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THE OTTAWA NATURALIST.

VOL. XI. OTTAWA, OCTOBER, 1897. No. 7.

THE CRYPTOGAMIC FLORA OF OTTAWA.

BY PROF. JOHN MACOUN, M.A., F.L.S., F.R.S.C.

INTRODUCTORY NOTE.

For a number of years the writer has been collecting and studying the Cryptogamic flora of Ottawa and the surrounding country, during his holidays and in spare hours. At the present time his notes and observations have accumulated to such an extent that he considers it better to publish an incomplete list rather than wait until his excursions could take in a wider area and include a larger number of species.

Dr. James Fletcher, in "*Flora Ottawaensis*," includes an area of about 30 miles around Ottawa, and the writer purposes to cover about the same radius, but owing to want of time and other causes, only the district close to the city has been properly examined. It is the writer's intention to continue this work and from time to time publish the additions made by himself or others. The aim of the writer has been to place in the herbarium of the National Museum a complete set of all the species enumerated, but where possible a characteristic specimen of each species has been laid aside so that should the day ever come when the local flora of our city and its vicinity be gathered into one herbarium the Cryptogams will be forthcoming. I may then say that every species which appears in the following lists is held in duplicate and can be seen and examined at any time by those interested in the study of botany.

My notes extend over many years, as my first collections were made in the autumn of 1883, and have continued up to the present time. Owing to my absence from the city every summer, my collecting is chiefly done in September and October, and hence many fungi that are quite common around the city do not appear in the lists. Musci, Hepaticæ, and Lichens are more fully represented, but there are many species yet to be detected when my excursions become more widely extended.

The chief excuse for publishing these lists at the present time is that our club may be shown what a field for research lies at its very doors and how easily any one desirous of doing something in the botanical field can find work ready to his hand. In the following lists the dates following a locality mean the date when the specimen in our herbarium was collected.

MUSCI.

I. SPHAGNUM. PEAT MOSS.

1. **S. fimbriatum,** Wilson.

Our peat bogs contain many species of Sphagnum, but none have been carefully examined except the Mer Bleue near Eastman's Springs, 12 miles from the city. This species has been gathered in the swamp on the Glebe property, Bank St.; in the Mer Bleue, and near Casselman on the C.A.Ry.

2. **S. Girgenshonii,** Russ.

This species is chiefly found amongst black ash, growing in rigid hummocks. Collected in the swamp at the north-east corner of Beechwood Cemetery.

Var. **hygrophilum,** Warnst.

This form has been found on the Glebe property and in the swamp on the north side of Beechwood Cemetery.

3. **S. fuscum,** (Schpr.) var. **fuscescens,** Warnst.

This is a common species in all peat bogs, and is particularly abundant in the Mer Bleue; at Casselman; and in the swamp on the Glebe property. This is the dull rusty-coloured form.

Var. **pallescens,** Warnst.

Very common in the Mer Bleue and certainly in all large bogs in in the district.

4. **S. tenellum** (Schpr.) var. **rubellum,** (Wils.)

This form is very abundant is the Mer Bleue, and is easily distinguished from the preceding by its bright red colour.

5. **S. acutifolium,** (Ehrh.)

This is a very common species in all peat bogs, and takes many forms and colours, passing from white to purple and bright red. The common form is abundant in the swamp on the Glebe property, in Dow's Swamp at Casselman, and in the Mer Bleue.

Var. **versicolor,** Warnst.

This form is white and purple, and is very beautiful. It is abundant in the Mer Bleue, and in the swamp on the Glebe property.

Var. **pallescens,** Warnst.

Growing generally in water, and always quite white. Common in the Mer Bleue.

6. **S. recurvum,** (Beauv.) var. **pulchrum,** Lindb.

This species prefers the borders of peat bogs, water-holes in them, and black ash swamps, and takes many forms. Its forms are recognized by their recurved leaves. Wet woods along the borders of the Mer Bleue.

Var. **mucronatum,** Russ.

Wet woods along the Mer Bleue.

Var. **amblyphyllum,** Russ.

In water in holes in the Mer Bleue,

Var. **parvifolium** (Sendt.)

In the Mer Bleue and in the swamp north of Beechwood Cemetery.

7. **S. cuspidatum,** (Ehrh.) var. **submersum,** Schpr.

Much like the preceding, but leaves not recurved. In the swamp on the Glebe property, Bank St.

8. **S. squarrosum,** Pers, var. **speciosum,** Russ.

This is a very beautiful species, generally found in hollows in damp woods. Its leaves are always very much recurved. In damp woods north of Beechwood Cemetery; at Casselman; and in woods by the Mer Bleue.

9. **S. Wulfianum,** Girg.

Abundant in spots in the Mer Bleue. A beautiful species.

Var. **macroclada,** Warnst.

In wet spots in the woods north of Beechwood Cemetery.

Var. **viride,** Warnst.

Swamp north of Beechwood Cemetery; and in the swamp on the Glebe property, Bank St.

10. **S. cymbifolium,** Ehrh.

This, the next two species and *S. acutifolium* form the bulk of peat moss found in the bogs of Europe and America and produce the

litter now so extensively used in the large cities of Europe and America. Abundant in Dow's Swamp, on the Glebe property and in the Mer Bleue.

11. **S. papillosum,** Lindb.

Abundant in the open parts of the Mer Bleue.

12. **S. medium,** Limpr. Var. **purpurascens,** Russ.

This species has been taken for a red or purplish variety of No. 10, but it is considered quite distinct. Abundant in the Mer Bleue.

II. EPHEMERUM. Hampe.

13. **E. minutissimum,** Lindb.

Abundant on the indundated ground on both sides of the discharge from Leamy's Lake, near Hull, Que. Sept. 16th, 1889. Fruiting.

III. ARCHIDIUM, Brid.

14. **A. ohioense,** Sulliv.

On inundated soil along the outlet of Leamy's Lake, Hull, Que. Fruiting in September.

IV. GYMNOSTOMUM, Hedw.

15. **G. curvirostum,** Hedw.

Under wet ledges along the Ottawa at Rockliffe, near the old mill, Nov. 9th, 1896; also on wet rocks, Kingsmere, near Chelsea, Que. Fruiting in summer.

16. **G. rupestre,** Schw.

On wet limestone ledges at the east side of Rockcliffe, near the old mill, May 7th, 1896.

V. WEISSIA, Hedw.

17. **W. viridula,** Brid.

On earth in woods east of Leamy's Lake, Que.; collected on earth along the cliff, Rockcliffe Park, April 22nd, 1896. Fruiting in September.

VI. CYNODONTIUM, Schimp.

18. **C. Wahlenbergii** (Brid.)

On dead and decaying logs in woods near Leamy's Lake, Hull, Que.; at Meeche's Lake, north of Chelsea, Que., Sept. 23rd, 1893.

VII. DICRANELLA, Schimp.

19. **D. varia,** Schimp.

On springy or wet clay banks. Fruiting in September. Sides of

ditches along the railway on the Experimental Farm : also along the Parry Sound Railway west of Hintonburg ; on the sides of the discharge of Leamy's Lake, near Hull, Que. ; in a C. A. Ry. cutting at Moose Creek. Sept. 6th, 1880.

20. **D. heteromalla,** Schimp.

Common in sandy woods or on the roots of turned-up trees and by roadside banks. Fruiting in summer. Woods at Ironsides and Chelsea, Que. ; also at Casselman and Carleton Place ; in woods at West End Park, Ottawa ; in McKay's Woods. Sept. 12th, 1889.

VIII. DICRANUM, Hedw.

21. **D. montanum,** Hedw.

On decaying logs, and stumps and bases of standing trees in woods. Does not fruit at Ottawa. On the bases of trees at Leamy's Lake, Hull, Que. ; on stumps on "Pine Hill," Rockcliffe Park, April 14th, 1896.

22. **D. fulvum,** Hook.

On boulders in woods. Not rare in McKay's woods, but seldom fruiting ; on boulders "Pine Hill," Rockcliffe Park ; on rocks, Aylmer Road west of Hull, Que October 10th, 1891.

23. **D. viride,** Schimp.

On the bases of growing trees ; always barren. Quite common in McKay's Bush and Beechwood Cemetery ; in woods at Buckingham, Que., May 14th, 1896.

24. **D. flagellare,** Hedw.

On decaying logs in damp or shady woods. Fruiting in spring. Meeche's Lake and Chelsea, Que. ; on "Pine Hill," Rockcliffe Park. April 28th, 1896.

25. **D. scoparium,** Hedw.

Very common on earth in all woods around Ottawa. Rockcliffe Park, April 22nd, 1897.

26. **D. scopariiforme,** Kindb.

Intermediate between *D. scoparium*, Hedw. and *D. fuscescens*, Turn. Dioecious. Leaves greenish-yellow, flexuous, lanceolate, subulate with a short and flat subula ; margin nearly flat or slightly incurved, densely and sharply serrate to one-third ; cell-walls rarely interrupted by pores ; upper cells oblong-oval, lower not much narrower, inner basal light brown ; costa thick, percurrent, with two serrate ridges at the back in the upper part. Capsule curved, not striate ; pedicel red, and short.

On earth and logs in damper woods than the preceding species. Damp and wet logs in the swamp north of Beechwood Cemetery ; on rocks Meeche's Lake, near Chelsea, Que. Sept. 23rd, 1893.

27. **D. fuscescens,** Turn.

On old logs in Dow's Swamp ; at Chelsea and Kingsmere, Que. Fruiting on old logs near Leamy's Lake, Hull, Que. Sept. 6th, 1889.

28. **D. Bonjeani,** DeNot.

On earth in Dow's Swamp ; in wet woods along the borders of the Mer Bleue. Aug. 26th, 1889. Barren.

29. **D. undulatum,** Turn.

Common in cool damp woods on earth. Stewart's Bush, Dow's Swamp, Mer Bleue, and McKay's Woods ; on the cliffs, Rockcliffe Park. April 22nd, 1896. Fruiting in summer.

30. **D. spurium,** Hedw.

On Laurentian rocks on Gilmour's Island, Chelsea, Que. May 22nd, 1892. Barren.

IX. FISSIDENS, Hedw.

31. **F. bryoides,** Hedw.

On earth in woods between St. Patrick's Bridge and Beechwood Cemetery, east of the road ; on earth in woods Leamy's Lake, Hull, Que. Oct. 16th, 1889. Fruiting.

32. **F. minutulus,** Sulliv.

On stones in the channel of the small brook entering McKay's Lake near Beechwood Cemetery. Oct. 12th, 1884. Fruiting.

33. **F. pusillus,** Wils.

Abundant on damp, flat, limestone rocks in McKay's Woods, south-west of the lake. Oct. 12th, 1884. Fruiting.

34. **F. osmundoides,** Hedw.

On earth on turned-up trees in Dow's Swamp ; on roots of trees in woods at Leamy's Lake, Hull, Que. ; on roots of trees in old woods at Carleton Place. May 31st, 1884.

35. **F. decipiens,** DeNot.

Very abundant on turned-up roots and old stumps in Dow's Swamp ; on earth in woods at Leamy's Lake, Hull, Que. ; also in McKay's Bush near the lake ; collected on damp rocks, Rockcliffe Park, April 22nd, 1896.

X. LEUCOBRYUM, Hampe.

36. **L. vulgare,** Hampe.

On earth in damp woods north of Beechwood Cemetery : also in woods on "Long Point," Mer Bleue ; on the banks of the Lievre River at Buckingham, Que, May 14th, 1896. Seldom fruiting.

XI. CERATODON, Brid,

37. **C. purpureus,** Brid.

Very common everywhere in pasture fields, by roadsides, on old fences and roofs of houses. Our commonest moss, and found in all parts of the habitable earth. Fruiting in early spring. With mature fruit, May 12th, 1896.

XII. SELIGERIA, Bruch and Schimp.

38. **S. campylopoda,** Kindb.

Agrees with *Seligeria recurvata* in the shape of the capsule and the arcuate pediel, but differs considerably in the leaves being broader, very much shorter, sublinear, obtuse, rarely short-acuminate and subacute, and the costa not excurrent, the perichetial leaves ovate-oblong, thin-costate, the peristome darker red. The male flower is fixed on the side of the female.

Under damp overhanging limestone rocks near the upper part of the Beaver Meadow, on the east side, west of Hull. Que. April 26th, 1891. Fruit nearly full grown.

39. **S. recurvata,** Bruch. and Schimp.

On large boulders by the roadside leading from the end of the Electric Railway eastward towards the old mill, Rockcliffe Park. May 7th, 1896. Fruit ripe.

XIII. DIDYMODON, Hedw.

D. rubellus, Bruch. and Schimp.

On damp limestone ledges near McKay's Lake ; also on ledges at Leamy's Lake, Hull ; Chelsea and Meeche's Lake, Que. ; on damp limestone rocks Rockcliffe Park. April 22nd, 1896. Fruiting

XIV. LEPTOTRICHUM, Hampe.

41. **L. tortile,** C. Muell.

Roadside near the Mer Bleue ; at Eastman's Springs, Sept. 29th, 1892 ; on an old road in woods at the end of the Electric Road, Rockcliffe Park

42. **L. glaucescens,** Hampe,

On calcareous earth in crevices of rocks along lakes and rivers. Along the outlet of Leamy's Lake, south side ; at Kirk's Ferry and Meeche's Lake ; on the cliffs facing the Ottawa, Rockcliffe Park. April 22nd, 1896

XV. BARBULA, Hedw.

43. **B. brevirostris,** Bruch. and Schimp. (?)

On large boulders, growing with *Seligeria recurvata* along the road leading east from the end of the Electric Road at Rockcliffe Park, May 7th, 1896. Fruiting.

44. **B. tortuosa,** Web. and Mohr.

On rocks near McKay's Lake and around the cliffs, Rockcliffe Park ; on "Pine Hill," Rockcliffe Park, April 16th, 1896 ; on rocks Meeche's Lake near Chelsea, Que., Sept. 23rd, 1893.

45. **B. unguiculata,** Hedw.

Very common, some years, on old roads and streets in and around Ottawa. Mackenzie Ave, Oct. 12th 1896 ; on limestone rocks by the Ottawa, Rockcliffe Park.

46. **B convoluta,** Hedw,

Quite common in pastures, growing with *Ceratodon purpureus*, known by its *yellow* pedicels. By roadsides and in pastures at the Experimental Farm and north-west to Hintonburg ; also by the C.P.Ry. at Carleton Place ; on earth in pastures at Rockcliffe Park, May 12th, 1896. Fruiting early in spring.

47 **B. ruralis,** Hedw.

Generally found on limestone shingle or gravelly ridges. Rockcliffe Park near Governor's Bay ; at Britannia and along the railway at Carleton Place. Barren.

XVI. GRIMMIA.

48. **G. apocarpa,** Hedw.

On boulders everywhere around Ottawa ; especially in McKay's Woods ; at Meeche's Lake and Chelsea, Que. ; at Carleton Place, and Stittsville ; on "Pine Hill," Rockcliffe Park, April 14th, 1896. Fruiting abundantly late in autumn.

XVII. HEDWIGIA, Ehrh.

49. **H. ciliata,** Ehrh.

Quite common on boulders, McKay's Woods, and other places

around Ottawa ; on boulders " Pine Hill," Rockcliffe Park, April 16th, 1896. Fruiting.

Var. **viridis,** Schimp.

On boulders in shady woods quite common at Ottawa ; Oct. 12th, 1884.

Var. **subnuda,** Kindb.

Leaves nearly hairless, the greater number broadly ovate, borders reflexed ; cells larger, subquadrate.

On boulders in McKay's Woods near the lake, April 28th, 1896. Fruiting.

XVIII. ULOTA, Mohr.

50. **U. Ludwigii,** Brid.

On trees along the creek in Beaver Meadow north of the toll-gate on the Aylmer Road : very rare on " Pine Hill," Rockcliffe Park. May 7th, 1896.

51. **U. crispa,** Brid.

On cedar trees in Dow's Swamp ; and on spruce trees along the Beaver Meadow Creek west of Hull, Que. : on spruce trees in Rockcliffe Park near Governor's Bay, April 22nd, 1896.

52. **U. camptopoda,** Kindb.

Stem not creeping. Leaves, when dry crisped, when moist patent, or squarrose, often curved, faintly papillose, from a short dilated ventricose base, suddenly narrowed into the acute or subulate acumen, borders recurved at the base, and also often above on one side ; outer basal cells, disposed in 2-5 rows, quadrate-rectangular thick-walled ; inner narrow, orange, upper rotundate ; costa elevate, stout percurrent. Capsule small, long-necked, when dry faintly plicate, narrow, subcylindric and not constricted below the mouth, obovate when moist ; teeth bigerminate, pale, when dry recurved : cilia none : lid long-apiculate ; pedicel long, but not much emergent, flexible, more or less curved or geniculate, in young as well as in the dry state ; calyptra densely hairy, covering the capsule.

Habit of *U. crispula.* Agrees with *U. maritima* in the curved pedicel ; differs from *U. Ludwigii* in the narrower capsule. Growing together with *U. Ludwigii* on trees along the Beaver Meadow Creek west of Hull, Que. ; also on the pales on the south-west corner of the Cemetery west of Hull on the Aylmer Road, Que. ; April 26th, 1891.

53. **U. connectens,** Kindb.

Monœcious. Tufts soft, pulvinate, green above ; blackish below. Stems erect. Leaves, from an ovate concave base, linear-lanceolate,

when dry very much crisped, when moist subarcuate, short attenuate to the acute apex ; borders revolute above the base, for the greater part, at least on one side, distinctly papillose, also at the back ; cells at basal wings sub-quadrate hyaline with incrassate transverse walls, those next the costa narrower, rectangular, in straight rows, the lowest orange ; costa pale, sub-percurrent. Male flower at the side of the female. Inner perigonial leaves broad, short-ovate, obtusate or suddenly short-acuminate ; cells round only in the acumen, the others narrow, the lower basal wider and yellow : antheridia about 9, with several paraphyses. Perichetial leaves with sublinear basal cells. Capsule dark-brown short subovoid, not contracted at the mouth, costate ; pedicel short, scarcely emergent. Calyptra densely hairy.

This species is a true *Ulota*, although the revolute leaf-borders, the distinctly papillose cells and short pedicellate capsule are more like an *Orthotrichum*.

On cedar trees (*Thuya occidentalis*) in Dow's Swamp, September 16th, 1886.

Both the preceding species are believed to be forms of *U. crispa* by Mrs. E. G. Britton, who has made a special study of the genus.

XIX. ORTHOTRICHUM, Hedw.

54. **O. anomalum,** Hedw.

On rocks and ledges along the Ottawa at Governor's Bay, Rockcliffe Park ; also on ledges near McKay's Lake, in fruit April 22nd, 1896. Fruiting.

55. **O. speciosum,** Nees.

Common on balsam fir, cedar and spruce trees in the woods east of Beaver Meadow west of Hull, Que. ; also on spruce trees in Rockcliffe Park ; collected on trees and fence rails near Hintonburg, April 13th, 1896. Fruiting.

56. **O. sordidum,** Sulliv. and Lesq.

Common on beech trees in woods near Ironsides, Que. ; collected on trees in Rockcliffe Park and Beechwood Cemetery, April 22nd, 1896. Fruiting

57. **O Ohioense,** Sulliv. and Lesq.

On trunks in woods near Leamy's Lake, Hull, Que. ; old fence rails at Carleton Place ; collected on trees in woods near Governor's Bay, Rockcliffe Park, April 22nd, 1896. Fruiting.

58. **O. Canadense,** Bruch and Schimp.

This species appears in Part VI under *O. Schimperi* but was discovered by Mrs. E. G. Britton when monographing the genus some

years since. It is apparently very rare as its occurrence in America was doubted when Lesq. and James' work on the mosses appeared in 1884.

On rocks at the corner of Rockcliffe Park close to Governor's Bay. October 12th, 1884.

59. **O. cupulatum,** Hoffm.

On limestone rocks along the cliffs facing the Ottawa near Governor's Bay, Rockcliffe Park. April 16th, 1891.

60. **O. strangulatum,** Beauv.

On trunks and fences around Ottawa; woods at Ironsides, Chelsea and near Leamy's Lake, Que.; also in McKay's Woods and in Beechwood Cemetery; collected on trees in Rockcliffe Park, April 22nd, 1896.

61. **O. psilothecium,** C. M. and Kindb.

Plants small, 1 cm. long or less, green. Leaves short oblong-lanceolate, obtusate or short-acuminate, sub-obtuse, revolute at the borders to the greater part, faintly papillose; costa percurrent, Capsule small, immersed, oblong, not striate before sporosis, very short-necked; vaginula naked; calyptra slightly hairy at the blackish apex, finally glabrous and light-brown, narrow, covering the whole capsule; lid rostellate. Male flowers on distinct branches.

This species has the habit of *O. fallax*, Schimp. (*O. Schimperi*, Hamm.) We have not been able to examine the peristome and the stomata of the capsule, because only one capsule (in our specimen) is nearly ripe, the others are quite unripe.

On old fences in Rockcliffe Park; on cedar rails along the Richmond Road, near Hintonburg; collected on old fences at Carleton Place, Aug. 26th, 1889.

62. **O. obtusifolium,** Schrad.

On old cedar rails and trunks of balsam poplar; on rails in McKay's Bush; on poplar trees along the Gatineau River, near Leamy's Lake, Hull, Que.; collected on poplar trees near Hintonburg, April 18th 1896.

XX. ENCALYPTA, Schreb.

63. **E. vulgaris,** Hedw.

On limestone ledges on the south side of the outlet of Leamy's Lake, near the Hull Cemetery, Que., Oct. 11th, 1890.

64. **E. Macounii,** Austin.

In crevices of limestone rocks around the whole cliff facing the Ottawa in Rockcliffe Park, April 22nd. 1896; crevices of rocks along the Gatineau at Kirk's Ferry, Que. Fruiting.

65. **E. streptocarpa,** Hedw.

On limestone rocks at the outlet of Leamy's Lake, near Hull Cemetery, Que., Sept. 6th, 1889; on the cliffs at Governor's Bay, Rockcliffe Park. Barren.

XXI. TETRAPHIS, Hedw.

66. **T. pellucida,** Hedw.

On the bases of stumps and dead logs (chiefly pine and cedar), in all swamps and wet woods around Ottawa On old stumps in Dow's Swamp, and on Cowley's Farm, near Hintonburg: collected April 18th, 1896. Fruiting.

XXII. PHYSCOMITRIUM, Brid.

67. **P. immersum,** Sulliv.

On inundated alluvial soil (in small tufts) along the outlet of Leamy's Lake, near Hull, Que. Sept. 16th, 1886. Fruiting.

68. **P. platyphyllum,** Kindb.

Lower leaves sublingulate, yellow-margined, serrate all round, with a percurrent costa: the upper very broad, ovate acuminate: indistinctly margined, serrate above the middle, costa percurrent or short excurrent; cells wide sub-hexagonal, the basal sub rectangular, all hyaline. Calyptra mitriform. Capsule pyriforme: lid mammillate: pedicel (unripe) yellow, about 1 cm long, or shorter.

Since this description was published Mrs. E. G. Britton has examined the specimen and pronounces it *P. turbinatum*, Mueli. Better specimens are wanted to settle the question, but houses and lawns and asphalt cover where it was found by Dr. Fletcher many years ago.

On earth at the southern end of Metcalfe Street, Ottawa.

XXIII. FUNARIA, Schreb.

69. **F. hygrometrica,** Sibth

Very common on old walls and especially on burnt soil in damp woods and on old turned-up roots in swamps. Common around Ottawa and at Carleton Place.

XXIV. BARTRAMIA, Hedw.

70. **B. Œderiana,** Swartz

On rocks east of the Beaver Meadow, west of Hull; on damp rocks, Chelsea and Kingsmere, Que.: on limestone rocks near McKay's Lake: collected on the cliffs by the Ottawa, Rockcliffe Park, April 22nd, 1896. Fruiting.

LIFE-HISTORIES OF FISHES.

The late Frank Buckland, two days before his death in December 1880, wrote: "We want to know the times and places of the spawning of sea fish. Where do the soles lay their eggs? When and how do the plaice, turbot, brill, halibut, &c., spawn?" Buckland, it is true, was not an exact scientific investigator: but he was an untiring enthusiast who turned to account every opportunity for obtaining knowledge about fishes. His queries show how little was known about the life-history of fishes, especially sea fishes, less that twenty years ago. But a great change has happily been accomplished and the issue of a handsome volume condensing existing knowledge upon this important subject by Dr. McIntosh, Professor of Natural History in St. Andrews University, Scotland, and Mr. A. T. Masterman, Assistant Professor in the same University, marks an epoch in Ichthyology. Printed at the Cambridge University Press, England, this book, entitled "British Marine Food-Fishes," is the most notable work published up to this time on the eggs and young of fishes. It is a handsome volume of 516 pages, with twenty beautiful plates, and a coloured frontispiece, and worthily summarises the results of researches during the last twenty years by scientific workers on both sides of the Atlantic.

Wide as the subject of fish-development is, the ground covered by the authors is wider still, and apart from the objection that some of the marine species described have only indirectly any economic importance, scientific readers generally will be very grateful for this, and for the comprehensive account given in Chapter III on pelagic fauna, *i.e.*, the succession of life, vertebrate and invertebrate, in the sea during the twelve months of the year. The important and interesting nature of the subject gives the book an unusual valu,e but its numerous beautiful illustrations and lucid descriptions, it is a work that no zoologist

can afford to be without. It is interesting to note that of over 250 figures of eggs and young of fishes, about 70 are from drawings by the President of the Ottawa Field-Naturalists' Club. The beautiful plate of the stickleback, which forms the frontispiece, is also from his pencil, and the references to Professor Prince's researches upon fish-life abound throughout the work, which, as the authors say in their preface, owes much to the "researches of McIntosh and Prince," published in 1890 by the Royal Society of Edinburgh

A worthy summary of the results obtained by diligent workers, in Europe and on this continent, has been eagerly looked for, and by all competent to judge, this publication adequately fills the vacant place. It is true that two small books by Mr, J. T. Cunningham, of the Plymouth Laboratory, have appeared, one upon "The Sole" and the other on "British Marketable Fishes," but their scope was limited, and they had little scientific importance. The present work, as Professor Ray Lankester pointed out in his review in "Nature," August 12th, 1897, "appears to be less directly addressed to the general public than that of Mr. Cunningham"; but in no sense is it, as Prof. Lankester erroneously assumes, a supplement to Mr. Cunningham's publications. It stands on a different level, and is addressed to a different class of readers, and while the minor books, no doubt, serve well enough for fishermen, the present work meets the needs of students and investigators by the range and amplitude of its treatment. If any complaint can be made it is that so much of the work done at the St. Andrews Marine Laboratory, Scotland, has been laid under contribution; but this was inevitable, for that small zoological station has accomplished in this field results wholly disproportionate to its cost and equipment. The meagre scientific results yielded by costly stations at Plymouth, Granton, Rothesay and other points on the British coast, are to be explained by the bad locations selected and the paucity of fish-life there.

The authors' reference to McIntosh and Prince's researches as attempting for Teleostean fishes what the accomplished Francis Balfour did for the sharks has been objected to by Prof. Lankester on the ground that the mere sketching and description of coloured larval fishes is not embryology at any rate is not morphological. It is, however, precisely because the study and sketching of these translucent young fishes, in which the form and growth of almost every organ can be studied, that it is morphological in the truest sense, and had the critic himself ever studied from the egg onward the development of a fish, he would not have committed so gross an error in criticism.

There are few living workers to whom biological science owes more than to Professor McIntosh, and it is not too much to say that his elaborate ichthyological investigations have overturned all preconceived notions respecting the life and characteristic features of young fishes. It had been long imagined that when hatched out from the egg, a young fish resembled its parents, and that if the fry of various species could be obtained they could be easily recognized. The caterpillar and pupa of a butterfly were wholly unlike the perfect insect, and the young of the most familiar fishes passed through stages of life in which they did not resemble the adult fish with which we were all familiar. The salmon, herring, cod, halibut and other well-known kinds of fishes may be said to pass through at least four stages, viz., the larval, late larval, post larval and final condition ; in the last they resemble their parents, but are of very small size. Few fishes when hatched bear any likeness to the full-grown condition, and these are generally viviparous. Most fishes deposit eggs, and from such eggs there emerge in due time minute creatures, generally very transparent with large head and long tail and incommoded by a ponderous ball of yolk attached to their under side. In a later stage the yolk is gone and the breast fins and long fin on the back and tail are fully grown. Later, the breast

fins, and in some species the hind pair of fins, become enormously developed and project like wide-spread fans from the side of the body. These, no doubt, are effective for protection rather than locomotion. The study of young fishes has, in various ways, an important bearing on the commercial development of the fisheries in rivers, lakes and sea.

To naturalists, working in the privacy of their homes, the study of young fishes is at once possible and desirable. Few other living objects are more fascinating and beautiful, and the commonest fishes in our waters afford the best material.

The highest biological results can only be obtained by an exhaustive study of sections under the microscope, and following the lines of Frank Balfour's Elasmobranch papers the St. Andrews biologists have thoroughly studied the minute structure and development of larval fishes, and their popular summary derives additional value from that fact.

As in all Professor McIntosh's publications, full justice is done to all that other workers have accomplished. Most of these workers, as Mr. Holt and others, having had the advantage of being trained at St. Andrews in this department of research.

The literature of the subject is so vast that the book would have been burdened unnecessarily had any attempt been made to include a bibliography. Such a bibliography is, however, accessible enough to the specialist, and the synoptical table and practical directions regarding procuring fish eggs for study, added at the end of the volume, are of far more value to the student.—B.

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