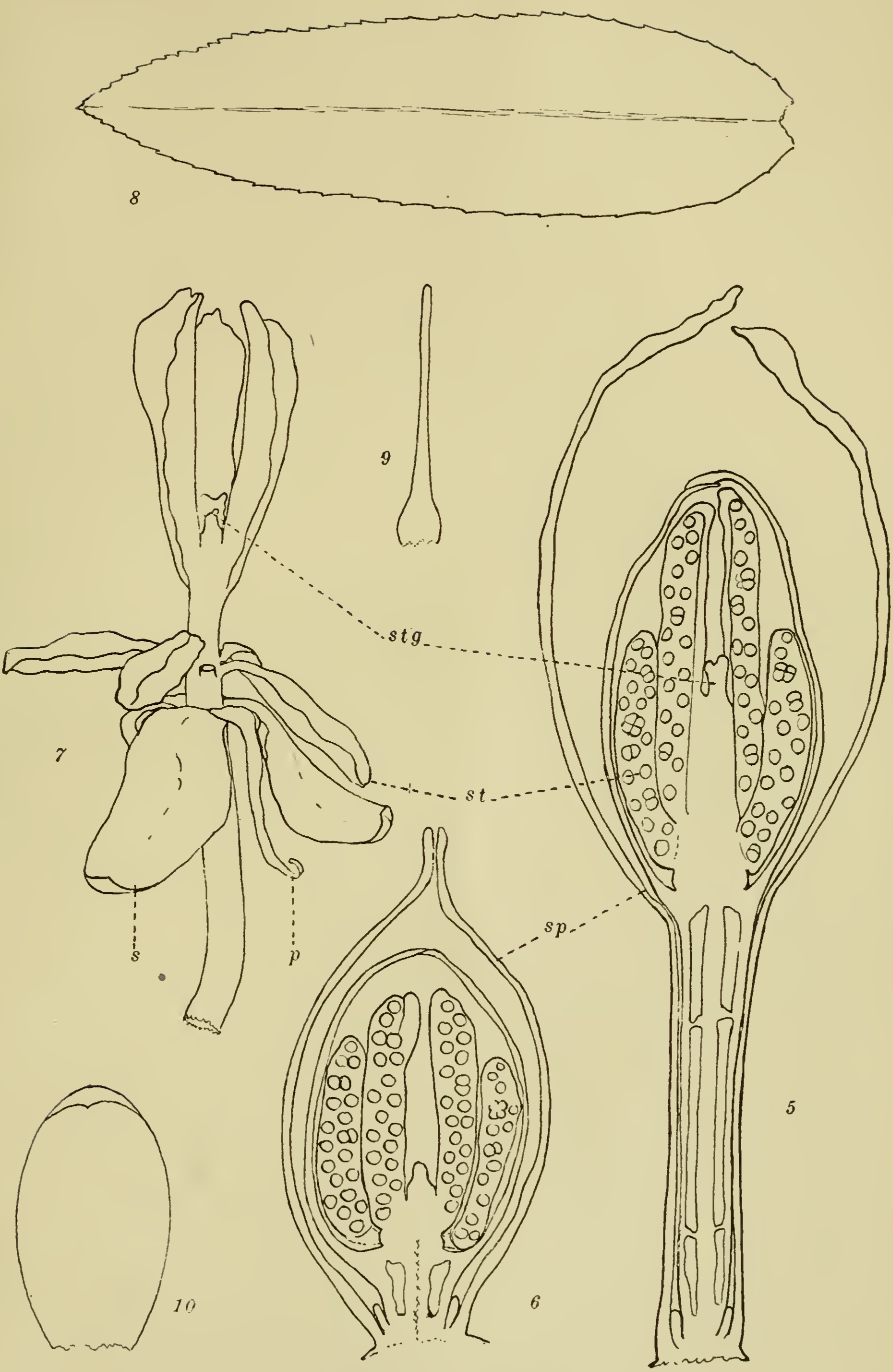
Fig. 9. Petal of staminate flower, *Elodea ioensis*.

Fig. 10. Sepal of staminate flower, *Elodea ioensis*.

PLATE I

WYLIE ON ELODEA

PLATE II



WYLIE ON ELODEA