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OTTAWA NATURALIST

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TRANSACTIONS

OF THE

OTTAWA FIELD-NATURALISTS' CLUB

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The Ottawa Field-Naturalists' Club.

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THE OTTAWA NATURALIST

VOL. XXX. OTTAWA, APRIL, 1916 No. 1

ANNUAL REPORT OF THE OTTAWA FIELD-NATURALISTS' CLUB, 1915-16.

The Council of the Ottawa Field-Naturalists' Club has the honour to report on the work of the past season—1915-16.

Standing committees, the Editor and Associate Editors of THE OTTAWA NATURALIST, the Librarian, and leaders of the respective branches, were elected at the first meeting of the Council, held on the 1st of April, 1915. Four meetings of the Council were held during the year, and a fifth called for 16th of March, but owing to lack of a quorum no regular business could be transacted.

THE OTTAWA NATURALIST.

Under the continued editorship of Mr. Arthur Gibson, THE OTTAWA NATURALIST, the official organ of the Club, has appeared regularly during the year, volume XXIX having been completed. Among the more important papers published in the volume, several of which are illustrated by plates or text figures, the following may be mentioned:—

Suggestions for Ornithological Work in Canada, by P. A. Taverner.
A Case for Small Museums, by Harlan I. Smith.
On the Validity of the Genus Plethopeltis, by R. M. Field.
Revision of the Canadian Species of Agelacrinites, by Percy E. Raymond.
Minerals from Baffin Land, by T. L. Walker.
Quebec Dragon-flies, by Rev. T. W. Fyles.
The Dangers of our Wilds, by Charles Macnamara.
Mimicry—Some of Nature's Strategems, by B. C. Tillet.
A New Ordovician Pelecypod from the Ottawa District, by Alice E. Wilson.
Shallow Water Deposition in the Cambrian of the Canadian Cordillera, by L. D. Burling.

The Evolution of the Sheep, by B. C. Tillet.

Some Habits of Swainson's Hawk in Manitoba, by Norman Criddle.

The Use of Gum Damar in Paleohistology (with notes on the genus Benthopecten), by G. H. Hudson.

Gleanings in Fernland, by Frank Morris.

The Curious Egg of the Hagfish (Maxine), by E. E. Prince.

Fossil Collecting, by E. M. Kindle.

Buprestidae Known to Occur in the Ottawa District, by Bro. Germain.

The Genera of the Odontopleuridae, by P. E. Raymond.

Prenanthes mainensis: Notes of the Morphology, Taxonomy and Distribution of this Hybrid form, by Bro. M. Victorin.

Birds of Algonquin Park, by W. E. Saunders.

EXCURSIONS.

The following field excursions were arranged last spring by the committee in charge:—

May 8.—Rockcliffe.
" 15.—Iron Mines at Ironside.
" 22.—Britannia.
" 29.—Aylmer.
June 5.—Wright's Grove, Rideau River.

For most of the excursions the weather was favourable, and the attendance fairly good. About seventy were at the Ironside excursion, which afforded an excellent opportunity for a study of the interesting geology of the old iron mines. The Rideau River excursion was attended by about forty. Attention was mostly devoted to botanical specimens. There were no excursions conducted during the autumn.

LECTURES.

The following is the programme of the series of lectures for the winter season, which was carried out with certain changes both as to time and place.

Dec. 7.—Wheat Improvement in Canada, by Dr. C. E. Saunders, Dominion Cerealist.

Jan. 11.—Canadian Folk-tales and Oral Traditions, by Mr. C. M. Barbeau, Division of Anthropology, Geological Survey.

Jan. 25.—The Use of Ornamental Trees and Shrubs, by Mr. W. T. Macoun, Dominion Horticulturist.

Feb. 8.—The Formation of the Great Plains, by Mr. D. B. Dowling, Geological Survey.

Feb. 22.—The Evolution of Army Sanitation, by Dr. R. Lorme Gardner.

Mar. 7.—The Identification and Nesting of Some of our Common Birds, by Mr. W. E. Saunders, of London, Ont.

Through the kindness of R. G. McConnell, Esq., Deputy Minister of Mines, arrangements had been made with the Lecture Committee to hold all the lectures in the auditorium of the Victoria Museum, but owing to the burning of the Parliament Building, which in itself was a Dominion-wide calamity, the auditorium had to be engaged for the House of Commons, and therefore only the first three lectures were held there. Through the kindness of Dr. White, the assembly hall of the Normal School was put at the disposal of the Club for the remainder three lectures, and that of Dr. Gardner was delivered there on the regular date, that by Mr. Saunders on March 13th, and that by Mr. Dowling on the night of the annual meeting. We have to express our hearty appreciation of the kindness of those gentlemen in granting the use of the auditorium and assembly hall, and also of the kindness of Mr. Sykes, Librarian of the Carnegie Library, for the use of a room in which the meetings of Council were held. Our thanks are also due to the city press for free insertion of lectures, excursion notices and reports.

MEMBERSHIP.

During the year 18 new members joined the Club. The present membership now stands at 325.

Mention is feelingly made of the decease of an ardent member of the Club, Mr. J.C. Kearns, and who before his death testified of his interest in it in a bequeathment of the sum of one hundred dollars. In memory of Mr. Kearns the Council agreed not to appropriate this sum for ordinary expenditure, but to invest it, and to devote the interest accruing to prizes to members of the Club for the best collections of natural history objects as may be determined upon.

It remains to be said that leaders of the respective branches have been busily engaged in their several lines of natural history or scientific work.

The Treasurer reports a balance on hand of thirteen dollars and seventy cents ($13.70.)

Respectfully submitted.

ANDREW HALKETT,
Secretary.

TREASURER'S STATEMENT 1915-16

RECEIPTS.

Balance from 1914-15		$ 36.25
Membership Fees:		
Arrears	$ 81.00	
1915-16	186.00	
1916-17	11.00	
		278.00
Advertisements in THE OTTAWA NATURALIST		88.50
Authors' Extras sold		64.40
Provincial Government Grant		200.00
Donation, Paul A. Cobbold, Esq.		1.00
Miscellaneous		.90
Copies of OTTAWA NATURALIST sold		12.30
		$681.35

DISBURSEMENTS.

Printing THE OTTAWA NATURALIST, 3 Nos. of Vol. XXVIII. and 9 Nos. of Vol. XXIX.	$420.70
Illustrations	19.10
Authors' Extras	87.60
Miscellaneous printing, envelopes, etc.	24.69
Postage, THE OTTAWA NATURALIST to members	34.40
Editor	50.00
Lectures expenses	13.00
Postage, bank exchange, etc.	18.16
Cr. Balance	13.70
	$681.35

Audited and found correct.

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THE FORMATION OF THE GREAT PLAINS OF NORTH-WESTERN CANADA.*

D. B. DOWLING.

The plains of Canada form but a portion of the larger plains of the continent, which occupy a large part of the interior and are divided into an eastern and a western portion by a great central valley. The eastern plains which extend to the St. Lawrence lowlands are forested and, therefore, seldom referred to as plains. Westward, the rainfall being lighter, there is a thinning of the forests and there are more open areas. These are generally referred to as the plains. In Canada the open prairie of the plains is being invaded by the forests from the north, so that a division can be made of treeless plains, plains with scattered trees, and forested plains.

The first requisite in a definition for these plains would perhaps be a nearly level surface, supplemented by a soil covering, and a climate admitting of the production of some vegetation, for the absence of moisture soon produces desert conditions. The formation of a level surface, to take a homely example suggests either *planing* or *plastering*. The planing process of nature is a slow decay of the old surface and its removal by erosion. The surface thus planed is inclined to be rocky and as it is losing its rock waste, the soil is to be found sparingly in the hollows or valleys. In plastering the nature process consists of the spreading out, generally by large bodies of water, of the rock waste poured in by the streams. This produces a more perfectly even surface outline than is ever produced by the planing process, but our surface features are the product of both. If the surface were a part of a perfectly rigid sphere, it would be difficult to explain the presence of large areas containing the rock waste, or of those plains built up by the spreading action of the sea, but as there is a vast amount of evidence showing that the continent has not been stable but sank in certain areas, rose in others, and repeated the sinking and rising several times, we are forced to believe that the crust is flexible, and that its equilibrium is influenced by tangential strains or the shifting of load. To this we owe the submergence of those parts which received a coating of rock waste deposited by the sea. Much of this rock waste underlies the great agricultural areas or plains, so that we may say that the flexibility of the crust made possible the peopling of the earth by providing soil covered areas for the plant growth necessary to sup-

*Resume of lecture before the O.F.N.C., March 21st, 1916.

port the animal life. The plains of North America bear in their underlying rocks records of long invasions of the sea, and these form a part of the history of a continent which seems to have been a very old feature.

Much of its early history is very obscure, but we know that at several periods the ocean encroached and almost submerged the continent. The maximum submergence was probably in Ordovician times, when much of the limestone deposits of the continent were formed. Later the seas seemed to have been shallower, and the rocks formed by the debris entering the sea were of a fragmental character, and became better soil makers. The plains of eastern America owe most of their fertility to the decay of these rocks, but the western plains, now called the Great Plains, received still further treatment beneath a shallow muddy sea which covered the sandstones and limestones of the former plain by a heavy coating of mud now hardened to shale. Then when the sea invasion was about over, the great mud flats supported a very rich vegetation, which is preserved in coal seams. The later additions to the building of the plains consist of coarser material, and indicate a nearer source of supply which means an elevation of the land underlying and adjoining the western edge of the basin. With the draining away of the salt water there was an additional elevation in the land area which amounted to mountain building. This consisted of the formation of folds as a partial relief from the tangential strain, but as the movemen continued, probably too rapidly for the material to follow without fracture, most of the folds became broken.

We thus find as a typical structure in the Rocky Mountains fault blocks piled one against the other in regular succession, repeating the same series of beds many times. In front of the broken area, or to the east of it, folds and breaks of less intensity and lower elevation occur at present, and towards the east the decreasing disturbance in the rocks show very clearly that the strain was from the west. The formation of the Rocky Mountains is about coincident with the elevation of the plains, for in their slow rise the soft rocks forming the covering of the broken folds were washed down and carried across the plains by the streams or spread out in lakes. On the completion of the first period of erosion, after the appearance of the outer mountains, the plains presented probably a rather rough rock-strewn surface on the higher slopes. The removal of much of this debris was made possible only by a further elevation, and with a steepening of the slope eastward the second scoring began. This was continued until from the surface hundreds of feet were removed. The cycle of denudation was not completed, as is shown by fragments of the first surface which still remain.

The coming of the ice sheet of the glacial period is thought to have altered the general topography but little, with the exception perhaps of a smoothing of the uneven surface or a filling up of sharply cut valleys. The period during which the ice was wasting or melting is marked by many drainage channels that are now abandoned. The occupation by the glacier of the valleys of the principal streams which have a north-eastward trend, caused no doubt a damming up of the water which, together with that from the melting ice, overflowed along the ice front and sought channels that were almost at right angles to the original channel. Many of these are still used as part of the present river courses, but in the southern portion of the Canadian plains there are many of these glacially-induced channels that are now abandoned, and have apparently no other reason for their existence. The Saskatchewan drainage was diverted to the Missouri for a short period while its former valley through the Coteau was blocked by ice. The diversion filled lakes Chaplin and Johnston and proceeded south, scouring out the valley now occupied by Lake of the Rivers, Willowbunch and Big Muddy lakes. A little later the outlet was shifted to east of the Coteau, and the Regina plain was a lake basin drained by the Souris river probably to the Red River valley. This lake was lowered by the retreat of the ice to a position farther north, and a new channel was again adopted. This was deeply cut by the flowing stream, and is now used by the Qu'Appelle and Assiniboine rivers, which have but a small flow at present.

The melting of the ice in the lowlands of the Red River valley created a lake along its front that was not as readily drained as was the case in the retreat of the ice cap across the prairies. In the Red River valley there seemed no outlet, and the basin filled until it spilled over its lowest point, far south in Minnesota at Lake Traverse. The removal or melting of a vast mass of ice in the north seems to have resulted in a slight elevation of the crust that had been depressed by the weight of the ice. This recovery, which means an actual tipping of the lake basin, lowered the lake by spilling its water to the south, and as the lake at its several stages formed beaches, the levels of these give us the amount of tilt that occurred between their dates of formation. This outlet was abandoned when the lake secured a lower northern outlet. The greatest depth of water over the site of the city of Winnipeg was about 560 feet.

The benefit of this old lake to the agricultural value of the Red River valley can hardly be measured. Over the surface of the boulder clay, which covered the limestone outcrops, the waters of the lake spread a thick coating of the finely-ground shale that was excavated in the digging of the several large valleys that cut through the plateau to the west. This deposit, in lessening amount and thickness, is found over the lake basin area north of the Red River valley, and underlies the plains around Dauphin, Swan and Red Deer lakes.

On account of the soft nature of the rocks the stream valleys are deeply incised, which adds to the difficulty of using this passing water on the upland where it is often needed, since the rainfall is barely sufficient during some seasons to make up for the evaporation. Were these rivers nearer the surface the question of diversion would be simple, but long and expensive canals are required. The surface is generally treeless owing to the light rainfall. Tree planting is proceeding rapidly and is quite noticeable in Manitoba, where the bare prairie is rapidly disappearing. This, if it does not induce a much greater rainfall, retards the evaporation of the ground moisture.

As a short summary, we may repeat that the basin which received the muddy deposits of Cretaceous time has had a varied history. The rocks of the western margin were elevated and broken into long narrow blocks, which are piled up in succession to form the Rocky Mountains. A second strip was strongly folded but not elevated as high as the mountains and constitutes the foothills. A third strip formed a ridge in advance of the folded foothills and now shows a simple synclinal structure, while the remainder, less disturbed but sloping generally to the east, forms the Great Plains of the northwest provinces.

SPRING EXCURSIONS, 1916.

May 6—Rockcliffe to McKay's Lake and vicinity—Geological excursion.

May 13—Cache Bay, west of Hull—General Zoological excursion.

May 27—Ferry Lake and vicinity—The study of Botany to be given special attention.

June 10—Aylmer Park and vicinity—General Zoological excursion.

June 17—Experimental Farm—Attention to be given chiefly to practical Botany and Horticulture.

THE MAGPIE IN WESTERN ONTARIO.

The magpie has long been recognized as an erratic straggler, but it has not happened to strike the eye of any observer in the Western Peninsula of Ontario of late years; but on March 31st, at 3.30 p.m., one flew over the farm of Mr. J. T. Miner, at Kingsville. He and his son were out, probably looking at the geese, of which there were at that time between five hundred and one thousand visiting him, and they noticed a bird crossing the farm to the north of them, and took it for a blue jay, but the tail was so long that they examined it with a field glass and found that the wings had white patches on them, and "the tail was as long as the body and dark." The flight was much like that of a blue jay.

Such a definite description from two good observers like Mr. Miner and his son should make a valid record of the occurence of this species.—W. E. SAUNDERS.

CORRESPONDENCE.

THE EDITOR, OTTAWA NATURALIST:

I should like to know, through the OTTAWA NATURALIST, the largest beaver ever caught, and the largest specimen in any museum. I am at present having one mounted which weighed 70 pounds. This was captured by Mr. Dan Patton, Midnapore, Alta. Mr. Thompson-Seton mentions one of 68 pounds in his "Northern Animals."

N. B. SANSON,
Curator, Govt. Museum, Banff, Alta.

UNUSUAL BIRD RECORDS AT MONTREAL DURING THE FALL AND WINTER OF 1915-1916.

Larus marinus, Black-backed Gull.—Nov. 3, I saw a female in the possession of Mr. Dumouchel, taxidermist. He informed me that this was shot at Cedars Rapids (near Montreal) on Oct. 31.

Larus philadelphia, Bonapartes Gull.—Nov. 1, I saw one at Dumouchel's shop, shot near Montreal on Oct. 28.

Branta canadensis canadensis, Canada Goose.—On the night of Jan. 21, a flock flew over St. Lambert (opposite Montreal) in a south-westerly direction, and were heard honking for several minutes. Geese were again heard a few nights later, although no record of the exact date was kept.

Buteo borealis borealis, Red-tailed Hawk.—On Oct. 28 I saw an adult male at Dumouchel's, shot near Montreal on Oct. 24.

Astur atricapillus atricapillus, Goshawk.—On Oct. 31 I saw one in flight; also on Nov. 3, I examined an adult male, shot on the Island on Nov. 1, in the act of devouring a domestic fowl.

Cryptoglaux funerea richardsoni, Richardson's Owl.—Nov. 21, I secured an adult male.

Hesperiphona vespertina vespertina, Evening Grosbeak.—Feb. 1, I saw two adult males, shot on the Island at Pointe aux Trembles on Jan. 30. On Feb. 18, I saw one adult male and three females or immature birds feeding on seeds of shade ash trees at St. Lambert. Again, on Feb. 24 two flocks, consisting of twenty-four birds, were feeding on ash seeds in the same locality. Of these, five were bright-coloured males. This species is still with us in considerable numbers at the present date (Feb. 28). The seeds of several Mountain Ash trees in the vicinity have been quite ignored.

Junco hyemalis hyemalis, Slate-coloured Junco.—On Jan. 23, I saw one with a flock of Chickadees.

Bombycilla garrula, Bohemian Waxwing.—Jan. 21, I saw three freshly-mounted birds at Dumouchel's. These were secured near Montreal on Jan 13. On Feb. 9 I heard the burr-like song of this species at St. Lambert, but failed to see the singer. Feb. 14, while passing the same place, I again heard the notes, and discovered an individual of this species in a maple tree, and had a fine view of the rufous under-tail coverts.

Of the above-mentioned species the Red-tailed and Goshawk are perhaps not rare here, but my records are so few that I always consider them worthy of note. I have never before observed either the Canada Goose or the Slate-coloured Junco during the months of January or February, and their occurrence was probably due to exceptional mild weather, with a steady south wind preceding their arrival.

There has been a remarkable absence of several of our most common winter visitors, notably Pine Grosbeak and Redpoll, due possibly to the open weather. On the other hand, Chickadees and Red-breasted Nuthatches have been more common than usual. Snow-birds are scarce, and only seen in small companies. During the fall and early winter I was struck by the unusual abundance of Hawk Owls to be seen in taxidermist shops. These were mainly shot by hunters in the Laurentian district.

L. McI. TERRILL, St. Lambert, Que.

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THE USE OF WILD PLANTS AS FOOD BY INDIANS.

By Tom Wilson, Vancouver, B.C.

Previous to the advent of the Christian Missionaries, the Indians of British Columbia did no cultivation, as such. They depended for their vegetable food on certain kinds of roots, shoots, leaves and berries which grew in their immediate neighbourhood, or which they might come across in their wanderings.

The coast Indians were fishermen and lived mostly in villages, but were partly nomadic as the seasons changed. The interior Indians were wholly so, and lived by hunting and trapping. Their methods of preparing vegetable stores varied with the locality and its climate. Fruits, such as saskatoon, salmon berry, etc., among the coast Indians were beaten to a pulp, partially fermented, then mixed with fish or bear's grease, and so kept, while in the dry or arid part of the country sun drying or evaporation was the method. This was prevalent among the Indians of the Lillooet, Shuswap, Okanagan and Similkameen countries, and to a limited extent among the Kootenays.

Commencing with the Service Berry, *Amelanchier florida* Lindl. and *A. Cusickii* Fern, Saskatoon, Stcokim, Sheea, or whatever happens to be the local tribe name, it is certainly the most important berry in their estimation. It grows plentifully in different parts of the province, extending up the coast as far as Alaska, and even into the interior and away beyond the confines of British Columbia. On the coast, the berry was pulped and mixed with oolachan grease, then pounded and moulded into cakes. This practice was carried on by the Tsimtsians, Tclinkets and other coast tribes. In the dry belt the berries were simply sundried.

The Soap-oolalie, *Shepherdia canadensis* L., was partially cooked by spreading on layers of damp grass after pulping and allowing it to steam over hot stones. The fruit was bitter, though not unpleasantly so. It was highly prized among the Indians, and an extensive trade existed between the people of the Thompson River and those of the coast, where it grows very sparingly. It evaporates easily, and when for any reason the people were rushed, the berries were sundried, and in this condition they kept very well. When wanted for use a quantity was put in a vessel and covered with warm water for some time; after softening it was beaten with an instrument like an egg beater, when it foamed up like soap suds (hence the name), or like pink ice cream. This would be flavoured with some fruit juice and eaten with a spoon. In other cases the berries were allowed to ferment, and a highly intoxicating liquor was the result, but the effect was not nearly so lasting or so injurious as bad whiskey.

The fruit of the choke cherry, *Prunus demissa* (Nutt.), Dietr., Zotku, according to the Thompson Indians, was gathered by the interior Indians, but this fruit is not known by the coast Indians, as the tree is not found within 80 or 90 miles of the coast. The berries were usually dried for winter use.

The Black Cap, *Rubus leucodermis* Dougl., grows luxuriantly and bears a heavy crop, which is easily picked. This fruit lends itself well to evaporation.

The Salmon Berry, *Rubus spectabilis* Pursh., is by far the most handsome of this genus. It grows luxuriantly all along the coast, and to a distance inland of about 80 miles. The fruit is large, sometimes of a deep crimson colour when ripe, at other times of an amber colour. As it is largely composed of water it will not dry up and is apt to rot. The Indians were in the habit of mixing the berries with bear's grease and boiling them, and so making a kind of jam.

The "Salal," *Gaultheria shallon* Pursh., which grows abundantly on Vancouver Island, and also on the coast of the mainland, some places forming an impenetrable jungle, bears heavy crops of a very wholesome berry, which was picked in large quantities by some tribes. With other tribes the berry was not a favorite. If the weather was favourable attempts were made to evaporate the fruit, otherwise the berries were cooked with grease.

The common wild crab apple was gathered to a limited extent by some of our Indians.

In the foregoing remarks mention has only been made of some of the fruits gathered and eaten by our Indians. In addition there is a long list of roots which were gathered and stored for food.

On the south-east end of Vancouver the favourite bulb, "La camas," *Camassia esculenta* Lindl., as well as several of the wild onions, are still largely gathered, and form an important item of vegetable diet. In Lillooet, also, the wild onion is gathered; in fact, the name Lillooet means "wild onion."

Among other bulbs and roots I may mention: *Lilium parviflorum* (Hook.) Holz, "Makaoeza," in the Thompson language, and "Skaniiz," *Erythronium grandiflorum* Pursh.; "Spitlum," *Lewisia rediviva* Pursh., or Bitter Root; all were eagerly sought for. The latter, which is extremely nourishing, was eaten either fresh as it was dug, or threaded on a piece of string and dried, very much as apples were in Canada in olden times.

One root known by the name of "potato" was frequently collected. This was the corm or root-stock of *Claytonia lanceolata* Pursh. These roots vary in size from that of an ordinary marble to that of an egg. They are very rich in starch, and contain a good deal of nourishment. This plant furnished the principal root crop. Certain families looked on certain pieces of ground as their own potatocilihie (potato ground), and I know an Indian to-day whose sole title to his land is owing to the fact that his mother, grandmother and other generations had been in the habit of digging "potatoes" on that patch. The "potatoes" are all gone now, but some of the land is growing wheat, and part is in orchard.

Bracken roots were occasionally boiled and eaten, but only in extreme cases, though a fairly nutritive food could be made even out of that unpromising article. Fungi of different kinds were also eaten, sometimes raw; very often they were sundried for winter use.

I come now to one of the strangest-looking materials for food purposes, namely, the lichens of the dry belt, which hang like old men's beards from all the coniferous trees, *Alectoria jubata* L. The process of preparation was something like this: A large pit was dug in the ground and the inside made as smooth as possible. A fire was then built inside, and the pit thoroughly heated. The ashes were then thrown out and the pit received a lining of damp grass, on which was laid a layer of "moss," (lichen). Another layer of damp grass, then more lichen, and so on till the pit was full. It was then topped off by more grass, and hot stones were laid around and over the whole mass, and it was kept as hot as possible for a day or more, when it was then supposed to be cooked. If not well prepared it was apt to mildew, but I have eaten it a month after cooking and it was quite good.

Among the Indians of the interior the most important, I may say the only plant used for cordage purposes, was Spatsum, *Apocynum cannabinum* L. The fibre was treated very much the same as hemp, and from it was made fairly thick rope and the finest thread. This was usully spun by the women, between the palm of the hand and the naked thigh.

What would the coast Indian be without the Cedar? Literally lost. Out of the mighty logs he chipped, hewed and burnt his great war canoe, often sixty feet long, and in which he did not hesitate to brave the wild waters of the Pacific, when he went off on a foray on some of the other weaker or less prepared tribes, after which he brought back the spoil, and sometimes captives, to the great potlatch house, sometimes one hundred and fifty feet long by fifty feet wide, all built of cedar—even the great totem pole that stood in front, telling maybe of the owner's pedigree, or perhaps the story of some adventure that he had had. And then the dance, which would be sure to succeed the successful foray. Why, the dancers themselves were ornamented with ceremonial masks of grotesque-looking animals, and these again had been cut out of cedar wood, while the clothes they wore were for the most part made from the inner bark of the tree. And while the dance was going on an old crone might be seen spinning a fishing line from the same material. A great tree the cedar, *Thuja plicata*, Donn.

Three different plants were smoked before the Indians had access to T. & B. or Old Chum. Among the Kootenays the inner bark of the Red Willow, *Cornus stolonifera* Michx., was used sparingly, and very probably the custom was borrowed from the Indians of the plains when they went through the passes to hunt the buffalo.

The leaves of the *Arctostaphylos uva ursi* (L.) Sprengel, were smoked under the name kinnikinnick; the name certainly was borrowed from the east.

The third plant was a veritable tobacco—albeit of poor quality, *Nicotiana attenuata* Torr. This was gathered in bundles and dried, and so smoked; it mu t have been very hot smoking.

Of the medicinal plants I shall only mention one, and not attempt to write the name that the Squamish Indians call it. It is difficult enough to pronounce. The plant I refer to is "Cascara," *Rhamnus Purshiana* DC The bark of this tree has been known to the Indians for ages as a medicine, and from the Indians it was adopted by the old miners and prospectors. No "old man of the mountains" would think of being without a bottle of the decoction made f om barberry bark and Oregon grape when far from a drug store. It is less than thirty years since Cascara became such a popular medicine among the whites. Usually a clump of *Rhamnus* may be noticed near an Indian village. It will be seen that though strips of bark have been removed that they have been taken vertically, and the tree is never entirely girdled, but is treated, in a crude way, very much the same as the Cinchona is treated in Ceylon and Java. And yet the trees grow vigorously.

There is an old saying that "he who takes what is to hand will never want." This was true of the Indians before the white man came among them. They always had enough to eat, such as it was. Now they sometimes suffer from hunger. Once they had the whole country to roam over, to hunt, fish, pick berries and gather roots. Now the area is circumscribed, and the habits of a people cannot be changed in one or two generations. An Indian friend of mine made this remark: "I'm afraid we are trying to be white men too rapidly."

The list of plants given above is not by any means complete, but enough has been given to show that the "poor Siwash" took what was at hand.

SOME NOTES ON FOSSIL COLLECTING, AND ON THE EDRIOSATEROIDEA.

By GEORGE H. HUDSON.

The timely and valuable paper by Dr. E. M. Kindle on "Fossil Collecting," which appeared in THE OTTAWA NATURALIST for January, 1916, has led me to present certain notes and problems belonging to the same subject.

We may group the history of fossil collecting into three overlapping periods or stages. At first specimens were saved out of simple curiosity, and in the "cabinet" they found themselves associated with minerals, archæological specimens and objects of recent historic interest. In this stage only the more showy or curious forms were preserved, and a trilobite might find a setting within the coil of a hangman's rope.

In the second stage the principle focus of interest was also the "cabinet," but this reflected more of the developing individuality or intellectual advancement of the collector, in that it showed a more restricted field and a devotion to its amplification. Certain persons limited themselves to fossils only, and came to value their collection by the number of markedly distinct species presented, and by the perfection of the specimens. Duplicates were saved principally for purposes of exchange, and closely allied species or varieties were rejected as not being *typical*. The idea of the fixity of species was responsible for this attitude. This stage was of the same type as that displayed in coin or postage-stamp collecting, save that it was less discriminating; for in the latter groups an exceedingly slight change in die or plate often enhanced the value of the specimen. As the principle interest shown by second-stage fossil collectors was a "stock-taking" of ancient life, we might call this the inventory stage. This "inventory," however, necessitated the giving of names, the description of types, and the classification of the whole—it was in consequence a "systematic" stage.

The third stage we may call the problem stage, and here, for the first time, we meet with collectors whose purpose is the development and illustration of biologic laws and the modern concept of organic evolution. The material collected must throw light on derivation; on distribution in space and time; on the effect of comparatively fixed or changing environments; and on the advancement or ultimate failure of the groups under investigation. To solve these and other biologic problems, the student must acquire a more thorough knowledge of ancient structure and function, and this can only be acquired through material capable of illustrating minute anatomical detail—both external and internal. Specimens are now saved, not so much for their individual completeness, as for their evidence concerning details of structure. A display series representing this stage is rarely to be seen outside of our larger museums.

The first stage is frequently represented to-day by the contents of a boy's pocket; the second stage by the amateur collection of fossils; and the third stage by the mass of fragments and sections found in the paleobiologist's work-shop. The first stage is of little educational value to the average adult. The second stage, however, is of great value to the general public (where it has access to such collections); to the student of geology, for by its means he comes to recognize forms that enable him to identify strata of the earth's crust; and to the student who desires to enter the field of paleontology, or to become acquainted in a general way with the past evolution of life. The third stage is of vital importance to the world's progress in more ways than we have room to enumerate, and in ways yet unknown to the searchers themselves.

We should recognize the fact that collectors in their individual development usually recapitulate these historic stages, and that a collector may become arrested in his development during the first or second stages. He may branch out at one of these levels and become a "new species," but as his work is usually typical of a stage, we shall find it convenient to speak of him as a collector of the first, second or third *types*.

The work of collectors of the first and second types is, in needless ways, antagonistic to the work of those of the third type. For instance, the inexperienced collector makes a surface find, and with chisel and hammer proceeds to secure his specimen. He begins with great care to cut a groove around it to enable him to preserve it on a rectangular block, which will display well in his cabinet. Before he has completed his work a fissure develops which cuts across the specimen and removes perhaps a third of it. To his mind this specimen is spoiled. He throws away the separated fragment, and disappointedly leaves his find in order to search for another. I cannot but contrast this procedure with that of a collector I well remember. In breaking off a part of a ledge some portions of a rare trilobite were discovered. Before attempting to remove the rest of the specimen this collector first secured all fallen fragments which preserved any portion of it, and fastened them to the removed piece with a little glue. The portion still remaining in the cliff edge was next secured and the whole carefully wrapped in paper and tied together. I recall an instance in which a specimen, after being freed from its matrix in the workshop, showed the loss of a portion of a remarkably long caudal spine. In the following year the original collector made a long journey back to the quarry, found the place from which the specimen was taken, and secured the rest of the imbedded spine.

Attention is called to the destructive work of the amateur, because he outnumbers the experienced collector ten to one, and not only destroys much valuable matter in the field, but oftimes loses his interest in his own collection, and allows it finally to go the way of all waste. Particularly is this true in the neighbourhood of certain boys' summer camps, where "nature study" leads them afield with their "councillors," and where indiscriminate collecting is encouraged.[3] The damage inflicted by the amateur is wholly unintentional, and the more experienced worker has but to take an interest in the younger collectors to make them very helpful allies.

The amateur is not the only person who injures the field in which he operates. Many experienced collectors of the "second type" still have the dominant idea that well-nigh perfect specimens are alone worth saving. This, to my knowledge, has led some of them to crush with the hammer certain finds that they had stopped to examine and found defective. This impulse to destroy in the field may arise from disappointment, or from the desire to avoid being misled at a subsequent visit.

To the above loss we must add that which often occurs when the "cabinet'" is re-arranged and many specimens thrown away. Because of the great difference in point of view between collectors of the second and third types, this loss may be a serious one.

Some will doubtless think the picture overdrawn. To their minds the supply of fossil forms is practically inexhaustable.

We may grant this so far as very common species are concerned, and for most specimens taken from below the present rock surface. There are two fields, however, in which the loss is not only real but at the same time serious. I refer here to weathered surface material and to rarer species whose structure is not fully known.

Well weathered material may in a single specimen reveal many minute details, both of outer surface and interior. If the nearly complete form is preserved, such a specimen may be saved, and finally yield new truths to some paleobiologist. On the other hand any great loss of surface or of other portions of the whole may make the specimen one of little or no value to a collector of the second type, yet the fragment might show details of inestimable value to the collector of the third type. We must elaborate these statements somewhat in order to get a clearer idea of their import.

A complete specimen may do no more than add a new species to our ever growing lists, while a well weathered fragment may add largely to our knowledge of the structure and function of a whole order. For example, the type of *Blastoidocrinus carcharidens* Billings, shows less than half of a complete specimen, but it reveals the character of its food-grooves; cover-plates; floor-plates; the drainage tubes situated between the outer ends of the latter and leading into the hydrospires; the outer surfaces of the hydrospire folds; the exceeding thinness of the latter, fitting the organ to perform the function of respiration; the fine corrugations on their inner surfaces, giving strength with extreme lightness; the external openings or discharge pores, showing the direction of flow to be downward (cataspires), and not upward (anaspires) as in the blastoidea; and the true basals. (See N. Y. State Museum Bulletin 149, plates I-IV.) Not one of these things was to be seen in the well-nigh perfect specimen collected by E. M. Hudson on Valcour Island, until it was sectioned, and even then the details shown were neither so numerous nor so complete as in the holotype, and in other still smaller fragments. (N.Y. State Museum Bulletin 107, plates 1-4). The holotype also demonstrates the absence of a lancet plate, and is itself clearly an example of a new order of Echinoderms, the *Parablastoidea* (last reference, page 119).

Let me refer to another specimen less than "half there." This is the type of *Protopalaeaster narrawayi*, papers on which appeared in THE OTTAWA NATURALIST in May, June, July and December, 1912, and October, 1913. In addition to these papers the species was figured in N.Y. State Museum Bulletin 164; by W. K. Spencer, in part I of his "Monograph of the Paleozoic Asteroidea," 1914; and further shown by a fine plate in Schuchert's "Revision of Paleozoic Stelleroidea," U. S. National Museum, 1915. Schuchert's additional material indicates that the type specimen had lost practically its entire apical skeleton. It, however, reveals structures not yet seen in any fossil sea-star ever collected before. This rare find of Mr. J. E. Narraway at City View should prove of interest to the readers of this magazine, and it is to be hoped that other fragments of this species will be found, as there are many points in its structure not yet satisfactorily explained.

A study of the specimen figured by Raymond, in OTTAWA NATURALIST, December, 1912, is also one of those marvellous dissections and preparations by nature which has so much to say concerning the minute anatomy or histology of an extinct subclass of Asterozoa. This specimen I have treated in an article which will appear in the Director's report of the N. Y. State Museum for 1915.

Now, we must bear in mind that Mother Nature has worked for hundreds of years on some of her surface material to prepare it in a manner that man cannot yet imitate. We might say that as a carefully dissected and preserved frog, so prepared as to display its internal organs, would have a greater money value than an ordinary dead frog, so would a dissection and preparation at nature's hands of one of her buried forms enhance its value. At the same time, however, we should bear in mind that the dissection of the frog is a much easier matter than the dissection of any fossil. The field of weathered surface is certainly limited, and collectors in any region that has been frequently visited will tell one that good finds are not so abundant as they used to be. When surface material has so much to tell, it is certainly a matter of regret to have a large percentage of it destroyed through ignorance and carelessness. It becomes a duty then to conserve this material, and to make it widely known that well weathered specimens of all uncommon species, even though very fragmentary (such as the separate ossicles of Blastoidocrinus, figured in N. Y. State Museum Bulletin 107, plates 4-7) is desired for study of external ornament, form of ossicles, or other elements of structure, manner of articulation, growth stages, etc.

Buried material is, of course, limitless so far as common species are concerned, but for all rare forms such material is desired for study through development and sectioning. In many cases fragments might be of inestimable value.

(To be continued.)

BIRD NOTES.

An influx of Evening Grosbeaks occurred during the month of March, large flocks appearing within the city limits and in less settled d stricts n arby. The birds were so conspicuous and popular that many interesting items appeared in the daily press. A number of ignorant people either trapped or shot these birds, but the timely intervention of the proper authorities prevented what might have been a wholesale slaughter of hundreds of this beautiful species. The Grosbeaks were subsisting on a diet of mountain-ash berries. Several trees, under personal observation, were stripped bare of berries in two days. The birds have apparently gone northward again, as none have been seen since March 26th. On March 28th, on the mountain side, I noticed a dead male, which was in perfect condition and had not been shot. Perhaps this bird died of starvation, as others have been lately picked up and their crops have been empty.

The Pine Grosbeaks have been conspicuous by their absence, only one male and two females being seen during the entire winter. These were also feeding on mountain-ash berries, and would occasionally drop into a pool of water to take a bath. The birds were quite tame, allowing anybody to approach within a few feet of them.

The spring migration has set in in earnest and quite suddenly. A week ago hard winter conditions were prevailing, but now the weather is warm and summerlike. The Prairie Horned Larks were observed on March 5th. Although crows have been reported from certain farming districts a few miles outside of Montreal during the winter, the first spring arrivals in this locality appeared on March 12th, becoming more abundant each day. On March 26th a flock of Red-winged Blackbirds was noted, and one Bluebird put in an appearance. On March 28th a Song Sparrow was heard, and the day following the birds were common, about fifteen being heard singing in an orchard where there was plenty of brush and cover.

March 30th was a fine, warm spring day. At 4 p.m. I visited an area of low ground some 400 yards square, and flanked on one side by a small stream and a thin growth of alder and willow bushes. This locality was covered by snow and water, and I was immediately attracted by a flock of about 50 Robins, which were probably going further north, and six Bluebirds running over its surface. The Bluebirds would fly into the bushes and quietly d op to the snow again, with an occasional soft call note. The birds were evidently feeding on spiders or insects, but after floundering through slush and water over boot tops, the food question still remained a mystery. At 5.30 p.m. three Robins perched in trees and started warbling, and continued so for ten minutes. The movement of the Robins and Bluebirds over the surface of the snow was an interesting sight. In the hardwoods adjoining, two Yellow-bellied Sapsuckers, one White-breasted Nuthatch, one Downy and one Hairy Woodpecker were seen. As I lingered about a Slate-coloured Junco joined the group on the ground.

Westmount, Que. W. J. BROWN.

ABERRATION IN *HEPATICA ACUTILOBA*.

BY BRO. M. VICTORIN, OF THE CHRISTIAN SCHOOLS, LONGUEUIL COLLEGE, QUE.

The common Liverleaf of our western Quebec woods, *Hepatica acutiloba* DC., is not only a very handsome plant, but also the subject matter of more than one interesting morphological problem. It can be, for instance, asserted that nearly every beginner in botany has been misled by the three-bracted involucre subtending the flower, thus encountering much trouble in using the keys of the manuals.

That this pseudo-calyx is strictly an involucre is evidenced by the fact that the parts of it show, in certain teratological specimens, a tendency to cleave after the manner of a well-known group of Anemones, of which *Anemone canadensis* L., is a good example. Holsted (1) hints at the fact, and Goffart (2) after a careful study of the leaf anatomy, holds that *Hepatica* cannot be separated from *Anemone*.

We wish to record here some particular instances of abnormality in *Hepatica*. Figure 1 illustrates a specimen collected in Lougueuil, Que., during the month of May, 1914, in which the bracts make a partial return to the leaf form. One of them is nearly perfect in outline, though of small size; the other two are merely enlarged, retaining their original form. The flower itself, markedly depauperate, is dioecious.

In April, 1916, we observed on the St. Bruno Mountain, among a luxuriant growth of *Hepatica*, specimens departing from the type in the following particulars: flowers of an infrequent

(1) Holsted, *Bull. Torr.Bot.Club*, 14: 121.
(2) Goffart Jules. *Recherches sur l'anatomie des feuilles dans les Renonculacées*. Arch. Inst. Bot. Univ. Liège, III, 1901.

rose colour, depauperate, dioecious; involucre composed of 4-5 bracts, one of them sometimes bifid.

The abortion of the stamens and the reduction of the petaloid sepals seem to account well for the increased luxuriance of the vegetative organs. Indeed, a mass of observations point to the fact that, in the metabolism of plants, vegetative and reproductive activity behave in inverse ratio.

The affinity of the genus *Hepatica* with *Anemone* is an interesting problem, and observers should be on the lookout for deviations that may open lines of research.

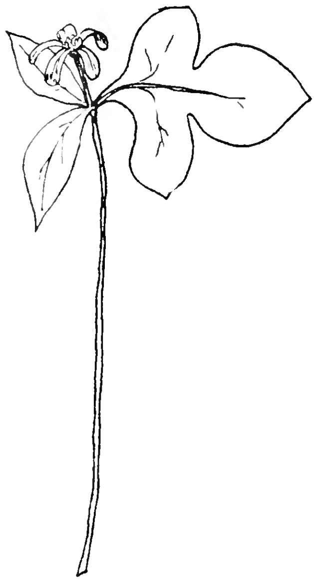

Fig. 1.
Abnormal involucre of *Hepatica acutiloba* DC.

A PRELIMINARY PAPER ON THE ORIGIN AND CLASSIFICATION OF INTRAFORMATIONAL CONGLOMERATES AND BRECCIAS.

BY RICHARD M. FIELD, AGASSIZ MUSEUM, CAMBRIDGE, MASS.

INTRODUCTION.

The term intraformational in contradistinction to interformational was first proposed by Walcott (1) in 1894. He writes: "An intraformational conglomerate is one formed within a geologic formation of material derived from and deposited within that formation." In the same paper he remarks upon the importance of determining the time element or sequence of events in the formation of a sedimentary or clastic rock, by a study of the shapes and textures of its constituents. Thus, in his introduction he writes (p. 91): "Usually the presence of a conglomerate in a stratigraphic series of rocks is a matter of considerable importance to the geologist. He naturally infers the presence of a break in the continuity of sedimentation; an orographic movement of greater of less extent; erosion of preexisting formation." In other words the term conglomerate by its definition conveys to the mind of the stratigrapher a great difference between the ages of the pebbles and the cement. It is proposed to show in this paper that there is often a nice distinction between the ages of the constituents in most conglomerates and in intraformational conglomerates in particular. It is true that we arrive at a knowledge of the sequence of the events which have taken place in the formation of any given clastic by describing the texture and shape of its constituents, but the writer believes that the tendency has been too strong among students of the sedimentary rocks to express their findings in purely textural and structural terms without special thought as to their history and origin. Thus, any rock, be it limestone or otherwise, which is formed of coarse and apparently water-worn materials, is dubbed a conglomerate, and its natural history, even if recognized, is lightly passed over in its classification.

It is not proposed in this paper to attempt a classification of all conglomerates on such a basis as outlined above. A study of certain Paleozoic limestone conglomerates, and especially of certain structural and textural phenomena as exhibited in the limestone formations at Trenton Chasm, Chambersburg, Bellefonte and elsewhere, has led to the belief that a compilation and discussion of the evidence of the so-called intraformational "conglomerates," breccias, or "corrugations," is needed if we are to arrive at exact conclusions regarding certain common phenomena associated with the history of the ancient seas.

Grabau (2) states that intraformational brecciation is "probably in all cases an extreme of subaquatic-gliding-deformation." The writer does not feel that most of the phenomena observed by him in the Appalachians will bear out this statement. The principal example of folding and brecciation cited by Grabau as due to this cause, is the one at Trenton Chasm, New York. Hahn (3) described the folds as due to "subaqueous solifluction." Grabau (sp. cit. p. 785) states that "Deformation through gliding may result in complete brecciation of the deformed layers. The fragments may lie in all positions, as in the ordinary intraformational conglomerates, or they may consist of thin cakes, many of which in the gliding process have assumed a vertical position in the mass. This forms the so-called 'edgewise conglomerate,' common in the Ordovician limestones of the Appalachian region. The characteristics of all these formations seem to point to rather shallow water as the place of deposition of these strata, and the possible periodic exposure and hardening of the surface layers." The writer has been able to prove to his own satisfaction that some of the edgewise conglomerates in the Bellefonte section are certainly not due to subaquatic-gliding-deformation, neither does he believe that any one hypothesis is able to account for the formation of all intraformational conglomerates, whether the orientation of their fragments be "edgewise" or not. He feels convinced that the folds and edgewise conglomerates exposed to view in the gorge at Trenton Falls are, as previously supposed, truly of tectonic origin, and, therefore, not, in the sense of Walcott's definition, "intraformational conglomerates" at all, since they were not "deposited in the formation." A recent study of the Trenton Chasm, in company with Drs. Raymond and Shuler, produced evidence which points conclusively to the tectonic origin of the folds and edgewise conglomerates, as is amply set forth in Miller's (4) recent paper.

It was only a few years ago that ripple-marks and mud-cracks in limestone were considered rare and unusual phenomena. Indeed stratigraphers and paleontologists did not expect to find and did not hunt for such structures in the Paleozoic limestones. To-day the investigators of the Cambrian and the Ordovician calcareous rocks are reporting such data from the

St. Lawrence valley to the Cretaceous boundary of the Paleozoic in Georgia and Alabama. Thus there is gradually being amassed more and more material significant of the diagenesis of the Cambrian and Ordovician rocks, and relating to the history of the seas from and under which they were deposited. It will not do, in this study, to dub all coarse, clastic, intraformational rocks, whose constituents may or may not be rounded, as simple conglomerates all of similar origin. It is believed that a more careful examination of these intraformational structures in the field and laboratory will greatly aid in deciphering the history of the original limestone sediments. Upon the rock-walls of the Bellefonte quarries have been observed many of the structural phenomena which are to be found on shallow water areas, mud-flats and beaches of to-day. Ripple-marks, mud-cracks, edgewise conglomerates and breccias are disclosed in close stratigraphic sequence wherever exposure and subaerial erosion have been able to develop the hidden structures. The conclusion has been reached that nearly all of the intraformational conglomerates and breccias seen at Chambersburg, Bellefonte and Tyrone, Pennsylvania, are of extremely shallow water origin; in fact, their formation postulates an emergence from the sea such as is common under tidal action. That mud-cracked beds and intraformational breccias are in certain cases one and the same thing is, perhaps, the only original contribution to the origin and classification of intraformational structures.

GLOMERATE AND PHENOCLAST.

Before proceeding with the classification of intraformational structures, it seems best to analyz the term conglomerate.* Indeed the study of intraformational "conglomerates" requires a more careful consideration of all conglomerates than has heretofore been deemed necessary. A review of the literature, as well as certain examples studied in the field, has shown that not all intraformational conglomerates are made up of water-worn materials; in fact, certain of them are composed of distinctly brecciated fragments which show no signs of attrition by water transportation, a common characteristic according to most geologists. Walcott (op. cit. p. 192) recognized this diffi-

* Most stratigraphers would certainly agree that true breccias cannot be defined under the general term of *conglomerate*, yet if we refer to the Century Dictionary we discover that although a conglomerate is defined as "a rock made up of the rounded and water-worn debris of previously existing rocks", a breccia is defined as "a conglomerate in which the fragments, instead of being rounded or water-worn, are angular". No less an authority than J. D. Whitney is responsible for these definitions but most geologists would probably refuse to accept them as they stand. Quotation is taken from the Century Dictionary only to show that there is some confusion at least at present in regard to just what *conglomerate* means.

culty when he wrote: "Care is to be taken that intraformational breccias are not to be confounded with intraformational conglomerates. The former have a wide geographic distribution, and owe their origin to local disturbances within the beds affected, without pre-supposing elevation above sea level and erosion." As will be pointed out later, limestone breccias can be formed under other than truly tectonic conditions. It may seem strange at first to consider a mud-cracked limestone as a brecciated rock, and yet viewed in cross section, or at right angles to the bedding plane, the hand specimen or field section will often show a characteristic brecciated structure. It is, therefore, proposed in the present classification to introduce two new terms, glomerate and phenoclast, in describing all those rocks (glomerate) which are of sedimentary origin, coarse, or psephitic in texture, whether or not their "show" constituents (phenoclasts) give signs of attrition and transportation.

GLOMERATE, according to the Century Dictionary, means "collected into a spherical form or mass." It is an old English word and rarely used. Conglomerate, in its ordinary sense, is also defined as "collected or clustered together," the shape of the materials forming the cluster being undefined; while the geological term "conglomerate" is defined as "a rock made up of the *rounded and water-worn debris* of previously existing rocks, etc.," (the italics are the writer's). It is proposed to use the term *glomerate* in a geological sense to mean any sedimentary or clastic rock made up of roughly graded debris formed within itself or from pre-existing rocks. Such a term would cover breccias, conglomerates and certain other rocks of doubtful origin, and its need will be more obvious further on in this paper. Nauman, in his "Geognosie," proposed the term *Psephite*, but it has never been widely adopted, and probably never will be, although it is a useful and descriptive word in petrology and geology. Nauman defined psephite structure thus: "Die Fragmente, aus welchen die klastischen Gesteine bestehen, sind entweder gross, so dass sie als formliche Gesteinstucke erscheinen, welche theils *eckig* theils *abgerundet* sein koennen. In diesem Falle lasst die structure als psephite-structure bezeichen, weil sich die betreffenden Gestein als Agregate grossere oder kleinen Steinen darstellen" (p. 446. The italics are the writer's.)

PHENOCLAST.—There is as great a need for a term to express the order or size of the constituents in a sedimentary rock as there is for the term *phenocryst*, which designates a large crystal in the ground mass of a crystalline rock. Phenoclast, from *pheno*: show; and *clast*: clastic, broken piece or fragment, is proposed to designate the larger fragments, pebbles or allied forms which are easily distinguished from the ground mass or cementing material. They, the phenoclasts, may be of several orders of size. The term is convenient, as it is not always correct to refer to the major constituents of a conglomerate as pebbles, or even brecciated fragments. For instance, in the edgewise "conglomerates," the "pebbles" and cement are apt to be formed from the same material; also the shape of the "pebbles" is hardly pebble-like, neither are the "pebbles" true, brecciated fragments. Also, in certain types to be described later, the bioglomerates, the phenoclasts are obviously neither pebbles nor angular material. Their outline is as peculiar and distinct as is their origin. Thus we find all variations, from sand-like particles to pebbles and breccias, and all of them conspicuously distinct from the cement or ground mass.

CLASSIFICATION.

(See table on page 35.) The stratigrapher is primarily interested in the "sequence of events," as exhibited by the relative position of, and the structures and fossils within, the formations which he studies in the field. He must observe texture and structure as well as fossils—in short, he should be lithologist and structural geologist as well as paleontologist. What little the present day stratigrapher knows regarding the texture of the sedimentary rocks, he has acquired with the methods of the petrologist, methods largely developed for the investigation of the igneous or crystalline rocks. The petrographer studies his thin sections and classifies his specimens according to their macroscopic and microscopic textures and mineral contents; the resulting data, together with the structural details and occurrence of the rocks in the field, are used by the petrologist to build his classification of the igneous rocks and to promote his theories as to their history and origin. Thus, studies in "paragenesis" and "order of crystallization" within veins and hypothetical rock melts have resulted in our present knowledge, through facts and hypothesis, regarding the main, great division of the rocks which form the earth's crust. Microscopic investigation of the sedimentaries, and especially of the limestones, has not appealed to the petrographer. The supposed lack of variation in texture, and more or less homogeneous mineral composition, has failed to raise the same amount of interest in their classification and origin as in the igneous rocks. Even granting the fact that with the limestones are associated, in many cases, the relics of past floras and faunas, which should stimulate investigation as to the history of the rock's formation, yet, because of the inherent difficulty of proving anything by the microscope, the limestones have been little studied. The tendency has also been to neglect their macroscopic phenomena in the field, although enough data has now been collected to stimulate an interest in its application to causes and events. It may soon be possible to classify sedimentary rocks according to the sequence of formative events which they have undergone. Such a classification is very much to be desired, as it will eventually give us a Natural History of the sedimentary rocks. In this paper the attempt will be made to classify intraformational glomerates with the above facts in mind. Thus, all intraformational glomerates may be divided into two groups: *A*, those whose present structure is contemporaneous with their primary lithification; and *B*, those whose present structure is non-contemporaneous with their primary lithification. Again, under class *B*, the present structures may be either previous or subsequent to the primary lithification. We will examine the classification more closely when we discuss the mode of origin of each type. As stated before, field evidence strongly points to the fact that it is impossible to explain all intraformational glomerates by a single hypothesis. It has been suggested that the rapidly growing amount of data concerning the occurrences of such rocks makes it unwise to classify them all under the term *conglomerate*. This statement will be appreciated fully by those who have observed different occurrences in the field, or have even read the descriptions by the authors who have studied and described them. Laying aside for the moment the conclusions reached by each investigator as to the origin of the particular intraformational glomerates in his area, we may at least rely upon his attempt to describe what he has seen. Descriptions of intraformational glomerates are so varied that one is forced to the conclusion that the variations cannot all be the result of a single set of factors. The study of intraformational glomerates is largely a study of the phenoclasts which bring them so strikingly to the notice of the field geologist, and it is upon the size, shape, structure (if present), and composition of the phenoclasts that this present classification is largely made. The arrangement of the phenoclasts may be heterogeneous, unsorted, parallel, banded, radiate or edgewise. The arrangement, as well as the size, shape, structure and composition, of the phenoclasts is intimately connected with their origin and the depth of water under which they were deposited, the strength of tidal currents, if any, the topography of the sea floor, and character of the sediments. The presence of organisms in the slimy mud of the seas may also have proved a determining factor in their evolution.

CLASSIFICATION OF INTRAFORMATIONAL GLOMERATES.

A. Present structure contemporaneous with primary lithification.
- I. Shape of phenoclasts not dependent upon transportation and attrition.
  - *a*. Endolithic breccias (mud-crack breccias.)
  - *b*. Bioglomerates.
    - 1. Result of animal (?) activity.
      - (a) "Strephochetal" glomerates.
      - (b) "Wingia" glomerates.
    - 2. Result of vegetable activity.
      - (a) "Corosion" glomerates (formed by algae).
      - (b) Algal glomerates (formed from algae).
  - *c*. Gleitungsphenomene; sub-aquatic-gliding-deformation "conglomerates."
    - 1. Lacustrine.
    - 2. Marine.
- II. Shape of phenoclasts partially dependent upon transportation and attrition.
  - *a*. Stratified glomerates.
  - *b*. "Edgewise" glomerates.

B. Present structure non-contemporaneous with primary lithification.
- I. Present structure partially previous to primary lithification.
  - 1. Shape of phenoclasts entirely dependent upon transportation and attrition.
    - *a*. Limestone conglomerates.
    - *b*. Mixed conglomerates.
  - 2. Shape of phenoclasts not affected by transportation and attrition.
    - *a*. Cliff breccias.
- II. Present structure subsequent to primary lithification.
  - 1. Tectibreccias.
  - 2. Enterolithic breccias.
  - 3. Ice-formed breccias. Formed by
    - *a*. Icebergs.
    - *b*. Continental glaciers.
      - 1. Result of shove.
      - 2. Result of thaw.

ENDOLITHIC BRECCIATION, (see Grabau, p. 777).—Mud-crack breccias.

Mud cracks are found to be of much commoner occurrence in the Cambrian and Ordovician limestones than was formerly supposed. Where there was a shallowing of the Ordovician seas so as to permit intermittent periods of dessication, mud-cracks are well developed over wide areas, and for a stratigraphic distance of several feet. Apparently the conditions which allow of the formation of mud-cracks (see fig. 1) also postulate a slight variation in the composition of the limy muds originally deposited. Thus, a series of alternating layers, which have been successively cracked by dessication, when viewed at right angles to their plane of deposition, show a series of stratified brecciated fragments. It is interesting to note that where quarries have been opened in the Bellefonte section (at both the middle Beekmantown and Lowville horizons) so as to expose the limestone beds for some distance along both the dip and strike, great mud-cracked areas have been brought to view. The writer has seen a mud-cracked surface on the west wall of the quarries at Tyrone which was at least one-half an acre in area. Only the closest inspection, however, of the section across or at right angles to the dip will show any structure that might lead the stratigrapher to suppose that mud-cracks were present, and in such great abundance. When the filling of the cracks, or rather, the material surrounding the phenoclasts, is of a different colour or texture from that of the phenoclasts themselves, a stratified intraformational breccia often proclaims that its other name is "mud-crack." Thus, in a region such as that characterized by the Appalachian type of folds, where the rocks are usually observed at an angle of between 25 and 60 degrees, it is quite natural that mud-cracks and ripple-marks should be considered rare phenomena, except where exposed in quarries and road-cuts along the strike. The mud-crack zone may have a stratigraphic thickness of only 3 or 4 feet and yet extend along the strike a distance as great as that from Bellefonte to Tyrone (60 miles), or even farther. What the total area of such a mud-cracked surface might amount to is difficult to surmise. Owing to the fact that the dip of the limestones at Pleasant Gap, several miles east of Bellefonte, is considerably flatter than the dip of the same beds at the latter place, the writer has been unable to get, as yet, any exact data as to the geographical extent of this phenomenon, but all signs point to its being an exceptionally wide one.

In connection with this subject it might be well to mention a certain columnar structure observed and described by E. M. Kindle (5) in the Silurian limestone on Temiscouata Lake, in eastern Quebec. The occurrence of columnar structure in limestone is unusual, and very like basaltic columnar structure in general, "but the columns are perhaps less regular in the number of faces shown, five to seven being a common number."

(To be continued).

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AMERICAN INSECT GALLS.

By E. P. Felt, Albany, N.Y.

American gall insects constitute an exceedingly interesting assemblage, representing at least five of the larger and better known orders. It is worthy of note that by far the greater majority of plant galls are produced by members of the dipterous family, Itonididæ, and the hymenopterous family, Cynipidæ. Of approximately one thousand insect galls listed, members of the above mentioned groups are responsible for over 90% (nearly 95%), with two species of the delicate gall midges producing deformations to every one of the relatively better known gall wasps. The plant lice or aphids come next in the number of species, though they would be outranked if the gall mites, the Eriophyidæ, were included in this discussion. The other gall-making Diptera, Hymenoptera, and the Hemiptera and the gall-making Coleoptera and Lepidoptera are, numerically speaking, of comparatively little importance.

The numerous gall midges show a diversity of taste not evidenced among the gall wasps. The more than 600 galls produced by the midges occur on plants belonging to 69 botanical families and 202 genera. There is no such specialization, as we shall see later, in the Cynipidæ. The larvae of 60 species of midges live at the expense of the Salicaceæ; 48 of these are found on *Salix*; 28 occur upon the Juglandaceæ, all but one infesting *Carya*; 37 attack the Fagaceæ (31 of these being upon *Quercus*); 52 species produce galls on the Rosaceæ, 23 on the Leguminoseæ, 18 upon the Vitaceæ, and 125 on the Compositæ. The most obvious concentration of species, aside from those mentioned above, is the 41 species reared from solidago and the 20 to be found upon aster. These figures are approximate, yet taken in connection with the great diversity in the structure of these small insect , indicate that this group has been able to maintain itself upon a great many different plants through a considerable physiological adaptability, and that the distinctness of the species has been established by relatively small modifications in structure.

The Cynipidæ or gall wasps present an entirely different condition so far as the relation to the flora is concerned. They attack plants referable to only six botanical families, and assignable to but eleven plant genera. There is, however, a most striking concentration in food habits, since a very large proportion of the more than 300 gall makers subsist at the expense of the Fagaceæ which, for this group, means the genus *Quercus*, the exact number in our list being 277, though this figure, like those above, is an approximation. Thirty species have been reared from the Rosaceæ, 21 (*Rhodites*) living at the expense of the genus *Rosa*. The other species referable to the Cynipidæ are scattered in their food habits, the most evident concentration, and this far from marked, being the 12 species reared from various Compositæ, the genera *Silphium* and *Lactuca* producing four and three, respectively. This marked limitation in food habits is accompanied, as might be expected, by a high degree of specialization in structure.

The Aphididæ or plant lice live on a great variety of plants, though the gall-making forms occur upon relatively few plant families and genera, the most evident concentration in food habits being in the genus *Phylloxera*, with its 29 species producing galls on *Carya*.

The nealy allied jumping plant lice or Psyllidæ present a similar condition in the genus *Pachypsylla* and its relation to the numerous types of gall occurring upon *Celtis*.

The occurrence of a number of galls produced by closely related insects upon food plants belonging to a genus or even species, indicates a physiological relationship, and some of these groups at least offer excellent opportunities for the investigator who would study the relation between the specific identity of gall makers and the galls they inhabit. It is undoubtedly true that marked diversity in gall structure usually indicates the work of different insects, though there is a possibility that variations in the structure of these deformities may be related to some extent at least, to the period when the infestation occurs; in other words, oviposition before the tissues have swoollen to any extent in the bud may result in a somewhat different deformation than if egg laying be delayed until the leaves are partly unrolled. There are a number of cases where apparently identical gall midges produce markedly different deformations in the same or closely allied plants, and we are inclined to believe that the time of infestation in relation to the development of the host may be an important factor as well as the part of the plant attacked.

There is still much to be learned about insect galls and their makers. Many new galls await description, and exact knowledge respecting the habits of gall makers is far from complete. Certain localities offer exceptional facilities for solving the unknown, and we would suggest to nature lovers that the local occurrence of numerous galls should be considered an invitation to enter a charming and delightful field of study.

THE BARN OWL NESTING IN SOUTHWESTERN ONTARIO.

BY W. E. SAUNDERS, LONDON, ONT.

The Barn Owl (*Aluco pratincola*) has been known in Ontario only as a casual visitor, and I may, therefore, be excused in stating that I regarded with incredulity a letter from Mr. W. C. Armstrong, of Chatham, written on June 29, which told me that there was a nest of the Barn Owl containing six birds near there. However, when I telephoned him he was very positive, and as a result I took the next train to Chatham, and in the afternoon drove out to Charing Cross, where the young birds were in the barn of Mr. H. C. Hunter. To my surprise there were really six young Barn Owls, almost full grown and apparently full fledged. They were in a little pigeon house under the ridge of the barn, and as may be supposed, the floor, about seven by five feet, was well covered with pellets. The pellets from these young birds were of a peculiar flattened oval shape, and were remarkably uniform in character. They contained a remarkably small proportion of bone, possibly indicating extraordinary digestive activity. All the identified bones were those of the common field mouse, and the fur appeared to belong entirely to the same species.

Immediately on our appearance on the ladder they began to hiss in a manner that was to me entirely novel and surprising. All six birds made the noise together, and it resembled that made by escaping steam. I supposed they stopped to take breath sometimes, but as they immediately began hissing again I failed to detect them in the act. They were crowded together in a corner of the little room, and when after a while they stopped hissing, it reminded one of the habits of the frogs which call so frequently and continually, and then on the advent of an intruder cease calling altogether. That is exactly what the owls did, and after several minutes of continual hissing the silence when they stopped could almost be felt.

When we offered them a stick they attacked it with their beak, and occasionally struck at it with a foot, but they had not yet reached the age when the uses of their feet were properly appreciated. After a while a ildness seized four of them and they rushed around the room, and one went out through a small hole and flew away. Where he went to is still a puzzle, but no doubt his parents found him at night.

The old ones do not appear in the day time, but come towards evening with food, and they have always been silent ever since they arrived in February, the hiss being the only sound Mr. Hunter has heard from them.

The only recent record of these birds for Ontario was when two were taken, one at Pelee Island and one at the base of Point Pelee in 1914, and there are a few other records of the occurrence of the bird, but this, I believe, is the first nesting that has ever been reported.

SOME NOTES ON FOSSIL COLLECTING, AND ON THE EDRIOASTEROIDEA.

By George H. Hudson.

Part II.

(Continued from page 25.)

Bather's "Studies in Edrioasteroidea," which appeared in the Geological Magazine at different times from 1898 to 1915 inclusive, have now been collected into one volume and published by the author at "Fabo," Marryat Road, Wimbledon, England. In this reprint the dates and paging of the Geological Magazine have been retained, and our references will, therefore, apply to both the original papers and the reprint. As examples of thorough study of what specimens have to reveal, these papers are unexcelled. It is highly probable, however, that the specimens themselves lack structures they once possessed, and that such structures will yet be found, either in more complete individuals or in fragments. Before specifying what I believe will be the nature of such finds, let me give some instances of structure rarely preserved.

Of what he calls the "tubular pyramid" on Pentremites, Hambach says ("Notes about the Structure and Classification of the Pentremites,"; Trans. St. Louis Acad. of Science, Vol. IV, No. 3, p. 6): "The only species on which Dr. Shumard observed the same, was a specimen of P. *sulcatus*, Roemer. . . . .

It is so seldom found preserved, that in thirty years' collecting, during which time I collected at one locality more than 6,000 specimens, I found only two specimens having this cone-shaped body preserved." In his "Revision of the Blastoidea," (1903, p. 14), Hambach also calls attention to a structure "on the posterior side above the anal opening, on very well preserved specimens, a small proboscis about one-fourth of an inch in length, constructed of small hexagonal pieces, as shown in Figs. 6 and 7. To my knowledge it is the first time that such a body has been observed on a Blastoid. I found this appendix on *Pentremites conoideus*, and have now four specimens of it showing this, so far unknown, organ." When, however, Hambach finds the ambulacral area more or less roofed over with small cover-plates, he believes them to be "fragments of broken-up pinnulae," or "small ovulum-like bodies," . . . . "due to the oolithic character of the rock in which they are imbedded." In the latter case a true structure, rarely found, is apt to be cleaned away, because of a belief that it does not belong to the specimen. It is well here to emphasize the need of most careful scrutiny before any attempt to modify an exposed surface.

Of Blastoidocrinus it seems that the nearly perfect Valcour Island specimen is the only one ever found still retaining its large "apical plate," its prominent series of "wing plates," (which form above the cover plates and completely hide the latter from view), and its brachioles; yet *B. carchariaedens* is one of the common fossils of the Chazy limestone. Additionl examples might be given, but the above are sufficient to show that species may be abundant and the mass of collected material very great indeed, and yet valuable evidence be lacking as to morphology, function and relationship.

From certain resemblances between Blastoidocrinus and some genera of the Edrioasteroidea, and from an examination of the only mechanism apparently used by the latter for the function of food-capture, I am forced to conclude that certain genera now grouped by Bather in this order possessed brachioles, and that purposive search for these structures in additional material, and it may be very fragmental, will sooner or later reveal them. My belief is based on the following facts.

The Edrioasteroidea are closely allied to the Cystidea, and by many made an order of that class, as in the last edition of Zettel's Text-book of Paleontology (Eastman). Bather follows Billings in recognizing the marked characteristics of this group, but places it no higher than a class of the subphylum Pelmatoza. making it equal in rank to Cystidea, Blastoidea and Crinoidea, All these classes were feeders on minute or microscopic plant and animal forms of the plankton, or on equally small but perhaps more abundant forms living on the bottom. The collecting apparatus consisted of numerous small brachioles or pinnules which captured the living organisms by means of ciliated grooves, lined with viscous secretions, and protected by a series of minute alternating cover-plates. The material caught by brachioles or pinnules was passed into common covered ways leading to the mouth. The main streams became in time mere conduits, and the surplus water taken in with capture and used for conveyance was either gradually lost between the cover-plates or carried to specialized separating areas, where the water was sent to hydrospires and made to assist in respiration. With this manner of food getting it will readily be seen that the cover-plates nearest the mouth would tend to remain closed and to become permanently fixed, or the proximal portions of the food grooves might become subtegminal in position. In every case the extent of the collecting portion of the apparatus is proportioned to the needs of the organism, and to the abundance of minute organisms in its habitat. Deprive Crinoid, Blastoid, Parablastoid or Cystid of its pinnules or brachioles, and its larger or main covered food-grooves could no longer function. Now, we must ask ourselves these questions. If the Edrioasteroidea are Cystids they belong to a group that secured their food by means of brachioles; they were for the greater part fixed and sessile forms, and could therefore only feed on such passing organisms as they could capture; for their size they show no greater length of covered food-grooves than we find in Malocystites, which was an elentherozic form and a feeder close to the sea bottom. Why should the Edrioasteroidea have lost the inheritance of the collecting mechanism of their class, and how could they secure sufficient food without it? These are serious questions, and they are made no easier by raising the group to class rank, for even then every other class of their subphylum required and retained the fringing brachioles or pinnules.

If we compare Blastoidocrinus with Steganoblastus, the need for and probable possession of brachioles by the latter will become more evident. Both are stemmed forms, with similarly shaped body cavities, and with proportional surface areas, covered by large food-grooves. In Steganoblastus, a name suggested by Bather on account of the *closely covered* condition of the main food-grooves (1914, p. 193), we find "large covering plates," (loc. cit.) which form a prominent rounded arch over the groove" (1914, p. 200). "At the proximal end smaller plates may be intercalated along the middle line" (1914, p. 199, and fig. 5, p. 200), or "the medial suture in the proximal region becomes curved and interlocking" (1914,

p. 199), and "apparently immovable over the mouth region" (1915, p. 212). In Blastoidocrinus we have also a closely covered condition of the similarly placed main food-grooves. We have *large covering plates* which *arch over the groove*, and are rendered *immovable* over both *rays* and *mouth region* by a series of still heavier accessory plates, called by the author "apical or anal pièces" and "wing plates," though for the former the term supraoral would be perhaps more appropriate. These ossicles are figured in N.Y. State Museum Bulletin 107, plates 6 and 7. In Blastoidocrinus a specimen the size of Styanoblastus would have about 350 brachioles for a catching apparatus to supply its covered main food-grooves. Bearing now in mind the fact that both were stemmed Ordovician forms which lived in the Ottawa sea, we must appreciate the difficulties which arise if we deny brachioles to Steganoblastus. Why should a continued stemmed existence in a similar environment cause the loss of a specialized and efficient collecting apparatus, and leave only the five main ways to the mouth, and these still closely covered with covering-plates, immovable at least for the mouth region, and for the older portions of the rays.

There are other interesting points to be gathered from Bather's description in which *Steganoblastus* resembles *Blastoidocrinus*. "The very deep folding of the plates," (1914, p. 195), in adapical and interambulacral areas are in Blastoidocrinus due to plate growth or development over hydrospires. There is a "series of pores" between the outer ends of the floor-plates and "just below the attachment of the cover-plates" (1914, p. 198). "The pores between the floor-plates pass through into the thecal cavity" (1914, p. 199), entering hydrospires in both Blastoidea and Parablastoidea. "There is a cover-plate to each floor-plate, and so far as can be ascertained after prolonged preparation and study, the sutures between the cover-plates coincide with those between the floor-plates. Thus, the pores, which as already stated, lie just below the attachment of the cover-plates, open under the sutures as in *Edrioaster*" (1914, p. 199). Precisely this condition is to be seen in Blastoidocrinus (N.Y. Museum Bulletin 149, plate I, fig. 2).

Of the outer border of the food-grooves Bather says: "The suture between the cover-plates and the adambulacrals is flush, and the curve of the cover-plates passes over, though with a distinct bend, into that of the adambulacrals. The suture is not a straight line, but a series of curves, the convex outer edges of the cover-plates fitting into slight concavities in the adambulacral margin. The position and number of the axial ridges on this margin indicate that the original adambulacral elements coincided in number but alternated in position with the cover-plates, and therefore also with the floor-plates. This suture, then, is essentially a zigzag suture between two sets of alternating plates. In consequence of this arrangement one would expect to see along the edges of the groove, when the cover-plates are removed, a series of depressions or façets for the reception of the cover-plates. Unfortunately the edges have in nearly every case been worn enough to remove all trace of these very faint depressions . . . ." (1914, p. 200).

This rather lengthy quotation has been made to show that besides the cover-plates and floor-plates we have present in Steganoblastus a third series of morphological elements belonging to the food-groove. One must at once question if these are not likely to be homologous with the outer side-pieces of Blastoidea, and to function as do the latter in assisting in the support of brachioles.

We should note that the question as to how these five closely or immovably covered rays secured an adequate food supply is not the only question raised by a study of the form and surface of Steganoblastus. How did it perform the very essential function of respiration, is another and very serious question. We find ample provision in Blastoidocrinus and the Blastids in elaborate hydrospire systems. Steganoblastus must also have possessed such a system, and the presence of hydrospires is strongly suggested in Bather's figures 2 and 3 (1914, plate XV), where the floor-plates have been lost. A system of this kind however, presupposes the possession of brachioles.

In Edrioaster the branch channels which end in pores (Bather, 1914, p. 118) are bordered by double ridges, the innermost of which are regularly broken transversely. This structure, shown by Bather, 1914, plate XIV, fig. 3, while not so elaborate as that shown by Hambach in his "Revision of the Blastoidea," plate II, fig. 5, is yet suggestive of the latter, and is an indication of structure associated with the segregation of the more solid contents of the food stream from the water accompanying it. Bather seeks to derive the Asterozoa from the Edrioasteroidea (an exceedingly probable derivation), but in doing so injures his case by interpreting the pores of Edrioaster as podial openings—going so far as to sketch outlines of an ampulla and base of a podium, in 1900, p. 197, fig. 4. Primitive sea-stars possess no podial openings between the floor-plates. This fact is now emphasized by Spencer in his "Monograph of the British Paleozoic Asterozoa," part I, (1914).

Under the heading "Relations of Steganoblastus," Bather says: "The absence of brachioles, inferred from the lack of brachiole-facets and the presence of large cover-plates, proves that Steganoblastus is not a blastoid, not even one of the Protoblastoidea, as was at first supposed" (1914, p. 202). We must modify this statement. The presence of brachioles should be inferred from the presence of small bordering plates equal in number to the floor-plates, and in zigzag arrangement with them; from the manifest need for additional structures to assist in food capture and respiration; from the appearances noted suggesting hydrospires; and from the presence of cover-plates nearly as large and solidly fixed as in Blastoidocrinus, which does possess brachioles. The peculiar blastoid-like markings on the channels of the food-grove noted in Edrioaster may be added to this list, for they will probably be found in both Blastoidocrinus and Steganoblastus. Bather goes on to say: "Secondly, the structure of the subvective groove, with its floor-plates and cover-plates, and its pores between the floor-plates, is paralleled by Edrioasteroidea alone among Pelmatozoa, and in that class most closely by *Edrioaster*, though there are minor differences" (1914, p. 202). This statement cannot stand, for in the points enumerated *Steganoblastus* is paralleled by *Blastoidocrinus*, and both plates and pores no doubt functioned in a similar manner.

We have here a very definite problem to solve, and as we are more likely to find or notice that which first exists in the "mind's eye," a clear comprehension of the problem may lead to an early solution. This idea of a problem-phase in collecting is one we should carefully bear in mind.

Before closing the present paper a few remarks on "field notes" may not be out of place. It is sometimes desirable to know the position assumed by a form, either while living or during burial. With surface material the determination is easily made. In the case of the holotype of *Palaeocrinus striatus* Billings, we desired to know whether or not the flattening of the theca was normal. The varying degrees of weathering, and the cutting away of the under side to free it from its matrix showed that this specimen was buried with the flattened posterior side down. The bent in condition of that surface may then have been simply due to pressure after burial. (N.Y. State Museum Bulletin 149, p. 216-217). In the Valcour Island specimen of *Blastoidocrinus carchariaedens* Billings, a knowledge of the side down at death would assist in proving the respiratory function of the hydrospires and the condition of the growing inner edges of their folds, for fine muds were swept into these folds after the stem could no longer support the theca, and before death occurred. (N.Y. State Museum Bulletin 107, p. 114, and fig. 2 on p. 105). In Canadacystis emmonsi (Hudson), the rounded, protruding portion of the theca seems to have been an adaptation to secure stable equilibrium on the sea floor with arms and mouth uppermost. Most specimens of Malocystites when rolled on a table come to rest with the food-collecting field uppermost. That the theca in this species rested on the bottom is shown by the area over which arm extension did not take place, and in this portion of the theca the plates were the heavier, thus lowering the center of mass and securing stable equilibrium with this part down. Dr. Foerste (1914) believes that the slope of the bed or surface of attachment influences not only the form of the theca, in Agelacrinus, but also the bending of the rays; and Bather (1915, Geological Magazine, p. 261) says: "Here, as in so many similar cases, the field collector and observers have not supplied the laboratory worker with the desired evidence." Not only has gravity left many an unread story of its influence, but even orientation has some important new items for us; for instance, see Patten, 1912 (Evolution of the Vertebrates) p. 377-379, and fig. 257, where much of the "mode of life" of Bothriolepsis is determined from the position of the remains of this genus as preserved in the beds near Dalhousie, New Brunswick. Orientation may also have much to tell the paleogeographer as to direction of stream flow and of tidal currents. It would be a very easy matter to mark collected material in the field with an arrow in its under surface, indicating north. There seems to be room yet for improvement in our purpose in going afield, in our judgment of the character of the material saved, in our marking the specimens when found, and in the character of our field notes. We must also bear in mind that there is much to be saved and gained through any guiding care or assistance we may give to those lovers of nature who belong to the generations that are following ours.

NOTE.

Mr. J. H. Emerton, of Boston, Mass., spider specialist, recently visited Ottawa and other points for the purpose of collecting spiders. During his stay in Canada he obtained a large number of different species, the collection of some of which extended the known range of distribution. Mr. Emerton is making a special study of Canadian spiders. Members of the Club interested in entomology could assist materially in such study by sending specimens from their immediate districts. If preferable, the Editor of THE OTTAWA NATURALIST would be glad to forward any material sent to him.

A PRELIMINARY PAPER ON THE ORIGIN AND CLASSIFICATION OF INTRAFORMATIONAL CONGLOMERATES AND BRECCIAS.

BY RICHARD M. FIELD, AGASSIZ MUSEUM, CAMBRIDGE, MASS.

(Continued from page 36.)

The author shows that in ground plan these structures are quite similar to mud-cracks, and that they may be accounted for by the excessive dessication of limy sediments or clay-like material which has been preserved above water level for a sufficient period of time to permit of an abnormal deepening of the surface mud-cracks. Should the spaces or cracks between successive layers of such columnated limestones become impregnated with a subsequent deposition of limy, or even sandy material, an interesting type of intraformational breccia would probably be formed.

Hyde (6) describes a peculiar limestone conglomerate from the so-called "fresh-water" horizon of the Ohio coal measures. He writes: "after complete evaporation and cracking of the limy surface, it is necessary to suppose that there was a submergence in order to account for the matrix of small fragments and shells in which the pebbles all rest. * * * * If, after the conglomerate was completely formed, the deposition of limestone had been resumed instead of a soft shale, the result would have been a typical intraformational conglomerate of a thinner type, in which the structure would probably have been so obscured that a detailed study would have been impossible, or only possible with a great amount of labour."

BIOGLOMERATES.

There is some evidence that certain intraformational conglomerates may have been formed partly by organic agencies. Their origin may have been the result of either plant or animal (?) activities, and furthermore, the organisms may have had either a direct or indirect structural influence. Certain so-called "limestone conglomerates" are supposed to be composed of fossil organisms. Thus, Seeley (7) describes conglomerates from the Beekmantown of the Champlain valley as having their pebbles formed from sponges, a new genus, which he called *Wingia*. Brown (8) describes certain conglomerates at Bellefonte as due to the action of lime-secreting algae. He notes how important the algae are as reef-building organisms to-day, and remarks that Lithothamnion-structure is easily obliterated by percolating waters so as to form a structureless limestone. He concludes: "It is freely admitted that in these pebble-like structures from the Cambrian and Ordovician limestones, no organic structure has been found sufficiently well preserved to prove conclusively that they are of algal origin, but their similarity to such structures now forming is very suggestive." In discussing the orientation of the edgewise conglomerates, he follows Hahn's and Grabau's theory that the deformation and regrouping is largely due to "submarine slumping." The "Strephochetal conglomerates" mentioned by Seeley (9) are probably not true conglomerates. Seeley writes (op. cit. p. 152): "The spherical or elongated masses breaking down from a weathering rock appear like rolled fragments or calcareous concretions, and such without doubt they are in many cases. Yet a careful study of these will disclose the fact that a portion of these nodular forms have definite structure." Thus, the stratigrapher is apt to be led astray by certain fossiliferous rocks, which, upon a macroscopic and hasty examination, have all the earmarks of a true intraformational conglomerate, but which really owe their structure to a certain type of organism included in them. It is possible, however, that true intraformational conglomerates may be formed by the activities of organisms. The writer collected an interesting specimen from the lower Beekmantown at Bellefonte, which would seem to suggest another mode of origin, but somewhat along the lines suggested by Brown. The specimen shows a narrow band of unstratified and peculiarly shaped phenoclasts (see fig. 2). The phenoclasts themselves are only slightly fossiliferous and are fine-grained, showing no definite crystal structure, and have peculiar and varied outlines. The interstices are filled with a cement largely composed of algae and the debris of small shells, the former preponderating. The shape of the phenoclasts and the presence of the algae in the cement would seem to show that the fine-grained, uncrystallized muds deposited in intermittent layers upon the sea floor were broken while still in a plastic state by the action of the algae. The processes of primary deposition of the limy mud, floculation, and redisposition of the "conglomerate mass" were practically coterminous with the primary lithification of the limestone under discussion. Sardeson (10) in discussing the pseudo-brecciated structure of the Ordovician limestones of Manitoba, originally described by Wallace (11), makes the following statement: "In the bed number 3, lumps, cakes and lenses of pure, light-coloured, fine-grained limestone lie isolated in a brown, fucoidal shale, and the evidence is then clear that the lime was originally deposited in lumps or masses. The lime quite certainly came mainly from the decomposition of marine algae in the manner lately described by Thomas C. Brown. Without entering into a discussion of the questions as to what plants and animals may have contributed to the limy deposit, or in what manner the lime was collected, it is sufficiently evident to me that something deposited lime in small and large masses. The lenses and lumpy patches of relatively pure lime in all parts of the Galena-Trenton frequently inclose fossil shells, etc., in a way to show that these limy bodies *were soft when deposited*: that is to say, they often partly inclose shells, stipes of graptolites, fucoids, etc., either in the manner of objects overflowed by soft lime or in the manner of objects partly sunken into such a soft deposit. Shells of Lingulae are found which had bored into them—and the boring, was done, of course, while they were not consolidated." Sardeson himself advances a rather ingenious hypothesis for the formation of "corrosion conglomerates" (op. cit. p. 276). He believes that the "fucoids" found in the shaly limestones associated with the conglomerates are the roots of a sea-weed, closely related to *Camarocladia*, and that because of the hardness of the sea-floor these roots are supposed to have been able to penetrate vertically but a short distance, and thus could be easily uprooted by the rafting of flotsam at the surface of the water. He concludes: "Since the conglomerates are found in limited horizons instead of throughout the beds or formations, their origin is to be attributed rather to catastrophies, such as rafts of sea-weeds, etc., * * * *." Here again we may have a true intraformational conglomerate formed by vegetable means.

GLEITUNGSPHEOMENE.

Sub-aquatic and sub-aerial-gliding-deformation or solifluction. Under the heading "Sub-aquatic, gliding deformation," Grabau (op. cit. p. 780) writes: "Offshore deposits of sediments on a gently sloping sea or lake bottom may suffer, from time to time, deformation of the surface layers through gliding or slipping down the gently-inclined sea floor. * * * The most remarkable fact about the gliding in Zug was that it took place on an average grade of 6% (3°26′), while the larger and more pronounced movement occurred on a grade as low as 4.4% (2°31′)). The material thus slid into the lake was *brecciated* (italics are the author's) and folded with overfolds, overthrusts, reversals of layers, excessive strata, etc., and furnishes an excellent guide to the interpretation of similar movement in the past." Under the heading "Examples of fossil subaqueous solifluction," (op. cit. p. 781), the author quotes numerous examples from the Cambrian to the Miocene, bringing out the interesting fact that the intraformational structures are to be found at all stages of the earth's history. He does not distinguish, however, between kinds of sediments in which these folds and *breccias* are developed, and whether or not they were formed under fresh or salt water. It is interesting to note that Hahn builds his hypothesis upon the observation of the movements and deformations of lake deposits and clays. Grabau, likewise, cites examples of deformation in the Miocenic marls of Oeningen. He shows two photographs of this clay folded in this way, in neither of which has the writer been able to observe any signs of true brecciation, or such brecciation as was supposed to have taken place in the formation of the edgewise conglomerates at Bellefonte, Gaspé peninsula, and Trenton Chasm. In short, the tightly closed and delicately delineated folds, so beautifully illustrative, are very typical of the subaqueous solifluction of clays. Whether or not this peculiar type of folding is to be found in limestones is open to question. The writer has observed such folds in clays and delta deposits, but he has not seen any signs of true brecciation. It is possible that many of the Pleistocene, and even older occurrences, may be of glacial origin. They appear to be rather typical of clay deposits and glacial rock flours. In the case of the Devonian examples of intraformational breccias from the Cape Bon Ami limestones of the Gaspé region, we have a contorted and brecciated bed made up of alternating layers of shale and limestone, which, as described, is similar to those found at Trenton Chasm. It seems a somewhat strange coincidence that while subaquatic solifluction is postulated as having taken place, in most instances, in a more or less homogenous type of deposit, that in such localities as Gaspé, Trenton Chasm and elsewhere it should be confined to that portion of the strata in which there is a variation in the constitution of the sediments deposited Although the writer fully realizes that the above cited facts may not be fatal to any hypothesis regarding submarine-gliding-deformation, yet, as the evidence in these cases tends very strongly to prove an alternative hypothesis, it must be scrutinized with some care. Although some "edgewise conglomerates" may be due to submarine slumping, it is difficult to conceive that the majority of intraformational breccias are the result of this process. Certain of the intraformational glomerates are of wide geographic extent, and of great stratigraphic regularity, although of great thinness. It is perhaps easier to conceive of a more or less horizontal, mud-cracked flat or tidal estuary than it is to conceive of a submarine slope, along which "slumping" had taken place regularly and evenly over a similar distance. Although it has heretofore been stated otherwise, the textures of the phenoclasts, in most of the stratified and unstratified glomerates examined by the writer, have been found to be slightly different from the matrix. This tends to show that the sediments forming the phenoclasts and the cement were not derived from the same horizon. It is only reasonable to suppose that this lack of homogenity between the phenoclasts and their cement is intimately connected with their history. The writer believes that subaquatic-gliding -deformation is undoubtedly a good theory to account for the production of intraformational phenomena, but that its application in the case of the intraformational limestone glomerates is, according to the present data, extremely limited.

UNSTRATIFIED AND EDGEWISE CONGLOMERATES.

Of all intraformational glomerates, probably the so-called edgewise variety is the most notable in the field. Edgewise glomerates are apt to have their structure well developed by differential weathering, and the striking arrangement of the phenoclasts has caused several students of the sedimentary rocks to offer an explanation as to their origin. Probably the two leading hypotheses regarding the origin of these special glomerates are those of Hahn, and Walcott, previously mentioned. The writer believes that certain edgewise conglomerates which he has seen owe the explanation of their origin to Walcott's theory, although it is possible that edgewise breccias may be formed under the conditions postulated by Hahn and Grabau. Certain thin-bedded glomerates whose phenoclasts are but slightly abraded, probably owe their origin to such conditions as those observed by Walcott (12) at Noye's Point, Rhode Island. "I noticed that when the tide went out before daylight, the layer of fine sand and mud, exposed to the dry wind and sun during the day, hardened, and that when the surface of the water of the incoming tide was broken by small waves, the hardened layer was lifted, broken into angular fragments and piled, in some places, to a depth of several inches; while in other places it was simply turned over and was very little disturbed. When much disturbed, the edges of the fragments were rounded, so as to give them the appearance of having rolled a considerable distance. In one instance, the ensuing out-flowing tide deposited a thin layer of sand and silt over the brecciated fragments." From these observations it is evident that should the same phenomena occur on a sinking shore line, glomerates of the character so often met with by the field geologist, would be formed. When there has been a special heaping or sorting of the phenoclasts by marine currents, we should expect to find true "edgewise conglomerates." It is conceivable that conditions suitable for the formation of such "edgewise conglomerates" would probably be more or less local within the whole disturbed zone —that is, that a typical arrangement of the phenoclasts might not exist throughout the intraformational glomerates. Walcott does not mention the possible effect of the scouring action of tidal currents upon a previously mud-cracked surface. A tidal flat whose sediments were composed of a limy mud, when dessicated, would, if disturbed by a subsequent and sufficiently powerful tidal action, yield a quantity of tough, not brittle, phenoclasts, which might be redeposited with little or no signs of attrition except at the edges. Ripple-marked and mud-cracked bars and flats are very apt, at the present day, to be dissected by shallow currents, and these channels should act as catch basins into which the phenoclasts derived from the mud-cracked zone are tumbled by the onrushing tide. Agassiz (13) noticed that the lime-mud deposited by the waves of Florida hardened within a few hours to such a degree that it made a ringing sound when walked upon. This scaly deposit becomes exceptionally brittle between tides, and might, under certain conditions of deposition, be broken up by the advancing waves and re-deposited in much the same manner as suggested by Walcott.

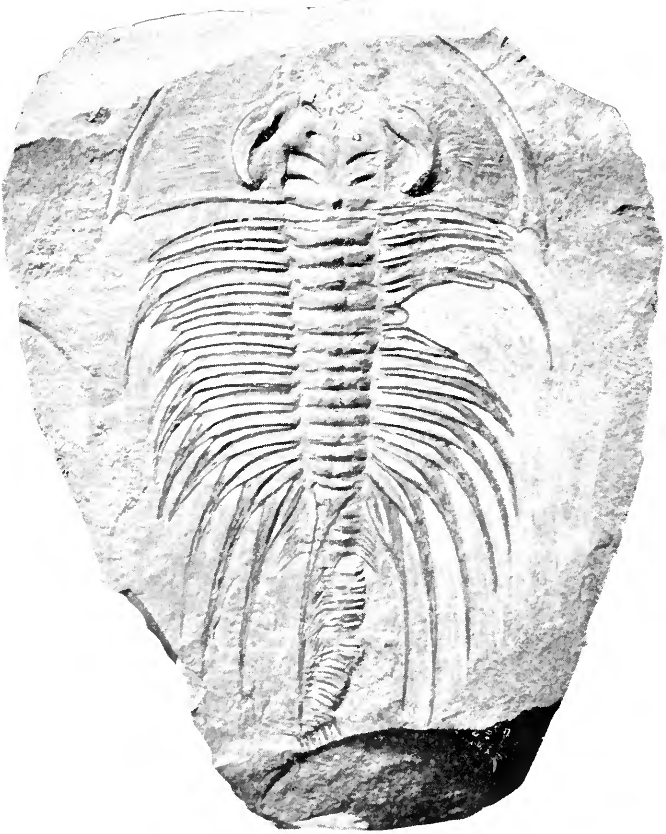
(To be continued)

NOTE.

The Editor of THE OTTAWA NATURALIST has frequently been asked, by members of the Club, for information on Nature Guide books. He has thought it advisable to list the pocket guides which are now available, and which may be obtained at The Book Store (A. H. Jarvis), Bank St., Ottawa, or from James Hope & Sons, Sparks St., Ottawa. These are as follows:

The Bird Guide—Land Birds
The Bird Guide—Water Birds
The Flower Guide
The Tree Guide
The Butterfly Guide
The Animal Guide

All of the above are beautifully illustrated in colours. They are invaluable to the nature lover, and in price are $1.00 each.



(Half natural size.)

Paedeumias robsonensis Burling
Lower Cambrian, British Columbia.

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PAEDEUMIAS AND THE MESONACIDÆ, WITH DESCRIPTION OF A NEW SPECIES, HAVING AT LEAST 44 SEGMENTS, FROM THE LOWER CAMBRIAN OF BRITISH COLUMBIA.(a)

BY LANCASTER D. BURLING.

By common consent we are accustomed to regard the crustacea as derived from the annelids, and we have pointed to their abundantly segmented body as a reason for assigning this ancestorship to them. As late as 1915 (b) it was possible, however, to say that there are never less than two nor more than 29 segments in the thorax of a trilobite. Walcott (c) has recently described and figured a specimen with 42 normal segments. The specimen to be described contains at least 44 segments (the end is broken away), 29 of which are rudimentary segments posterior to a spine-bearing fifteenth. The great number of segments gives sufficient interest to this trilobite to warrant its description, and a discussion of its bearing on the evolution of the Mesonacidæ.

Paedeumias robsonensis n. sp.

Pædeumias n. sp., Burling, 1916, Bull. Geol. Soc. America, vol. 27, pp. 158-159.

Pædeumias n. sp., Burling, 1916, Geol. Surv. Canada, Summ. Rept. for 1915, p. 100.

Description.—Outline of the cephalon almost semi-circular, marginal rim relatively wide and flat, genal and intergenal spines distinct. Glabella crushed in front, but apparently parallel-sided and reaching in front to the marginal rim. Eyes prominent, broad at the anterior end, where they merge into and even cross portions of the glabella, and narrow at the posterior end which lies just within the posterior margins, is raised, and does not reach the sides of the glabella. Glabellar furrows deeply marked, four pairs being visible in the unmashed portion of the glabella described. The two posterior pairs are almost transverse, and extend two-thirds of the way from the dorsal furrow to the centre of the glabella; the third pair, counting

(a) Published by the permission of the Deputy Minister of Mines.
(b) Schuchert, Pirsson and Schuchert's Textbook of Geology, 1915, p. 606.
(c) Smithsonian Misc. Coll., vol. 64, 1916, p. 162, pl. 26, figs. 4b, 4c.

from the back, is represented on either side by a dimple situated midway between the side and the centre of the glabella, and midway between the furrows anterior and posterior to it. The glabellar furrow nearest the front is a short diagonal groove starting just back of the point of union between the anterior end of the eye lobe and the glabella, and occupying the central portion of the distance from the side to the centre of the glabella. Surface of the cephalon an irregular network of raised inosculating lines more or less radial to the outer margin. Pleurae of two distinct types, an anterior normal set of fourteen and a posterior rudimentary set of 29 (or more, the end is broken away) separated by a spine-bearing segment. The ends of the first fourteen ribs become progressively longer toward the posterior end of the trilobite, and the fourteenth pair almost surround the rudimentary 29. These are further protected by the spine on the fifteenth segment, which is likewise extended. The rudimentary ribs differ little in width of axis from those which precede them, but the sides are very small. Pleural grooves broad, flat, and almost parallel-sided in those forming the middle portion of the trilobite. Toward the spine-bearing fifteenth segment the pleurae become relatively much wider for their length, and the pleural groove cuts more and more diagonally until in the thirteenth and fourteenth it cuts directly across from the anterior inner corner to the posterior outer corner. Rudimentary segments almost plain, pleural grooves being indistinct or wanting. The taper to the 29 rudimentary segments which have been preserved is so gradual as to render it extremely probable that there were many more than 29 segments anterior to the pygidium.

The fourth, fifth, and sixth pleurae on the right side of the specimen described have suffered injury, being broken off close to the axis at such a time or in such a manner that the ends have healed, and show a tendency toward a normal termination. The fifth one in particular is broken clear across, and in it the pleural groove stops just inside of the newly curved margin; the fourth and sixth were broken across transversely so as to leave the greater portion respectively of the upper and lower margins. This particular trilobite is as large or larger than the largest that has so far been discovered in the Lower Cambrian of British Columbia or Alberta. If we assume that the accident occurred during the youth of the trilobite, we must grant that these early forms did not have the power of renewing broken or lost portions, but this conclusion is negatived by its ability to heal up the broken ends and fashion them off. The accident was, therefore, probably of recent occurrence. And since it must have happened during his maturity, we are somewhat justified in assuming that our trilobite lost this portion of his anatomy to a foe more voracious, if not larger, than himself. The occurrence certainly lends weight to the inference that the Lower Cambrian trilobite was not the supreme arbiter we have supposed him to be; however, he may have been struck by material dislodged from a ledge beneath which he was crawling.

Horizon and Locality.—Lower Cambrian, Mahto formation, collected from drift block on the slope of the Mural glacier just under Mumm Peak, Mt. Robson region, British Columbia. Collected by E. C. Annes.

OBSERVATIONS.—*Paedeumias robsonensis* differs from *P. transitans*—the only other species known—(*a*): (1) in having 29 instead of 2 to 6 rudimentary segments posterior to the spine-bearing fifteenth, and in the more highly developed character of the rudimentary segments—they are better described as small short ribs in *P. robsonensis*, while those of *P. transitans* are truly rudimentary; (2) in having a highly ornamented cephalic surface; (3) in the character of the glabellar furrows, which approach closely to those represented in the cephalon from Mt. Stephen, B.C., doubtfully referred to *Olenellus gilberti* by Walcott (*b*); and (4) in the width and flatness of the marginal cephalic rim.

Paedeumias robsonensis resembles *P. transitans* in general shape and outline, in the number and general character of the normal segments and the pleural furrows, and in the abruptness of the change from regular to rudimentary segments.

These resemblances seem to warrant the inclusion of *Paedeumias robsonensis* in the genus *Paedeumias*, but the differences are such as to justify its reference to a new species. The specific name *robsonensis* is derived from Mount Robson, in whose general vicinity this trilobite was secured.

GENERAL CONSIDERATIONS.—The resorption of segments posterior to the fourteenth or fifteenth in the genera of the Mesonacidæ (a family of trilobites apparently confined to the upper portion of the Lower Cambrian) would seem to indicate that the functioning parts, those necessary for the life of the individual, were confined to the first fourteen. Once this adaptation to fourteen vital segments is made, and *Wanneria* appears to show the trilobite at the moment this took place, resorption of the remainder begins. The finding of 29 rudimentary posterior segments would seem to indicate that this resorption takes place laterally, that is, they become smaller in size before

(*a*) Walcott, Smithsonian Misc. Coll., vol. 53, 1910, pp. 305-310, pls. 24, 25, 32, 33, 34 and 44.
(*b*) Smithsonian Misc. Coll., vol. 53, 1910, pl. 36, fig. 16.

they become fewer in number. Of known genera of the Mesonacidæ, *Mesonacis* and *Paedeumias* have a spine-bearing fifteenth segment, and the progression from the rib-like fifteenth segment of *Mesonacis* through the more rudimentary fifteenth segment of *Paedeumias robsonensis*, and the almost telson-like segment of *Paedeumias transitans* (which cuminates in the telson of *Olenellus*) is paralleled by the progression from the rib-like posterior segments of *Mesonacis* to the less rib-like segments of *Paedeumias transitans*. Moreover, the close relationship of the three genera is shown by the fact that in each the third segment is enlarged. That the number of rudimentary segments alone bears little or no relation to the relative primitiveness of the form is indicated by the fact that *Mesonacis*, which is clearly more primitive than *Paedeumias*, has less than one-third the number of rudimentary segments. *Nevadia*, which appears to be the most primitive as well as the earliest of the Mesonacidæ, does not seem to have reached the stage where differentiation of its segments might take place. In it there is a steady progressive decrease in the length of the pleural groove from the first to the eighteenth, with from six to eleven posterior segments whose pleural portion is unmarked.

In *Elliptocephala* the five segments posterior to the anterior thirteen (not fourteen as in the *Mesonacis-Paedeumias-Olenellus* line) are all spine-bearing, and are identical in everything but size. This feature has only been described for one other form, namely, *Redlichia chinensis*, and while the posterior five segments in this species are spine-bearing and do not otherwise differ from those anterior to them, we have no information as to the number of the anterior segments. It is at least 12 (*a*), however. In *Wanneria* there is a tendency toward nodes or spines on the anterior thirteen segments, and the fourteenth bears a short spine, but except in this respect it is indistinguishable from the progressively smaller segments posterior to it. In this genus there is no suggestion of a resorption of segments, and it seems natural to suppose that *Holmia* may have been derived from it since that genus also betrays no tendency toward resorption, and the anterior fourteen segments only of the sixteen bear spines. In neither *Holmia* nor *Wanneria* is there any enlargement of the third segment.

The fact that there is no enlargement of the third segment in *Nevadia* corroborates the indication given by the character of its ribs, and appears to justify us in believing it to be very primitive. The general resemblance between this genus and species of *Callavia* such as *eucharis* and *perfecta* (*b*) is worthy

(*a*) Walcott, Research in China, vol. 3, 1913, pl. 24, figs. 1, 1a.
(*b*) Walcott, Smithsonian Misc. Coll., vol. 57, No. 11, 1913, pl. 53, figs. 1 and 3.

of note. *Schmidtiellus mickwitzi* (Schmidt) (*a*), with its thirteen segments, absence of any enlargement of the third, and the presence of a spine on the eighth segment, is clearly distinct from *Mesonacis*, but its relationships are obscure. Of the genera in which there is no tendency toward resorption (*Wanneria*, *Holmia*, and *Callavia*), *Callavia* (*b*) alone shows a tendency toward an enlargement of the third segment. The genera showing resorption (*Mesonacis*, *Paedeumias*, and *Olenellus*) all have an enlarged third segment. This is also true for *Elliptocephala* (*c*), though the differentiation between the third and other ribs disappears in this species in the adult. In *Olenelloides* (*d*), a bizarre survivor of Mesonacidæ, the third segment is enlarged.

The enlargement of the third segment appears to be important from a morphological standpoint, and it is preserved among Middle Cambrian trilobites bearing relationships to the Lower Cambrian Mesonacidæ in the youthful forms of *Zacanthoides* (*e*), and the adult forms of *Albertella helena* (*f*). Its importance in the latter species is, however, largely negatived by the fact that in the very closely related *Albertella bosworthi* (*g*) it is the fourth segment which is enlarged. In both species the total number of segments is the same, seven, but the number of segments uniting to form the tail is larger in *bosworthi* than in *helena*. The second segment is enlarged in the young of the following species of *Paradoxides*: *bohemicus* Boeck, *inflatus* Corda, *lyelli* Barrande, *rugulosus* Corda, and *spinosus* Boeck. In *Hydrocephalus carens*, *H. saturnoides* and *Paradoxides pusillus* Barrande the anterior two segments are enlarged. In *Shumardia pusilla* (Sars) the fourth segment is large, irrespective of the number of segments between the fourth and the tail. In several species of *Cybele* it is the sixth pair, and *Cyphaspis barrandei* and *C. burmeisteri* are each characterized by the presence of a very long median spine on the sixth segment. In one species of *Illaenus* (*hisingeri* Barrande) it is the first. In *Bathynotus* it is the eleventh and last. Median thoracic spines have been described for the following Cambrian species: *Saratogia hera* Walcott (*h*), *Norwoodia tenera* Walcott (*i*), and *N. gracilis* Walcott (*j*). *Zacanthoides*, which has been mentioned as one of the two Middle

(*a*) Moberg in Moberg and Segerberg, 1906, Kongl. Fysiog. Sallskapets Handl., N.F., Bd. 17, 1906, p. 35.
(*b*) Walcott, Smithsonian Misc. Coll., vol. 57, No. 11, 1913, pl. 53, figs. 1 and 3.
(*c*) Walcott, Smithsonian Misc. Coll., vol. 53, No. 6, 1910, p. 269.
(*d*) Peach, Quart. Jour. Geol. Soc. London, vol. 50, pp. 669-670, pl. 32, figs. 1-6.
(*e*) Walcott, Smithsonian Misc. Coll. vol. 53, No. 2, 1908, pl. 3, figs. 5 and 10.
(*f*) Idem, pl. 2, fig. 8.
(*g*) Idem, pl. 1, fig. 5.
(*h*) Smithsonian Misc. Coll. vol. 64, 1916, pl. 35, fig. 3b.
(*i*) Idem, pl. 28, fig. 2d.
(*j*) Idem, pl. 27, fig. 2f.

Cambrian genera showing enlargements of the third segment, includes one species (*idahoensis* Walcott) (*a*) characterized by the presence of a long median spine on the fifth segment, and one species (*typicalis* Walcott) (*b*) in which the median spine adorns the eighth segment. This enlargement of certain segments is comparatively rare among the trilobites, and its further study should yield results of morphologic value. The foregoing can only be considered as a resumé of some of the facts which may contribute "to the observational basis of the ultimate discussion."

A PRELIMINARY PAPER ON THE ORIGIN AND CLASSIFICATION OF INTRAFORMATIONAL CONGLOMERATES AND BRECCIAS.

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(Continued from page 52.)

LIMESTONE CONGLOMERATES.

Intraformational conglomerates have been described which are more nearly related to conglomerates in the ordinary sense than those heretofore discussed. The phenoclasts (true pebbles in this case) of these conglomerates are usually of several orders of size, and all but the largest are water-worn, i.e., derived, by transportation and attrition, from indurated, angular material. The pebbles contain the same fossils as are found in the cementing material or ground mass, and thus the conglomerate is proved to be truly intraformational in time. Such conglomerates are of manifold occurrence. Walcott (op. cit. p. 34) describes one from a locality below Schodack Landing, Rensselaer County, N.Y. He writes: "It (the conglomerate) shows that the limestone pebbles, boulders and brecciated fragments were formed from a calcareous sediment sufficiently consolidated to be broken up and more or less rounded by attrition, and these collected to form a bed of conglomerates, the matrix of which is usually calcareous." Sometimes these glomerates are very coarse, and contain phenoclasts the size of boulders (two to four feet in diameter). Walcott describes such conglomerates from eastern Pennsylvania, and others from Tennessee, in Cook, Sevier and Blount counties. In one portion of the Cictico conglomerates, he states (op. cit. p. 38), some of the boulders reach

(*a*) Smithsonian Misc. Coll., vol. 53, No. 2, 1908, pl. 3.
(*b*) Canadian Alpine Journ. vol. 1, 1908, pl. opp. p. 248, fig. 1.

a diameter of six feet. Regarding the origin of the coarse intraformational conglomerates, Walcott writes (op.cit. p. 39): "The relation of the bedded limestone to the subjacent conglomerates proves that the calcareous mud which was subsequently consolidated into the limestones solidified soon after deposition. This is shown by the presence of limestone with sharp, clear-cut edges. The presence of the conglomerates above the limestone beds, from some portion of which they were derived, leads one to believe that the sea-bed was raised in ridges or domes above sea-level, and thus subjected to the action of sea-shore ice, if present and aerial agents of erosion * * *." The mode of occurrence of these boulders, especially those in the limestone at Stone's Quarry, leads to the hypothesis that they may have been dropped upon the sea-bed from floating ice. No other explanation occurs to me that will account for the placing of them upon the sea-bed, so as to not disturb to any marked degree the sediment then accumulating."

MIXED CONGLOMERATES.

A very interesting type of conglomerate which might be classified under B, I, 1, is that described by Raymond (14) from the Lévis. "The Lévis formation consists mostly of shale, with zones of hard blue and light grey limestone, and thick and thin beds of limestone conglomerate. Neither the top nor bottom of the formation is known. * * * Very fossiliferous pebbles have been found in the conglomerates in the Lévis, and the fossils show them to be derived from strata of three geological ages. The pebbles are: 1st, Lower Cambrian; 2nd, Upper Cambrian or Lower Ordovician; 3rd, Beekmantown. Besides the limestone pebbles there are many of igneous rocks and quartzites, but they do not form nearly so large a proportion of the conglomerates as do those composed of limestone. These conglomerates also contain pebbles of the red and green shale and sandstone of the Sillery, thus proving that the Sillery is older than the Lévis, while the *presence of Beekmantown fossils in both pebbles and matrix* of the conglomerates shows that the Lévis is of the same age as the Beekmantown at Phillipsburg, Quebec." According to Walcott's definition these may not be considered as intraformational conglomerates, since the majority of the pebbles are apparently not derived from the strictly subjacent zones of the same formation. Since such a type is not interformational, and since it is intraformational in all other respects, except for the fact that its pebbles are not derived from the same formation, it is believed best to provisionally classify it under B, I, 1. In short, this type of clastic does not postulate any such condition of unconformity as that represented by a basal conglomerate. Deposition was continuous throughout Lévis time, as shown by the fossils, but the conditions governing the character of the sediments deposited were varied.

CLIFF BRECCIAS.

It is possible that certain intraformational glomerates whose phenoclasts are angular and not rounded are largely made up of cliff breccias. Certain of the unevenly graded glomerates as mentioned above may have had their larger and angular material derived from ridges or domes raised above sea level, as postulated by Walcott.

TECTIBRECCIAS.

For a full discussion of intraformational folds and breccias of tectonic origin the reader is referred to W. J. Miller's paper: "Notes on the Intraformational Contorted Strata at Trenton Falls." The writer's visit to this interesting locality convinced him of two important facts. Firstly, that the "contortions" and breccias had taken place most characteristically in zones where deposition of sediments had been varied and alternating. Secondly, breaking down of the folds was, locally, very pronounced; extreme overthrusts of the hardened or purer limestone layers resulting in the formation of edgewise breccias contained in a greatly crushed and squeezed but structureless mass of shale. It seemed obvious from a personal examination of this phenomenon, that the thin limestone bands must have been well indurated before they were brecciated, and that the interbedded, shaly limestones, because of their composition, took up the thrust in such a way as to show little or no contortions or folds, such as is shown in the stringers of brittle limestone contained within them. The general overthrust phenomena exhibited in the more massive beds of the Trenton formation and their association with the nearby Prospect fault, seem to point conclusively to the tectonic origin of the contortions and breccias. Intraformational breccias of this type are not to be confounded with Fault breccias or Crush conglomerates. They are to be expected in those portions of a formation which have undergone varied conditions of deposition and subsequent exogenic deformation. As intraformations they are interstratified with the formation in which they occur, and are never found in crosscutting position. It is also interesting to note that the phenoclasts of such glomerates should be of a different composition and texture from the matrix.

ICE-FORMED GLOMERATES.

It is possible that icebergs and glaciers may have featured in the formation of intraformational glomerates. The shoving force or push and drag of a glacier has been supposed to have produced folding and overthrusting in the partly consolidated Pleistocene clays which it overrode. A single case has been mentioned by Sardeson (15) in which the loosening of subjacent limestone strata consequential to glaciation, has produced a local brecciation. This case is not intraformational under Walcott's definition, as the beds in question are Paleozoic in age, but it is conceivable that the glaciation of certain surfaces might have produced true intraformational breccias. It has been supposed that the close and peculiar folding in certain Pleistocene clays and delta deposits is the result of "drag" by grounding icebergs. Whether or not these folds owe their origin to such a cause, it is probably doubtful if intraformational breccias could be formed in this way, owing to the peculiar consistency of the sediments. The argument here against brecciation as a result of intense folding and overthrusting is much the same as in the case of subaqueous-gliding-deformation in clay deposits.

CONCLUSIONS.

The attempt has been made in the foregoing pages to classify intraformational glomerates according to their possible as well as probable origin. It is fully realized that the classification is merely preliminary in its scope, and no attempt has been made to cover all the literature on the subject. The thesis has been to emphasize the importance of certain textures and structures, especially in limestones, and to suggest that their systematic study may lead to a more comprehensive view of the history of the seas from and under which they were deposited. Walcott was the first to define the difference between intraformational and interformational conglomerates. His paper is important as it deals with the origin and deposition of limestones, and points the way to a more careful consideration of unconformity and disconformity in the field. Wherever the stratigrapher finds a change in the structure of the zones, no matter how superficial such change may at first appear, he should be on his guard for a probable change in the conditions of deposition and all the attendant geological phenomena, which may hypothetically be the *cause* of such a change. It has been pointed out that the usual rock section, as exposed by streams and roads, is apt to give little or no evidence of important structural phenomena, such as ripple-marks, mud cracks, etc. Under certain conditions intraformational limestone glomerates are very difficult to detec in the field, owing to the more or less homogenous composition of the phenoclasts and cement. The relation of intraformational zones to fossiliferous zones is of great significance in the study of limestones, and it has been found

FIGURE 1.

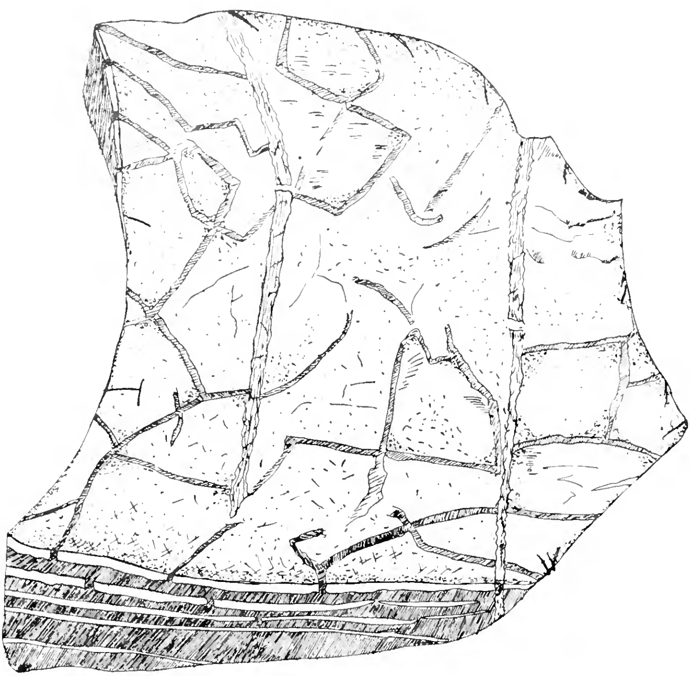

FIGURE 2

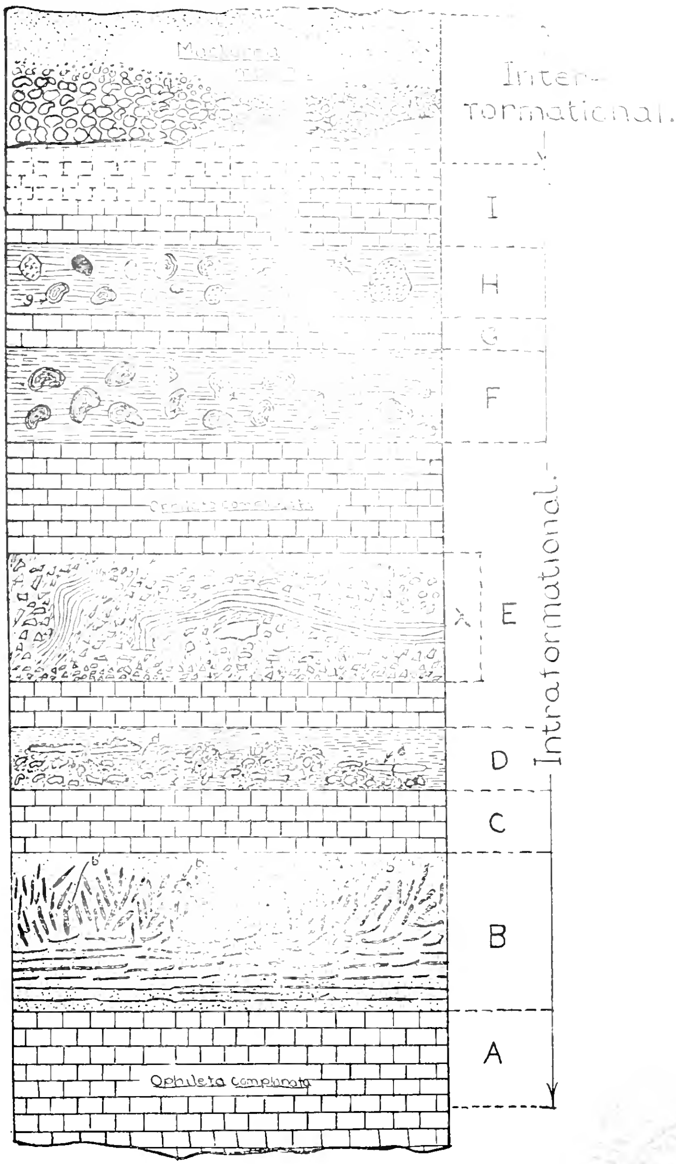
Inter-
formational.
I
H
G
F
E
D
C
B
A
Intraformational.
Ophileta complanata

FIGURE 3.

that it is sometimes a good deal easier to discover the fossiliferous zones in the Beekmantown than the glomerates subjacent to them. The study of intraformational glomerates includes a careful examination of the phenoclasts and cement as well as the structure and field relations of the strata above and below the zone in question. The examination of the texture, shape and composition of the phenoclasts and cement is mainly petrographic in its nature, and upon it will largely depend the plausibility of the students' views as to origin.

Certain liberties have been taken with Walcott's original definition of intraformational conglomerates. This was deemed necessary for two reasons: first, because some of the types discussed by Walcott are not typically conglomeratic (in the geological sense); second, because the term is such a useful and necessary one in stratigraphy that it should be applicable to an important group of clastics intimately associated with the history of the Paleozoic and Mesozoic seas. Whether or not it will ultimately be deemed advisable to group such rocks as tectibreccias, bioglomerates and edgewise conglomerates under the term intraformational is open for discussion. The attempt has been made to list and classify certain clearly, as well as obscurely, defined examples of limestones, with the hope that this systematic study may help in reaching the ultimate goal—the history and origin of the calcareous terrains of the world.

DESCRIPTION OF FIGURES.

FIGURE 1.—Diagramatic sketch of a supposed bioglomerate from the lower Beekmantown limestone at Bellefonte, Penna. The large phenoclast on the right hand side of the figure shows structure which may be organic in origin. Most of the phenoclasts present peculiar outlines not at all similar to the outlines of the pebbles in an ordinary conglomerate. The small dots are supposed to represent agal-like organisms which have worked their way into the soft limy material and broken it up into the characteristic shapes shown in the diagram. The phenoclasts are fine grained, and sometimes contain fragments of small fossils. Most of the fossils, however, are found in the more granular ground mass.

FIGURE 2.—This figure is illustrative of an actual specimen of mud-cracked limestone found in one of the quarries at Bellefonte, and illustrates on a smaller scale the phenomena exhibited on the east wall along the strike of the quarries from Bellefonte to Tyrone, Pennsylvania. The shaded lines on the surface, traversed by the two parallel calcite veins, represent mud-cracks. Viewed in section the structure is that of a typical stratified glomerate. The figure is supposed to illustrate the

two principal factors controlling the formation of such a glomerate:

1. Alternation of the conditions of deposition.
2. Dessication.

Figure 3 of this article is a diagramatic summary of the argument for a classification of sedimentary rocks, and especially of intraformational glomerates, according to the sequence of formative events which they have undergone. The figures are more or less diagramatic, and no attempt has been made to draw an accurate picture of each type. The reader may consult the various descrip'ions for accurate illustrations. Seven types of glomerates are represented in the columnar section, six intraformational and one interformational. In order to make the comparisons of the six intraformational glomerates relatively the more graphic, they are all supposed to have formed within a single formation, characterized by the index fossil *Ophileta complanata*.

Beginning with *A* time, we have deposition of pure limestone until *B* time, which commences with alternating depositions of pure and shaly limestone, followed by mud-flat conditions with dessication and the formation of mud-crack zones or stratified breccias. Here the phenoclast *b* is practically of the same age as the cement or matrix. During the rest of *B* time, marine currents are dominant and form edgewise glomerates, whose phenoclasts of the *b′* type have been carried a short distance and slightly abraded, so that they are slightly older in relation to their matrix than those of the *b* type. From the close of *B* time to the beginning of *D* time, pure, structureless limestone is laid down. During *D* time conditions are favorable for the formation of bioglomerates. Here again, as in the case of early *B* time, the phenoclasts are formed in place, and are practically contemporaneous with the cement. Through *E* we have a period of pure limestone deposition, except during the middle when shale was formed interstratified with the limestone. In *F* time we have the formation of a limestone conglomerate whose phenoclasts *e* are true water-worn pebbles derived from the subjacent zone *E*. Obviously the pebbles of this conglomerate were formed long before they were deposited, and long before the ensuing lithification of the mass. Compare the pebbles of this type with the phenoclasts of the preceding types. During *G* time there is a short period of pure limestone deposition, followed by a period characterized by conglomerates of the mixed type, certain of whose pebbles contain the same fossils as the cement (*Ophileta complanata*), proving that the conglomerate is truly intraformational in character. *I* time sees the close of the period characterized by *O. complanata*. Uplift and erosion result in a basal conglomerate resting with unconformity on older strata, and succeeded by sandstone and limestone in which occur *Maclurea magna*.

Long after the deposition and lithification of the formation described, and perhaps of several succeeding ones, tectonic forces cause the deformation of the sub-zone X in the zone *E*. Obviously the age of the phenoclasts in this tectibreccia is much younger than the ages of any of the phenoclasts heretofore discussed, whether they are intraformational or even interformational. Finally, it is a fact that not all the types described can be distinguished in the field at a glance. Type X may be easily conf sed with gliding deformation structures; type *D* with type *F*, etc.

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ANOTHER NESTING SITE FOR THE PRAIRIE WARBLER IN ONTARIO.

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The Prairie Warbler (*Dendroica discolor*) is one of the rarest and most casual migrant visitors to Ontario, and the only hint of a breeding station in this province was the one obtained when I found a few singing males near the tip of the Bruce Peninsula in 1900.

On the 14th of June this year I was at Port Franks (at the south-east corner of Lake Huron), in company with Mr. N. Tripp, of Forest. Early in the morning Mr. Tripp took me across the river to a region where he found two birds which he took to be Prairie Warblers, on June 14th, 1915, and as soon as we reached the locality we heard the characteristic song of this bird, consisting of ten or twelve very short notes, rising not more than two tones in the whole song, the notes resembling a wheezy whistle.

The location was within two or three hundred yards of the lake shore, where most of the surface was sand, with scattering vegetation, but the warbler was singing from an island of juniper, with a few white and red pines and birch, the mound rising to perhaps thirty feet in height, and the top of it being something like thirty or forty feet across. After watching him sing in a red pine at very short range, where he was feeding, he flew sixty yards to another similar island, where he sang again.

The next morning I investigated the locality more thoroughly, and found at least two other males singing, but nothing more was learned of their business in this locality, though the date is an acceptable proof that they were on their breeding ground.

The country along the lake shore for several miles each way is similar to that where these birds were found, and it is probable that extended investigation will disclose the presence of a breeding colony of some moment. On the west side of the river mouth, in a grassy marsh, were a number of pairs of the Short-billed Marsh Wren, but outside of these two species nothing rare was seen in the two days which I spent at the Port.

There were no White Throats, Juncos, Northern Thrushes, no Olive-sided Flycatchers, all of which are supposed to nest in small numbers in that district; nor did I find either Broad-winged nor Sharp-shinned Hawks, which were the object of the expedition.

The Yellow Lady's Slipper was growing near the Short-billed Marsh Wren colony, on the open prairie-like land, in exactly similar conditions to those under which I have found it on the Alberta prairies. The Blue-eyed grass (*Sisyrinchium*) was in thousands on the same territory, while in the shaded sand under the pine trees blue lupines occurred by the acre. White variants of the latter were common, and one such was seen of the *Sisyrinchium*. This district is a very interesting one to the botanist, and I have a feeling of fresh surprise on every visit to find the tulip tree and the red pine growing together. In the autumn of last year I visited this district, and was delighted in the great quantity of *Liatris* flowering in the woods. Owing to the fact that a great deal of the latter is wild, and also that cattle are absent, many unusual plants are found in comparative profusion.

BOOK NOTICE.

"CONSERVATION OF FISH, BIRDS AND GAME," issued by the Commission of Conservation. This volume is a report of the proceedings of a conference of the Committee on Fisheries, Game and Fur-bearing Animals of the Commission, and contains a fund of information regarding the present condition and the necessity for protection of Canada's fish, birds and mammals.

Canada is taking a prominent part in the international movement for the protection of wild life. A Migratory Bird Treaty between Canada and the United States is under consideration. Through the influence of the Commission of Conservation and other interests, bird reservations are being created, where the birds may find safe nesting and breeding places.

The fur-bearing animals of Northern and Western Canada are being rapidly exterminated. This is clearly shown by the present report. To secure their more adequate protection, the Commission is advocating the amendment of the Northwest Game Act to place responsibility for its administration upon the Dominion Parks Branch, which already protects the animals in the Dominion National Parks.

The future of the fisheries of Canada is dealt with in an able manner. That they are of great present value is recognized, but there is also a potential value in our oceanic and inland waters which, upon development, would mean the creation of new industries. To meet this condition the Commission is suggesting vocational training and simple demonstration stations for the fishermen, that they may take advantage of the most practical and modern methods of their calling.

The report is replete with illustrations applicable to the subject matter.

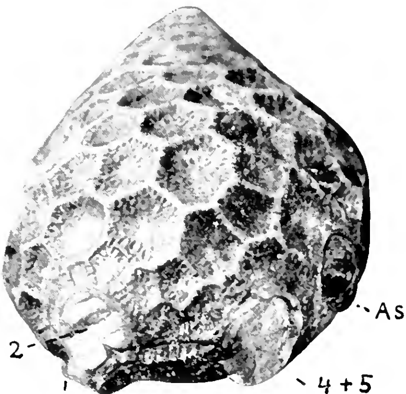

Fig. 1A × 3

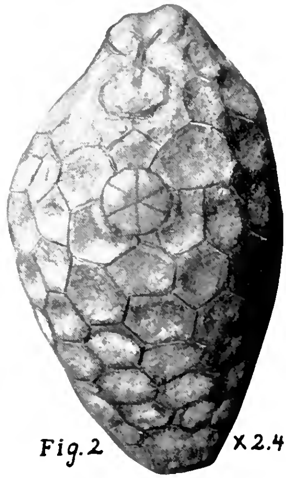
Fig. 2 × 2.4

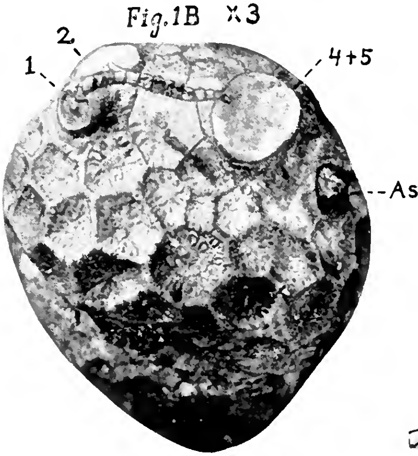

Fig. 1B × 3

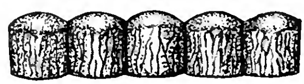
Fig 1C × 13

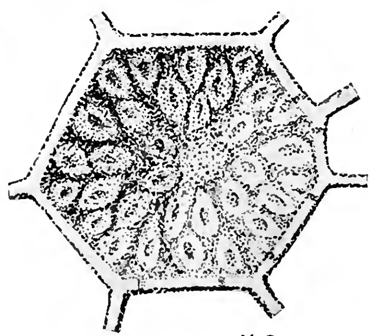
Fig. 1D × 8

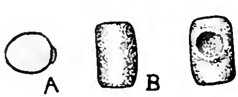

Fig. 3 × 3

Fig. 4 × 6

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COMAROCYSTITES AND CARYOCRINITES

Cystids with pinnuliferous free arms.

By A. F. Foerste, Dayton, Ohio.

INDEX

I. Preliminary Remarks on the Arm Structure of Crinoids and Cystids.

1. *The origin of biserial arms.*—According to Dr. F. A. Bather (Caradocian Cystidea from Girvan, 1913, p. 385), "the brachioles of Blastoids and Cystids differ from the Crinoid brachium, not merely in more fundamental features, but also in the fact that they are invariably biserial and present no trace of an anterior uniserial stage." The crinoid arm, on the contrary, is regarded by Bather (Echinoderma, 1900, p. 116), to have

originated from a uniserial form, even in those cases in which the arm structure at present is biserial, and diagrams are given illustrating how a uniserial arm might develop into a biserial one. It is well known that biserial arms frequently are uniserial at the base, and the arrangement here is regarded as more primitive. (See also Wachsmuth and Springer, Revision of the Palaeocrinidea, II, 1881, pp. 22-25; III, sec. 1, 1885, p. 14; III, sec. 2, 1886, p. 230.)

According to Austin H. Clark (A Monoograph of the Existing Crinoids, 1915, pp. 184, 189, 350, 352, 354), however, the biserial arrangement is more primitive in crinoids; the biserial arrangement being the palaeozoic type, while the uniserial arrangement originated chiefly in post-palaeozoic times.

Clark's conception of the origin of the biserial arrangement of the ossicles of crinoid arms is so different fr m that commonly accepted that it is quoted here in full:

"The crinoid arms are primarily paired interradial structures which have become joined along their radial edges, forming a radial biserial appendage, the ossicles later slipping in between each other so that an elongate uniserial appendage results. The original arms were, therefore, primarily ten in number. . . Originally, before their union into five, the arms probably bore no ventral ambulacral structures, and had no function other than that of increasing the surface of the disk by increasing the distance between the points of attachment." (Loc. cit., p. 350.)

The following statement by Clark also is illuminating:

"In such fossil forms as have biserial arms it is to be remarked that at the arm bases the brachials become uniserial; this is not to be interpreted as indicating that the arms were originally uniserial, but quite otherwise; mechanical considerations have forced the amalgamation of the two primitive radials into one, and similarly have forced the uniserial arrangement of the first two, and partially of the third and fourth, brachials." (Loc. cit., p. 354.)

"It is probable that the pinnules represent the original type of crinoidal appendage, and that these appendages were arranged in five pairs, the two components of each pair being, so to speak, back to back; but the pinnules have become enormously reduplicated, while in addition (they) have come to lie along either side of long body processes (arms) of subsequent development." (Loc. cit., p. 274, but omitting all references to cirri.)

Since the pinnules of crinoids are uniserial, it is certain that Clark regarded the uniserial arrangement of ossicles as primitive among crinoid appendages. Even the primitive arms of crinoids were imagined to have been uniserial. However, in times preceding the advent of the actually known paleozoic crinoids, adjacent uniserial arms were supposed to have united laterally in pairs in such a manner as to give rise, first, to biserial arms, and, later, to pseudo-uniserial ones. According to this theory, the pinnules of the theoretical uniserial arms might be arranged in a single series along one side of the arm, while the pinnules of the pseudo-uniserial arms should occur in two series, successive pinnules being attached alternately to opposite sides of the series of arm ossicles. If the food-groove along the ventral surface of the crinoid arms be regarded as originating along the line of junction of the two imaginary primitive uniserial arms, this food-groove might be retained in pseudo-uniserial arms originating from biserial forms, but need not be present in the imaginary primitive uniserial arms.

The views favored by Clark, and the various possible deductions from them, are interesting. They would be more interesting if they found support in the probable phylogeny of fossil species. It must be conceded, however, that in the earliest known representatives of the crinoids, the primary radials and primibrachs of Clark already were united laterally so as to present an initial series of five, instead of ten arms, as demanded by Clark's theory, and all the arms bear food-grooves. Moreover, even the earliest known biserial arms are more or less uniserial at the base.

2. *Uniserial arms and pinnules in Comarocystites.*

In the absence of anything corresponding to the supposed primitive arm structure of crinoids, among known Crinoidea, it may be interesting to note that, among the Cystidea, the free arms of *Comarocystites* are uniserial (Plate III), do not bear a food-groove along the ventral side, and support pinnules arranged in a single row along the right side of the arm (the ventral surface being directed away from the observer, and the distal end of the arm being directed upward); moreover, the pinnules consist of a uniserial row of ossicles. In a similar manner the uniserial row of plates supporting the recumbent food-grooves of *Amygdalocystites* (Canadian Organic Remains, III, 1858, plate VI), also might be regarded as uniserial arms, bearing a single row of uniserial pinnules along the right side of each arm. It is probable that *Canadocystis* (Bulletin 80, N. Y. State Museum, 1905, pp. 273, 274),had an arm structure similar to that of *Amygdalocystites*. It must be admitted, however, that these forms are not normal cystids. The possession of uniserial pinnules in *Comarocystites* and *Amygdalocystites* is sufficient to indicate this. *Canadocystis* probably also had uniserial pinnules. However, none of these genera could have given rise to five biserial arms, in accordance with the theory favored by Clark. At best *Comarocystites* could have given rise to only two biserial arms.

3. *Biserial arms and brachiolar pinnules in Caryocrinites.*

Caryocrinites (Plate IV) is anomalous in presenting brachioliferous free arms in which the ossicles of both the brachioles and of the arms are biserial in arrangement. It is anomalous also in other respects. Successive ossicles on the same side of the arm usually alternate strongly in size, the lower ossicle of each successive pair being distinctly shorter, sometimes, in fact, being reduced to a small, transversely cuneate remnant along the inner half of the horizontal suture separating the larger ossicles. When both of these successive ossicles are more nearly of the same size, both are in contact with the base of the same brachiole, the lower, shorter ossicle of each pair being in contact with one of the series of ossicles forming the brachiole, and the upper, longer ossicle of the same pair being in contact with the other series of brachiolar ossicles. Hence, it is possible to regard not only the arm of *Caryocrinites* as made up by lateral junction of two uniserial arms, but, in a precisely similar manner, the brachiole of *Caryocrinites* might be regarded as built up by the lateral junction of two uniserial pinnules, the supporting brachial ossicles of each of these theoretical uniserial pinnules still remaining distinct.

As a matter of fact, the brachioles of *Caryocrinites* may be diagrammed also as uniserial forms, the ossicles alternating in position from right to left, across the brachiole, the lowest ossicle at the base being regarded as the first ossicle of the brachiole.

4. *Biserial brachiolar pinnules in Stephanocrinus.*

Biserial pinnules are so anomalous among crinoids that in the case of *Stephanocrinus*, the only crinoid known to possess them, Wachsmuth and Springer identified them as pinnules. (Revision of the Palaeocrinidea, III, sec. 2, 1886, pp. 283, 284, 292), stating: "that these appendages, although they are equally thin and short, are not pinnules, is proved by the fact that all are supported by a radial plate, instead of being distributed separately along the sides of an ambulacrum." More recently (Zittel, 1913, p. 207) Springer has described *Stephanocrinus* as possessing "arms with one short biserial trunk to the ray, giving off slender biserial, non-pinnulate side arms from the outer shoulder of each brachial."

Evidently, *Stephanocrinus* is as anomalous among crinoids as *Caryocrinites* is among cystids.

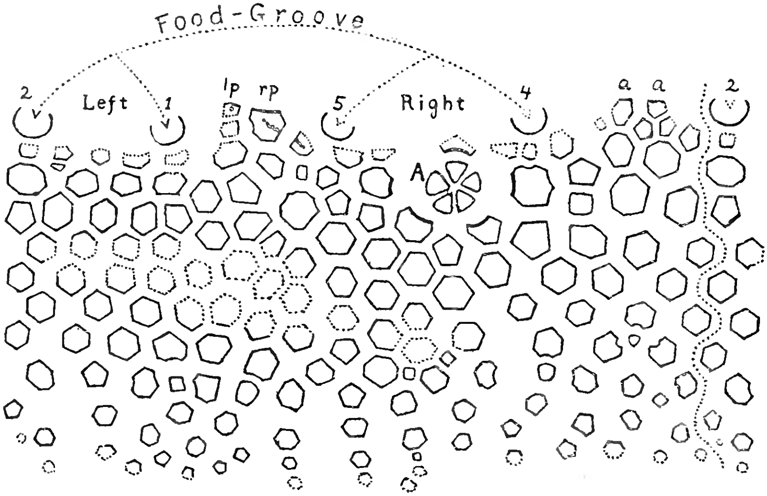
In presenting the preceding lines, there is no desire to favor the view that the biserial arms of crinoids have originated by the lateral junction of pairs of uniserial arms, but rather to call attention to the fact that the arms of certain cystids apparently present similar problems. Since these cystids are not as fully known as desirable, a more detailed description of *Comarocystites* is given here, and a few notes on *Caryocrinites* are appended. Moreover, these are the only cystids known at present in which the arms are free and pinnuliferous, and, as such, possess special interest. Both genera are American, occuring both in Canada and in the United States.

II. DETAILED DESCRIPTION OF COMAROCYSTITES PUNCTATUS BILLINGS.

5. *Chief characteristics of the theca.* Theca obovate, sometimes attaining a length of 75 millimeters, composed of about 150 plates, most of which are hexagonal in outline. Theca moderately compressed from front to rear. The two primary food-grooves diverge toward the right and left from the mouth in such a manner as to present the appearance of a single transverse, slightly curved, food-groove (Plate II, figs. 1A, 1B). The mouth does not present the appearance of a slit, as in *Aristocystis bohemicus* Barrande, and apparently also in *Caryocystis angelini* Haeckel, but takes the form of a more or less circular or elliptical aperture located in the bottom of the transverse apical food-groove already described. At each end of this food-groove the latter branches dichotomously on the proximal side of a nodular protuberance of stereom about 10 or 11 millimeters in diameter. Each nodular protuberance supports two arms. There are, therefore, four arms, arranged in pairs, one pair at each end of the transverse apical food-groove. These correspond in position to the lateral arms of the five-rayed cystids, there being no arm corresponding to the anterior arm of other cystids. The anal pyramid (Plate II, figs. 1A, 1B, 2; also Plate III) is situated a short distance below the protuberance supporting the pair of arms on the right side of the specimen. In larger specimens the transverse apical food-groove, between the points of dichotomous branching, has a length of about 13 millimeters, thus giving to each of the two lateral primary rays a length of 6 millimeters. Throughout its length the transverse apical food-groove follows the suture line between the anterior and posterior peristomial thecal plates. Along the basal margin of the nodular stereom protuberance, the exterior surface of the adjoining thecal plates of some specimens presents the appearance of being crowded back by the growth of the protuberance, and consequenlty of being reduced in size. The upper margin of these thecal plates appears to rest against the lower half of the protuberance, but cross-sections of other specimens indicate that the upper inner margin of these thecal

plates extends sufficiently beneath the base of the protuberance to suggest the origin of the latter as an accessory stereom deposit upon the surface of the theca, necessitated by the demands for support made by the growing arms.

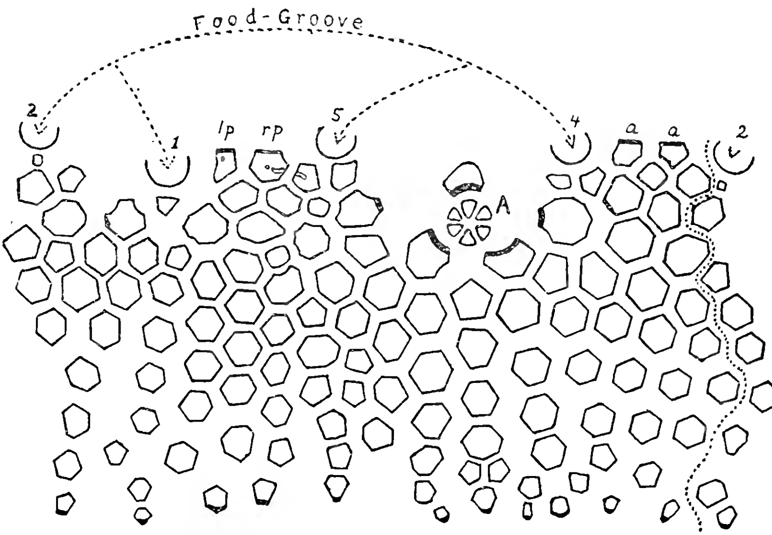
The degree of compression of the undistorted theca is moderate, the horizontal diameter from front to rear equalling about .80 to .84 of the lateral diameter. Specimens preserved in soft clay frequently present a much greater degree of compression, due to distortion after death. The length of the theca equals about ten-sevenths of the greatest transverse diameter.



Text figure No. 1. Diagram of the thecal plates of the specimen represented by figure 1 on plate II. The plates on the right of the vertical sinuous line on the right side of the figure duplicate those at the left margin of the diagram. The anterior peristomial plates are lettered *a*, *a*; the right and left posterior peristomial plates are lettered *rp* and *lp* respectively. The relative position of the different arm facets is indicated by the numbers 2, 1, 5 and 4, explained in the text. The dotted line indicates diagrammatically the transverse apical food-groove which forks at each end, each branch leading to the base of one of the arms, the latter being arranged in pairs. The anal pyramid is indicated at A. The linear hydropore extends from the middle of plate *rp*, diagonally downward and toward the right, as far as the middle of the adjoining plate.

Viewed from a direction at right angles to the plane of symmetry passing vertically through the theca, and parallel to the transverse apical food-groove, the sides of the theca differ slightly in outline. On the anal side the outline is more angularly convex, the maximum convexity being near midlength. On the opposite side the maximum convexity tends to be distinctly less curved. This difference in outline evidently is due to the location of the anus which has been dragged sufficiently by the gut to reduce the convexity of the upper part of the theca along its outline on the right, thus lowering the point of maximum convexity on this side.

6. *The numbering of the rays of the food-groove system.*—There is no trace of an anterior ray of the food-groove system in *Comarocystites.* However,it is possible to number the arms present in such a manner as to make comparisons with the rays of cystids whose food-groove system shows evidence of pentameral symmetry readily possible. (Plate II; figs. 1A, 1B; also text diagrams 1 and 2).



Text figure No. 2. Diagram of the thecal plates of the specimen represented by figure 2 on plate II. All letters and numbers as in text figure No. 1. That edge of the thecal plates which is in contact with the anal pyramid is heavily blackened. That edge of the basal plates which is in contact with the column is blackened in a similar manner.

In that case the left posterior arm is numbered 1, the left anterior arm, 2; the right anterior arm, 4; and the right posterior arm, 5. The absence of an anterior ray is indicated by the omission of the number 3.

7. *The thecal plates bordering on the transverse apical food-groove.*– If the thecal plates bordering on the transverse apical food-groove be termed peristomial plates, then the anterior side of this food-groove (Plate II, fig. 1A) may be described as bordered by two peristomial plates sufficiently similar in width to place the intermediate suture-line about half-way

between the ends of the transverse food-groove. It is evident that if an anterior ray ever was present in any of the ancestral forms leading to *Comarocystites*, this ray may have rested on the suture between the two anterior plates (between plates a, a, of the text diagrams) here under discussion. The outline of the right anterior peristomial plate is more or less obliquely hexagonal, while that of the left anterior peristomial plate is pentagonal.

The posterior side of the transverse apical food-groove also is bordered by two peristomial plates (Plate II, fig. 1B; also thecal plates lp and rp in text diagrams), of which the right is so much larger that it forms about two-thirds of this posterior border. The general outline of this plate is hexagonal, but the apex of the angle on the left side is broadly truncated by a concave curvature, as though three plates were in contact with the left margin of this plate:—a large, more or less hexagonal plate along its lower left margin, and two more or less quadrangular plates in contact respectively with the middle and upper parts of this left margin. The line of contact between these two quadrangular plates is not defined distinctly in any of the specimens examined, but the upper one of these plates borders on the left third of the transverse apical food-groove, and may be described as the left peristomial plate.

8. *The location of the hydropore.*—The orientation of the cystids is determined, not by the location of the mouth and anus but by the vertical plane passing through the mouth and hydropore. The hydropore is regarded as occupying a position directly posterior to the mouth. In *Comarocystites* the only surface structure suggestive of an entrance to a hydropore is a narrow, sinuous, almost linear ridge, extending from the middle of the right posterior peristomial plate (Plate II, fig. 1B; also thecal plate rp in text diagrams), across the suture on its lower right-hand margin, to the middle of the adjoining plate. The upper margin of the latter plate is in contact with the posterior margin of that nodular stereom protuberance which supports the right pair of arms. Along the top of the narrow, linear ridge there is a very narrow, faint groove, suggesting the presence of a narrow slit-like opening. Whatever the homology of this ridge, it evidently locates the posterior side of the theca. In several specimens there is a minute pit just beyond the upper left-hand termination of this hydropore ridge; however, since it was not observed in the majority of specimens, it cannot be determined definitely as a gonopore.

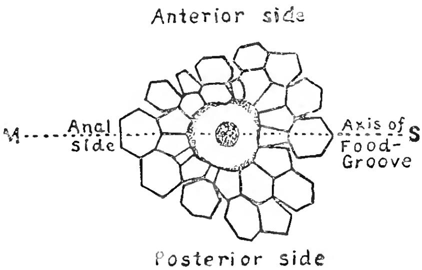
Nothing suggesting a hydropore is known at present in *Amygdalocystites*. In *Canadocystis emmonsi*, however, G. H. Hudson (N.Y. State Museum Bulletin 80, 1905, pp. 273, 274) has figured a possible madreporite at the posterior end of the suture between the two posterior peristomial plates making it possible to orient this species in the same manner as *Comarocystites* with the anal pyramid on the right side of the theca.

9. *The covering-plates of the transverse apical food-groove.*—The transverse apical food-groove is covered by two series of quadrangular covering-plates (Plate II, figs. 1A, 1B, also C), one on each side of the food-groove. These plates meet along the middle line of the food-groove so as to form an acute ridge. They are ornamented by minute granules similar to those of the adjacent thecal plates and there also is a tendency toward a low elevation along the median line of each covering plate. About five covering-plates occupy a length of 3 millimeters along the food-groove. In one specimen 8 or 9 covering-plates occupy the entire distance along the unbranched part of the food-groove, and 3 or 4 covering-plates line each side of that short branch of the food-groove which leads from the left end of the food-groove to the base of the left posterior arm. In another specimen about 15 or 16 covering-plates occur on each side of the unbranched part of the transverse apical food-groove, and 3 or 4 covering-plates line each side of the branches leading from the left end of the food-groove to the bases of the left anterior and left posterior arms.

10. *The anal pyramid.*—The number of plates exposed in the anal pyramid (Plate II, fig. 2; also A in the text diagrams) varies in different specimens from 5 to 6. The general form of the pyramid is semi-globose, but the apical part is more or less flattened. In all of the specimens examined, the anal pyramid is bordered by 5 thecal plates. Of these, two plates form the lower border, one plate occurs on each side, and the fifth plate forms the upper part of the border. The plate on the right side of the pyramid always is larger than the rest. The upper margin of the plate forming the upper border of the anal pyramid is overlapped on each side by a narrow plate separating the latter from direct contact with the base of the nodular stereom protuberance supporting the right pair of arms. The sutures of these overlapping plates often are indistinctly defined. That part of the thecal plates which borders directly on the anal pyramid is smooth, and moderately elevated.

11. *Fixity in arrangement of thecal plates limited to the immediate vicinity of the transverse apical food-groove and of the anal pyramid.*—Evidently there is a considerable degree of fixit in the number of thecal plates bordering on the transverse apical food-groove and in the number of those surrounding the anal pyramid, and there also is an approximation toward fixity in the general outline of these plates; but this fixity in number,

position, and outline usually is absent among those thecal plates not bordering on the transverse apical food-groove or on the anal pyramid. However, certain tendencies may be observed even among these other thecal plates. For instance, the plate directly below the middle of the anal pyramid (Plate II, fig. 2; also text diagrams), but not in contact with the latter, is pentagonal in form, and has its upper angle inserted between the two plates forming the lower border of the pyramid. Directly beneath this pentagonal plate is a series of hexagonal plates which, instead of forming a strictly vertical row, are arranged along a line which curves moderately toward the front on approaching the base of the theca. Parallel to this series of plates, on its anterior side, are similar series of hexa-



Text figure No. 3. The two lower series of thecal plates of the specimen represented by text figure No. 2, and by figure 2 on plate II; drawn as though viewed from the lower side and oriented as indicated in the diagram. The vertical projection of the plane passing through the anal pyramid and parallel to the transverse apical food-groove is indicated by the dotted line. The dotted parts surrounding the top of the column indicate the extent to which the basal part of the lowest series of plates rises above a line drawn strictly horizontal around the top of the column. The dotted area at the center represents the lumen. Fifteen plates occur in the basal series of thecal plates in the specimen diagrammed, but the number varies greatly in different specimens.

gonal plates, causing the anterior side of the theca to present the appearance of diagonally intersecting rows, with the angles of the thecal plates directed toward the top of the specimen. On the posterior side of the theca, a similar tendency toward the arrangement of plates in rows causes one of the sides of the hexagonal plates, rather than one of its angles, to face the top of the specimen.

12. *The arrangement of the basal thecal plates.*—The outline and arrangement of the basal thecal plates, where in contact with the stem or column, varies from 11 to 15 (Text diagram No. 3) in different specimens. The line of contact between the basal thecal plates and the top of the column is not strictly horizontal, but rises and falls in an irregular manner, varying

in different specimens. All efforts to diagram the basal thecal plates of *Comarocystites punctatus* in such a manner as to secure a primary series of 3, 4 or 5 plates has failed, nor is it possible to demonstrate the presence of any radial plan of arrangement of the lower thecal plates, extending outward from a supposed primary basal series.

If any increase in the number of plates forming the theca takes place in any except the earliest stages of growth, this increase in number can take place only at the base of the theca, where in contact with the column. Elsewhere the plates of the theca are almost uniform in size. The series of plates in contact with the column, however, frequently are unequal in size, smaller plates not infrequently being wedged in between larger ones, and the line of contact between the margin of the lowest plates and the top of the column is more or less irregular.

EXPLANATION OF PLATE II.

Fig. 1. Comarocystites punctatus Billings. Specimen belonging to James E. Narraway. A, anterior side, photographed so as to show the thecal plates nearest the transverse apical food-groove, and coverplates on the anterior side of the food-groove; also the position of the anus and of the masses of stereom supporting the two pairs of arms. Several of the plates give distinct indications of the pairs of lunate pores which occur directly beneath the epistereom. B, posterior side, photographed so as to show the thecal plates along the upper half of the specimen, the cover plates on the posterior side of the food-groove, and the linear hydropore passing from the right posterior plate diagonally backward and to the right toward the middle of the adjoining plate. The facet for the support of the left posterior arm and the branch of the food-groove leading to the margin of this facet are well preserved; only a short part of the adjoining branch of the food-groove is seen. The upper part of the mass of stereom on the right of the food-groove has broken off beneath the level of the facets supporting the right pairs of arms. In both figures the anal pyramid is located on the right. C, five of the cover-plates of the food-groove enlarged. D, one the thecal plates enlarged so as to show the indications of the presence of pairs of lunar pores presented by the epistereom in unweathered specimens. A, B, enlarged 3 diameters; C, enlarged 13 diameters; D, enlarged 8 diameters. The form and relative location of the thecal plates of this specimen are indicated in text diagram 1.

Fig. 2. Comarocystites punctatus Billings. Specimen belonging to Walter R. Billings; view of right side, magnified 2.4 diameters. Photographed so as to show the anal pyramid, the thecal plates immediately surrounding the anal pyramid, and the diagonal arrangement of the thecal plates on this side of the specimen. Indications of the transverse apical food-groove terminating at the two masses of stereom supporting the pairs of arms are seen along the upper part of the figure.

Figs. 3, 4. Comarocystites punctatus Billings. One of the brachials and one of the pinnulars of the type illustrated on plate III, magnified. 3, three views of a brachial, magnified 3 diameters; A, cross-section with indication of facet for attachment for the pinnule on the right; B, side opposite the facet; C, side showing the facet. 4, three views of a pinnular, magnified 6 diameters; A, cross-section; B, side opposite the cover-plates; C, side showing three cover-plates along one edge.

(To be continued)

SEA SQUIRTS.

By Professor E. E. PRINCE, Commissioner of Fisheries, Ottawa.

No one who has spent a few hours on the sea shore, turning over weed-covered stones, can have failed to notice clusters of leathery objects, styled by the fishermen sea peaches, sea apples, sea potatoes, etc. They are of various shapes, as these names indicate, and differ in colour, some bright pink, others scarlet, or orange, or pure white, or stone colour, and other tints. Some strongly resemble leathery grapes, or coarse plums, or even small leather bottles, while many are semi-transparent, and not unlike green-glass flasks, one or two inches long. They cling by the base to stones and other objects, and frequently hang from the underside of shelving rocks, others are upright and stalked, resembling a brown potato on a long stem (like *Boltenia*), others are jelly-like colonies (such as *Amarousium*), and some occur as long strings of clear glassy creatures, floating as *Salpa* does, near the surface of the sea. On touching them they squirt out two thin jets of water, from an aperture at the top, and another at the side. They have the appearance of motionless vegetables, and are scientifically called Tunicates, or less accurately, Ascidians, but by more philosophical naturalists they have been dignified with the name Urochordates. They merit some notice in these pages for two reasons, viz:—their very special scientific interest, and for a second important reason, that they have formed the subject of some most remarkable original investigations by Dr. A. G. Huntsman, of the University of Toronto, a distinguished worker among our younger Canadian biologists. The high scientific interest possessed by the Tunicates, or Sea Squirts, arises from the fact that they have been looked upon as the ancestral progenitors of the human race (or rather of all vertebrates), and about them Andrew Lang wittily wrote:

"The ancestor remote of Man,
Says Darwin was the Ascidian."

The additions to our knowledge of Canadian Ascidians, due to Dr. Huntsman's labours, are a source of just pride to our scientists. Dr. Huntsman was trained under Professor Ramsay Wright, whose retirement from his Toronto chair zoologists on this continent will never cease to deplore. Laborious and successful work at the three Dominion Government biological stations, during many years, led to Dr. Huntsman's appointment by the Biological Board recently to the responsible position of curator in charge of the marine and fishery investigations at the Biological Station, St. Andrews, New Brunswick. His work now covers a varied field, but it is his Tunicate researches that claim notice here.

In 1908 and 1909 Dr. Huntsman investigated the Ascidians of British Columbia, making a fine collection himself, and having placed in his hands collections made by Professor John Macoun, and by myself and the late Rev. G. W. Taylor, and others. As a result of his studies he was able to publish several papers on these curious creatures, but his most notable memoir: "The Holosomatous Ascidians from the coast of Western Canada," covering over 80 pages of the volume; "Contributions to Canadian Biology, 1908-1911," with 12 splendid photographic plates, and issued by the King's Printer, Ottawa, in 1912, is an extensive and thorough record of his discoveries. It has attracted wide attention, and specialists in various countries, from the United States in the west, to Russia in the east, have welcomed this memoir as an unusually important one. Indeed, Professor W. Redikovzew, a distinguished Russian zoologist, has been so impressed by Dr. Huntsman's results as to adopt these Canadian discoveries and conclusions set forth in the memoir alluded to, and has embodied them in a fine paper, in Russian, recently issued at Petrograd.

Dr. Huntsman's beautiful plates, with precisely 100 figures, are heliotypes of his own exquisite photographs of Ascidians. They are so skilfully done that the most minute structural features are shown with marvellous delicacy and faithfulness. The descriptions in the text are clear, accurate, and models of scientific exposition. Important classificatory features are given in graphic tabular forms, inserted under each species, and summarizing measurements, and other details.

It is impossible here to do more than indicate some of Dr. Huntsman's results. They embrace the following families:—The Perophoridæ; the Family Agnesiidæ, with one species new to science; the Chelysomatidæ, three new species; the Caesiridæ, four new species; the Styelidæ, five new species, including, indeed, a new genus, Chemidocarpa, and one new species *Metandrocarpa Taylori*, appropriately named after the late Rev. Mr. Taylor, who did herculean work as a pioneer in Pacific zoology; and, finally, the Family Tethyidæ. In view of our extended knowledge, due to Dr. Huntsman's researches, the last-named Family has acquired a new significance, and one of the genera, Boltenia, has changed its application. Very interesting facts are to be noted regarding the geographical distribution of these sedentary forms. The two species *B. ovifera*, of the eastern shores, and *B. villosa*, of the Pacific shores, meet in the northern waters of Alaska, and as Dr. Huntsman observes, "perhaps overlap" in Behring Sea. Some species seem to be very local, while others are world-wide in their range. The familiar *Pelonaia corrugata* occurs in both oceans, and in the Arctic as well, and presents in all localities the same features; "they do not seem to differ in any respect," as Dr. Huntsman notes. Alas, they are the homeliest in looks of all the Tunicates! The same ubiquity applies to the greenish transparent *Ciona intestinalis*. *Phallusia ceratodes* appears, on the contrary, to be very local, and is a species first found and named by Dr. Huntsman, and "quite distinct from any yet described." In contrast are forms like *Ascidiopsis paratropa*, a new species described by the author, and very distinct, yet closely related to species from Corean seas, from Northern Europe, and from Puget Sound, which latter is, however, less than a hundred miles south of Departure Bay, where it was first discovered.

But if the colours, the forms, and the distribution of these strange animals present such striking features, their life-history, physiology and anatomy are, to the popular mind, even more extraordinary. Thus, they possess a heart, without valves, and ventral in position, below the base of the endostyle. The heart, in all true invertebrates possessed of that pulsating organ, is dorsal in position, but in man and the Vertebrata it is on the ventral or under side, as in Tunicates. It is enclosed in a pericardium, and pulsates with a progressive vermiform movement, and every few minutes it reverses its action, and drives the blood in the opposite direction. Thus the heart's contractions drive the blood now this way, now that way, a curious characteristic feature of the Sea Squirts, and not probably found in any other group of animals. Can it be that human fickle-heartedness has come down to us from our Ascidian ancestors, with their uncertain cardiac phenomena! The endostyle is interesting, and is a long open canal, glandular and ciliated, with thickened sides, and extending along the ventral face of the cage-like gullet or perforated branchial pharynx. It is active in the digestive functions. The sac-like body has two important openings, one at the top, inhalent, and the other lower down at the side, which is exhalent. A thick coat or tunic loosely encloses the whole animal, whence the name Tunicate. This peculiar leathery tunic shows fibrillæ, and even cells (mesoderm cells which have wandered from the body of the enclosed animal), but it contains, most wonderful of all, a substance, like the cellulose which is peculiar to plants. Bertholet regarded it as a special substance, Tunicin, but recent researches appear to confirm the old and long accepted view that it is really cellulose. Now, cellulose has been regarded as affording one of the distinctions between plants and animals, but this outer coat of the Ascidians is an animal product, though not more essentially a part of the Tunicate's body than the shell of an oyster or clam. A thin epidermis covers the tunic, in which pigmented cells occur, and these migrate into the tunic itself and impart to the animal its colour, which is very brilliant and striking in some Ascidians.

A few words only can be added about the life-history and development of Tunicates. Eggs and sperms are produced by the same individuals, though some are protandric, and do not produce eggs until after the sperms are ripened; but budding also occurs, and reproduction by stolons, a peculiar phenomenon. From the egg issues a larva, very like a tadpole, the enlarged head of which possesses several sticky papillæ for the purpose of adhering to external objects. A strong muscular tail permits it to progress actively through the water. A rod passes down the centre of the tail composed of a row of cells at first, but later by the coalescence of these cells, it appears as a clear hyaline resistent rod, or axis, representing the notochord or primitive backbone of all higher animals. This first indication of a vertebral column is a profoundly interesting feature in Tunicates. Hardly less interesting are the larval organs of vision and hearing, though, like mythical Cyclops, there is only one eye, and the ear or otocyst is unpaired. Some Tunicate larvæ secrete a clear gummy blanket or floating house, and live in it for a time, at the sea's surface. *Oikopleura* does that.

It is unnecessary to describe subsequent changes further than to say that, at a certain stage, the wriggling tadpole becomes rooted by its mouth-end to rocks or other objects, loses its tail, its eye, its ear, and other organs, and becomes changed into a leathery sac-like creature, sightless and motionless, the typical rooted Ascidian, such as those Dr. Huntsman describes. There are three main types among the Tunicates, viz.: the Ascidiaceæ, the Thaliaceæ, and the Larvaceæ, and over one hundred genera. A promising field waits investigation, and Dr. Huntsman's additions to our knowledge proves what a great opportunity for scientific discovery young Canadian workers have who resort to our three Government biological stations each summer. The Tunicates offer a fruitful field for research. Science has revealed unexpected marvels in the study of these lowly-looking Tunicates, but while they are degenerate, as a class, they appear undoubtedly to have formed the starting point whence higher animals have evolved, and have progressed in an ascending scale until Man, the highest Chordate or Vertebrate, developed.

BOOK NOTICES.

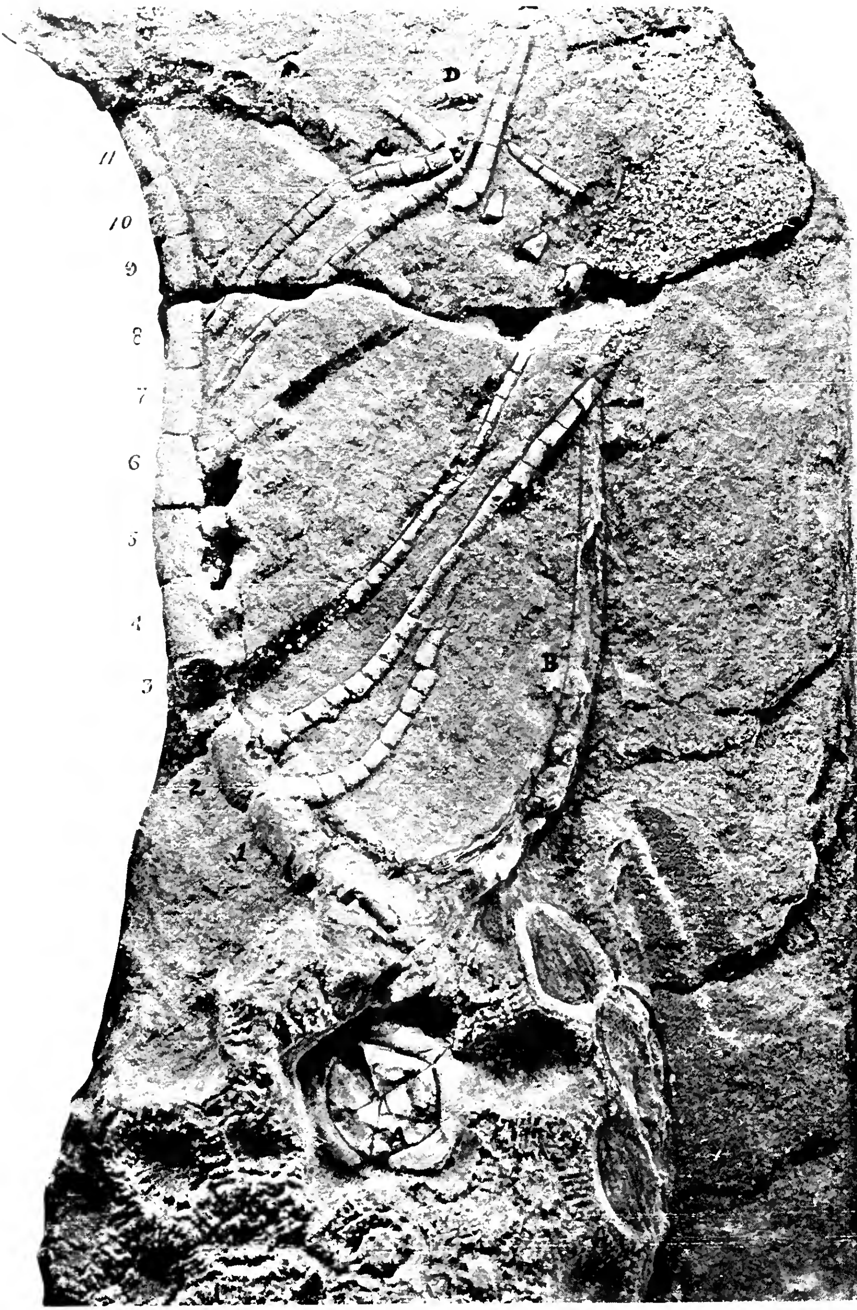
"EDIBLE AND POISONOUS MUSHROOMS," by W. A. Murrill, appeared June 26th, 1916. This work consists of a large colored chart and a handbook containing descriptions of the chief edible and poisonous species in North America, together with a discussion of edible and poisonous fungi in general, and methods of preparing and cooking mushrooms. The treatment is brief, requiring only about seventy-five pages, but it covers the ground in a practical and safe way, and will enable the intelligent mushroom-loving public to enjoy many of our native wild species without fear of unpleasant consequences. The writer has erred rather on the side of safety, failing to figure and recommend for food the royal agaric, the blushing amanita, the sheathed amanitopsis, and many other species which are excellent and often eaten.

The chart was prepared under the author's direction by a very careful artist, and is suitable for hanging on the wall in libraries and schools, as well as in botanical museums. Different backgrounds are used for the edible and poisonous species, which are separated and plainly labelled, so that no mistakes can occur. The maximum of safety lies in accurate figures, and descriptions not only of species that may be safely eaten, but also of all the dangerous species that should be avoided.

The price of the handbook and chart is $2.00. Copies may be obtained from the author, whose address is Bronxwood Park, New York City.

ENTOMOLOGICAL SOCIETY REPORT.

The 46th Annual Report of the Entomological Society of Ontario recently appeared. It is one of the most valuable reports ever issued by the Society, comprising 232 pages, and presents the proceedings of the 52nd annual meeting, held in Ottawa on November 4th and 5th, 1915. Thirty papers are given in full, many of which are illustrated. All students of insect life, not only in Canada, but elsewhere, will undoubtedly welcome the appearance of this splendid report. Most of the articles discuss important crop pests of the farmer and fruit-grower.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COMAROCYSTITES AND CARYOCRINITES.

Cystids with pinnuliferous free arms.

By A. F. Foerste, Dayton, Ohio.

(Continued from page 79.)

13. *The structure of the thecal plates.*—The exterior surface of the thecal plates of *Comarocystites punctatus* is deeply concave. The interior surface, however, appears more or less stellately convex. The convex appearance is due, in part, to the slopes of the suture planes, converging toward the center of the theca, and, in part, to the thinning of the plates toward the angles of their polygonal outlines. The stellate character is due to grooves separating the different sets of mesostereom plates, described later in this paragraph. These grooves narrow toward the angles, thus increasing the stellate appearance.

In cross-sections which are vertical to the surface of the thecal plates and perpendicular to the middle parts of the sutures between the plates, the inner surface of the plates presents an almost straight outline between the center of one plate and the center of the next, or there is a moderate outward bending of this outline at the suture. However, toward the angles where three plates meet, the inner surface of the plates curves so strongly outward as to produce the appearance of deep triangular pits at these points of junction. Owing to the deep concavity of the exterior surface of the plates, the thickness of these plates varies from five-tenths to six-tenths of a millimeter at the center to nearly two millimeters along the middle of the suture lines. Toward the angles, however, where three plates meet, and where the inner surface of the plates curves strongly outward, so as to approach the outer surface, the thickness of the plates frequently is reduced to about a quarter of a millimeter. Viewed from the interior of the theca, with the plates still connected, the deep triangular pits or depressions between the ends of the stellate rays characterizing the individual plates, form the most striking features.

Beneath the thin non-porous epistereom lies the thick mesostereom. That part of the mesostereom which is in contact with the epistereom forms a practically continuous sheet, penetrated only by pores, and from this sheet the greater part of the mesostereom is suspended in the form of vertical lamellæ. (Plate IV, figs. 3 and 1D.) Viewed along the suture planes, where exposed by the dismembering of the theca, these lamellæ appear thin and narrow toward their junction with the continuous exterior part of the mesostereom, but they thicken toward their inner terminations for a distance of almost a millimeter. These lamellæ do not radiate from the center of the thecal plates, but form groups, all lamellæ belonging to the same group being perpendicular to the same suture line between two adjacent plates. If imaginery lines be drawn from the center to the angles of each plate, then the lamellæ will be found grouped in triangles limited laterally by these imaginary lines. In each triangle the lamellæ will be found perpendicular to the suture line forming the base of the triangle, the triangles of adjacent plates forming rhombs, which, however, give no indication of their presence on the unweathered surface of the plates. The adjacent triangular groups of lamellæ are separated usually by grooves, widening toward the center of the plates and narrowing toward the angles. Both the lamellæ and the inter-lamellar spaces are directly connected across the suture planes.

The epistereom is thin and non-porous. However, if only slightly weathered, it is found to be underlaid by pairs of short lunate pores extending parallel to the epistereom, just beneath the latter, appearing on the weathered upper surface of the mesostereom as short lunate grooves, the concave sides of each pair facing each other. The presence of these pairs of lunate pores often is indicated on the exterior surface of the epistereom by short lunate ridges (Plate II, figs. 1A, 1B, also 1D), which correspond in size, form and position with the pores beneath. Three or four series of these pairs of lunate pores may occur between the centers of the thecal plates and the suture lines, the pairs of different series more or less alternating with each other in position.

Each lunate pore is connected near its distal end with a small circular or oblong pore penetrating the outer more or less continuous sheet of the mesostereom, and leading into the spaces between the vertical lamellæ. Pores of the same pair always connect with different inter-lamellar spaces, being separated by one of the lamellæ. The right hand pore of one pair, however, usually is connected with the same inter-lamellar space as the left hand pore of the nearest adjacent pair, proximally or distally, i.e., either nearer the center of the thecal plate or nearer the suture line. In this manner, three or four pores belonging to different pairs may be connected to the same inter-lamellar space. There is no connection between pores belonging to the same pair.

The pores penetrating the outer continuous sheet of the mesostereom are directed perpendicularly toward the suture lines between the plates, but incline more or less obliquely downward. They apparently widen in a direction parallel to the inter-lamellar spaces in passing through the outer sheet of the mesostereom, since, in strongly weathered specimens showing the inter-lamellar spaces (Plate III), the latter frequently appear interrupted by transverse partitions a short distance below the outer continuous sheet of the mesostereom. At the center of each thecal plate there is a space, at least a millimeter wide, within which no trace of the vertical lamellæ appears.

14. *Sections across the anal pyramid and the transverse apical food-groove.*—A cross-section of the anal pyramid of *Comarocystites* shows that the lower margin of the pyramid plates fits into a groove extending along the lower part of the proximal margin of the bordering thecal plates. The upper part of this proximal margin rises sufficiently to admit of the presence of some substance for opening the anal passage on the relaxation of the muscles holding the anal plates shut from within the thecal cavity.

The mouth, or opening into the interior of the thecal cavity, is scarcely a millimeter in diameter, and is located at the posterior end of the suture between the two anterior peristomial plates (a, a, in the text diagrams). In form this opening varies from nearly circular to more or less elliptical, with the longer diameter parallel to the direction of the transverse apical food-groove. From this mouth the lateral primary rays of the food-groove system diverge in opposite directions in such a manner as to produce a slightly curved transverse continuous groove across the apical end of the theca, with the convex side of the groove directed toward the front. This transverse food-groove, between the bases of the arm pairs, is frequently exposed, but the central mouth opening is rarely seen. Cross-sections perpendicular to the length of the transverse apical food-groove in one specimen indicate that the lower part of the posterior peristomial plates, projects slightly beneath the adjoining part of the anterior peristomial plates, especially toward the lateral extremities of this food-groove. To what extent this feature is present in other specimens is unknown.

15. *The arms of Comarocystites punctatus.*—Each pair of arms is supported by a single nodular stereom protuberance, but each protuberance is supplied with two more or less divergent facets (see facet 1, in fig. 1B on plate II.) for the attachment of the arms. Each end of the transverse apical food-groove, on coming in contact with the adjoining protuberance, bifurcates, each branch of the food-groove, together with its covering-plates, extending to one of the arm bases, and then rising along the adoral side of the first brachial.

Arms are known only in the case of two specimens, one found and figured by E. Billings, the other found and figured by Sir James

Grant. The first presents a clearly defined view of the lower half of the right posterior arm, with its attached pinnules. The second presents a much less clearly defined view also of what appears to be the right anterior arm, with its attached pinnules. Evidently both the brachials and pinnulars of these two arms are arranged in uniserial order. It is assumed that the left pair of arms presented the same characteristics. Only the right posterior arm attached to the Billings type-specimen is here described in detail.

Twelve brachials (Brachials 1 to 11 are numbered in the figure on plate III) are exposed, and each bears a single pinnule on its right side. All of the brachials above the first are flattened slightly from front to rear (Plate II, figs 3A, B, C), the ratio of the lateral diameter to the adoral-aboral diameter being as 10 to 9 (Fig. 3A). The length of each brachial usually equals about three-halves of its lateral diameter. The facets supporting the pinnules are concave (Fig. 3C), their margins being distinctly elevated, especially on their lower sides. The location of these facets is slightly above the middle of each brachial. On that side of the brachial which is opposite the pinnule (Fig. 3B), the brachial tends to be slightly more angular in a direction parallel to the length of the arm. The original length of the complete arm is unknown, but probably it equalled about three-halves of the length of the theca. The rate of tapering of the successive brachials, as far as preserved, is but moderate. Analogy with *Amygdalocystites* and *Canadocystites* suggests that the pinnules of all four arms of *Comarocystites* were attached to the right side of the arms, the aboral side of each arm facing the observer, and the distal end being directed upward.

16. *The pinnules.*—The length of the pinnules probably equalled 30 millimeters, and may have reached 35 millimeters. There is but little variation in the length and width of the pinnulars, about four occupying a length of five millimeters. Except in the case of the first two or three pinnulars, most of the pinnulars are strongly flattened transversely (Plate III; also figs. 4A, B, C, on plate II), the pinnules being placed, for purposes of description, in an approximately vertical position, with the aboral side facing the observer. The ratio of the transverse diameter to the adoral-aboral diameter (Fig. 4A) is about 8 to 5. The lateral edge of the pinnulars (Fig. 4B) tends to be more or less angular in a direction parallel to the length of the pinnule, thus giving the pinnulars a lens-shaped cross-section.

In the Billings type-specimen, here figured, a series of small, flat, quadrangular plates lines one side of two joints of that fragment of the pinnule which is marked D on plate III, and traces of similar small plates are seen at the point C, on one side of the pinnule attached to the eighth brachial. (See also fig. 4C on plate II.) These small quadrangular plates are interpreted as covering-plates. Their number varies from three in a length of one pinnular, to five in a length of two of these pinnulars.

17. *The absence of food-grooves on the brachials.*—In case of the right posterior arm of *Comarocystites,* one of the branches of the transverse apical food-grooves rises for a short distance along the ventral side of the first brachial, but disappears before reaching the top of this brachial. There are reasons for believing that the absence of food-grooves on the arms of *Comarocystites* is secondary and not primitive. The small quadrangular covering-plates along one side of the pinnules, as described above, suggest the former presence of a food-groove. As a matter of fact, no trace of an actual food-groove has been noticed so far on any pinnular, but analogy with *Amygdalocystites* demands that they should be present.

In *Amygdalocystites* the food-groove follows one of the narrower sides of the pinnule, the pinnulars being compressed laterally, and the food-groove faces the mouth. In a similar manner the few covering plates found so far on the pinnulars of *Comarocystites* are on the side facing the mouth, and the sides of these pinnulars are even more compressed than in *Amygdalocystites.* Originally, a food-groove must have followed that side of the pinnule supporting the covering-plates, and a second series of covering-plates must have existed along the same side, but beyond the food-groove. Formerly the food-groove on the pinnulars must have connected with one of the brachials, thus reaching the transverse food-groove along the apical side of the theca, if the analogy between *Comarocystites* and *Amygdalocystites* and *Canadocystis* is as great as here suspected. It should be noted, however, that the facets supporting the pinnules of *Amygdalocystites* are distinctly indented on the side where the branch from the food-groove on the arm passed on the base of the attached pinnule. In *Comarocystites,* however, the facets supporting the pinnules are circular, and show no such indentation. Evidently the absence of a food-groove extends to the lower pinnulars at least.

18. *The column or stem.*—The column or stem is cylindrical, with no evidence of pentamerism either exteriorly or interiorly. The segments or columnals are very thin, alternating in thickness, about 20 occurring in a length of six millimeters in the column attached to that Billings type-specimen which retains the arm. This column has a diameter of four millimeters. The surface of the column is ornamented by minute granules, seven in a width of one millimeter, arranged quincuncially, in diagonally intersecting rows. The lumen equals about one-fourth of the diameter of the column. The flat surfaces of the columnals are striated radially. The only known complete column is attached to the specimen discovered and described by Sir James Grant, and figured by him in the Transactions of the OTTAWA FIELD-NATURALISTS' CLUB, in 1880. In this specimen the

theca is 65 millimeters in height, the length of the column is 108 millimeters, its width near its attachment to the theca is 7 millimeters, at mid-length this width is nearer 5 millimeters, toward the base of the column it increases to 6 millimeters, and then, within a distance of 3 millimeters, the column widens rapidly into a circular attachment disk, about 17 millimeters in diameter. The upper surface of this attachment disk is convex, and the lower surface is sufficiently concave to suggest attachment to a more or less convex object. The outlines of this attachment disk probably were irregularly circular, certain parts extending farther than others from the center. There is no differentiation in size or form between the columnals along the middle third of the stem compared with the columnals toward either end. All are very thin and of approximately the same lateral diameter. During the growth of the stem the columnals probably were added at the top. The stem evidently was sufficiently strong to support the theca in a more or less erect position.

19. *Geological horizon and geographical distribution.—Comarocystites punctatus* Billings is known chiefly from the Trenton, in the vicinity of Ottawa, in Canada. Professor Percy E. Raymond, who has made a special study of the Ottawa area (Guide Book No. 3, International Geological Congress, 1913, p. 151), cites *Comarocystites punctatus* only from the quarry located in the angle between the two railroads, several hundred yards north of Walter's Axe Factory quarry, in Hull, a town on the opposite side of the river from Ottawa, northwestward. Here it occurs in the *Crinoid* zone, associated with *Edrioaster bigsbyi, Cyclocystoides halli, Isotelus latus,* and *Amphilichas cucullus.* The strata in this quarry consist of rather thick-bedded, coarse-grained, gray limestone, separated by black shale partings in which most of the fossils are found. The writer found two specimens of *Comarocystites* on the surface of the highest layer of massive limestone exposed in the Robillard quarry, three miles east of Ottawa, on the south side of the Montreal road. This massive limestone is referred by Raymond to the *Tetradium* zone, and belongs above the *Crinoid* zone. The top of the *Tetradium* zone is exposed also in the quarry immediately behind the axe factory, in Hull. In the overlying *Prasopora* zone Mr. James E. Narraway found several specimens of *Comarocystites.* Several small specimens were found by Mr. Narraway in the lower part of the *Cystid* zone exposures at Nepean Point, within a short distance of the horizon at which *Agelacrinites inconditus* is fairly common. This part of *Cystid* zone is probably not far above the top of the *Prasopora* zone. The well preserved theca illustrated by figure 1 on plate II of the present communication was found by Mr. Narraway, in the quarry at the northeast corner of Bell Street and Carling Avenue, immediately east of the railway leading into the lumber yard east of Dow lake. Here

Agelacrinites chapmani occurs in one of the lower layers of limestone, and the *Comarocystites* was found about five feet above this level. The exposures in the quarry belong to the upper part of the *Cystid* zone. It is evident that the types of *Comarocystites punctatus* were found in the *Cystid* zone, since Billings stated in his original description that the specimens occurred "generally along the water's edge, from the Rideau Falls to the Chaudiere." The remarkable specimen obtained by Sir James Grant from an excavation on St. Patrick street, near Chapel street, in Ottawa, also may have come from the *Cystid* zone, but there are no exposures at present in this area, by means of which the horizon may be established definitely. Evidently *Comarocystites* has a considerable vertical range in the Trenton of the Ottawa area, being unknown so far only from the *Dalmanella* zone, at the base of the Trenton, and from the *Hormotoma* or *Sponge* zone, at the top of the Trenton. In the intermediate zones it evidently occurs at more or less remote intervals, and is a comparatively rare fossil.

Possibly there are two species of *Comarocystites* in the Ottawa area; one of larger size, with more compressed theca, and with nearly smooth thecal plates; the other smaller, less compressed, with minutely granular thecal plates, marked by pairs of distinctly lunate short ridges. The second form is known to occur at the top of the *Tetradium* zone, immediately beneath the *Prasopora* zone, and in the *Cystid* zone. Possibly the smooth form occurs at a different horizon, but the number of well preserved specimens at hand is not sufficient to determine whether the smooth and ornamented forms in reality are distinct or not.

Comarocystites punctatus is cited by Rominger also from the Trenton, in section 17 of township 41, above the big bend in the Escanaba River, north of Little Bay de Noquette, in Michigan.

20. *Literature on Comarocystites punctatus*:—
Comarocystites punctatus Billings:

Billings, Canadian Journal, 2, 1854, p. 270, figs. 1-3.

Figure 1 in this paper corresponds to figure 2 on plate V of Decade III. Figure 2 is an apical view of the same specimen and corresponds to figure 2b in the Decade, but is not identical with the latter; there is no indication of a pair of arms at the upper end of the figure, but only of a single protuberance, and the location of the anal pyramid beneath the pair of arms in the lower part of the figure is shown. Figure 3 corresponds to figure 1 of the Decade.

Geol. Surv. Canada Rep. Progr. for 1853-56, 1857, p. 288.

Geo. Surv. Canada, Dec. 3, 1858, p. 61, pl. 5, figs. 1-1b, 2-2b.

Figure 1 (No. 1391g, in Victoria Memorial Museum) represents the right side of the theca; *o* is the anal pyramid. In figure 1b, the smooth proximal parts of the polygonal plates surrounding the anal pyramid are represented incorrectly as though forming a circle of separate plates surrounding the anal pyramid. In figures 1a and 2a, the non-porous epistereom has been removed by weathering from the marginal parts of the thecal plates. Figure 2 (No. 1391, in Victoria Memorial Museum) presents a view of the anterior side of the theca, with the anal opening on the left upper margin of the figure; the nodular stereom mass supporting the right pair of arms is seen immediately below the number 2, and the angle at the upper right hand margin of the figure indicates the location of the other stereom mass. Figure 2b is a very unsatisfactory representation of the transverse food-groove extending from the central mouth in opposite directions to the base of the stereom mass, where it forks dichotomously at each end.

Grant, Trans. Ottawa Field-Nat. Club, 1, 1880, pl. 1, figs. 1-5.

Figure 1 (No. 333 in Victoria Memorial Museum) probably presents a view of the anterior side of the theca, in addition to a view of the entire length of the column, including its base. Only the lower parts of the arms and pinnules of this specimen are represented in this figure. The remaining figures are re-publications of figures in Decade III, of Billings, figs. 2, 3, 4 and 5 corresponding to figs. 1, 2, 1b and 2b respectively of the Decade

Chapman, Exposition of the Minerals and Geology of Canada, 1864, p. 109.

Haeckel, Amphorideen u. Cystoideen, 1896, p. 70, pl. 1, figs. 4-4c.

Figure 4 is a reproduction of Billing's figure 1 on plate 5 of Decade III, amplified by Haeckel so as to suggest the appearance of a complete arm system and a complete column. The biserial arrangement of the pinnules is incorrect. In figure 4a, the series of small plates surrounding the transverse food-groove is imaginary; the figure evidently is based on figure 2b of the Decade.

Jaeckel, Zeits, d.d. geol. Gesell. 52, 1900, p. 676.

EXPLANATION OF PLATE III.

Comarocystites punctatus Billings. Upper part of type figured by Billings in his monograph on the Cystideae of the Lower Silurian rocks of Canada, in Decade III, of Canadian Organic Remains, in 1858, where it forms figure 1 on plate V. The specimen has been crushed in a direction perpendicular to the anal pyramid. Only the upper part of the right side of the theca is shown in the figure here presented, magnified 3 diameters. A considerable part of the right posterior arm is exposed. The brachials are numbered. The exposed surfaces are interpreted as the dorsal side, most of the brachials showing the facets for the attachment of the pinnules on the right. The pinnules are twisted so as to show both the narrow edges and the flat faces of the pinnulars at different points along the pinnules. The first brachial and several closely appressed pinnules belonging to the right anterior arm occupy the position indicated by B, but can not be distinguished in the figure here presented. Cover-plates may be seen along the right margin of the pinnulars marked D, and along the corresponding margin of several pinnulars marked C in the figure. The position of the anal pyramid and the smooth border of the surrounding thecal plates is indicated at A. The surface of the thecal plates is strongly weathered, except at the center, and indicates clearly the parallel arrangement of all folds and pores of the mesostereom: these are perpendicular to the same edge of the plates; consequently those groups which are perpendicular to different edges form angles with each other along the imaginary lines drawn from the center of the plates to the angles of the latter. The passages of the folds and pores perpendicularly across the sutures from plate to plate, in an apparently continuous manner, also is indicated. For the remainder of the specimen, see the figure presented by Billings. Figure based on photograph supplied by courtesy of the chief photographer of the Geological Survey of Canada. The original specimen is numbered 1391 in the collection of the Survey deposited in the Victoria Memorial Museum, at Ottawa.

NEW SPHÆRIIDÆ.

Dr. Victor Sterki has recently published in the Annals of the Carnegie Museum (Vol. X, Nos. 3 and 4, pp. 429-474), a preliminary catalogue of the Sphæriidæ of North America. The small bivalves of this family are remarkably abundant in the vicinity of Ottawa, and constitute no small part of the food of many fishes and birds. The whole of the material submitted to Dr. Sterki has not yet been thoroughly studied, and what was collected in 1915 and 1916 has not yet been submitted to him. Most of the shells are minute in size, and alike in colour, and for these and other reasons their determination is attended with great difficulty, and, not infrequently, with doubt. The trained eye of Dr. Sterki, and his keen mental apprehension of slight differences, have in my opinion, rendered him capable of accomplishing a task before which other have "backward shrank appalled." While the result of his labors, as published, are modestly stated to be tentative and preliminary, they undoubtedly constitute one of the most valuable contributions made in recent years to the study of our inland mollusca. Several of the species and varieties now described for the first time are from the vicinity of Ottawa, and may be of interest to members of the Field-Naturalists' Club, who wish to spend a little of their leisure riding a delightful if neglected hobby. An hour or two devoted to any elementary work on zoology, dealing—as nearly all do—with the mollusca, will enable any intelligent student to understand Dr. Sterki's descriptions which will then be found to be full, clear and distinctive, though necessarily technical.

The shells themselves occur in every stream around the city. A kitchen bowl-strainer, of coarse mesh—procurable at a cost of a few cents—makes an excellent dredge for the larger species. In the shallows on the right bank of the Rideau Canal, above the by-wash at Hartwell's Locks, hundreds of fine specimens, mainly *Musculium transversum*, may be collected in a few minutes; and this and other species may be found without a dredge by turning over small boulders in the Rideau River, in the rapids near Billings' Bridge. Every depression in which water gathers in our deciduous woods contains the beautiful little *Sphaerium occidentale*, a species capable of living through long periods of drought; and in late summer the northern shores of Duck Island, just at the water's edge, are littered with myriads of small bivalves, mainly a variety of *Sphaerium striatinum*, or, perhaps, a species as yet undescribed. More and more material is required. It is with the hope of stimulating interest, and in order to render accessible to members of the Club descriptions not otherwise readily available that, with Dr. Sterki's permission, the following extracts are reprinted from his catalogue:—

21. MUSCULIUM ROSACEUM FULIGIOSUM var. nov.

Mussel small, rather short, subequipartite, moderately inflated, somewhat "pinched" along the margin; beaks nearly in the middle, narrow, somewhat prominent, calyculate; superior margin angular at the beaks, its anterior and posterior parts straight or nearly so, equally sloping; supero-anterior and posterior slopes, or truncations, well marked, nearly straight, the posterior longer and steeper, nearly at right angle with the longitudinal axis, anterior and posterior ends rounded; inferior margin moderately curved; surface shining and with a silky gloss derived from very narrow, membranous, scaly projections of the periostracum on the fine concentric striæ; shell very thin, glassy transparent, with a marked grayish or smoky hue.

The largest specimen measures: Long. 7; alt. 6; diam. 3.8 mm.

The mussel is striking in appearance, and at first sight seems to be distinct, especially since all specimens are remarkably uniform, but young and adolescent individuals reveal features of other forms of *M. rosaceum*.

Habitat.—Scott Graham Creek, Carleton County, Ontario, collected by Mr. Justice Latchford, 1911 and 1913. Specimens are contained in his collection and in the Carnegie Museum, Nos. 6,945 and 7,431. Justice Latchford writes in November, 1913: "No. 2,925 is quite common. I have visited the creek at all seasons and never found any larger shells than those which I send; I therefore regard them—the larger ones—as full-grown."

[The creek referred to flows eastward through Britannia Highlands, about four miles west of the city limits. Near the Shouldice farm it affords remarkably large and beautiful specimens of *Sphaerium sulcatum*.]

13. SPHÆRIUM TORSUM sp. nov.

Mussel inequipartite, oblique, well inflated, posterior part higher, and much more voluminous than the anterior; dorsoventral axis curved and oblique; beaks strongly inclined forward, large, prominent, rounded, not, or slightly, mamillar; superior margin curved, not, or barely, bounded by angles; scutum and scutellum well marked; anterior and posterior ends rounded, inferior margin moderately curved; surface with fine, slight, irregular or subregular concentric striæ and a few lines of growth, shining; yellow, straw-colored in younger specimens; shell moderately strong; hinge long for the shape and size of the mussel, almost regularly curved, rather slight; cardinal teeth small, the left posterior tooth vestigial in some specimens; laminæ rather slight, at almost a right angle to each other; ligament covered, resilium moderately strong. Soft parts not examined. Long. 11 mm.; alt. 9 mm.; diam. 7 mm. (100 : 83 : 64.)

S. torsum appears to range near *emarginatum* of the same region, but is more oblique, of more rounded outlines, more evenly inflated. The beaks are less elevated, less mamillar, and more inclined forward. and the hinge is much slighter.

Habitat.—Quebec, Ontario, along the Ottawa River, near Hull and Ottawa, collected by Justice Latchford, 1911 and 1912. Types in the collection of Mr. Latchford, and No. 6956 for full-grown, and 7286 for young and adolescent specimens. It occurs also in Wisconsin

Fossil.—Goat Island, Niagara, collected by Miss J. E. Letson 1900 (No. 2224a).

[Moore's Creek, on the Aylmer Road, north of the road, affords large numbers of this species.]

32. PISIDIUM LATCHFORDI sp. nov.

Mussell small, inequipartite, oblique, nearly oval in lateral aspect, well inflated; beaks somewhat posterior, rather large, prominent, rounded; superior margin curved, supero-anterior slope slightly marked, short, anterior end rounded, well below the longitudinal axis; posterior part short, subtruncate, or rounded; surface slightly glossy, with very fine and slight microscopic striæ, colorless to whitish, shell translucent to opaque; hinge rather long, curved angular, stout, plate rather broad, short; right cardinal tooth well curved, not much projecting, its posterior end not or but little thicker; between it and the somewhat projecting lower edge of the plate there is an elongate-triangular excavation for the left anterior, well defined all around; left anterior set rather well up on the plate, small, posterior oblique, curved; laminæ rather massive, with their surfaces rugose, the anterior and posterior at right angles to each other; cusps of the left ones pointed, with the proximal and distal slopes steep and almost equal, those of the right inner less pointed, outer anterior about one-third the length of the inner, posterior short and small; ligament short, resilium stout.

Measurements.—Long. 2.6; alt. 2.4; diam. 1.9 mm. (100 : 93 : 73).

Habitat.—Ontario, apparently rare. Collected in 1913 by Hon. Justice Latchford, in whose honour the species is named. It occurs in Scott Graham Creek, Graham Bay Creek, and Hare's Spring, all in Carleton County, Ontario. Specimens are in the collection of Justice Latchford and in the Carnegie Museum, Nos. 7,439 and 7,475. Only a rather small number of specimens are at hand, but markedly uniform, and different from all other described species. Their shape, the formation of the hinge, and the stout, short ligament and resilium place them in a group with *P. aequilaterale, fraudulentum,* etc.

["Hare's Spring" is on the Hare farm, Nepean, near the Watson line, about five hundred yards south of the Richmond Road.]

80. PISIDIUM SUBROTUNDUM CANADENSE var. nov.

Mussel larger. Long. 5.5; alt. 4.6; diam. 3.4 mm. More oblique; beaks more posterior; upper margin markedly straight, slightly alate in front of the beaks and bounded by an agle. In shape they somewhat resemble *P. ovum* from Montana, but are less inflated, and the hinges are different. Some specimens in the same lot have the beaks narrower, and are more markedly different from *P. subrotundum.*

Habitat.—Hare's Spring, Carleton County, Ontario, collected in considerable numbers by Justice Latchford. Represented in his collection, and in the Carnegie Museum, No. 7,437. May be distinct.

84. PISIDIUM VEXUM sp. nov.

Mussel small, slightly inequipartite and oblique, rather well inflated; beaks slightly posterior, rather broad, more or less flattened on top, moderately prominent, descending abruptly towards the posterior part; superior margin nearly straight, bounded by angles, posterior margin subtruncate or rounded, passing into the moderately curved inferior without an angle, anterior end rather broadly rounded, supero-anterior slope marked, nearly straight; surface dullish to somewhat shining, with very fine and slight subregular striæ. Shell thin, translucent to transparent, colorless; hinge rather slight, but well formed, moderately long, plate rather narrow; cardinal teeth rather long, the right curved to nearly straight in its middle, its posterior end thicker and grooved to bifid, left anterior more curved (in plane), not much bent upward, posterior long, nearly straight and a little oblique: laminæ; right anterior inner rather long, its cusp nearer the cardinal; outer short; posterior both short; left: both with the cusps rather abrupt, pointed; ligament short, resilium rather stout.

Measurements.—(Specimen from Ontario) Long. 2.5; alt. 2.1; diam. 1.5 mm. (100 : 84 : 60). (Specimen from Massachusetts) Long. 3; alt. 2.5; diam. 2.1 mm. (100 : 83 : 70).

P. vexum is somewhat like *P. inornatum* in size and shape, but more inflated; the shell and hinge are slighter, and the depressed beaks distinguish it.

Habitat.—Lake Gorman, Renfrew County, Ontario, collected by Justice Latchford, August 29, 1913. Types are in Justice Latchford's collection and in the Carnegie Museum, No. 7455. One specimen, somewhat larger, was collected in Hounds Ditch, Duxbury, Massachusetts, by Mr. William F. Clapp in 1913.

F. R. L.

THE SHARP-SHINNED HAWK.

By W. J. Brown, Westmount, Que.

Acquaintanceship with the Sharp-shinned Hawk (*Accipiter velox*) occurred twelve years ago, in April, in second growth woods. Here we discovered a specimen, under a cedar tree, devouring a small bird. A friend in parting the branches was rather surprised and startled. Sudden impulse, and visions of a Woodcock's nest, prompted further investigation, but the bird was equally alarmed and left the brush spasmodically. Previous to this, and for some time afterwords, I had entertained confused and mixed ideas as to the status and habits of this species. On May 24, 1908, I noticed a male flying in a jerky fashion through a small area of tamarack woods. At that time it did not occur to me to look for the nest, but the following year I investigated this locality with a friend and we found the nest, with five eggs, in a small tamarack. After watching the actions of the female about the nest I decided at once to learn more about these interesting birds. During the next two weeks I came in contact with two more nests, one in a black spruce and the other in a balsam, all three sets, of five eggs each, varying greatly in size and coloration.

At this period of my investigations I looked upon the Sharp-shinned Hawk as rare in the Province of Quebec. Subsequent research, however, has developed the fact that the bird is one of our most abundant raptores and is much more common that was formerly supposed. Any zealous ornithologist could probably locate two dozen nests in a season, but it is by no means an easy task to cultivate the bird's acquaintance at any time. Shyness is one of the hawk's peculiarities, to say nothing of it's retiring habits, especially in the nesting season. The bird is seldom seen during the period of incubation, except when the nest is in danger. If the male bird is present at this time the flicker-like alarm notes are a sure indication that a nest is close by. Experience (I use this term with calm deliberation) has driven me to the conclusion that the male bird is seldom at home while the female is incubating, but is off on some foraging expedition, —in many instances miles from the nest tree. Having become quite familiar with the breeding haunts of this species and meeting casually with the male in the open country, I have been able to form some estimate of the erratic movements of the smaller parent in the nesting season. Looking for sharp-shinned hawks' nests is tedious work, especially in black spruce bogs of any size, but this is the only satisfactory method of meeting the birds.

The early stragglers appear during the first week in April, but migration depends largely on the season. Some pairs start domestic duties early, as nests have been built by the end of April and contained full sets by May 8. The young have been hatched in the first days of June, but these, of course, are exceptional records. The eggs are usually laid by May 24, and the young are out of the shell about three weeks later. The number of eggs laid is three to six, usually four or five. They are richly marked, and there is an endless variety in a large series of sets.

Unfortunately the sharp-shinned hawk makes heavy raids on our song birds, the white-throated sparrow, chickadee and the warblers being the principal sufferers. I notice that the bird selects a mossy stump or squirrel's nest as a perch for plucking it's victims. Again and again I have stumbled across masses of bird feathers adhering to moss on the ground and on stumps in evergreen woods. Occasionally the hawk loses a feather or two in it's wild flight. These are all telltale signs that a pair of these destructive birds are tenants in the wood, and a thorough search always reveals the nest. Where a family has been raised the woods are almost stripped bare of song birds. The majority of nests have been found in black spruce trees, a few in balsam and an occasional one in hemlock, cedar and pine. The height varies from ten to sixty feet from the ground against the base on horizontal branches. The nest does not resemble the bulky structure of the crow as some authorities aver, but is easily distinguishable from the latter by the shallow platform of interlaced spruce twigs. A large number of nests have been built over old foundations, but as a general rule the bird constructs a new nest each season. The usual nest of this hawk is a frail affair of twigs and is sometimes lined with flakes of bark. The tree chosen is on the outskirts of the woods, or at the edge of any clearing or opening in the middle of the woods. A favorite location of the nest is in a thick clump of spruce near a clearing. Any large area of black spruce usually contains a pair of sharp-shins. The bird is generally a close sitter and only a well aimed stick or stub will dislodge her.

There is a certain amount of individuality in this species. Some birds are very quiet after being flushed off the nest, the alarm notes even being absent, while others are very lively and noisy and will return immediately to attack. One pair would not permit packing of the eggs under the nest, but would dart to the ground and almost fly in my face. Some pairs return to the same woods year after year even after bing disturbed. Others may raise their young in a woods, but it does not necessarily follow that the birds will occupy the same locality the next season. Should the first set be taken, the birds have been known to lay a second one in the same nest, or depart a short distance away and start operations afresh, but this is not the rule; the pair generally leave the woods.

The sharp-shinned hawk has two distinct alarm notes when the nest is approached, the usual cackling call in the earlier stages of the nesting season and a series of squealing notes, not unlike those of the grouse, after the young are hatched, alternating from one call to the other when the young are well grown.

En passant, it has occurred to me to point out the characteristics of a pair of hawks which I have kept under observation for a few years.

In the fall of 1912, while exploring some mixed small growth of timber encroaching on a spruce bog, I noticed seven or eight nests of the sharp-shinned hawk placed at low elevations, ten to fifteen feet in height, in black spruce saplings. These were all within a radius of fifty yards and apparently the work of one pair of birds.

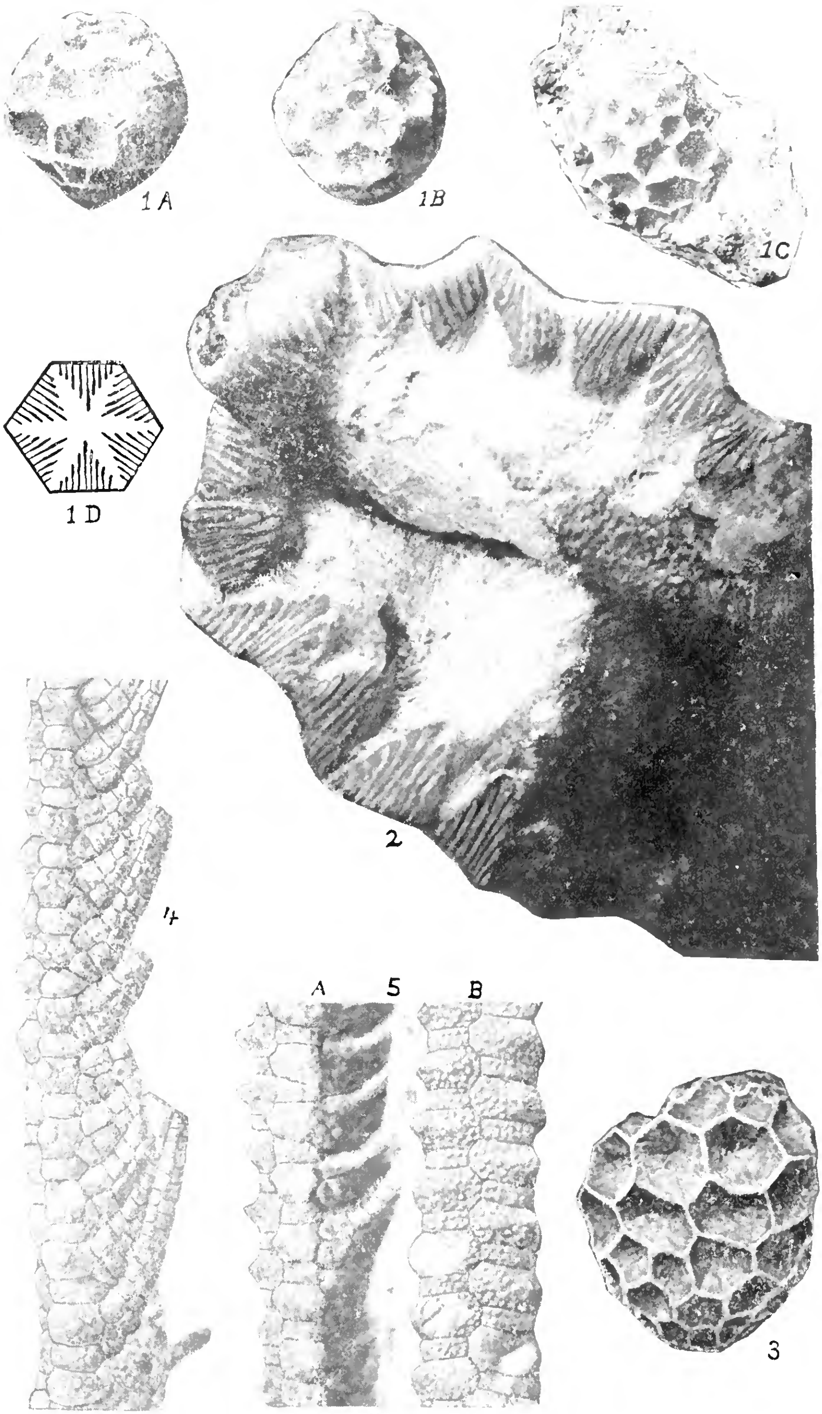
On May 24, 1913, I visited this wood again and rapped all spruces containing these small nests . There were no signs of occupancy about the nests and it was quite apparent that no bird was on any of them. No hawk was seen in the neighborhood, nor was one heard, so the trees were not climbed. Four weeks later, on June 22, I passed through this group of nests and was amazed to see a sharp-shinned hawk leaving one of the identical nests I had previously pounded. In a minute I was gazing at five young sharp-shins in white down, probably only a few days old. The female flew in wide circles around the nest, but was peaceful and silent. On my first visit the bird had, no doubt, left the nest on my approach.

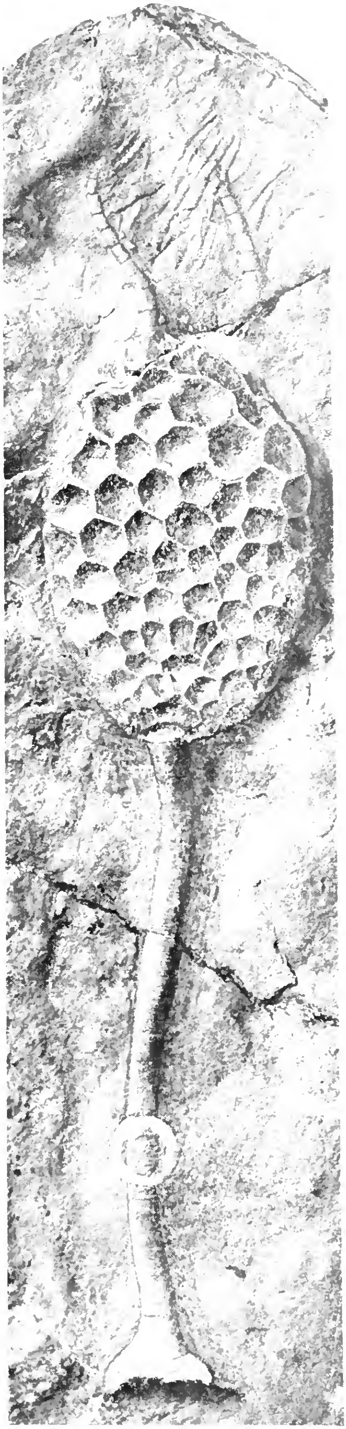
On May 29, 1914, Mr. L. M. Terrill and I purposely set out to gather additional information as to this secretive pair of hawks. On the way we decided not to leave anything to hazard, but to climb to all the nests and examine them carefully. The wood was quiet and no birds were in sight. My friend started to ascend one nest and pointed out another a few yards away. The nest looked old and shabby and I held out little hope, but it's easy accessibility prompted inspection. When on a level with the nest I was surprised to see a set of five eggs. My friend evidently noted my amazement, but all he said was: "Come down and let me have a look at them." About half an hour later we were returning through the same bush and were successful in catching the female slipping quietly off the empty nest. She was very shy and disappeared, and had evidently left the nest when we first entered the woods. The male was not seen. This bird is an early breeder, as the eggs were about ten days incubated.

On May 22, 1915, I moved cautiously through this woods, as I desired to observe this hawk on the nest. I noted the down of the hawk clinging to the branches of trees and knew that the pair were again in their old haunts. Twenty yards away I saw a new nest, the rim of which was covered with down and feathers. Looking more closely through the thick shrubbery I saw the hawk gliding furtively off the nest. She disappeared amongst the dense growth without making a sound. This nest was similar to the others, both as to height and construction, and the five eggs were marked like the first set. I remained in the locality for some time, but neither the male nor female returned.

On May 23, 1916, I learned that the pair had changed their quarters, but I decided to look for them in some familiar spruce woods a mile off. In four hours I discovered a small nest about thirty-five feet up in a black spruce at the extreme edge of the woods near a path. After throwing several sticks into the tree a sharp-shinned hawk bolted off and disappeared immediately into the woods and did not return whilè I was around. The male, as usual, was conspicuous by being absent. I had located the same pair once more, as the eggs are very much like those taken in the other woods and the actions of the bird were the same. The only departure was the size of the tree and the height of the nest.

It is strange, and at the same time interesting, that the male has not been seen, and that the female has shown persistent lack in vocal effort in the nesting season.


1A
1B
1C
1D
2
4
A 5 B
3



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COMAROCYSTITES AND CARYOCRINITES.

Cystids with Pinnuliferous Free Arms.

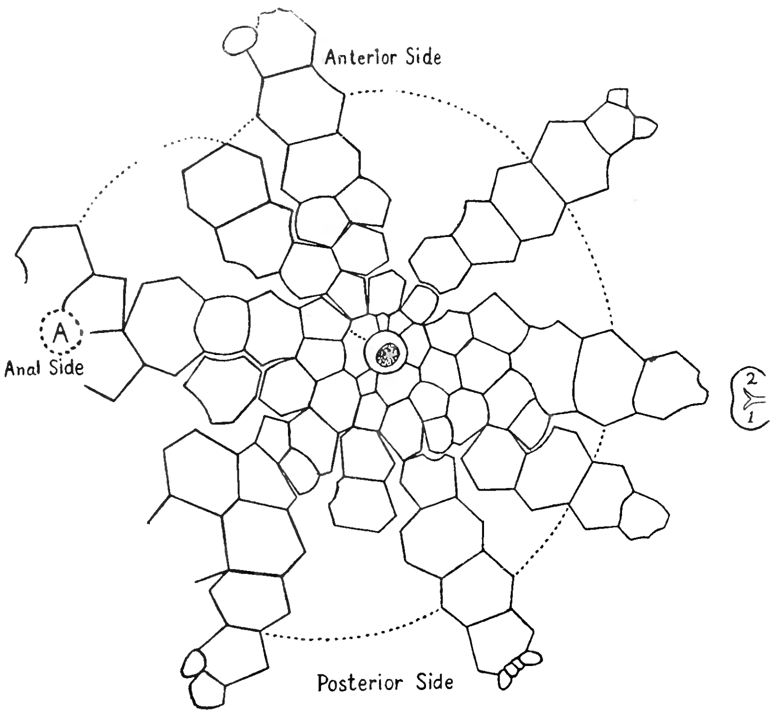
By A. F. Foerste, Dayton, Ohio.

(Continued from page 93.)

Detailed Description of Comarocystites shumardi, Meek and Worthen.

21. *Comarocystites shumardi*, (Figures 1A, B, C, on plate IV) differs from *Comarocystites punctatus* chiefly in the more deeply and more angularly concave thecal plates. These features are well shown by the type specimen illustrated by figures 1A, and 1B on plate I in volume III of the Geological Survey of Illinois. In plates eight to ten millimeters in width the depth of the concavity usually is about three millimeters, in one case equalling four millimeters. From the center of the concavity the inversely pyramidal flattened walls of the concavity slope upward and outward; along lines leading from the center to the angles of these concavities, the flattened walls are separated by more or less distinct narrow grooves, giving the exterior surface of each thecal plate a stellately indented appearance (Fig. 1C). The number of thecal plates in the type specimen probably was somewhere between 65 and 70. The general shape of the theca is shorter and more globose-obovate than in *Comarocystites punctatus*. The line of demarcation between the basal plates is indistinctly defined, but these plates probably numbered more than three.

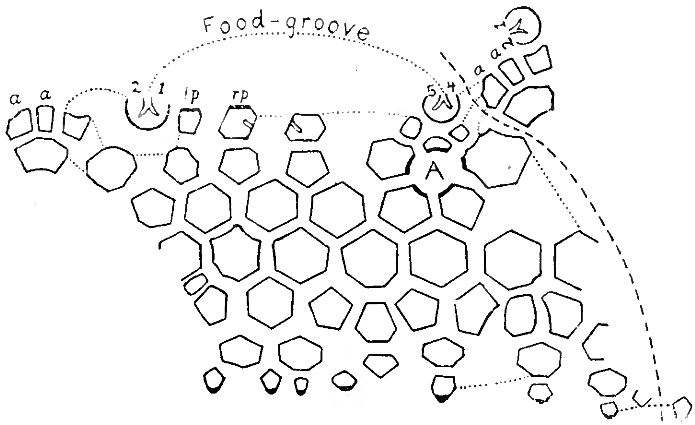
In his original description of *Comarocystites punctatus* (Canadian Journal, 2, 1854, p. 268) Billings stated that "upon the upper joint of the column stand three low but broad pentagonal plates, with serrated edges above. These form a narrow circular pelvis, and are so closely united at their sides that it is difficult to detect the lines of division between them." It probably was the attempt to make their type specimen agree with the description of *Comarocystites punctatus* given by Billings which lead Meek and Worthen to diagram *Comarocystites shumardi* as having three basal plates. (Geol. Surv. Illinois, 3, p. 292). At the time this diagram was prepared a part of the plates of the type specimen of the latter species still were covered by the matrix. Recently the writer removed this matrix and a new diagram has been prepared (Text diagram, No. 4).



Text figure No. 4. Diagram of the thecal plates of the type specimen of Comarocystites shumardi, replacing the diagram published by Meek and Worthen in the report of the Geological Survey of Illinois, volume III, page 292. In order to compare this diagram with that in the Illinois report, the page should be turned so that the part marked anal side forms the bottom of the figure. Additional plates have been exposed recently by removing the matrix. The position of the nodular stereom protuberance supporting the left pair of arms is indicated at 1, 2. The approximate location of the anal pyramid is indicated by A. The apical part of the theca surrounding the right pair of arms, as far down as the plates bordering on the lower side of the anal opening, is missing. The diagram is not intended to suggest any radiate structure in the arrangement of the thecal plates. It is intended, however, to suggest the presence of more than three plates in the basal series, although the evidence in the particular specimen here diagrammed is obscure.

The height of the type specimen equals 39 millimeters, the lateral diameter is 34 millimeters, and the diameter from front to rear is 30 millimeters. The top of the column at its junction with the theca was 6 millimeters in diameter. The left half of the apical transverse food-groove, with its bifurcation on the proximal side of the stereom mass supporting the left pair of arms is distinctly shown, but the right half and all adjacent parts, including the anal area, are missing. Both the apical area, as far as preserved, and the basal series of thecal plates appear compressed in a vertical direction, and there is no reason, judging from other specimens, for believing that the horizontal position of these basal plates is a specific characteristic.

Most of the specimens of *Comarocystites shumardi* so far seen exceed 25 millimeters only slightly in length. In thecal plates 6 millimeters in width, the depth of the concavity may equal 1.7 millimeters. At the bottom of the concavity there frequently is found a circular flattened or slightly convex area, about three-fourths of a millimeter in diameter.



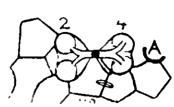
Text figure No. 5. Diagram of the thecal plates of the specimen represented by figures 1A, 1B, on plate IV. The plates on the right side of the vertical sinuous dotted line on the right side of the diagram duplicate some of the plates at the extreme left of the diagram. The anterior peristomial plates are lettered a, a; the right and left posterior peristomial plates are lettered rp and lp respectively. From plate rp the linear hydropore extends diagonally downward and toward the right toward the middle of the next plate. The relative position of the four arms is indicated by the numbers 2, 1, 5, 4. The location of the anus is indicated by the letter A. The basal plates in actual contact with the top of the column, seven in number, are heavily margined at the bottom. Several of the thecal plates on the left side of the specimen are missing.

In the specimen in the Chicago University Museum, illustrated by figures 1A and 1B on plate IV, the area surrounding the anus is distinctly flattened, the area facing diagonally upward, thus producing a strongly angular outline a short distance above mid-height on the right side of the the theca. The arrangement of the thecal plates on this specimen is indicated by diagram No. 5. A part of the thecal plates are missing, the specimen being imperfect, but all of the basal plates are preserved, and, of these, seven appear to be in direct contact with the top of the column. These are indicated in the diagram by the heavy basal margin.

In most other respects, than those cited above, *Comarocystites shumardi* closely resembles *Comarocystites punctatus*. The transverse apical food-groove (Figures 1 A, B, C, and diagram No. 6) branches at each end dichotomously, along the adoral side of the nodular stereom protuberance which supports the right or left pair of arms. Only the facets for the attachment of these arms are preserved, the arms themselves not being retained in any specimen at hand.

The mouth or entrance into the theca consists of a small opening located at mid-length along the transverse apical food-groove, at the proximal end of the suture between plates *a*, *a*, in the diagram. The food-groove is covered by a double series of covering-plates. Two peristomial plates typically are in contact with the posterior margin of the transverse apical food groove, and of these the right peristomial plate is distinctly the larger (Diagram No. 5). From the center of the latter, the linear hydropore ridge (Figure 1C on plate IV, also diagrams 5 and 6) extends diagonally downward and toward the right, toward the center of the plate adjoining it on that side. One specimen shows a minute pore immediately beyond the upper left hand end of the hydropore ridge. There is no evidence of this being a constant feature.

The anal pyramid is not preserved in any specimen at hand, but the circular opening into which this pyramid fitted (Figure 1B on plate IV) is preserved in several specimens, and this shows a diameter of 3 millimeters in a specimen 25 millimeters in height. This circular opening is surrounded by five thecal plates occupying the same position as in *Comarocystites punctatus*.



Text figure No. 6. Diagram of a few of the thecal plates at the apical end of the specimen represented by figure 1C on plate IV; the numbering and lettering as in text figure No. 4. The transverse apical food groove, branching at each end, where the facets of the two pairs of arms are located, the location of the mouth, the anus, and the linear hydropore also are indicated. Special attention is called to the monopolizing of the space posterior to the transverse food-groove by the plate marked rp. In other specimens there is room for smaller plates on the left.

In one specimen (Diagram No. 6) showing the transverse apical food-groove very well, the posterior margin of this food-groove appears occupied exclusively by the plate marked *rp* in the diagram. The stereom protuberances, supporting the arm pairs, appear to rest upon the margins of the adjacent thecal plates. These stereom protuberances appear to be deposits made by the bases of the arms at the ends of the transverse apical food-groove, and not to be a part of the thecal plate system. The peristomial plates, on the contrary, are ordinary thecal plates. Judging from the presence of small plates along the margin of the stereom protuberances in some specimens, and their absence in others, these small plates may be additions during the later stages of growth of the individual.

In *Comarocystites punctatus* the number of thecal plates in a vertical series often numbers 9 or 10; in *Comarocystites shumardi* this number usually is only 6 or 7. The theca grows in size chiefly by growth at the margin of the individual thecal plates. It is quite evident from the absence of small intercalated plates in some of the specimens at least that the enlargement in growth does not depend upon the introduction of intercalated plates within the general body of the theca, although it is not impossible that additional plates, during earlier stages of growth, may be added at the base. The evidence in favor of such a suggestion is not very clear and consists chiefly in the presence, at the base, of plates of small size inserted between those of larger size.

22. *The so-called variety obconicus.*—Meek and Worthen probably were in error in attempting to distinguish a variety *obconicus,* as distinct from *Comarocystites shumardi.* Close examination of the type specimen (Figure 2a, on plate 1, Geol. Surv. Illinois, vol. III) fails to show any distinguishing features excepting that presented by the more attenuate base. As a matter of fact, however, there is no evidence that this attenuate base is anything more than an individual characteristic. The second specimen figured by Meek and Worthen under the variety name *obconicus* (Figure 2b, on plate 1, of the Illinois report cited above) does not differ in any respect from ordinary specimens of *Comarocystites shumardi,* and certainly does not possess an obconical base. The first specimen presents clear evidence of the division of the mesostereom into vertical plates, shorter toward the angles of the plates, and separated by very narrow interspaces. The column has a width of 2.8 millimeters, and 17 columnals of about equal size occur in a length of 5 millimeters. The surface of the column is minutely granulate, as in *Comarocystites punctatus.* The second specimen does not differ in any respect from small specimens of *Comarocystites shumardi.* Only the left half of the theca is exposed but this half includes all, from the base to the stereom protuberance supporting the left pair of arms. Even the forking of the left end of

the transverse apical food-groove, on the adoral side of the protuberance, and traces of the facets for the attachment of the arms are preserved. The presence of vertical plates belonging to the mesostereom is seen along the strongly weathered sutures between the plates. Several of the plates present very clear evidence of the arrangement of the pores, through the continuous exterior surface of the mesostereom, in pairs, and directly beneath the epistereom these pores evidently are elongated in a direction parallel to the narrow spaces between the mesostereom plates beneath.

23. *The structure of the thecal plates.*—A fuller knowledge of the plate structure of *Comarocystites shumardi* is presented by the specimens belonging to the Walker Museum, at Chicago University, and by the specimens belonging to the Illinois State Museum of Natural History (Plate IV, figure 3). The structure evidently is identical with that of *Comarocystites punctatus.* There is the same grouping of pores traversing the mesostereom. The thin epistereom is non-porous, but when weathered away the outer terminations of the pores traversing the mesostereom are seen to be arranged in more or less alternating pairs. Directly beneath the epistereom, each of these pores is connected with a semi-lunate pore parallel to the outer surface of the plate, the concave sides of each of the semi-lunate pores. belonging to the same pair, facing each other. As in *Comarocystites punctatus,* some specimens show no indication of the presence of these pairs of semi-lunate pores on their exterior surfaces; in others, their presence is indicated by low, short, semi-lunate ridges. The mesostereom consists chiefly of more or less vertical plates, from 6 to 9 in a width of 3 millimeters, intercepted by much narrower spaces apparently connected directly with the interior of the theca without the intervention of a hypostereom. Directly beneath the epistereom, however, the mesostereom forms a continuous sheet penetrated only by the pores connecting the narrow spaces between the vertical mesostereom plates with the semi-lunate pores immediately beneath the epistereom. The thecal plates appear to have grown from the margin outward, so that the pores originating at the sutures later were located in the more central parts of the plates.

24. *Horizon and Distribution of Comarocystites shumardi.*—From the preceding statements it is evident that *Comarocystites shumardi* is a typical representative of the genus *Comarocystites.* The so-called variety *obconicus* is founded, it is believed, upon individual characteristics, and the name should not be retained, even as the name of a variety.

Both *Comarocystites shumardi* and its so-called variety *obconicus* were described from the Kimmswick limestone at Cape Girardeau, Missouri. By Ulrich, this Kimmswick limestone is placed at the top of the Black river group beneath the Curdsville horizon at the base of the Trenton, while Bassler cites *Comarocystites punctatus* from the Curdsville at Ottawa, in Ontario, Canada. From this it is evident that Bassler correlates at least the lower Trenton horizons at Ottawa with the Curdsville of central Kentucky. The two horizons at which *Comarocystites* occurs, even if referred to different groups, evidently are not far removed from each other.

25. *Literature on Comarocystites shumardi and obconicus.*

Comarocystites shumardi, Meek and Worthen.

Meek and Worthen, Proc. Acad. Nat. Sci., Philadelphia, 1865, p. 143. Geol. Surv. Illinois, 3, 1868, p. 292, fig.; pl. 1, figs. 1a, b.

The diagram on page 292 is so drawn as to suggest the presence of only three basal plates: in the preparation of this diagram the authors probably were influenced by the original description of *Comarocystites punctatus* (Canadian Journal, 2. 1854. p. 268) in which Billings states that "upon the upper joint of the column stand three low but broad pentagonal plates, with serrated edges above." As a matter of fact. however, these serrated edges suggest the presence of more than three basal plates, although the sutures separating these plates are not clearly defined in the type specimen diagrammed. A line drawn vertically through the center of the diagram would be parallel to the transverse apical food-groove of the specimen, the plates on the left side of the theca being indicated at the top of the diagram, and those on the anal side, at the bottom of the diagram. At the time the diagram was prepared, the upper part of the left side of the theca was concealed by the matrix. Traces of the transverse apical food-groove, bifurcating at the end, were present on the left side of the top of the theca, but were not recognized by the authors. The specimen has been cleaned by the present writer and redrawn for this paper. (Text diagram No. 6). Figure 1a on plate 1 is oriented exactly opposite to the diagram, the anal side facing the top of the figure and the left side facing the bottom. Figure 1b presents the right or anal side of the specimen: the parts immediately surrounding the anal pyramid and all of the upper left hand part of the theca is missing, the extreme top of the figure representing the broken edges of that part of the theca which is beyond the break.

Keyes, Missouri Geol. Surv., 4, 1894, p. 132, pl. 18, fig. 2, Figure 2 presents the basal view of the theca, copied from the Illinois report.

Jaekel, Zeitsch, d. deutsch. geol. Gesellsch.· 52, 1900, p. 676·

Comarocystites obconicus, Meek and Worthen.

Meek and Worthen, Proc. Acad. Nat. Sci., Philadelphia, 1865, p. 144. Geol. Surv., Illinois, 3, 1868, p. 294· pl. 1, figs. 2a, b

The total length of the theca of the specimen represented by figure 2a probably did not exceed 20 millimeters. The appearance of the figure suggests that the plates on the left side of the theca were of enormous thickness, compared with their width. This appearance is due, however, to the growth of calcite in the interior of the theca, the actual thickness of the plates thus represented varying from about 1.5 millimeters, towards the bottom· to almost 2 millimeters at the top of the theca. Figure 2b represents the left side of another specimen with the stereom protuberance, formerly supporting the left pair of arms, at the top.

Keyes, Missouri Geol. Surv·, 1, 1894· p. 132, pl. 18. fig. 1. Figure 1 is a republication of figure 2a of the Illinois report.

26. *The zoological position of Comarocystites.*—In 1896, Haeckel separated from the remaining *Cystidea* those forms in which no radial branching of the food-groove system, either trimerous or pseudo-pentamerous, can be detected spreading over the upper surface of the theca. These forms he distinguished as a co-ordinate group under the name *Amphoridea*. Among the *Amphoridea* were placed not only the asymmetric and bisymmetric forms but also those in which the arms branch off radially from the top of the theca, without, however, being attached dorsally, for at least a part of their length, to the upper surface of the theca. To these *Amphoridea* with radially arranged arms he applied the term *Palaeocystida*, and evidently regarded them as ancestral to the *true Cystidea*· especially to the *Glyptocystidae*. Among these *Palaeocystida*, he placed the genus *Comarocystites*.

Bather (Echinoderma, 1900) retained the group *Amphoridea*, but as one of the subdivision of the *Cystidea,* characterized by the absence of radial symmetry in both food-grooves and thecal plates· *Comarocystites,* however· is referred by him to the *Rhombifera*. In the *Rhombifera,* as defined by Bather, radial symmetry affects the food-grooves, and the stereom and stroma are arranged in folds and strands at right angles to the sutures between the thecal plates. In order to bring *Comarocystites* in line with pseudo-pentamerous *Rhombifera*, the former presence of an anterior ray of the food-groove system is imagined.

Jaekel, in 1900, separated from the *Cystidea*, under the name *Carpoidea*, a considerable number of the genera included by Haeckel in his *Amphoridea*, adding also the genera *Malocystites*, *Canadocystites*, and *Amygdalocystites*, included by Haeckel under his *Cystidea*, in the restricted sense. The chief characteristics of the *Carpoidea* were supposed to be: a loose relation of the ambulacral organs to the theca, leaving only slight traces on the latter; theca never pentamerous, often distorted, usually compressed dorso-ventrally, more or less symmetrical toward the right and left; ambulacra extending into two radii; the brachials bearing the ambulacral grooves uniserial as far as known; base tetramerous or trimerous Those *Carpoidea* possessing biserial columnals Jaekel placed in the subdivision *Heterostelea*, and those possessing a single series of ring-shaped columnals he placed in the subdivision *Eustelea*. The *Eustelea* included *Malocystites*, *Canadocystitis*, *Amygdalocystites*, and *Comarocystites*.

It must be acknowledged that the four genera here listed form a very coherent group in which trimerism or pseudo-pentamerism seems never to have prevailed. Under Bather's term, *Malocystidae*, this group has been placed among the *Amphoridea* in the more recent editions of Zittel. The relationship between *Canadocystis*, *Amygdalocystis*, and *Comarocystites* appears especially close. All of these forms are bisymmetric with the main apical food-groove extending laterally from the mouth, the anal pyramid being on the right side of the theca. Both the brachials and pinnulars are arranged in uniserial order. When the arms are oriented so that the ventral side faces away from the observer and the distal side of the arm points upward, then, in all three genera, the pinnules are seen to form a single row on the right side of the arms. In *Comarocystites* the arms are free. In *Amygdalocystites* and *Canadocystis* the arms are twisted in contrasolar direction and are attached by their left sides to the theca, leaving the right side free for the pinnules.

In the structure of their thecal plates, however, all three genera differ greatly. In *Comarocystites*, the vertical plates of the mesostereom, as exposed on the inner side of the theca, suggest strongly the plates characterizing the pectinirhombs of the *Rhombifera*, although the spaces between these plates do not open at the top in slit-like pores, as in true pectinirhombs. In *Amygdalocystites*, the inner surface of the thecal plates is marked by radial ridges, which in some specimens are sufficiently defined to be called short plates. One radial ridge always extends to each of the angles of the plate, and in some specimens another ridge extends to the middle point of each side. In some specimens pores exist along the sutures between the plates, either a single pore at the middle of each side, or two pores along each side, close to the radial ridges extending to the angles of the plate. Half of each pore occurs on half of each of the adjoining plates. It has not been proved, however, that these pores are open in unweathered specimens. They may be covered by the epistereom, as in the case of the pores of *Comarocystites.* In *Canadocystites,* neither pores nor vertical mesostereom lamellae are present. This difference in plate structure in the three genera is remarkable in view of the close relationship suggested by the structure of the food-groove system. Owing to the entire absence of true pectinirhombs, notwithstanding the suggestive structure of the thecal plates of *Comarocystites,* the separation of these three genera from the *Rhombifera* seems desirable. Regarding *Malocystites,* which appears related to *Canadocystis,* too little is known at present. The recumbent food-grooves extend over the upper surface of quadrangular plates arranged in uniserial order, but it is not known whether the pinnules were attached in a single row, and whether the pinnulars were arranged in uniserial order or not.

V.—ADDENDA.

27. *Notes on Caryocrinites ornatus* Say.—In *Caryocrinites ornatus* both the brachials and pinnulars are biserial in arrangement (Plate IV. figs. 4, 5). This was recognized by Hall (Pal. New York, 2, 1852. p. 219, pl. 49, figs. 1 i, k, m), although he did not get a clear idea of the structure of the pinnules from his specimens. Much better material is present in the collections of Frank Springer, in the U.S. National Museum, at Washington, and this material has been placed freely at the disposal of the writer. Compared with the length of the arms, the pinnules are very short. In a specimen, with a theca 30 millimeters in height, the pinnules attached to an arm 55 millimeters in length were 4 millimeters long. In another specimen, with a theca 12 millimeters in height, and with arms from 36 to 40 millimeters in length, the pinnules were only 3.5 millimeters long (Plate IV, fig. 4). In this specimen, each of the two series of pinnulars rests upon a separate brachial, the lower brachial of each pair being shorter. In other specimens, however, the shorter brachials occasionally are reduced to mere transversely elongated vestiges remaining between the horizontal sutures separating the larger brachials, and in those cases the two series of pinnulars rest practically against the same brachial.

Since typical crinoidal pinnules should present only a single row of pinnulars, it might be emphasized that these so-called pinnules of *Caryocrinites* are not homologous to the pinnules of crinoids, but to the brachioles of cystids. These brachioles, among the *Rhombifera* and *Diploporita,* are uniformly biserial, the individual ossicles alternating in position across the width of the brachiole. As a matter of fact, it is possible to diagram these brachioles so as to suggest a uniserial origin, and this is true also of the so-called pinnules of *Caryocrinites*, the ossicle in contact with the lower brachial being regarded the first.

The pinnulars of *Caryocrinites* are long and narrow in a direction parallel to the length of the pinnule, and are arranged in alternating series, as already indicated. The covering plates are long and narrow in a direction transverse to the length of the pinnule, about three or four occurring in the length of one pinnular.

The arms of *Caryocrinites* apparently varied in length. In an individual having a theca 30 millimeters in height, the arm nearest the left side of the anal opening has a length of 55 millimeters, while the second arm anterior to the latter, but on the same side· evidently was considerably longer since the part remaining, lacking the tip, is 75 millimeters in length. Possibly the posterior arms were shorter than the anterior arms also in other specimens.

The number of arms attached to the same theca varies in number in different individuals. In the youngest specimens, of which two occur in the Springer collection, the facets for 3 arms are distinctly developed· In one of the largest specimens, 14 arms are present. These are arranged in three groups, the anterior and left posterior groups including 5 arms· while the right posterior group includes only 4 arms. This varies in different individuals.

The question arises how and where the additional arms arise. It is noticed that in addition to the facets supporting the arms, the theca presents also smaller depressions, apparently for the attachment of appendages. Some of these depressions are traversed by a single median ridge placed in a radial direction, suggesting former articulation with some appendages. While no appendage actually ever has been found attached to these depressions it has been noticed that the order of appearance of these depressions is also the order of appearance of the additional arms, when a comparative study is made of the larger and smaller specimens of the same species. From this it is evident that these depressions are the points of emission of the additional arms.

Since similar depressions are present even in the largest specimens, and the position of these, of course, is never occupied by arms, it is possible that some of the later appendages were never strongly articulated with the theca, probably always remained comparatively small, and were specialized for the purpose of bearing the genital glands. Jaekel (Thecoidea und Cystoidea, 1899, p. 302, fig. 70) figures the relative position of the arm bases and of the smaller openings. Wachsmuth and Springer,(1881, Revision of the Palaeocrinoidea, Proc. Philadelphia Acad. Nat. Sci., vol. II, p. 51), long ago called attention to similar small depressions or pores at the sides of the arm facets of *Batocrinus*, and suggested respiratory purposes.

The area of attachment at the base of the column of *Caryocrinites* consisted of a more or less flattened expansion of small area, with a tendency toward radicular extensions at the margin, similar to the form of attachment of certain crinoid columns.

28. *Acknowledgments.*—The present paper could not have been written without the assistance of numerous individuals. The writer is under great obligation to the Director of the Geological Survey of Canada not only for the privilege of examining all of the specimens of *Comarocystites punctatus* preserved in the Victoria Memorial Museum at Ottawa, including the Billings types and the remarkable complete specimen presented to the Museum by Sir James Grant, but also for the excellent photograph of this complete specimen and for the enlarged photograph of that one of the Billings types preserving the pinnulate arm, here reproduced. To Mr. James E. Narraway and Mr. Walter Billings he owes not only the loan of the specimens figured on plate II, but also the use of other specimens, and valuable notes on the distribution of this species in the Ottawa area.

The types of *Comarocystites shumardi* and its so-called variety *obconicus* belong to the Worthen collection at the University of Illinois, and were loaned by Prof. T. E. Savage. The type of *Comarocystites shumardi* is here figured. Of the specimens of *Comarocystites shumardi* in the Walker Museum, at Chicago University, loaned by Prof. Stuart Weller, two are here figured. Of two specimens of the same species, belonging to the Illinois State Museum of Natural History, at Springfield, loaned by the curator· Dr· A. R. Crook, one is here figured.

The arm bearing specimens of *Caryocrinites ornatus,* preserving the pinnules, in the U. S. National Museum, at Washington, were placed at the disposal of the writer by Mr. Frank Springer, to whose collection they belong; and to his assistant, Mr. Herrick E. Wilson, the writer owes the excellent photographs of the pinnulate arms here reproduced. To all of these named the writer wishes to acknowledge the favors freely granted and gratefully received.

PLATE IV.

Fig. 1. Comarocystites shumardi, Meek and Worthen. Specimens No. 10974, belonging to Walker Museum, at Chicago University. A, anterior view of theca, specimen tilted so as to show the peristomial plates along the anterior side of the apical transverse food-groove. The quadrangular plate and the more pentagonal plate on its left margin correspond to the plates marked a, a, in the diagrams of Comarocystites punctatus. The mouth is situated at the posterior end of the suture between these plates. The branching of the transverse apical food-groove is indicated on the proximal side of the left stereom protuberance. The cavity occupied by the anal pyramid is seen on the left side of the figure. On the right side of the figure, the theca is defective. B, right side of same specimen, tilted so as to show the anal opening and the immediately adjacent thecal plates. For diagrammatic purposes the stellate grooving of the thecal plates has been accentuated and the remote (left) end of the apical transverse food-groove is represented as branched, although the specimen here is too imperfect to show this branching. C, posterior view of a second specimen, tilted so as to show the thecal plates on the posterior side of the transverse apical food-groove. The plate posterior to the middle of this apical food-groove corresponds to the plate marked rp in the diagrams of Comarocystites punctatus. From this plate the linear hydropore passes diagonally downward and toward the right, across the

suture, to the plate bordering on the posterior margin of the right stereom protuberance. The stellate grooving of the deeply concaved plates is clearly defined. The specimen is still partly imbedded in the rock. Kimmswick limestone, Cape Girardeau, Missouri. 1D, diagrammatic representation of arrangement of lamellae on interior surface of one of the thecal plates.

Fig. 2. Comarocystites shumardi, Meek and Worthen. Specimen No. 10472, in the Worthen collection at the University of Illinois. Type, used for figures 1a, and 1b, on plate I and diagram on page 292, Geol. Surv. Illinois, Vol. 3, 1868. Anterior side with the apical part flattened by pressure and depressed toward the left. The thecal plates surrounding the left pair of arms, as far down and including the anal pyramid, are missing. (Comarocystites shumardi obconicus forms No. 10473 in the Worthen collection). Cape Girardeau, Missouri.

Fig. 3. Comarocystites shumardi, Meek and Worthen. One of two specimens numbered 1574 in the Illinois State Museum of Natural History. Left anterior side of the theca, weathered away so as to expose the vertical mesostereom lamellae at the sutures separating the thecal plates. The stereom protuberance supporting the left pair of arms is located in the upper left hand corner of the figure, and the base of the theca lies beyond the opposite corner. The plate supporting this protuberance shows traces of the lamellae and of the inter-lamellar spaces connected with the respiratory system, corresponding to the more striking evidence of this system in the other plates. Three thecal plates are represented in the figure toward the right of the protuberance, both along the upper and lower margins of the figure. Each plate exposes two sets of lamellae, directed perpendicularly to two different suture lines. In each set, the lamellae extending from the middle of the suture lines are longer, and those nearer the angles of the thecal plate are shorter. The grooves separating the sets of lamellae belonging to the same plate from each other narrow toward the angles. The deep triangular pits at the angles of junction of the thecal plates produce a similar appearance. The sides of five additional plates are exposed in parts extending beyond the lower right hand corner of the figure, but these did not show up well in the photograph utilized in the preparation of this figure.

Fig. 4. Caryocrinites ornatus, Say. Arms with pinnules attached. Opposite the number 4, and near the base of the figure, are two pinnules which are entire.

Fig. 5. Caryocrinites ornatus, Say. A, arm with pinnules attached, only the basal parts of the latter well seen near the middle of the figure. Several of the larger brachials bear a strongly nodose protuberance. B, an adjacent arm of the same specimen, showing the granulate surface, and the pronounced alternation of longer and shorter brachials. Figures 4 and 5 are enlargements of specimens in the collection of Frank Springer in the U.S. National Museum, at Washington, and were prepared by Mr. Herrick E. Wilson.

PLATE V.

Comarocystites punctatus, Billings. Specimen retaining the entire length of the column, including the basal attachment disk (described on page 89 of present volume). Figure reduced to about eight-tenths of the natural size. Only the left arm in the figure is attached to the theca. The right arm may have belonged to another individual. Presented to the Victoria Memorial Museum by Sir James Grant, who published the first description and figure in 1880. (Trans. Ottawa Field-Nat. Club, 1, pl. 1, fig. 1.)

KILDEER PLOVER.

Ten years ago the Kildeer Plover (*Oxyechus vociferus*) was a rare summer resident in the Province of Quebec. During the past five seasons the bird has become very numerous and is now a common breeder, nearly one hundred nests having been found in the past four or five years. Several observers agree that the Kildeer is spreading rapidly throughout the Province, as in the case of the Meadowlark, which was also very rare a few years back.

The Killdeer usually arrives during the first week in April and a little later the birds have chosen their summer homes. Pebbly or rocky pastures and hillsides, near ponds, are their favorite grounds for nesting purposes. From April 24th to May 6th the set of three or four eggs may be found in such localities. The novice may have some difficulty in discovering the nest amongst pebbles and lichens so cunningly are the eggs placed and so well do they harmonize with their general surroundings; but the experienced eye can detect the eggs some yards off. The saucer-shaped nest is generally encircled by pebbles or stones and is lined with lichen, pieces of wood and weeds, manure and pebbles. One nest was located amongst stones near a stone fence. One pair of birds were succssful in raising a brood alongside a wagon road running through a pasture.

During the mating season the birds are evidently nervous, as they make many attempts in excavating holes or nests in the ground, or perhaps these are only decoy nests. The real nest, however, is usually not very far away from such endeavors. In two instances the bird has been flushed off the nest a few feet away, but this is the exception rather than the rule. If one is watchful the bird may be seen running quietly away from the nest, but I believe the birds are off feeding most of the time, especially in bright, warm weather. The eggs have often been found with no birds in sight. Usually, however, they are very alert and soon make their presence known should anyone pass near the vicinity of the nest. After the nest is found it is rather amusing to watch the actions of the female. The bird, of course, is endeavoring to lead the intruder away and will squat down in some slight hollow in the ground as if she were about to settle on the nest, and will keep this performance up for some distance should she be successful in her efforts, returning to the nest by a circuitous route. I have only seen one bird feign a broken wing and turn somersaults, thus displaying the beautiful plumage of this species. The Killdeer raises at least two broods in a season.

W. J. BROWN.

BIRD NOTES.

BY FRANK C. HENNESSEY, B.A.

RAPACITY OF THE BRONZED GRACKLE. (*Q. q. aeneus.*)

At Albion, Michigan, on May 25, 1916, and also on the 29th of the same month, I observed an action which, so far as I know, has not been attributed to the bronzed grackle.

While passing down a street of the suburbs of Albion, I noticed an English sparrow feeding in the dusty road. As I came within forty feet of it, a grackle, seemingly without provocation, swooped down from a nearby tree and fell upon this unsuspecting bird. With a succession of rapid blows the grackle killed the sparrow outright. Before I could prevent it, a friend who was with me ran out to drive off the grackle. The grackle was a male. On examining the bill and feathers of the dead sparrow, I found that this bird was not young, in fact, I am certain that it was mature. On plucking the sparrow I found that the neck and base of the skull were badly bruised. The injury seemed to indicate that it had been killed by sheer impact of blows.

On the other occasion my attention was caught by a great clamoring of English sparrows. A grackle in their midst was being pursued, and finally floundered into some nearby trees. A mature, dead sparrow was left behind on the road.

On both occasions, unfortunately, I was prevented from witnessing what the grackle would have done with its victim if left undisturbed. This, of course, deprives one of determining the significance of the action in question. My friends at Albion told me of witnessing two other instances of similar action by "blackbirds."

RESTRICTED BREEDING COMMUNITIES OF THE HENSLOW'S SPARROW.

From May 25 to June 2, 1915, at Barbee Lake, Kosciosko County, Indiana, and from June 2 to June 11, 1916, at Albion, Michigan, I had an opportunity of studying the Henslow's sparrow.

On both occasions the sparrows occurred in low, wet meadows. The interesting point to me is that although there were many spots identically the same as those frequented by the sparrows, the birds occurred at one spot only in both of the regions studied.

At Barbee Lake, Indiana, the birds were found only over an area of about one-quarter of a mile square, at the south end of the Lake. Here there were about twenty birds, and the conditions of the cloaca and the egg stages in the oviduct of the female specimens collected showed that they were on their breeding ground. The females were always in greater evidence than the males, and most of the birds collected were of this sex.

At Albion, Michigan, the birds were found only over an area of about one-half a mile square. I explored extensively the country about Albion to within a radius of seven miles of the town, and although this region abounded with suitable localities for the breeding of Henslow's sparrow, I found them only at one spot east of the town. I estimated that here there must have been from forty to sixty birds.

The question arises, do these observations tend to show that the species group during the breeding period?

EUROPEAN BUTTERFLY FOUND AT LONDON, ONT.

During the past few years Mr. John A. Morden, of London, Ont., has captured an unkown butterfly of a shaded orange colour, belonging to the skipper family. On sending it to the authorities at Washington it was determined as *Adopea (Pamphila) lineola*.

This European insect does not seem to have been previously reported from America. Mr. Morden first found it near the Dundas Street Bridge where refuse had been dumped. Possibly the eggs of the insect came from Europe with something that was thrown out and when hatched the larvæ found food in close proximity.

Mr. Morden says that the butterfly is now moderately common during July and is apparently spreading over the city.

The first capture was made July 21, 1910, when 10 specimens were taken, mostly worn. In 1911, most of the quack grass (*Agropyrum repens*) around the dump where the insects were taken had been killed and none were seen at that locality, but two were taken at Paul street not far away, in a waste lot overrun with quack grass.

Each year since then he has found them in a strictly wider area and, in 1914, one was taken in Hyde Park, five miles away.

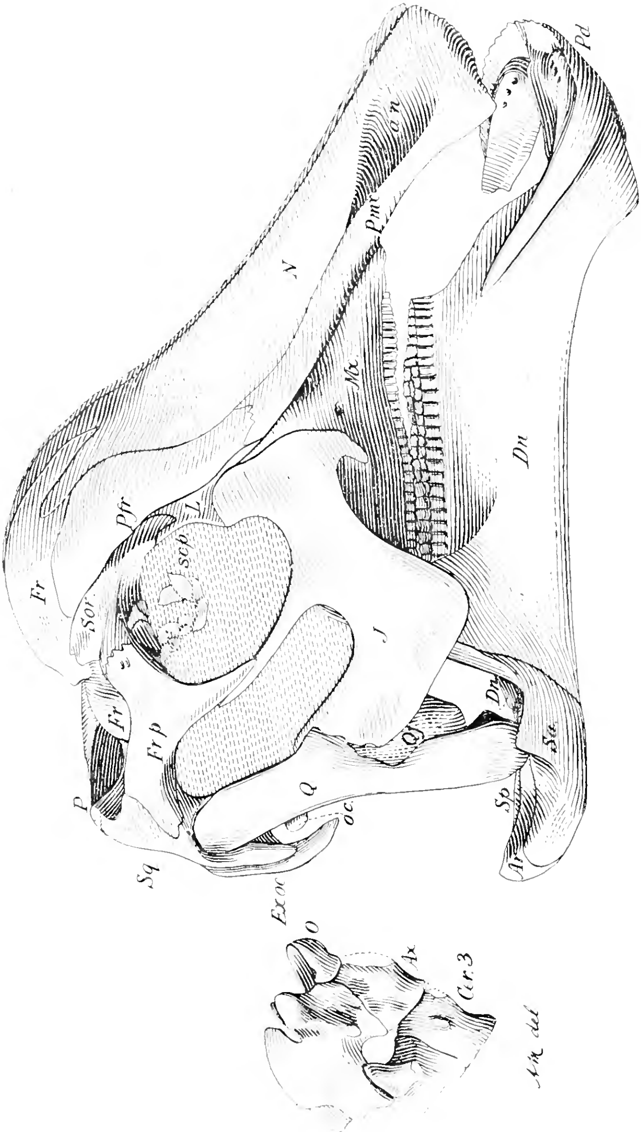
To Mr. A. A. Wood, Coldstream, who has been working on the matter in conjunction with Mr. John A. Morden, I am indebted for these facts.

W. E. SAUNDERS, London, Ont.

BOOK NOTICE.

"Water Powers of Manitoba, Saskatchewan and Alberta," issued by the Commission of Conservation, is a valuable contribution to the literature respecting the natural resources of Western Canada. This report, by Leo G. Denis and J. B. Challies, comprises the results of special surveys by the Commission of Conservation and a compilation of records from other reliable sources.

While the Prairie Provinces, as a whole, are not lavishly endowed with water-powers, the report demonstrates that the utility of their rivers for power development can be vastly enhanced through proper storage of flood waters. At present in the absence of conservation dams, and of adequate natural regulation, the great volume of flow is lost during high water seasons. Methods of development to ensure the maximum utilization are now being carefully worked out on the Winnipeg, Bow and other large rivers. The more northerly regions possess numerous sites of great potential value for pulp, electro-chemical and other special industries.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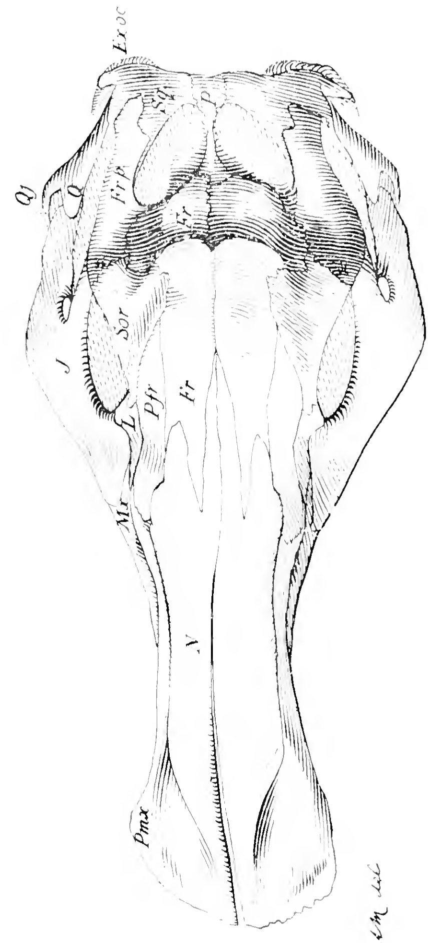
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ON CHENEOSAURUS TOLMANENSIS, A NEW GENUS AND SPECIES OF TRACHODONT DINOSAUR FROM THE EDMONTON CRETACEOUS OF ALBERTA.*

By Lawrence M. Lambe, F.R.S.C.,
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The present paper is descriptive of the skull of a trachodont dinosaur of small size included in the Geological Survey vertebrate palæontological collection of 1915 from the Edmonton formation of Red Deer river, Alberta. The skull displays an assemblage of characters which clearly point to its belonging to a type generically distinct from any hitherto described member of the Trachodontidæ. With the skull, and belonging to the same individual, were limb bones, the pelvic arch, not altogether complete, vertebræ, and other parts of the skeleton (field No. 6, cat. No. 2246); a second skull belonging to a much smaller individual, was also obtained (field No. 2, cat. No. 2247) in beds of the same geological age. These remains were discovered by George F. Sternberg, in charge of the field party, about four miles apart in the valley of Red Deer river. The larger skull is from the west side of the river, about five miles above Tolman ferry, in sec. 11, twp. 34, range XXII, at 150 feet above the river level. This locality is roughly twenty-seven miles above the mouth of Three Hills creek, and eight miles west and somewhat north of Rumsey on the line of the Canadian Northern railway. The smaller skull was found farther up stream about one mile north-west of the mouth of Big Valley creek on the west side of the river.

The rock in which these remains occurred is a hard, very fine sandstone which is removed with difficulty from the bones. Mr. Sternberg has most successfully freed both skulls from their matrix, and has mounted the larger skull for exhibition. This larger skull is

*Communicated with the permission of the Deputy Minister of Mines.

in an excellent state of preservation and is but slightly distorted. The sutures are very distinctly marked defining the exact limits of the various elements. The smaller skull is imperfect in the occipital region but elsewhere most of the sutures are clearly displayed; it is of special value for comparison with the larger specimen.

The larger skull is selected as the type of the new genus for which the name Cheneosaurus (*Gr. Chencios*) is proposed on account of the supposed resemblance of the specimen, when viewed in profile, to the outline of the head of a goose. The species is named after Tolman ferry and post-office, both of which are not far from where the type was discovered.

CHENEOSAURUS TOLMANENSIS GEN. ET SP. NOV.

Generic and specific characters.—Skull small, high, short, dome-shaped above, and steeply descending in front. Domed prominence formed by frontals, nasals, prefrontals and supraorbitals. Lachrymal small. Nasals broad, covering the narial passages. Narial opening small and placed very far forward. Anterior premaxillary portion broadly expanded and terminating almost squarely in front. Mandible strongly decurved anteriorly. Teeth long and narrow, with marginal papillation at the apex to a varying extent. Orbit broadly ovate. Lateral temporal fossæ long and narrow. Supratemporal fossæ small.

This genus of the Edmonton formation differs from all other known members of the Trachodontidæ in the dome-shaped form of the upper, interorbital surface of the skull, and in the roofing over of the narial passages by the broad nasals, resulting in a diminution of the anterior nares and their limitation to a far advanced position. In no other form is the angle of descent of the facial portion so uniformly steep. Attention is called to the presence in Cheneosaurus of a large supraorbital, a cranial element not hitherto recognized in the Trachodontidæ except doubtfully in the single instance of Gryposaurus (Belly River formation).

The skull of *Cheneosaurus tolmanensis* is broad behind and narrow in front. It is most elevated in the region above the orbits and for a short distance forward, forming a conspicuous rotundity in the upper surface in advance of which it descends narrowly and steeply to the horizontally expanded snout. Behind the apical prominence the remainder of the superior surface is depressed. The mandible is long in comparison with its height and is strongly decurved in front where it ends in a broad predentary. The height of the type skull is less than three-fourths its length, and its maximum breadth is nearly one-half its length. The orbit is moderately large and is situated toward the front of the posterior half of the cranium.

By referring to the two drawings of the type, reproduced herewith, one a right side view, the other from above, the proportions of the different elements of the skull as they appear at the surface can be readily seen.

The dome-shaped prominence of the upper surface is formed by the frontals, prefrontals, nasals and supraorbitals. The frontal contribution is the largest of the four and occupies the greatest part posteriorly and superiorly, the prefrontals reach upward laterally, while the nasals assist anteriorly continuing backward slenderly between the frontals to the highest point of the dome. The supraorbitals contribute to a minor extent laterally behind.

The orbital opening is broadly ovate in outline with the more pointed end downward. It is bounded by the supraorbital, the postfrontal, the jugal, and the lachrymal, the last named element contributing least, and the postfrontal and supraorbital nearly equally to the formation of the rim.

The lateral temporal fossa is more than three times as high as wide and is enclosed in its lower half length by the jugal, and in the upper half by the quadrate, the postfrontal, and, to a slight extent, the squamosal.

The prefrontal is largely developed and is more than three times as long as broad. It lies in advance of the supraorbital and the lachrymal, is in contact above with the frontal, in front with the nasal, and below with the premaxilla which it overlaps.

The lachrymal is small and narrow, its extreme length being three times its maximum breadth. Its narrow upper end underlies the supraorbital while its posterior margin in its entirety enters into the formation of the orbital rim. Inferiorly it is in contact with the jugal and anteriorly with the prefrontal. Infero-anteriorly it is prolonged narrowly downward between the jugal and the prefrontal, the extreme end of the extension lying between the premaxilla and the maxilla.

The jugal does not present any very unusual characteristics. It is in contact with the quadrato-jugal and the quadrate behind, overlapping the former. In front it lies over a large surface of the maxilla, and supero-anteriorly is in contact with the lachrymal for a considerable distance. The end of its upwardly directed process, forming the lower half of the slender postorbital bar, passes behind the process from the postfrontal.

The premaxilla is a large bone broadly expanded horizontally outward in front where with its fellow it forms the edentulous anterior termination of the cranium. Postero-exteriorly it extends upward between the maxilla and the nasal as a long, narrow surface to meet the lower end of the prefrontal which overlaps it. The front border of the premaxilla curves outward and slightly backward from the midline of the skull and is met at an obtuse angle by the outer border descending freely from its contact with the maxilla. The upper surface of the bone is shallowly excavated in advance of the narial opening forming a slightly depressed area exterior to which the lateral angulation curves slightly downward. Anteriorly the thickness of the bone is suddenly increased on the lower surface a short distance back from the front edge. This edge is conspicuously notched by about from ten to twelve grooves which pass inferiorly backward across the thinned marginal area.

The nasal bones are contiguous along the midline of the cranium throughout their length, except possibly at their extreme anterior end. They are broad for the most part and curve downward outwardly to meet the premaxilla and the prefrontal. They arch over the nasal passages and their openings which latter are placed far forward. In advance of the openings the nasals continue narrowly forward for a short distance over the premaxillæ on either side of the midline, but the exact outline of their anterior ending is obscured. Posteriorly they appear to bifurcate, the exterior branch overlapping the frontal while the interior one continues, much attenuated, on the inner side of the frontal to the summit of the dome-shaped superior surface. This surface bifurcation of the nasal is not a division in reality, as the bone underlies the narrow front termination of the frontal.

A notable feature in the skull of Cheneosaurus is the presence of a large supraorbital bone which enters into the formation of the orbital rim almost to the same extent as the postfrontal. This bone is roughly subtriangular in shape and is in contact posteriorly with the postfrontal and frontal, superiorly with the frontal, and anteriorly with the prefrontal. Its lower edge for the most part forms the antero-superior portion of the curve of the orbital rim. Infero-anteriorly it extends narrowly downward and overlaps the upper end of the lachrymal.

The postfrontal has a somewhat larger surface area than the supraorbital and meets it anteriorly in a zigzagged suture. Posteriorly it overlaps the squamosal extensively. Superiorly its posterior half-length bounds the supratemporal fossa externally at the front, while the remainder of its upper half-length joins the frontal in a jagged suture.

The frontal is larger than the prefrontal, and is of an irregular shape. It is in sutural contact with the nasal, the prefrontal, the supraorbital, the postfrontal and the parietal. For nearly the whole of its anterior half-length it is separated from its fellow along the midline by the narrow backward extension of the nasals. It forms the greater part of the dome-shaped elevation of the cranium rising from behind, and descending on the anterior slope its forwardly directed attenuation overlaps the nasal. For a short distance forward from its junction with the parietal, equal to about one-fifth of its total length, its surface is lower than the part that rises into the dome-shaped prominence and is defined from it by an overhanging transverse fold of bone. This posterior area of the frontal is much depressed in its outer breadth but rises convexly inward to the mid-line. The suture between the pair is conspicuously zigzagged.

The supratemporal fossa is small, narrowly oval, and about twice as long as wide, and passes downward into the lateral temporal fossa. The two openings are close together posteriorly but toward the front they diverge from each other. They are bounded by the frontal, postfrontal, squamosal, and parietal, each of the four elements participating to an almost equal extent.

The squamosal runs forward beneath the postfrontal to a point in line with the anterior end of the supratemporal fossa. Intero-posteriorly it meets the parietal in a short jagged suture. Postero-inferiorly it is deeply cupped to receive the upper end of the quadrate, and sends downward a slender process which is applied to the paroccipital (exoccipital) alar extension in the usual way.

The occipital condyle is tripartite, the two exoccipitals and the basioccipital entering into its formation to an equal extent, with the bases of the exoccipital pair forming the upturned ends of the curved, U-shaped condylar surface.

The exoccipital in assisting in the formation of the condyle, bounds the foramen magnum laterally. A paroccipital process of large size supports the pendent extension of the squamosal from behind and passes freely downward beyond it.

The parietal bounds the supratemporal fossa on its inner side, and intero-anteriorly along the greater part of its sutural junction with the frontal. Postero-laterally it unites with the squamosal. Within the supratemporal fossate area the pair rise to each other at the median line together forming a narrow longitudinal ridge separating the openings.

The maxilla appears externally in contact principally with the premaxilla and the jugal. Superiorly it passes for a short distance between the jugal and the lowermost portion of the downward extension of the lachrymal.

The dentary supports a high and robust coronoid process, and is in contact posteriorly with the surangular to the extent usual in the Trachodontidæ. Its anterior edentulous portion is strongly decurved.

The teeth are of the general trachodont type, with the well known mode of vertical succession and replacement. They are best preserved in the right dentary where the inner enamelled surface is seen to be long and narrow, with a high median keel and raised margins. In this dentary the second tooth from the front has marginal papillations near the tip resembling the dental border sculpture of the small Belly River trachodont described from a maxilla under the name *Trachodon altidens* by the writer in 1902* The larger teeth toward the centre

*Contr. to Can. Palaeont., vol. III (quarto), p. 76, pl. IV, figs. 2, 3 and 4.

of the dental magazine appear to have their margins smooth or with only a slight indication of papillæ near the top. In the broadest part of the dental grinding surfaces there are generally two functional teeth in a transverse direction. The estimated number of teeth in the dentary in each vertical series near the midlength of the dental magazine is about three. There are about thirty-five vertical rows of teeth in the maxilla and thirty-three in the dentary. The above small Belly River form with long, narrow teeth may prove to be ancestral to Cheneosaurus.

The predentary was missing in the type skull but has been restored, as figured, principally from the smaller skull, in which this bone was preserved. As in the premaxillæ the front margin is coarsely notched, indicating the probable presence in life of a firmly attached, strong, horny covering to the beak-like termination of the jaws.

About thirteen sclerotic plates are wholly or partially preserved in the upper part of the orbital opening. The ring in which these plates occurred in life is clearly indicated but its symmetry is destroyed and the full number of plates may not be represented.

With the skull are figured the odontoid process, the axis, and the third cervical vertebra which were found in place. The remaining parts of the atlas were missing.

MEASUREMENTS OF THE TYPE SKULL OF CHENEOSAURUS TOLMANENSIS.

	Mm.
Length of cranium from anterior end of premaxillæ to occipital condyle	445
Length of cranium from anterior end of premaxillæ to posterior border of exoccipital process	477
Height of skull, as mounted, from lower surface of dentary vertically upward to highest point of upper surface	308
Distance from lowermost portion of jugal to highest point of superior surface of skull	276
Distance from grinding surface of maxillary teeth to highest point of skull	229
Anterior premaxillary breadth from midline of skull to outer angulation (half breadth of snout)	97
Length of quadrate (slightly restored at lower end)	190
Extreme length of mandible (predentary restored, articular restored)	473
Length of dentary	358
Depth of dentary, at about midlength of mandible, from outer alveolar border to lower edge	64
Maximum breadth of predentary (restored)	151
Maximum height of orbit	99

Maximum width of same	79
Length of lateral temporal fossa	140
Width of same at midlength	42
Length of supratemporal fossa	64
Width (transverse) of same	30
Length of maxillary dental grinding surface	175
Enamelled surface of tooth, about to become functional, in fourteenth vertical row from the front, in right dentary:	
Length	32
Breadth	7

The figures of the two accompanying plates are from drawings by Mr. Arthur Miles.

EXPLANATION OF PLATES.

Plate VI.—Right lateral aspect of skull (type) of Cheneosaurus tolmanensis; one-fourth the natural size. To bring the vertebrae clearly into view they are represented two and a half inches back of their proper position.

Plate VII.—Superior aspect of the same skull: one-fourth the natural size.

Abbreviations.—Ar, articular; Ax, axis; Cer. 3, third cervical vertebra; Dn, dentary; Ex. oc., exoccipital; Fr, frontal; Fr. p., postfrontal; J, jugal; L, lachrymal; Mx, maxillary; N, nasal; O, odontoid process; P, parietal; Pd, predentary; P.fr., prefrontal; Pmx, premaxillary; Q, quadrate; Qj, quadrato-jugal; Sa, surangular; Sor, supraorbital; Sp, splenial; Sq, squamosal; a.n., anterior nares; o.c., occipital condyle; sc.p., sclerotic plates.

BIRDS OF LAKE ONIGAMIS REGION, QUE., AND ALGONQUIN PARK, ONT.

BY JOHN M. COOPER, WASHINGTON, D.C.

INTRODUCTORY REMARKS.

The following two lists of birds were received by the undersigned from the Rev. John M. Cooper. As they apply to districts from which we have little exact information, I requested and received permission from the author to publish them.

Mr. Cooper informed me that in neither locality were specimens taken, and while the species are undoubtedly correct the sub-specific designations rest only upon the probabilities of known geographical distribution. It is refreshing to find an observer who realizes the difficulties of sub-specific identification and the advisability of making such an explanation.

The list at the end of the Onigamis list of birds that were expected but not seen is also a feature worthy of being repeated in other such work.

P. A. TAVERNER.

BIRDS OBSERVED IN LAKE ONIGAMIS REGION AND UPPER ST. MAURICE RIVER, QUEBEC, BETWEEN 48° AND 49° N. LAT. AND 73° 45′ AND 75° 30′ W. LONG., JUNE 9-22, 1916.

Loon, *Gavia immer* Brunn.; not common.
Herring Gull, *Larus argentatus* Pont.; common.
Black Duck, *Anas rubripes* Brewst.; common.
Great Blue Heron, *Ardea herodias herodias* Linn.; rare.
Spotted Sandpiper, *Actitis macularia* Linn.; common.
American Osprey, *Pandion haliaëtus carolinensis* Gmel.; not common.
Great Horned Owl, *Bubo virginianus virginianus* Gmel.; common.
Kingfisher, *Ceryle alcyon* Linn.; common on St. Maurice River.
Yellow-bellied Sapsucker, *Sphyrapicus varius varius* Linn.; common.
Northern Flicker, *Colaptes auratus luteus* Bangs; common.
Night Hawk, *Chordeiles virginianus virginianus* Gmel.; common.
Olive-sided Flycatcher, *Nuttallornis borealis* Swains.; common.
Least Flycatcher, *Empidonax minimus* W. M. & S. F. Baird; common.
Canada Jay, *Perisoreus canadensis canadensis* Linn.; common.
Northern Raven, *Corvus corax principalis* Ridgw.; common.
Crow, *Corvus brachyrhynchos brachyrhynchos* Brehm.; not common.
White-throated Sparrow *Zonotrichia albicollis* Gmel.; abundant.
Slate-colored Junco, *Junco hyemalis hyemalis* Linn.; common.
Song Sparrow, *Melospiza melodia melodia* Wils.; common.
Tree Sparrow, *Iridoprochne bicolor* Vieill.; abundant.
Red-eyed Vireo, *Vireosylva olivacea* Linn.; abundant.
Nashville Warbler, *Vermivora rubricapilla rubricapilla* Wils.; not seen, but heard distinctly at close range near Lake Asawewasenan; am reasonably certain of identification, being quite familiar with its distinctive song.
Yellow Warbler, *Dendroica aestive aestiva* Gmel.; abundant especially along St. Maurice River.
Myrtle Warbler, *Dendroica coronata* Linn.; common.
Black-throated Green Warbler, *Dendroica virens* Gmel.; common.
Oven Bird, *Seiurus aurocapillus* Linn.; not common.
Water Thrush, *Seiurus noveboracensis noveboracensis* Gmel.; not common in lake region, abundant along river.
Redstart, *Setophaga ruticilla* Linn.; common.
Winter Wren, *Nannus hiemalis hiemalis* Vieill.; not common.
Red-breasted Nuthatch, *Sitta canadensis* Linn.; common.
Olive-backed Thrush, *Hylocichla ustulata swainsoni* Tschudi; abundant.
Hermit Thrush, *Hylocichla guttata pallasi* Cab.; not common.
Robin, *Planesticus migratorius migratorius* Linn.; not common.
Merganser, *Mergus* was common, but not seen at close enough range to tell whether *americanus* or *serrator*. Several other species

present were observed or heard but not distinctly enough for unmistakable identification. I hope to renew observations in the same region this coming June.

None of the following birds were seen or heard:

Whip-poor-will, *Antrostomus vociferus* Wils.
Chimney Swift, *Chaetura pelagica* Linn.
Barred Owl, *Strix varia* Barton.
Goldfinch, *Astragalinus tristis* Linn.
Catbird, *Dumetella carolinensis* Linn.
Brown Creeper, *Certhia familiaris americana* Bonap.
Chickadee, *Penthestes atricapillus* Linn.
Veery, *Hylocichla fuscescens* Steph.

BIRDS OBSERVED IN ALGONQUIN PARK, ONTARIO, JUNE 2-19, 1908-14.

Loon, *Gavia immer* Brunn.; abundant; nests often, once June 10, 1911, at Tea Lake; young not out by June 19 of any of above years.

Herring Gull, *Larus argentatus* Pont.; abundant; nests often, usually on little rocky islets; young June 13, 1914.

Common Tern, *Sterna hirundo* Linn.; one seen on Lake Opeongo; seen at fairly close range, grayish underparts clearly observed.

Black Duck, *Anas rubripes* Brewst.; common; nests several times.

Bittern, *Botaurus lentiginosus* Montag.; not common.

Great Blue Heron, *Ardea herodias herodias* Linn.; common; heronry observed at Magnetewan Lake, 12 nests in 4 tall pines, probably 30-50 feet above ground; there are said to be other heronries near Potter Lake and on Maggie's Lake.

Spotted Sandpiper, *Actitis macularia* Linn.; common; nests; young observed June 19, 1914.

Canada Spruce Partridge, *Canachites canadensis canace* Linn.; fairly common; young seen June 11, 1913, near Phillips Lake.

Canada Ruffed Grouse, *Bonasa umbellus* (presumably *togata*) Linn.; common.

Broad-winged Hawk, *Buteo platypterus* Vieill.; common.

Bald Eagle, *Haliaeetus leucocephalus* Linn.; distinctly seen at close range at Clear Lake.

Sparrow Hawk, *Falco sparverius sparverius* Linn.; fairly common.

Osprey, *Pandion haliaëtus carolinensis* Gmel.; common; nests seen several times, always in large dead trees, at top about 40 feet from ground.

Barred Owl, *Strix varia varia* Barton; abundant.

Saw-whet Owl, *Cryptoglaux acadica acadica* Gmel.; fairly common; not seen but heard at times; identification rests partly on guide who without any suggestive questions on my part told me he had the previous year searched for, caught and learned the name of bird; we heard the oft repeated sort of whistle quite distinctly on several occasions.

Belted Kingfisher, *Ceryle alcyon* Linn.; common; nests.
Hairy Woodpecker, *Dryobates villosus* (presumably *villosus*) Linn.; common; nests.
Downy Woodpecker, *Dryobates pubescens* (presumably *medianus*) Swains.; not common.
Arctic Three-toed Woodpecker, *Picoides arcticus* Swains.; fairly common; am fairly but not absolutely certain of identification; usually observed under somewhat imperfect light conditions; was told on good authority that both *arcticus* and *americanus* are in Park.
Yellow-bellied Sapsucker, *Sphyrapicus varius varius* Linn.; common.
Northern Pileated Woodpecker, *Phloeotomus pileatus* (presumably *abieticola*) Bangs; fairly common.
Northern Flicker, *Colaptes auratus luteus* Bangs; common; nests
Whip-poor-will, *Antrostomus vociferus vociferus* Wils.; locally abundant.
Night-hawk, *Chordeiles virginianus virginianus* Gmel.; common.
Chimney Swift, *Chaetura pelagica* Linn.; abundant.
Ruby-throated Hummingbird, *Archilochus colubris* Linn.; fairly common.
Kingbird, *Tyrannus tyrannus* Linn.; abundant; nests seen were in majority of cases (5 out of 7) on tops of dead stumps, 2½-5 feet up from water level.
Phoebe, *Sayornis phoebe* Lath.; uncommon, several seen, one at Cedar Lake.
Olive-sided Flycatcher, *Nuttallornis borealis* Swains.; abundant.
Wood Pewee, *Myiochanes virens* Linn.; common.
Least Flycatcher, *Empidonax minimus* W. M. and S. F. Baird; common; nest.
Blue Jay, *Cyanocitta cristata cristata* Linn.; common.
Canada Jay, *Perisoreus canadensis* Linn.; common; young about full size in early June.
Northern Raven, *Corvus corax principalis* Ridgw.; not common.
Crow, *Corvus brachyrhynchos brachyrhynchos* Brehm; uncommon.
Red-winged Blackbird, *Agelaius phoeniceus phoeniceus* Linn.; abundant.
Bronzed Grackle, *Quiscalus quiscula aeneus* Ridgw.; abundant.
Purple Finch, *Carpodacus purpureus purpureus* Gmel.; common.
Goldfinch, *Astragalinus tristis tristis* Linn.; common.
Vesper Sparrow, *Pooecetes gramineus gramineus* Gmel.; common in clearings.
White-throated Sparrow, *Zonotrichia albicollis* Gmel.; abundant.
Chipping Sparrow, *Spizella passerina passerina* Bech.; common in clearings.
Slate-colored Junco, *Junco hyemalis hyemalis* Linn.; common.

Song Sparrow, *Melospiza melodia melodia* Wils.; abundant; nests.

Swamp Sparrow, *Melospiza georgiana* Lath.; common.

Rose-breasted Grosbeak, *Zamelodia ludoviciana* Linn.; rare; seen only once, at Victoria Lake.

Indigo Bunting, *Passerina cyanea* Linn.; rare; seen and heard only once, at Victoria Lake.

Scarlet Tanager, *Piranga erythromelas* Vieill.; common in all parts of Park, including the extreme northern part around Tea Lake.

Barn Swallow, *Hirundo erythrogaster* Bodd.; common; nests.

Tree Swallow, *Iridoprocne bicolor* Vieill.; abundant; nests.

Bank Swallow, *Riparia riparia* Linn.; uncommon; seen at Manitou Lake.

Cedar Waxwing, *Bombycilla cedrorum* Vieill.; common.

Red-eyed Vireo, *Vireosylva olivacea* Linn.; abundant.

Blue-headed Vireo, *Lanivireo solitarius solitarius* Wils.; fairly common.

Black and White Warbler *Mniotilta varia* Linn.; common.

Nashville Warbler, *Vermivora rubricapilla rubricapilla* Wils.; abundant, in second growth chiefly.

Northern Parula Warbler, *Compsothlypis americana usneae* Brewst.; common, even in northern and northwestern part of Park.

Yellow Warbler, *Dendroica aestiva aestiva* Gmel.; rare, seen and heard only once, at Cache Lake.

Black-throated Blue Warbler, *Dendroica caerulescens caerulescens* Gmel.; common.

Myrtle Warbler, *Dendroica coronata* Linn.; abundant; nests.

Magnolia Warbler, *Dendroica magnolia* Wils.; common.

Chestnut-sided Warbler, *Dendroica pensylvanica* Linn.; common, especially in second growth.

Blackburnian Warbler, *Dendroica fusca* Mull.; common in northern part as well as in southern part.

Blackthroated Green Warbler, *Dendroica virens* Gmel.; common.

Pine Warbler, *Dendroica vigorsi* Aud.; rare, seen only once, at Proulx Lake; grayish yellow underparts, grayish neck and head, tail feathers tipped with white and two white wing bars seen well; song (rather sharp-cut trill) heard distinctly; am reasonably certain of identification.

Oven-bird, *Seiurus aurocapillus* Linn.; common, especially among maple.

Water Thrush, *Seiurus noveboracensis noveboracensis* Gmel.; common.

Mourning Warbler, *Oporornis philadelphia* Wils.; common.

Maryland Yellow Throat, *Geothlypis trichas trichas* Linn.; common.

Canada Warbler, *Wilsonia canadensis* Linn.; common.

Redstart, *Setophaga ruticilla* Linn.; abundant.

Catbird, *Dumetella carolinensis* Linn.; rare; observed only twice, once at Opeongo Lake, and once at Island Lake.

Brown Thrasher, *Toxostoma rufum* Linn.; rare; one observed in Park at Joe Lake and two on outskirts of Park near South River and Egan Estate.

House Wren, *Troglodytes aëdon aëdon* Vieill.; common.

Winter Wren, *Nannus hiemalis hiemalis* Vieill.; abundant.

Brown Creeper, *Certhia familiaris americana* Bonap.; not common; nest seen once, at Canoe Lake, in bark of large dead hemlock in floodwater about three feet up from water level; at distance of about five yards heard its rather melodious song, a clear high-pitched whistle of five distinct notes, and first and third long, the other three short.

Red-breasted Nuthatch, *Sitta canadensis* Linn.; common.

Chickadee, *Penthestes atricapillus atricapillus* Linn.; common.

Golden-crowned Kinglet, *Regulus satrapa satrapa* Licht.; rare; seen only once, at Merchant's to White Trout Lake portage.

Wood Thrush, *Hylocichla mustelina* Gmel.; not common; never seen, but heard pretty clearly on several occasions; once when heard a half-breed at Manitou Lake with whom I was talking at the time told me the bird had a 'red head.'

Veery, *Hylocichla fuscescens fuscescens* Steph.; fairly common.

Olive-backed Thrush, *Hylocichla ustulata swainsoni* Tschudi; abundant; nests.

Hermit Thrush, *Hylocichla guttata pallasi* Cab.; faily common.

Robin, *Planesticus migratorius migratorius* Linn.; not common; nest.

Bluebird, *Sialia sialis sialis* Linn.; uncommon.

1. Mr. Bartlett, the Park Superintendent, has in his office a specimen of the Golden Eagle, *Aquila chrysaëtos*; the bird took wolf poison near Tea Lake (Big Tea in n. part of Park) the winter of 1908-9.

2. Mr. Waters, one of the older rangers, and a man who knows the Algonquin birds perhaps better than any one else, told me that the Great Horned Owl, *Bubo virginianus virginianus* Gmel. is found in the Park.

3. Dr. Claghorne, a former forest ranger, told me that he had seen the Baltimore Oriole, *Icterus galbula* Linn., near Cache Lake in the spring of 1911 and had found the Cliff Swallow, *Petrochelidon lunifrons lunifrons* Say, on the Madawaska River.

4. The Alder Flycatcher, *Empidonax trailli alnorum,* and the Yellow-bellied Flycatcher, *E. flaviventris,* probably both breed in the Park, but I have never been sufficiently sure of their songs and would not feel safe in identifying them in the bush.

5. *Mergus*, common, but whether *americanus* or *serrator* am uncertain. Oddly enough have never observed a male in the Park, though the female was seen nearly every day.

6. A grebe with young seen once; presumably Pied-billed Grebe *Podilymbus podiceps*, but male was not observed, so could not be sure of identification.

7. I have noted in above list cases where nests have been found; judging from the dates when birds themselves were observed, it is most likely that all the birds in the list nest in the Park.

NOTES ON THE FEEDING HABITS OF TWO SALAMANDERS IN CAPTIVITY.

BY CHARLES M. STERNBERG, GEOLOGICAL SURVEY, OTTAWA.

While attending an excursion of the Ottawa Field-Naturalists' Club to Cache Bay, on the Ottawa River, about two miles above Hull, P.Q., on May 13 last, the writer was fortunate enough to capture two salamanders, *Amblystoma punctatum* (the spotted salamander), and *Amblystoma Jeffersonianum*, as well as a newt *Diemictylus viridescens*. The habits of the salamanders have since been observed. They were all placed together in a box, with a screen netting on the top, and with damp earth, moss, and rotten wood in one corner. Under this they crept and have since remained, (with the exception of the newt) apparently much at home.

The newt refused to eat from the first and died in July, but the salamanders readily ate earth and other worms, crickets, house flies, and other soft insects. They refused however to eat small grasshoppers, spiders, and insects with hard wing covers, such as the Lady Birds and other small beetles. Dead worms left in the box were not eaten, but on one occasion a small strip of fresh pork, moved to imitate the action of a live worm, proved sufficiently attractive to one of them. Like many of the lower forms of vertebrates, salamanders can live without food for several weeks with apparently no discomfort; then they make up for lost time by gorging themselves. This was proven on one occasion when, after being without food for about five weeks, each ate three angle worms before they were satisfied. They began by catching a worm near one end and then by a succession of quick snaps taking a fresh hold, each time about one-fourth of an inch ahead, they gradually swallowed it. These movements were very rapid but the interval between bites varied and sometimes they waited as long as half a minute before continuing. On one occasion the two salamanders took hold of opposite ends of a very large angle worm and began to devour it, each being apparently ignorant of the other's action until they approached each other near the middle of the worm; then each pulled and jerked but could not loosen each other's hold. Neither had they strength enough in their jaws to sever the worm with their teeth. When about half an inch apart, after much backward jerking and pulling, the smaller one, (*A. Jeffersonianum*) suddenly rolled over three times in an effort, no doubt, to twist the worm in two. Not succeeding in this it made a second attempt, rolling over only twice this time, but still without success. These turns were always made to the right and very rapidly. (The alligator resorts to the same practice, but its movements are relatively slow). The second attempt having failed the smaller salamander loosened its hold and the larger one took possession of the worm, even the portion which the smaller one had already swallowed. At another time the smaller one was offered one end of a worm, which it took while the writer held the other end firmly. When it had swallowed nearly the entire worm it pulled and jerked, trying very hard to break or tear it in two. Failing to do this it rolled over and over as it had done on the previous occasion, though a greater number of times, and with such rapidity that the turns could not be counted. In this attempt it was successful.

Both captives have continued to grow, the larger one (*A. punctatum*) having increased from four inches in length, when collected, to five and one-eighth inches at the present time (Jan. 1917), and the other from about three inches to four inches.

CONCERNING SOME ONTARIO CRAYFISHES.

By A. G. Huntsman, B.A., M.B.
Biol. Dept., University of Toronto.
Curator of the Atlantic Biological Station, St. Andrews, N.B.

The crayfish or 'crab' as it is often wrongly called, is abundant in nearly all our waters, but there is comparatively little known concerning the species occurring in Canada and their distribution. As they are used regularly for teaching purposes in our higher schools and are easily captured and preserved, specimens and data as to distribution could readily be collected by anyone interested.

There are considerable difficulties in the matter of identification, owing to the specific differences being slight and often inconspicuous. Those desirous of studying this group of animals I would refer to the works of Faxon (A Revision of the Astacidae. Mem. Mus. Comp. Zool. Harv., vol. X, No. 4, 1885) and Ortmann (Proceed. Amer. Phil. Soc., vol. XLIV, p. 91, 1905)* for keys for the determination of the species.

*Also "The Fresh-water Malacostraca of Ontario" in Contr. Canad. Biol., Suppl. 47th Ann. Rep. Dep. Marine and Fisher., Fisheries Branch. 1915.

I shall be very glad to receive any information concerning our crayfishes or to assist anyone in the identification of specimens. Whenever possible, specimens should be kept, together with records of the locality and habits.

All our crayfishes east of the Rocky Mountains belong to the genus *Cambarus*, and we have at least eight species. The most interesting ones are those that dig out burrows for themselves in the mud. The material excavated is usually left at the opening of the hole as a 'chimney' of mud, which may be several inches in height. These 'chimneys' are frequently seen in low ground or on the banks of streams.

Recently I took occasion to investigate some of these burrows that are quite abundant in the clay banks of the Twenty-Mile Creek, near Tintern, in the Niagara Peninsula. The species that inhabits these burrows proved to be *C. immunis*, which has not previously been recorded from Canada. It is abundant in Ohio, southern Michigan, and farther south and west. The present record places it in the drainage area of Lake Ontario.

All the specimens very evidently belonged to *C. immunis*, but without exception they showed the presence of small lateral rostral spines, which are only occasionally found in this species. In this respect they agree with Faxon's variety *spinirostris*. The excavation at the base of the movable finger of the large claw was not invariably present, being absent on one or other side in three specimens (two males and one female). This species is most easily recognized by the condition of the first pair of abdominal legs of the male. The two branches of each leg are long and slender and curved so as to form at least one quarter of a circle.

The banks of the stream, where the burrows were situated, were of a stiff blue clay. I believe that the stream never becomes wholly dry. There is not then the same necessity for the crayfish to burrow, as in the case of those inhabiting swamps and pools that become dry in the summer months. Ponds and ditches of this sort are given as the usual habitat of this species.*

None of the burrows showed well-formed chimneys when I examined the spot (September). They had apparently been destroyed by passing animals or by the weather. The burrows were not built in any regular fashion, but varied greatly. Each had either one or several openings. The openings were sometimes all on the bank above water, at other times some above and some below, and apparently, sometimes all below. The level of the water varies during the season and at times all the openings would probably be exposed.

The length of the burrows varied from half a foot to several feet. Sometimes they were nearly straight, but usually they were quite

*See Harris, Amer. Natural., vol. 35, p. 187.

tortuous. Their direction varied from horizontal or slightly upward to vertically downward.

I was not able in any case to demonstrate a special shelf on which the animal rested, although the end of the burrow or of one of the side branches might be enlarged into a chamber.

Sometimes the crayfish was easily caught without digging out the entire burrow. If the entrance were opened out, and the open hand placed in it in the muddy water, the crayfish usually came up into my hand in a few minutes.

The irregularity in the burrows is doubtless due to the burrows having been constructed in different seasons and at times of different water levels. Separate burrows would frequently become connected into one, thus giving more than one opening. The variation shown in the direction of the burrow would be caused by local differences in the nature of the bank, the presence of stones and other hard materials.

Burrows in the bed of a small stream running into the Credit River near Port Credit, were found to contain the large species, *C. bartonii robustus*. In this case also, there was no regularity in the mode of construction. The majority of the openings were in the middle of the bed of the stream and under water. This species does not ordinarily burrow, but is to be found underneath large stones. The scarcity of stones and the small size of the stream (drying up at times?) doubtless forced the crayfish to burrow.

BIRD NOTES.

OCCURRENCE OF THE RING-NECKED PHEASANT IN THE VICINITY OF MONTREAL.

At Dumouchel's taxidermy shop, on October 10, I saw a male Ring-necked Pheasant in the flesh, which had been shot at Ormstown, on October 8, by Mr. Dionne. Another bird seen at the same time, concerning which I could obtain no data, was probably shot in the vicinity of Montreal. The necks of both birds were distinctly ringed with white. These are the first records I know of for this locality.

BIRDS AFFECTED BY ARTIFICIAL LIGHT.

St. Lambert has recently acquired a new system of street lighting which makes the streets much brighter than formerly. About 9 p.m. on November 2, I heard a commotion in a maple tree and discovered two European Sparrows amongst the foliage. I watched them for several minutes, moving about and chirping quite naturally in the brilliant glare of a neighboring lamp, with no apparent intention to retire. It is well illustrated, in the 'gay white ways' of cities, how man has been induced to turn night into day, but this is the first instance I have noticed amongst day-feeding birds. Perhaps it is natural that the adaptive 'sparrow' should be the first to adopt this bad habit. L. McI. TERRILL, St. Lambert, Que.

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NOTES ON SOME OTTAWA DISTRICT PLANTS.

By W. Hague Harrington, F.R.S.C.

My former contributions to The Ottawa Naturalist having been chiefly of an entomological nature, it may appear presumptuous for me to offer a botanical one, but the following explanation may serve as my excuse and apology. About ten years ago it became evident that the insect studies, to which much of my spare time was then largely devoted, would be materially aided by a fuller acquaintance with the flora of the district. The identification of plants on which insects were captured would then be speedier and more satisfactory, and errors would be avoided to a greater degree. A partial knowledge of our flowering plants had already been obtained at outings and botanical meetings of The Ottawa Field-Naturalists' Club, and more especially from rambles with Prof. Macoun and the late Dr. Fletcher. The latter had been my instructor and co-worker since 1877 in these studies and his wide knowledge of botany was ever at my disposal in any difficulties. It seemed, however, time to have a more systematic knowledge of our plants, and a collection of them for reference. During all available time for several seasons close examinations were made of the surrounding district, especially the section northward from the Ottawa river to Aylmer, Kingsmere, Chelsea and beyond. The resulting collections eventually included nearly all the plants of the Flora Ottawaensis, and the majority of them were examined and had the determinations verified by Fletcher. Some species afterwards collected, especially grasses, were kindly named by Prof. Macoun and J. M. Macoun. On the issue of Gray's New Manual of Botany, the collection was arranged and labelled in conformity therewith, and a list was kept of some species which seemed of special interest. The list, with some notes, was then intended for publication in The Ottawa Naturalist, but was withheld in view of the proposed issue of a revised Flora Ottawaensis. That has not yet appeared and it is hoped that these notes may still have some interest and possible value. The subjoined list of fifty species includes some unrecorded ones, which our botanists may have also collected, as well as some of the rarer forms, and some plants which may have become extinct, or which are disappearing through the destruction of their habitats. The most interesting and attractive collecting grounds were those among the rocks and ravines of the Kingsmere hills. It was to King's Mt. that the first delightful excursion of the Ottawa Field-Naturalists' Club was made, on May 22, 1879, and although nearly two-score summers have since enriched the varied scenes, there still survive some of those who enjoyed that enthusiastic outing. Yearly since then some have climbed the winding path to the mountain top and garnered fresh treasures, but still there remain discoveries to reward the careful seeker. It is above all a place for outlook and meditation, where from the bald rocks of the summit, or the shade of some fair tree, one may gaze forth over the farspread plain below, with its farms and hamlets, and the towers of the busy city beyond the river, and try to picture and realize the wonders of the primeval ocean that beat about its base in the days of yore.

Selaginella rupestris (L.) Spring. Creeping Selaginella.

On dry rocks on the summit of King's Mountain, Kingsmere, P.Q.; collected on Sept. 11, 1910, being then much dried up. This moss-like humble plant occurs in similar situations along the high western escarpment of the mountains. In 1914, it was observed to be abundant on the rocky slopes of the Okanagan hills opposite Peachland, B.C.

Isoëtes echinospora Dur. (?) Quillwort.

Somewhat abundant on marshy river front (much trampled by cattle) near Deschenes, P.Q., Aug. 1, 1908.

Isoëtes sp.

A smaller plant, but possibly the same species, growing in Meech Lake, P.Q., in water over one foot in depth; Aug. 19, 1906.

Eriocaulon articulatum (Huds.) Morong. Pipewort.

At Lake La Peche, P.Q., (locally known as Wilson's Lake) an emersed form of this species was collected on July 17, 1910, on a sandy shore, the fruited stems being from two to four inches high. Nearby was a turtle's nest containing a large number of empty eggs. The usual form of this pipewort was abundant in Meech Lake, Aug. 14, 1910, in water varying in depth from one foot to three or four feet. The stems generally projected above the water several inches and at the water line were thickly encrusted with a black band an inch or more wide composed of the eggs of some aquatic insect. In the adjoining Harrington Lake, usually miscalled Mousseau's Lake, the plant grows in still deeper water with flowers floating on the surface.

Mediola virginiana L. Indian Cucumber-root.

This plant attracts attention by its tall floculent stem with a central whorl of large pointed leaves, usually about six in number, and a terminal whorl of smaller leaves from which depend the small lily-form flowers on slender pedicels. The most prolific localities for it are the rich woods of the Laurentian Hills. Kirk's Ferry, P.Q., flowers and fruit, July 6, 1905; Cascades, P.Q., flowers, June 19, 1906.

Habenaria flava (L.) Gray. Small Pale Green Orchis.

The habitat of this plant is a marshy river-front where its pale green spike of blossoms is inconspicuous amid the sedges and other plants among which it is dispersed. On July 5, 1906, it was found in some abundance on the shore near the Country Club, P.Q., and on July 21, 1907, in the same locality it was less numerous, having been badly trampled by cattle which seek the river either to drink or stand in the water, and destroy much of the littoral vegetation.

Habenaria psycodes (L.) Sw. Smaller Purple-fringed Orchis.

The tall purplish spikes of bloom appear some seasons in great abundance and beautify the low meadows and roadsides which are their usual habitat. The Beaver Meadow, Hull, P.Q., was often richly adorned in July with these charming plants but, alas! the devastation and ravages of the extensions of Hull are fast destroying the beautiful scenes to which the Field-Naturalists' Club frequently resorted to study the rich fauna and flora. The winding creek overshadowed by stately elms, with all the wealth of bloom which made gay the luscious meadow, and the many rare plants, which combined to make this area so enticing to the botanist and constituted it a profitable collecting ground for the entomologist and a rich reserve for the bird lovers, are vanishing. Collected at Chelsea, P.Q., July 9, 1905, and Hull, July 15, 1905.

Habenaria fimbriata (Ait.) R. Br. Large Purple-fringed Orchis.

This species is distinguished from the preceding by its larger and paler blossoms and is much more local and rare. The best locality known to me was a small area of springy ground near a cedar swamp in the deep woods north of Chelsea, but this habitat will probably have been destroyed by the fires which followed the cutting down of the beautiful forest. Instead of grateful shade and lovely woodland vistas, there are left the crumbling rocks denuded of soil and desolate with the blackened trunks and stumps of the forest monarchs. Plants collected in the locality described on July 1, 1906, and July 7, 1907. An unusually large and massive spike was found on July 1, 1906, on the edge of the railway ditch near Kirk's Ferry. Unfortunately these beautiful flowers do not preserve their colours well when dried, and do not make such attractive sheets as those of Pogonia, Calapogon and Arethusa.

Spiranthes lucida (H. H. Eaton) Ames. Wide-leafed Ladies' Tresses.

This is one of our rarest orchids and only two plants were found. The first was in flower on July 2, 1905, on the wet river-front below the Victoria Hotel, Aylmer, P.Q., but the habitat has since been destroyed. The second plant grew by the brookside near Old Chelsea and was collected Sept. 20, 1908, withered but still retaining some of the seed-filled ovaries.

Spiranthes cernua (L.) Richard. Nodding Ladies' Tresses.

This is the most fragrant of our Ladies' Tresses, growing in cold wet soils and blooming late in the autumn. It was formerly common in the old gravel-pit at Britannia, Ont., and of recent years was abundant in a swampy meadow lying between the Kingsmere hills and Simmon's Corners, P.Q. Collected Britannia Sept. 20, 1905; Kingsmere, Sept. 6, 1909.

Ranunculus aquatilis L. var. *caespitosus* D.C. White Water Crowfoot.

This dwarfed and small-flowered emersed form of the water crowfoot was common Sept. 19, 1908, spreading over the mud flats, exposed by the low water of that year, along the shore below the Country Club. The common immersed form var. *capillaceus* D.C. was also abundant in the stream.

Dentaria laciniata Muhl. Cut-leafed Toothwort or Pepper-root.

This plant, as listed in the Flora Ottawaensis, was collected in a limited area at Beechwood, Rockcliffe, near the Cemetery, and I obtained specimens there on May 13, 1906. A second locality for this species was discovered in the woods near the angle of the road which branches toward Old Chelsea as one comes cityward from Kirk's Ferry, May 26, 1906.

Cardamine parviflora L. Small-flowered Bitter-cress.

The only example observed of this little species was collected, July 4, 1909, on the rocky western summit of King's Mountain, Kingsmere.

Podostemum ceratophyllum Michx. River Weed.

The afternoon and evening of September 14, 1908, were spent by me at the Experimental Farm with Fletcher in entomological and botanical work and conversation, etc., during which he gave me directions for finding the habitat which he had discovered for the River Weed. Little did I then think that these would be the last of the innumerable pleasant and profitable hours in which I had the privilege of enjoying the genial companionship, the over-flowing hospitality and the unlimited assistance and encouragement of my gifted and lovable friend and teacher. Two days later, September 16, 1908, specimens of the plant were obtained in the Brewery Creek, Hull, almost opposite the pork factory. They were about two to four inches high but so covered with slime and dirt that it was almost impossible to make decent herbarium specimens from them. This was a year of exceptional low water in the Ottawa river, which afforded good opportunities for obtaining the littoral and aquatic plants. On September 19, while collecting along the shore near the Country Club, it was found that the rapids were so low that one could pass dry-footed, by stepping stones, to the islands. The whole channel bottom of boulders was covered with a luxuriant growth of river weed vastly different from that in Brewery Creek. Here the plants were clean and vigorous, averaging perhaps a foot in height and with terminal clusters of larger seed capsules. At this time a new concrete dam was being constructed above the Chaudiere Falls and the water was entirely diverted, leaving the river bottom exposed right to the brink of the ledge over which the torrent plunges. An opportunity was taken, November 22, to inspect the curiously split and water-worn ledges of limestone which the rushing floods of spring and the heavy ice formations of winter are always changing and wearing away. The whole river bottom, right to the brink of the chasm, was carpeted with river weed, but the plants were so dwarfed by the swift current as to be only from one to three inches in height

Potentilla arguta Pursh. Tall Cinquefoil.

The only locality known to me for this, the largest and coarsest of our cinquefoils, is on the top of King's Mountain, where it was collected in fruit August 1, 1909, and in flower June 19, 1910.

Potentilla recta L. Rough-fruited Cinquefoil.

One specimen taken at Meech Lake, September 26, 1908, apparently an accidental seedling from some garden. A second example was found on the sloping canal bank of the Driveway, near the resident of the Papal Ablegate, May 29, 1909, which also was an evident straggler.

Potentilla tridenta Ait. Three-toothed Cinquefoil.

While examining the rocky western summits of King's Mt., on August 1, 1909, it was with much surprise and genuine delight that this lowly plant, as yet unrecorded from the district, was found established in crevices of the rocks. Though not abundant the plants immediately recalled my native shores of Cape Breton, where many dry barren slopes are profusely clothed by the stiff, dark-green foliage and starred by the innumerable small white flowers. When discovered the plants were in fruit, but flowering examples were obtained June 19, 1910.

Geum virginianum L. Rough, or Virginian Avens.

This is a coarse bristly plant with whitish flowers, a clump of which was found in the upper part of the Beaver Meadow July 9, 1908. It was also collected in a field below the Golf Club on July 11, 1908.

Trifolium arvense L. Rabbit-foot, or Stone Clover.

This dull-foliaged plant, with silky flower heads looking more like pussy-willow catkins than the honey-laden clover blossoms that brighten and perfume our fields, is listed in the Flora Ottawaensis as found in a field at Billings' Bridge, and it is stated to be rare. The only locality which I have found for it is a field of sandy gravelly soil adjoining the C.P.R. track between Aylmer and the Park, where it was abundant August 2, 1909.

Geranium Bicknellii Britton. Bicknell's Crane's-bill.

Near Skead's Mills, September 2, 1905; Britannia, June 1, 1906, flowers; top of King's Mountain, August 1, 1909, fruit.

Rhus canadensis Marsh. Fragrant Sumach.

This shrub was originally collected near Tetreaultville, P.Q., where all the individuals forming a considerable patch were thought by Dr. Ami to be parts of the same plant, having only staminate flowers and no seedlings. It also grows on the top of King's Mt., the shrubs being younger than those at Teatreaultville. Collected July 25 and August 1, 1909, and in flower May 8, 1910.

Elatine americana (Pursh.) Arn. Waterwort. Mud-purslane.

This is a diminutive plant, almost microscopical in its dimensions, which grows on the muddy margins of pools, etc. I have specimens collected by Fletcher at Brigham's Creek, Hull, in September, 1893. A good series was obtained, July 23, 1908, at Cache Bay, near Hull, on the soft mud flats laid bare by the unusually low water. The plants are firmly rooted and have to be taken up with a knife and then have the adhering mud washed off before they can be pressed.

Panax quinquefolium L. Ginseng.

In the three localities mentioned in the Flora Ottawaensis for this plant, to which the Chinese attach such an excessive medicinal value, it is now extinct. The best locality was in Powell's Grove, south of the railway track, about where Powell Avenue is now, well toward the centre of the city. The plant appears to be very rare and to occur only in the shade of rich woods. A fine specimen with its striking bunch of bright red fruit, was found in the wood north of Chelsea, September 18,

1909. During the past summer, 1916, I had the pleasure of seeing at Hudson Heights, P.Q., a quantity of ginseng, which was being grown by Mr. Girdwood, of Montreal, under the shelter of cheesecloth, and which was producing a good crop of roots and seeds.

Sanicula trifoliata Bicknell. Large-fruited Snakeroot.

Distinct by its elongate fruit and thinner foliage, making it the most pleasing of our sanicles. It was not uncommon in the rich woods beyond Chelsea, where collections were made July 1 and 22, 1906, and July 5, 1908.

Cornium maculatum L. Poison Hemlock.

This plant of ill repute grows several feet high and its delicate fern-like foliage and broad panicles of minute white flowers make it the handsomest of our umbelliferæ, or parsley family. A patch of vigorous specimens existed for some years on the roadside at Kingsmere, but has now been eradicated. There is another large patch of it about half way across the hills by what is known as the Hermit's Road. Chelsea, September 15, 1907; Kingsmere, August 5, 1908.

Cornus paniculata L'Her. Panicled Cornel.

This dogwood is of upright growth, with oblong, pointed leaves, paler beneath, and numerous cymose panicles, making a handsome ornamental shrub. On limestone ledges, margining the upper Beaver Meadow, Hull, in full flower June 29, 1906.

Pyrola asarifolia Mich. Liver-leaf Wintergreen.

In ravines of coniferous woods, Kirk's Ferry, July 9, 1905.

——— var. *incarnata* (Fisch.) Fernald. Swamp Wintergreen.

Leaves round, instead of kidney shape at base; flowers brighten pink; on mossy hummocks in swampy ground, among larches, west of Kingsmere hills; June 26, 1910; June 29, 1912.

Calystegia spithamens L. Low Bindweed.

This somewhat rare convolvulus is very different in appearance from the abundant large-flowered species which trails and climbs extensively over roadside fences and shrubberies. The leaves are oblong and, with the stems, are covered with pubescence, which gives them a greyish colour; the growth of the plant is upright, instead of trailing and it also seems to prefer dry sandy, or rocky, soils. On winter road through woods at Lake LaPeche, P.Q., July 17, 1910, and on island in Blue Sea Lake, P.Q., July 24, 1910.

Myosotis arvensis (L.) Hill. Mouse-ear. Field Scorpion-grass.

This small forget-me-not has been growing in my yard since July 1908. It apparently was introduced by debris emptied from my vasculum, although the plant had not been collected or observed by me elsewhere in the district.

Echium vulgare L. Viper's Buglos. Blueweed. Blue Devil.

When the Flora Ottawaensis was issued this plant was noted as "gradually becoming a troublesome weed." It has since spread with great rapidity in all directions, especially in dry or stony soil and well deserves its name of blue devil. Occasionally the flowers are pinkish and such plants have a more pleasing aspect.

Dracocephalum parviflorum Nutt. Dragon Head.

On gravelly shore near Aylmer Park, August 5, 1905, and in open rocky woods, top of King's Mt., larger plants August 1, 1909.

Hedeoma pulegiodes (L.) Pers. American Pennyroyal.

Fletcher recorded this plant as found in "rich wood Billings' Bridge, very rare." It was one for which I was specially on the lookout for several years without success. On June 14, 1916, while I was walking leisurely from Chelsea to Kingsmere, and about half way from Old Chelsea to the lake, a patch of bright colour, not far from the roadside, attracted my attention. On examination it was found to be *Hedeoma* growing thickly over an area of some twenty feet or so square. Nearly every summer this pleasant hillside road had been frequently traversed and a sharp lookout kept for insects, birds and plants. It seemed scarcely possible that the little mint should have been overlooked, although when not in bloom it would be inconspicuous. From the area occupied it would seem to have been colonized for some time.

Pycnanthemum virginianum (L.) Durand & Jackson. Virginian Mountain Mint.

Several specimens were found October 20, 1906,, in a dry field, between the Ottawa Golf Club, P.Q., and the river. The plants were about two and one-half feet high, with small lanceolate leaves and large-fruited corymbs.

Verbascum Blattaria L. Moth Mullein.

Dry pasture, Billings' Bridge, August 19, 1905. Slopes at north end of Fairy Lake, P.Q., July 25, 1908. Common along roadside near Buckingham, P.Q., July 1912.

Penstemon hirsutus (L.) Willd. Hairy Beard-tongue.

On talus under limestone cliff, Cache Bay, Hull, in flower, June 9, 1906. On limestone ledges, Tetreaultville, P.Q., in flower July 11, 1906. Among the rocks on top of King's Mt., fruited July 25, 1909, and common in same locality in full flower June 19, 1910.

Mimulus moschatus Dougl.

In 1908 this plant, so easily recognized by its soft, pubescent leaves, and sweet musk-scented yellow tubular flowers, was found well established in cold springy ground bordering a streamlet that crosses the road at Kingsmere and flows down toward the Gatineau through a wooded ravine. Occasional specimens occurred along the stream for about a mile. As to this plant being indigenous, or introduced, in the East is uncertain and at Kingsmere it may have become established by garden escapes or seeds carried down by the brooklet, which flows by a couple of farms. The species is native to British Columbia, and Macoun in his Catalogue of Canadian Plants, vol. 1, p. 358, says of it: "Certainly a garden escape in N.B." Britton & Brown, in recording eastern occurrences give them as "Adventive from the Pacific Coast." Gray's Manual gives it as found in "Damp soil, especially by cold streams, Newfoundland to Michigan; abundant in the Rocky Mountains, whence perhaps introduced." The Kingsmere plants were still growing and blooming last summer, although they had been much destroyed by the trampling of cattle around the water. Specimens collected September 20, 1908, and July 4, 1909 .

Gratiola aurea Muhl. Golden Hedge Hyssop.

Rather abundant on muddy shore, among rocks, on point in Ottawa river, near Deschenes, P.Q., August 26, 1905. On river shore, Hull, near C.P.R. bridge, August, 1908.

Veronica arvensis L. Corn Speedwell.

Specimens from Fletcher are labelled "Roadside, Gilmour's Grove, Chelsea, P.Q., June 8, 1901." Mine were collected on dry rocky ground about half-way between Fairy Lake and Hull, June 6, 1909.

Lonicera caerulea L. var. *villosa* (Michx.) T. & G. Mountain Fly Honeysuckle.

In spruce woods bordering the peat swamp, Mere Bleue, Carlsbad Springs, Ont , on July 18, 1905, with ripe fruit. A shrubby plant with lightly pubescent twigs; leaves oblong and thickish; twin fruits coalescent into one large blue berry, stated in Gray's Manual to be edible.

Lonicera oblongifolia (Goldie.) Hook. Swamp Fly Honeysuckle.

Recorded in Flora Ottawaensis from "Peat Bog, Mere Blue. Rare." It grew, however, nearer home, as I found it in fruit in Dow's Swamp on June 24, 1905. The leaves are broadly oval or oblong with a bluish tint; fruit small, purplish, coalescent or semi-coalescent.

Triosteum perfoliatum L. Feverwort. Horse Gentian. Tinker's Weed.

My search for this plant was void until it was found in fruit on October 3, 1909, at Kingsmere. Flowering examples were taken June 19, 1910, in the same locality. The plant is of coarse growth, with much of the appearance of a milkweed. The flowers and fruits are situate at the axils of the leaves, and this, combined with the stout stems, makes it difficult to produce good herbarium specimens.

Viburnum pubescens (Ait.) Pursh. Downy Arrow-wood.

Rocky open woods, top of King's Mt., in fruit July 25, 1909.

Lobelia spicata Lam. Pale Spiked Lobelia.

Several examples found growing in hay-field in Beaver Meadow, Hull, July 14, 1905, and a few in a hayfield near the railway station at Chelsea, July 5, 1908. Extinct in both habitats through subsequent cultivation.

Lobellia Dortmanna L. Water Lobelia.

Taken by Fletcher in Mud Bay, Meech Lake, but searched for there unsuccessfully for several years, failure to find the plant being probably due to its not being in flower and still below the surface of the water. On August 7, 1912, I found this plant growing profusely, in full flower, in water two to three feet deep with gravelly bottom, in the Forks Lake, a few miles from Sydney, N.S.

Eupatorium perfoliatum L. Thoroughwort. Boneset.

Examples of this common boneset were found August 7, 1905, growing along a ditch at Kirk's Ferry, with whorls of three connate perfoliate leaves in place of the usual two opposite ones. The extra leaf adds much to the symmetry and beauty of the specimens. Other examples of the same triperfoliate form have since been observed on several occasions in swampy ground nearer Chelsea.

Solidago latifolia L. Zigzag, or Broad-leafed Goldenrod.

This species appears to be rare and has been found only in a wet cedar wood near Hull, between the Aylmer road and the river, September 16 and 28, 1905. The broad sharply saw-toothed leaves and the racemose spikelets of flowers arising from the leaf axils of several terminal inches of the stem make this a handsome goldenrod.

Antennaria fallax Greene. Everlasting. Pussy's Toes.

This species is not given in the Flora Ottawaensis or in Macoun's Catalogue of Canadian Plants, but I have a specimen collected by Fletcher at Rockcliffe, June 11, 1904. It seems to be well established on the top of King's Mt., near the signal station. Possibly this is the species recorded as *plantaginifolia* in the Flora Ottawaensis.

Helianthus divaricatus L. Rough, or Woodland Sunflower.

Under the record of *H. annuus,* as an escape from cultivation, Fletcher says, "It is rather remarkable that we have so far found none of the native Helianthi wild in this locality." This absence was often discussed by us because we had received, in

1885, from Mr. Wm. Bowles, of Montreal, numerous examples of a tortoise-bettle, *Physonota unipunctata* Say, which he had taken feeding on such plants. We were anxious to ascertain whether the beetles occurred here, but never during Fletcher's lifetime could find any sunflowers. The next summer, while exploring the summits of King's Mt., August 1, 1909, not far from the signal station, I was greatly surprised, as well as delighted, to find in full bloom many of these conspicuous flowers which were scattered over the western rocky front of the mountain. They have been abundant each season, but so far the beetles have not appeared It is strange that we should so often have visited the mountain and that, at such a short distance away, these long-sought flowers must have been blooming unseen. The species had evidently been established many years earlier and I find that Macoun in his Catalogue of Canadian Plants records it as found by Billings at Chelsea, and that the McGill Coll. Herb. contains examples from the vicinity of Ottawa.

Bidens Beckii Torr. Water Marigold.

This is an aquatic form of beggar-ticks, which the Flora Ottawaensis gives as "Not uncommon in the Ottawa and Rideau rivers, but seldom flowering." In the canal, not far from Hartwell's Locks, flowers were abundant September 7, 1908.

Chrysanthemum Parthenium (L.) Bernh. Feverfew.

This is evidently a garden escape which became established along the roadside at Kingsmere, but it is of interest in connection with the occurrence of the musk flower previously mentioned, as it was found July 4, 1909, at some distance down the ravine through which the brooklet flows. Growing in the shade of the trees and in wetter soil the plants were taller, more spindly, and with thinner foliage.

Petasites palmatus (Ait.) Gray. Sweet Coltsfoot.

I can remember when this plant grew in the swampy enclosure of the old race-track at Powell's Grove, on the Glebe property, and May 1, 1906, Fletcher gave to me flowers grown at the Experimental Farm from plants gathered years before in the locality mentioned. My friend Mr. Frank Latchford (now a Judge) subsequently informed me that he had found the plant growing in a swamp near Simmon's Corners, P.Q., but I could not find the location until June 29, 1912. Leaves only were obtained then and I have not since visited the swamp early enough to collect flowers.

HORNED LARKS AT AWEME, MANITOBA.

BY STUART AND NORMAN CRIDDLE.

There are few small birds better known than the Horned Larks when considered collectively, that is to say, when we merely recognize them as a species without attempting to divide and distinguish them as they have been separated by systematists. We are, for instance, all familiar with the Prairie Horned Lark, or think we are, until its close allies are placed alongside, when few indeed will be able to tell one from another. The fact that these birds have been divided into so many geographical races which are so alike in general appearance, makes them of particular interest to students of geopraphical distribution. The systematists have divided them and given them names. It remains for the workers in ecology to confirm or reject this classification by showing that there is, or is not, a difference in life habits. We doubt very much, whether two distinct races will ever possess identical habits and we hold that if these habits differ ever so little, then there is every reason to believe that the animals possessing them are distinct. A difference of a few days in the average date of arrival, the selection of a different situation or kind of locality for breeding purposes should be alone sufficient to demonstrate that there are two races involved. We have a case in point in the local Lapland Longspur migrations. With these birds there are two very marked differences, both as to time of arrival and departure. We have never actually demonstrated by collecting specimens, that there are two races involved, yet there can be little doubt that such is the case. Turning to our Manitoba Horned Larks, we have long realized that there were three or four races present, though it is only within recent times that the senior writer has actually shown this to be so by the collecting of examples. These specimens have been determined through the courtesy of Dr. Henshaw, by Mr. Oberholser of the U. S. Biological Survey, to both of whom the writers are under many obligations.

We have, so far, been able to recognize four horned larks in the vicinity of Aweme, Manitoba, namely: the Prairie Horned Lark, *Otocoris alpestris practicola;* Oberholser's Horned Lark, *O. a. enthymia*, the Pallid Horned Lark, *O. a. arctica*, and the Hoyt Horned Lark, *O. a. hoyti*. Of these the first two are summer residents in the neighbourhood, while the latter have only been noted as migrants.

PRAIRIE HORNED LARK.

This is the dominant race around the farm yard and seems to take more kindly to the haunts of man than do its allies. In nature it is found breeding in the vicinity of semi-wooded areas; uplands where the grass is sparse and the soil sandy seem to suit it best. It is far less of a true prairie bird than *enthymia* and while it invariably selects open ground for nesting purposes, it is not uncommon to find such nests situated within a few feet of low trees or bushes upon which the males sometimes perch while singing.

The Prairie Horned Lark is the first of all migrants to return from the south and in consequence its arrival is heralded as the first harbinger of spring, a forerunner of the glories to come when animated nature awakens once more from its long winter's sleep. Even Manitobans admit that the winters, while invigorating, are, at times, a trifle long, hence the reappearance of the horned larks is a welcome one. They frequently return to us while the country is still under a mantle of snow but we feel, nevertheless, that their northward movements are impelled by Old Sol's persuasion and that it will not be long before this is demonstrated.

From an examination of records covering 20 years, we find that the first spring arrival reaches us, on an average, about February 22. At times they have been seen much earlier, at others, later. In autumn, the last to leave averages November 16. There are winters when odd individuals may be seen throughout the season, but these are exceptions.

The male horned larks, like so many other birds, arrive well ahead of the females, and until the latter appear remain comparatively quiet, contenting themselves with the daily search for food and with uttering, from time to time, that cheery little song with which we are all familiar. In a little more than two weeks the females appear, altering in a moment the peaceful existence of their mates to be. Individual combats are now of frequent occurrence and continue until both mates and nesting sites have been won. The males now exercise all their powers of song, rising high in the air during the day and at twilight making the whole countryside resound with their characteristic songs. In these efforts they continue as long as there is light and commence again in the morning at the first indication of dawn. To us there are few more cheerful songsters and as they frequently choose a singing perch within a few feet of the house we have every opportunity to judge of their merits.

Nests are invariably sunk into the ground so that their upper edge is little above its surface. At times some beautiful clump of anemonies may hide the young from view, at others there is practically no shelter, the birds apparently depending wholly upon their dull colours to hide them from their enemies. We have found nests with eggs in them about the middle of March and young birds able to fly on April 14. How they manage to survive the snow storms and cold, not uncommon at this time of year, is a mystery. That they do so there is no doubt. As a rule, however, the percentage of young reared in the early season is low and in the first brood one seldom meets with more than a single fully developed nestling, though in later broods three or four are often reared. We find that the average number of broods is three, though at times there may be a fourth. In their domestic duties both birds take an active part, the male not only relieving the female upon the nest but also taking his share in feeding the young. In fact they are an excellent example of true domestic harmony, in as much as each contribute an equal share to the family welfare.

In 1916, a nest of this species was located in a garden among some old dead flowers. It suffered somewhat by being raked over before it was noticed, but was replaced with sufficient care to satisfy the old birds. They were an unusually tame couple and were thus able to be watched without disturbing their daily habits. It was seen that both were equally energetic in tending the young though the male was less frequently found upon the nest, while during the early morning and again in the evening, his musical tendencies overcame his usual domestic thoughts, or perhaps, as seems more likely, the young required less attention at such times, so he devoted his energy to a serenade for the benefit of his domestic little mate. Food for the young was secured close at hand and consisted of a mixed up mass of insect matter, as a rule unidentifiable. From this mass, however, numerous cutworms were seen hanging, from time to time, the identity of which was unmistakable. The female was particularly fearless and would continue her domestic duties while we watched from a few feet away. Thus we often saw her feed the young and likewise fit her body snugly over them afterwards. On June 27 one young bird had left the nest and was followed next day by the remaining one. Neither could fly at this time and both were frequently seen close at hand afterwards.

These birds remain for a considerable time around their homes after nesting and seldom, if ever, gather into flocks or congregate upon the ploughed fields as do other kinds of horned larks.

Oberholser's Horned Lark.

We are less familiar with this bird than with the last and owing to the difficulty of determination, it was longer before we were able to distinguish it in the field. As was to be expected, birds so closely related as the horned larks have much in common concerning habits of living, though it is astonishing how many differences there are when they are studied closely. We shall not attempt to present the habits of this race in detail, as in a general way they resemble those of *praticola*, but will content ourselves by comparing the chief points of difference.

To begin with, *enthymia* is practically a month later in arriving from the south. Then, instead of arriving as odd individuals, as does the Prairie Horned Lark, it comes in flocks varying from seven to twenty or more, and at the height of the migration in bunches of several hundred. Thus they are soon found in large gatherings upon ploughed fields, where they remain for about a month before dispersing for their nesting grounds. It is, therefore, May before they commence domestic duties, our earliest record for a nest with fresh eggs being May 3. In selecting their breeding grounds these birds show a preference for the larger plains which are well away from trees of any kind. They also nest in colonies like the Chestnut-colored Longspur, in fact the summer homes of these two birds are very similar. The nests of *enthymia* do not differ in any marked degree from those of *praticola*, but they are usually in rather denser vegetation.

Colonies of Oberholser's Horned Larks have been known to us for a number of years situated on a small plain north-west of our home. Another lot of almost a hundred have recently taken up their quarters on some deserted fields which they have occupied for the last two years.

The fact that this race is gregarious seems to account for the individuals being less pugnacious than the Prairie Horned Lark, and perhaps, also, for their being less musical. Our observations indicate that they rise less high in the air while singing and that their song is softer and the notes less distinct. On account of their lateness in commencing to nest it does not seem probable that there are more than two broods in a season. Nor do the birds remain as long upon their breeding grounds, but as soon as the nesting season is over they return to the ploughed fields, where they are joined later on by other kinds and so become hopelessly mixed from a naturalist's point of view.

Thus it will be seen that while these two breeding races are extremely difficult to tell apart, their habits are such as to leave no doubt as to their distinctness.

THE PALLID HORNED LARK AND THE HOYT HORNED LARK.

Of the Pallid Horned Lark—*arcticola*—and Hoyt Horned Lark—*hoyti*—we have little to write. They are, so far as we know, both migrants only, and pass to other parts for nesting purposes. They usually arrive within a few days of each other and with the Lapland Longspurs in large flocks about April 6. Soon the ploughed fields are swarming with them and their value as destroyers of noxious weed seeds must be considerable. At this time they are somewhat secretive. They nearly always run in a crouching attitude and squat down flat at the least alarm, when their colour resemblance to the surrounding landscape makes them almost invisible from a short distance away. The squatting action also prepares them for a spring upwards and as one rises, in alarm, the others quickly follow, so that in a moment thousands of birds are in the air rapidly darting up and down. Then suddenly they drop onto the field again and all is quiet as before.

It is an interesting sight to see these birds, in company with thousands of Longspurs, circling for miles around some large hawk, though their object in doing so is a mystery and seems to be almost ignored by the hawk. Their music, as they fly around in millions, fills the air, producing an effect which is long remembered. Both Horned Larks and Lapland Longspurs may also be seen to rise some 30 feet, uttering as they drop a short song. It is evident, however, that this is only a prelude to what is to come when the birds reach their true homes.

NOTES.

Over seven hundred fragments of pipes made of pottery have been counted among the finds made in the prehistoric Iroquoian Indian site at Roebuck, Ontario, by Mr. W. J. Wintemberg, who explored there for the Geological Survey in 1912. Wagon loads of pottery and some charred corn and beans, but only four arrowheads chipped out of stone, being found here among other finds, suggest that the prehistoric inhabitants were apparently agriculturists who did not hunt and fight as much as we are generally led to believe that the Indians did. Over eighty graves were found, but only one contained anything besides the skeleton, the custom apparently being different from that among many other kinds of Indians.

An aged Maya Indian woman from near Progresso, Yucatan, is residing in Ottawa, undoubtedly the only person in the Dominion who can speak Maya. The Mayas are the remnants of the tribe that is believed to have built the most beautiful of the ruined cities of Mexico and Central America—the finest architecture of the New World.

Oyster and quahog shells were found by Mr. W. J. Wintemberg in exploring a shellheap on Mahone Bay, N.S., for the Geological Survey of Canada. The oyster and quahog have not been known to live on the southeastern or outside coast of Nova Scotia since the region was first visited by white people. The finding of these shells consequently suggests that the heaps are of considerable antiquity and is of interest to the students concerned with these shell fish as indicating that at least these two species formerly lived in the waters near Mahone Bay. While the Indians may have carried dried oysters and clams for some distance, it is hardly likely that they transported them in the shells or that they carried the shells from a distant place, especially since we do not find these particular shells were used by the Indians in this vicinity. In fact the Indians who left the shellheaps of the eastern coast of Canada did not use shell to any very great extent.

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NOTES ON THE BOTTOM ENVIRONMENT OF THE MARINE INVERTEBRATES OF WESTERN NOVA SCOTIA.[1]

By E. M. Kindle.

During the summer of 1914, a study of the relationship of the bottom materials to the composition of the faunas living upon them in the shallow coastal waters of western Nova Scotia was undertaken by the writer assisted by Mr. E. J. Whittaker. At the time the report [a] on this work was written only the pelecypods and gasteropods collected during the progress of this work had been determined. The remainder of the fauna which was referred to Dr. Paul Bartsch of the U.S. Nat. Mus. for identification has since been studied by Dr. Bartsch and other specialists. The resulting list of species includes at least one species,—*Libinia emarginata* Leach,—not previously known in Nova Scotian waters. The following list which I am able to prepare through the courtesy of Dr. Bartsch is offered as a minor contribution to our knowledge of the bathymetric range and the bottom environment of the several species which were collected. For the sake of completeness the present list is made to include the pelecypoda and gasteropoda which were listed in the writer's earlier paper.[b]

The character of the bottom at each collection station is indicated in the following list of stations.

Collecting Stations.

Sta. No. 1. Digby, N.S., Intertidal zone, boulder strewn beach.

2. Digby, N.S., 300 to 400 yards east of Government pier in 2 fathoms. Soft black mud bottom.

3. Digby, N.S., 3 to 4 miles N.E. of Digby, Outer margin and inside of bar running S.W. from Bear Island; in 3 to 6 fathoms. Collection nearly all from muddy sand.

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1. Published with the permission of the Director of the Geological Survey of Canada.

a. E. M. Kindle, Bottom control of Marine faunas as illustrated by dredging in the Bay of Fundy. Am. Jour. Sci. vol. XLI, 1916, pp. 449-461.

b. Ibid.

4. Bear Island, N.E. of Digby, N.S. 4 miles. Intertidal zone, boulder strewn beach.
5. Head of St. Mary's Bay, N.S., Intertidal zone. Beach of sand, gravel and mud.
6. Kingsport, N.S. 1½ miles N.E. of pier. Gravel bottom, shallow water.
7. Kingsport, N.S. Channel opposite Kingsport pier; 1 fathom at low tide; sandy mud bottom.
8. Kingsport, N.S. Intertidal zone. Beach of rocks, gravel and muddy sand (Living shells in pools).
9. Kingsport, N.S. Beach of sand and mud between tides (Dead shells).
10. Mouth of Avon River opposite Chiverie Pt. N.S. 2 to 6 fathoms, rocky and sandy bottom.

The term intertidal zone is used here instead of littoral zone which was formerly in universal use for the zone between low and high tide, because the latter term has in recent years been used by Dall, Grabau and some others to include the marine habitat down to depths of 100 fathoms.

FAUNAL LIST.	Boulders and sand. Intertidal zone.	Black mud.	Sandy mud.	Boulders & gravel. Intertidal zone.	Sand, gravel & mud. Intertidal zone.	Gravel.	Sandy mud.	Gravel and rock. Intertidal zone.	Mud and sand. Intertidal zone.	Rocky and sandy bottom.
	1	2	3	4	5	6	7	8	9	10
PORIFERA.										
Desmacidion palmata Johnston							x			x
COELENTERATA.										
Hydractinia echinata (Fleming)			x							
Monocaulus glacialis (Sars)			x							
VERMES.										
Harmothoe imbricata (Linn) Mob., 3 specimens		x	x							
Lepidonotus squamatus (Linn) Kinberg, 1 specimen						x				
Nephthys caeca (Fabr.) Oersted			x							
Phascolion strombi Montagu, 2 specimens			x							
Sternaspis fossor Stimpson, 1 specimen		x								

FAUNAL LIST	Boulders and sand. Intertidal zone.	Black mud.	Sandy mud.	Boulders & gravel. Intertidal zone.	Sand, gravel & mud Intertidal zone.	Gravel.	Sandy mud.	Gravel and rock. Intertidal zone.	Mud and sand. Intertidal zone.	Rocky and sandy bottom.
	1	2	3	4	5	6	7	8	9	10
MOLLUSCOIDEA.										
Alcyonidium mytili Dalyell			x							
Cribrilina punctata (Haasall)						x				x
Membranipora monostachys (Busk.)						x				x
Membranipora flemingii (Busk)						x				x
Mucronella peachii (Johnston)						x				x
Schizoporella biaperta (Michlin)						x				
PELECYPODA.										
Anomia simplex Orb.										x
Astarte crenata Gray						x				x
Astarte undata Gld.			x			x			x	x
Callocardia morrhuana Linsley						x	x		x	
Cardium pinnulatum Conr.		x	x							
Clidiophora gouldiana Dall			x			x				
Cyprina islandica L.			x							
Cytherea convexa Say—(Callocardia morrhuana Linsley)					x					
Ensis americana Gould					x		x		x	
Epitonium groenlandicum Perry			x							
Lyonsia hyalina Conr.		x								
Macoma balthica L.							x		x	x
Macoma balthica fusca Say					x					
Macoma calcarea Gm.			x							
Macoma sp.			x							
Mactra solidissima Dillwyn (Spisula solidissima)									x	
Modiolaria discors L.										x
Modiolaria nigra Gray									x	
Modiolus fragm.						x				
Modiolus modiolus L.					x	x			x	x
Modiolus plicatula Lam. (M. demissus Dillw.)					x					
Mya arenaria L.	x			x	x	x	x	x	x	x
Mytilus edulis L.	x				x	x		x	x	x

Faunal List	Boulders and sand. Intertidal zone.	Black mud.	Sandy mud.	Boulders & gravel. Intertidal zone.	Sand, gravel & mud. Intertidal zone.	Gravel.	Sandy mud.	Gravel and rock. Intertidal zone.	Mud and sand. Intertidal zone.	Rocky and sandy bottom.
	1	2	3	4	5	6	7	8	9	10
Nucula proxima Say	-	x	x	-	-	-	-	-	-	-
Pecten magellanicus Gm.	-	-	-	-	-	x	-	-	-	-
Periploma fragilus Totten	-	-	x	-	-	-	-	-	-	-
Petricola pholadiformis Lam.	-	-	-	-	-	x	x	-	x	x
Saxicava arctica L. (S. rugosa)	-	-	x	-	-	-	-	-	-	-
Thyasira obesa Ver.	-	x	x	-	-	-	-	-	-	-
Venericardia borealis Conr.	-	-	-	-	-	x	-	-	x	-
Yoldia limatula Say	-	x	x	-	-	-	-	-	-	-
GASTROPODA.										
Acmaea testudinalis L.	x	-	-	x	-	-	-	-	-	-
Aporrhais occidentalis Beck.	-	-	x	-	-	-	-	-	-	-
Bela nobilis Moll	-	-	x	-	-	-	-	-	-	-
Buccinum undatum L.	x	-	x	x	-	x	-	x	-	x
Chrysodomus decemcostatus Say	-	-	x	-	-	-	-	-	-	-
Crepidula fornicata L.	-	-	-	-	-	x	-	x	x	x
Crepidula plana Say	-	-	-	-	-	x	-	x	x	x
Crucibulum striatum Say	-	-	-	-	-	x	-	-	-	-
Cylichna alba Brown	-	x	x	-	-	-	-	-	-	-
Ilyanassa obsoleta Say	-	-	-	-	x	x	x	x	x	x
Lacuna vincta Turton	-	x	x	-	-	-	-	-	-	-
Littorina litorea L.	x	x	x	x	x	x	x	x	x	x
Littorina palliata Say	x	-	-	-	x	-	-	-	x	-
Lunatia heros Say	-	x	x	-	x	-	-	x	-	x
Lunatia triseriata Say	x	-	x	-	x	-	-	x	-	-
Melampus lineatus Say	-	-	-	-	x	-	-	-	-	-
Thais lapillus L.	x	-	x	-	x	x	-	x	x	x
Tritonofusus stimpsoni lirulatus Verr.	-	-	x	-	-	-	-	-	-	-
Tritia trivittata Say	x	x	x	-	x	x	-	-	x	x
Urosalpinx cinereus Say	-	-	-	-	-	-	-	-	-	x
ECHINODERMATA.										
Asterias vulgaris Stimpson 15 specimens	-	-	-	-	-	x	-	-	-	-
Echinarachnius parma (Lamarck) 6 specimens	-	-	x	-	-	-	-	-	-	-

FAUNAL LIST	Boulders and sand. Intertidal zone.	Black mud.	Sandy mud.	Boulders & gravel. Intertidal zone.	Sand, gravel & mud Intertidal zone.	Gravel.	Sandy mud.	Gravel and rock. Intertidal zone.	Mud and sand. Intertidal zone.	Rocky and sandy bottom.
	1	2	3	4	5	6	7	8	9	10
Henricia sanguinolenta (O. F. Muller) 12 speciments						x				
Strongylocentrotus drobachiensis (O. F. Muller) 1 specimen			x							
CRUSTACEA.										
Cancer irroratus Say		x	x			x				x
Hyas coarctatus Leach										x
Leptocheirus pinguis (Stimpson)			x							
Libinia emarginata Leach (new to N. S.) 1 specimen										x
Pagurus acadianus Benedict 41 specimens		x	x							
Pagurus longicarpus Say, 6 specimens shells encrusted with Hydractinia echinata (Fleming)						x				x
Pagurus pubescens Kroyer 2 specimens			x							
CHORDATA.										
Boltenia ovifera (L) 1 specimen Bay of Fundy; collected by fishermen in deep water off Digby										

BOTTOM ENVIRONMENT.

Analysis of the data given in the preceding table will show that different types of sea bottom are occupied by assemblages of animals which are almost as sharply contrasted in composition as are the land faunas of deserts and swamps. On land some plants can live only on wet marshy ground; other groups require dry uplands, and some flourish only on rocky slopes; while over great areas which support a rich flora trees cannot exist. The groupings of land animals is controlled in the same way directly by the character of the soil and indirectly by the plant life which itself is almost wholly influenced by surface physical features. Thus the frog, salamander and turtle which dominate the animal life of the marshes give way entirely to other types on the uplands.

The influence of this familiar and powerful factor,—the character of the soil or rock,—in determining the major features of land biotas, is paralleled by the control which the physical character of the bottom exercises over marine biotas. When marine dredging is conducted with the object of ascertaining the relationship of the various kinds of bottom to the kinds of life living on them, as most of the writer's have been, the association of certain faunal with certain bottom facies becomes clearly apparent. The control exercised by the physical character of the bottom in bringing together certain groups of animals and plants into marine communities and in excluding others is just as effective as is the operation of the physical character of the land surface in producing varied faunal and floral groups.

The distribution of the sponges is one of the interesting features brought out in collecting the fauna listed above. These were found in such abundance on the coarse rocky bottom at the mouth of the Avon river and on the hard muddy sand bottom off Kingsport as to completely fill the dredge in some hauls. On soft mud bottom however, not a single sponge was taken. The molluscoidea also show a strong affinity for hard bottom, five species being taken on gravel and rocky bottom, one on firm muddy sand bottom, and not a single species on soft bottom. The four species of echinoderms taken were all found either on gravel or the comparatively firm sandy mud bottom. The preference of the crustacea for hard or firm bottom is also evident. The seven species listed were all taken either on gravel, rocky, or sandy mud bottom, and but two of them on soft bottom Only two specimens of *P. acadianus* were taken on soft mud bottom and 39 specimens were taken on the sandy mud bottom.

The fauna of the soft mud bottom shown by the list includes thirteen species which are confined to the four groups, vermes, pelecypods, and gasteropods and crustacea. Two of the species were not found outside the limits of the soft mud. The specialized character of the black mud fauna is apparent from the fact that it contains no representatives of the *Porifera*, *Molluscoidea* nor *Echinodermata* The mud bottom in developing its soft bottom facies draws from but four of the eight phyla which are abundantly represented in the region.

When you are in or near the forest this summer, never leave your camp fire until it is absolutely OUT. Never throw away lighted matches or tobacco or pipe ashes. These rules are followed by all veteran sportsmen and good citizens.

MY BIRD HOUSES.

By Clyde L. Patch.

As it will soon be time to construct bird houses, which should be in place a couple of weeks before the feathered tenants arrive, thus giving the newness time to wear off, an account of my last summer's experience may assist and encourage other members of the O. F. N. Club.

Until last spring I had supposed that a martin house was usually in place two or three years before the birds discovered it, or at any rate would nest in it; also, that the person owning the house was particularly lucky, and thirdly that the house must be situated in a large open yard.

Having been requested to furnish bird house plans for manual training work, I built an experimental martin house, with twelve compartments measuring 6 in. x 6 in. x 6 in., each having an entrance 2 in. in diameter the bottom edge of which is 2 in. above the floor. Across the outside of the house and 2 in. below the entrance holes is a 3 in. platform, which forms a landing stage for the parent birds and a play ground for the young when they first venture out.

So, having constructed the house I, one evening, with the assistance of a neighbor, erected it on a twenty foot pole in my sixteen by twenty back yard in the Glebe, (Ottawa) expressing the hope that if the wind didn't blow it down I might get tenants by 1920. Three days later Mrs. Patch informed me that house seekers had been about during the morning, and upon looking out I saw a pair of those beautiful opals of the air, commonly called tree swallows, exploring my apartment house. A few days later they began carrying sticks and straws from all over the neighborhood and alighting promiscuously on the landing platform running under the three top holes, followed their noses straight into the nearest hole, thus building three nests. Seeing that this would never lead to a happy family, I constructed a box 6 in. x 6 in. x 15 in. deep with a landing platform under the 1½ in. entrance hole and the overhanging eave of the sloping roof above it. A day or so after placing this house on a near-by fifteen foot pole, the swallows examined it and after driving off another pair of persistent house-seekers, they abandoned the three nests in the martin house and began house furnishing in the new home. Following a few days of busy stick carrying the feather lining was added, and thereafter for the next two weeks Lady Swallow was seen only a short time each day when she trusted the four transparent and later delicate rose-coloured eggs to the care of Mr.Swallow and fed in the immediate neighborhood.

Then one day to my great delight a martin lit on the martin house, remaining a short time and returning next day with a mate. This pair shortly began nest building in one of the apartments under the eave of the roof. Before the nest was completed another pair had taken an apartment under the eave on the opposite side of the house, which convinces me that eaves are desirable, therefore I intend to put hoods or some sort of protection above all the entrance holes.

Before the martin nests were complete a pair of wrens put in an appearance, clinging to the martin house hole and at every opportunity alighting on the house and peering in. The martins were very much annoyed and made ferocious swoops at the wrens, who darted, almost faster than the human eye could follow, behind the board fence.

I immediately built a box 5 in. x 5 in. x 12 in. deep with an entrance slightly larger than a silver quarter, under the entrance a landing platform and above it the overhanging eave of the sloping roof. This box was placed on a pole about five feet below the martin house. In half an hour the wrens were happily singing as they built their nest.

I wonder if all wrens are as intelligent as mine! A twig four or five inches long was frequently brought to the platform and one end shoved through the entrance hole, then the wren passed in drawing the twig with him. The martins, with the same length twig grasped in the centre, would attempt to pass straight through their two-inch entrance hole. If after several strenuous efforts the twig or straw did not break or bend it was dropped to the ground. Consequently the martins' nests were made chiefly of short or bendable material, while the wrens' nest were of surprisingly heavy twigs.

The swallows kept to their own premises, but not infrequently the curiosity of one of the martins—probably a female—necessitated a visit to the swallow home, where alighting on the front porch and putting her head through the entrance she was apparently given a peck in the face, as her head would be quickly withdrawn in time to see father swallow swooping down from a nearby telephone wire. Then both birds would rise in the air and for half a minute or so face each other apparently sitting on their tails and, with fluttering wings, say unprintable things; then the martin would fly home and the swallow back to his wire.

When the babies arrived the parent swallows were constantly busy capturing flying insects, while the parent wrens hunted the flower beds and bushes for hairless caterpillars.

The tree swallows were quiet birds and at no time did I see the young, although I frequently heard them in their nest box. Evidently they do not return to their nesting site after once leaving it. The martins were quite different, adhering to the old saying "the more the merrier," as the frequent appearance of visitors from Wellington Street eaves or bird houses in Ottawa South was the signal for a great chattering, melodious martin calls and circling in the air, and the entrance to their home was nearly always filled with expectant baby mouths and later the youngsters ventured out onto the platform and when able to fly they, for two or three weeks, returned every night; then their visits became less frequent until one day, accompanied by some friends, there being twenty-three birds in all, they bade the old homestead a noisy farewell.

The young wrens remained in the neighborhood a week or so and the adults were often heard singing until late fall.

My two male martins had the white and gray plumage similar to that of the female. This spring I hope to see them in their black-purple-sheened plumage which is probably acquired in their second year.

BIRDS OBSERVED AT GRANDE PRAIRIE CITY, PEACE RIVER DISTRICT.

BY FRANK L. FARLEY, CAMROSE, ALTA.

I spent four days from June 30 to July 3, 1916, in and around Grande Prairie City, and noted the birds mentioned below. This town is the centre of the far famed district of the same name, and is about sixty miles due south of the old post, Dunveagan, on the Peace River and is, roughly, 250 miles northwest of Edmonton. The town is only a year or so old, and is now as large as some of the towns in the older settled portions of the Province. It is situate on Bear Creek, a small stream which flows into the Wapita, a few miles to the south. The country is mostly prairie, with scattered bluffs of poplar and willow, and rolls slightly. The grasses and shrubs are very similar to those around Edmonton. To the east of this prairie country the railway passes through one hundred miles of large poplar, some of which is twenty inches in diameter. This is surely the great summer home of the White-throated Sparrow and the Junco. There were more White-throats noticed than all other birds combined. I counted a dozen singing in the valley of the Smoky River, all within three hundred yards of the train. They were particularly very plentiful throughout this territory. On the prairie, the Vesper Sparrow was by far the most abundant bird. I was surprised to find the English Sparrow quite at home in the town, there being at least a hundred feeding around the elevators and warehouses. They of course, used their regular way of travel—the freight car. The list is given in the order that the birds were observed.

Junco; very common.
White-throated Sparrow; very common.
Clay-colored Sparrow; fairly common.

Crow; 50 seen.
Red-eyed Vireo; common.
Yellow Warbler; common.
Wood Pewee; 10 heard.
English Sparrow; 100 seen.
Lincolns Sparrow; fairly common.
Robin; 25 seen.
Yellow-shafted Flicker; common.
Least Flycatcher; common.
Savanna Sparrow; common.
Red-winged Blackbird; a few seen.
Leconte Sparrow; not common.
Tree Swallow; fairly common.
Spotted Sandpiper; few seen on creek.
Mallard; one pair seen.
Vesper Sparrow; very common on prairie.
House Wren; fairly common.
Fox Sparrow; about 25 heard.
Brewers Blackbird; a few seen.
Trail's Flycatcher; not common.
Warbling Vireo; common.
Wilson's Thrush; a few heard in bluffs.
Night Hawk; one heard.
Cliff Swallow; common, nesting on the cliffs.
Bank Swallow; common.
Cow Bird; not common.
Pewee; a few seen.
Tennessee Warbler; heard several.
Golden-eyed Duck; one seen.
Red Start; one heard.
Sparrow Hawk; not common.
Song Sparrow; rare.

ARE OUR FORESTS VANISHING?*

Belgium, the most intensively cultivated country of Europe, with 652 inhabitants to the square mile, had, before the war, over eighteen per cent. of its area in permanent forest. Ontario, with some ten inhabitants to the square mile, has about five per cent. of its area in permanent forest. Similarly France, with 190 people to the square mile, has nearly one-fifth of its area in forest; Switzerland, with 235 persons to the square mile, has 23 per cent. in forest; Sweden is nearly

*Extracts from Address by Mr. R. H. Campbell, Director of Forestry, before O.F.N.C., January 9, 1917.

one-half forest and Germany and Austria, respectively, one-quarter and one-third of their area in forest. The above seems sufficient reply to those who argue that the making of forest reserves will hinder the development of Canada.

The wood manufactures of this Dominion have a total yearly value of $177,000,000. In respect to capital invested, wages paid and cost of material they take first place, and the value of the product is one of the highest among the industries. Wood industries employ 110,000 employees, as compared with 66,000 for iron and steel, their nearest competitor.

In the present war wood is playing a great part. In the trenches it is used for walls, floors and braces. Behind the lines it is used for temporary buildings for the use of combatants and homeless non-combatants. For bridges, wharves and similar structures much is used and for replacing permanent structures destroyed by enemies it is indispensable. Wood cellulose is used for making a substitute for cotton for bandages, etc., crepe paper for slings and fibre board for splints. Paper clothing is worn to quite an extent in the Russian, Austrian and German armies, and in Austria paper is displacing many other textile products—from flour bags to twine. The chief products of the forest, in Canada, are lumber, wood for pulp, poles and railway ties.

In order to give the forest a chance to develop properly, it is necessary to ward off many injurious factors. Chief of these is fire. The average annual loss through forest fires in Canada is five million dollars, and it is estimated that two-thirds of Canada's forests have been burned over Only seventeen per cent. of the forest area explored in the prairie provinces had been found to contain merchantable timber. The most important by far of the means of fire protection was the education of the inhabitants and frequenters of forest regions to guard against fire. After that, fire patrol, lookout stations, trails and various fire-fighting appliances had their places.

The forest must also be protected against insects and fungi. In British Columbia serious damage had been done to the western yellow pine by a bark-boring beetle. Poplar on Dominion lands had been much injured by a species of fungus, the chestnut in the United States had been almost exterminated by the chestnut tree blight, and a like fate was threatening the white pine of the east. The White Pine Blister Rust had obtained such a footing that much of the adult timber was threatened, and the planting of white pine put out of the question.

Improvements in forestry practice in the work of the Forestry Branch had been the marking of trees for removal, the disposal of brush after cutting and the study of natural regeneration and the natural mixture of species in the forest. The Forest Products Laboratories had also been established for the study of questions regarding the composition and characteristics of timber and the adapting of them to various uses.

F. W. H. J.

NOTES.

The Ottawa Humane Society held an exhibition during March at the Carnegie Library of over a thousand bird houses made by school children. Prizes were given to the exhibitor having the largest number of houses and the one exhibiting the best bird house. Several hundred bird houses were entered. There were many kinds, from little wren cottages of one room to large martin apartment houses big enough for twenty families. The houses were offered for sale and the proceeds, over $75.00, were given to the Red Cross. The boys of forty years ago robbed birds' nests, sometimes to make egg collections. Such exhibitions and competitions as this will do much not only to cure boys of robbing nests and to replace the collecting of eggs by the more valuable observation and study of birds, but also to attract and increase a bird population of great value to our food supply. The efforts of the Ottawa Field-Naturalists' Club, which resulted in placing bird houses at the Experimental Farm and in Rockcliffe Park, doubtless had an influence towards this present interest in bird conservation.

The reclamation of swamps is one of the most important problems of the present time. Many of the best lands are still in swamp form, and the sanitation produced if this land were reclaimed would more than pay for the work necessary, by the increased healthfulness of the country. The draining of the swamps is one of the best means of destroying the breeding places of the mosquito, and the extermination of the mosquito is one of the great issues of the day. It was this extermination that made the Panama Canal possible, and has rendered Havana a justly favored health resort.

Miss M. Young of the Mines Branch recently gave a demonstration of pottery making in relation to Mr. J. Keele's work on Canadian clays at the Red Cross meeting of the Women's Branch of the Civil Service, Ottawa. Miss Young has been using designs from prehistoric Canadian Indian pottery in the Museum of the Geological Survey, to develop art pottery distinct from that of the old world or the orient and appropriately Canadian. Some of the best English ware had its birth in the private studio. There is an open field here in Canada for the commercially interested and for the lover of beauty.

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