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On the Formation of Pegmatite Veins.

By Prof. W. C. Brögger, of Stockholm, Sweden.

(Translated from "Die Mineralien der Syenitpegmatitgänge der südnorwegischen Augit und Nephelinsyenite," by Nevil Norton Evans, M. A. Sc.).

(*Concluded.*)

This hypothesis is supported by a large number of facts; in what follows, will be given a *résumé* of the more important of these.

1. As far as the principal minerals are concerned, the composition of pegmatite veins corresponds, with great uniformity, and frequently over long distances, to that of the allied eruptive rock of the magma of which the veins are generally the final ejections. With certain special isolated exceptions, their composition is quite independent of the nature of their wall-rock.

As examples, we may again cite the norite pegmatites occurring in the norite and labradorite rocks of the large norite-labradorite district of the south-west part of Norway; the augite syenite pegmatites of the region round Fredriksvärn, corresponding to the augite syenites; the nepheline syenite pegmatites of the boundary zone along the Langesundfjord, corresponding to the nepheline syenite rocks of the neighborhood, and quite uninfluenced by the fact of whether they occur in rocks poor or rich in nepheline, *i. e.* whether they occur in laurvikite or in nepheline syenite; the akmite granite pegmatite of Rundemyr, Eker, in Silurian limestones and slates, corresponding to the adjacent ägerine granite of Kyrfjeld, etc.; the granite pegmatites of Hitterö in labradorite rock and norite, corresponding to the granitite of the neighboring main-land, etc. From the occurrence of certain mineral species, such as albite, some authorities have wished to deduce certain conclusions with regard to the origin of pegmatite veins in general.[1] Although at the present time it ought to be superfluous to reply to such propositions made many years ago, similar views are still put forward from time to time and render a reference to them necessary. Among the first to describe the microperthitic intergrowth of orthoclase and albite, or microcline and albite, from the above-mentioned locality, was Credner, and he quite correctly considered it to be a primary intergrowth ; as far as this phenomenon is concerned, it also occurs very plentifully in the syenite and nepheline syenite veins which have been discussed in this treatise ("Die Mineralien der Syenitpegmatitgänge"); it occurs, however, developed in an exactly corresponding manner, very commonly, indeed predominatingly, in the normal-grained trachytoidal foyaïtes of Laugenthal which are true eruptive veins, and even in the same combination, microcline-albite, as in the pegmatite veins of the Langesundfjord, etc. Albite also occurs independently in the same rocks, though not widely distributed, in the form of individual crystals developed tabularly parallel to the brachypinacoid. In view of these facts, all

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[1] See H. Credner, l. c. p. 179: "Albite forms for the association of minerals of which it is a member a 'guide' for aqueous formation. Now as albite is most intimately intergrown with the principal component of our pegmitite and granite veins, with orthoclase,—as the one, so the other of these two feldspars must have originated, and also the quartz which penetrates them both in the graphic granite structure ;" see also F. Klockmann, l. c. p. 406.

theories which hold the presence ot albite as proof of aqueous origin must fall to the ground.[1]

It has been sufficiently dwelt upon above that all the minerals of the pegmatite veins (even all the albite) have not necessarily been formed by crystallization from a magma.

2. In their geological occurrence the pegmatite views are similar to other eruptive veins; they traverse all sorts of rocks, contain fragments of the same, etc. Examples of the first statement have already been cited, the presence of foreign fragments in pegmatite veins is so common that it is quite unnecessary to cite special cases. It can hardly be superfluous, however, to state explicitly that both in acid granite pegmatite veins (several of the veins in the neighborhood of Arendal) and in nepheline syenite pegmatite veins (southern point of Stokö) I have observed foreign fragments of the wall-rock exhibiting an arrangement relative to one another such as is possible only in the case of a rock formed from an eruptive magma.

The extremely intimate relations of pegmatite veins to veins formed in a different manner but of corresponding composition and of undoubted eruptive origin are also of weight in this connection; the gradual passage of the nepheline syenitic pegmatite veins of the boundary zone on the Langesundfjord into the normal-grained nepheline syenite veinstones of the same locality has been amply described above; in the case of ordinary acid granitic pegmatite veins this phenomenon is well known, and has been frequently and deservedly referred to by prominent petrographers.[2] The same thing is also true of granite types

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[1] See further : Alfred Gerhard, "Beitrag zur Kenntniss d. sogen. Soda-granite," Neues Jahrb. f. Min. 1887, **2**, 267-275 ; he found as principal component of the vein-form granite of Ulfserud, Sweden, an almost pure albite, with microcline, quartz, biotite and muscovite, zircon, apatite. Significantly this granite rich in albite was a vein granite !

[2] Michel-Lévy (Struct. et class. d. roches érupt. p. 15) remarks, for instance, "notre structure pegmatoïde (pegmatite graphique à grands éléments) dont nous affirmons la liaison intime tant avec les granulites massives qu' avec les granulites en filons (aplites)," &c. See also the excellent and instructive remarks of J. Lehmann, l. c. p. 26 : "It is not admissible to separate the half pegmatitic, half granular vein formations and the smaller veins of purely granular structure from

which differ from these in composition; in a special part of this Treatise, under akmite, the relationship between the fine-grained apophyses of the aegerine granite district and the akmite pegmatite vein of Rundemyr, is pointed out.

To every one who has occupied himself with a thorough study of the methods of formation of pegmatitic veins and has had opportunity of investigating in the case of hundreds and hundreds of veins of all varieties of occurrence, their close approximation to the normal eruptive vein type and their very various transitions to and connections with the same, these purely geognostic peculiarities of occurrence will perhaps be considered as the strongest proof of the undoubted eruptive origin of the veins.

3. The varieties of structure of pegmatite rocks are of kinds which in part at least are known only in eruptive rocks. In the case of acid granitic pegmatite veins there is very often a purely eugranitic granular structure with coarse grain (*e. g.* in the granitite of numberless pegmatite veins near Stockholm); in the nepheline syenite pegmatite veins, as has been mentioned above, a coarse-grained typical trachytoidal structure, corresponding to the foyaïtes of the Laugenthal (*e. g.* Laven), is frequently observed. The drusy structure of many pegmatite veins, particularly of granitic ones, is not (as considered *e. g.* by Klockmann l. c. p. 407) an argument against the eruptive nature of pegmatite, but is frequently very characteristically developed as large laccolites in the boundary zones of granitic rocks themselves (*e. g.* Hörtekollen, Solbergfjeld, near Drammen, Norway, Holmsboe and Rödtangen on the Drammenfjord, etc.). The peculiarity of structure most convincing in its nature, which must be considered virtually as proof of the eruptive formation and magmatic solidification of pegmatite veins in general, is the centric structure (spheroidal structure) first described by L. v Buch, afterwards by G. Rose, and re-

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the more massive granites recognized as eruptive. An unprejudiced observer will not wish to make such a separation," &c. J. H. L. Vogt (Kristiania Vid. Selsk. Forhandl. 1881, No. 9. p. 28), describes, occurring at Skarningsfos, a granite pegmatite apophysis in gneiss, &c., passing directly into the main granitite.

cently by Klockmann, in the granitic pegmatite veins of Kynast, of Schwarzbach, etc., in Silesia (l. c. p. 399); Klockmann himself, although otherwise agreeing with Credner, has pointed out quite correctly that this structure can hardly be brought into accord with Credner's theory. In this connection it also deserves mention that Mr. H. Bäckström and I have found perfectly pegmatitic large-grained feldspar individuals forming the cores of spheres occurring in centrically-formed massive granitite at Vasastaden near Stockholm.[1]

A further argument in favor of the magmatic solidification of the pegmatite veins consists in the peculiarities of structure which point towards a simultaneous crystallization. First, the graphic structure which was more particularly referred to above, and which also occurs in a similar way in massive eruptive rocks, must be mentioned. Further also, must be considered the incomplete formation of the pegmatite vein minerals which is generally evident when these minerals have not crystallized out into drusy cavities originally open (sometimes still so); this fact also was more fully treated above. Such incomplete idiomorphically-bounded crystals exhibit through their whole nature unequivocally, that they have crystallized out from a surrounding magma.

As a peculiar detail of structure, which is also satisfactorily explained only upon the assumption of magmatic solidification, may be mentioned the very frequent occurrence of bent, broken, and in part re-cemented crystals; examples have been described above in many places.

As special structural forms, may be mentioned the sometimes exceptionally distinct fluid structures (Fluidalstructuren) of the nepheline syenite pegmatite veins on the Langesundfjord.

In assuming an eruptive origin for pegmatitic veins, some have found great difficulty in the fact of the occasional

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[1] See W. C. Brögger and H. Bäckström: "Om förekomsten af 'klotgranit', i Vasastaden, Stockholm." Geol. Fören. Förhandl. 1887, **9**, 331 and 332, also Fig. 6, p. 325.

banded or zone-form arrangement of the vein material. This however is never laminated, as in the case of mineral veins deposited from genuine aqueous solution, [1] but only indistinctly zonal inasmuch as the outer zones pass continuously into the inner. [2] The zonal structure, when any such is present, which however is generally not the case, usually makes itself evident only in a finer-grained condition of the vein boundaries, and sometimes (especially in the case of granitic pegmatite veins) in a zone with graphic structure next the fine-grained eugranitic marginal zone, upon which there frequently follows (especially in acid granitic pegmatite veins) in the middle of the vein a tremendous size of grain, here often with special enrichment in rarer minerals and (also particularly in acid veins) not seldom with open or distinctly drusy cavities filled with peculiar mineral deposits.

Thus, this "zonal," band-form, etc., structure, as it occurs in genuine pegmatitic veins, may without any great difficulty be accounted for through magmatic crystallization. [3] Finer grained structure along the sides of the veins is in general characteristic of eruptive veins, the graphic structure is explainable only through magmatic crystallization, and the drusy structure of the middle of the vein, which however is frequently wanting, [4] may be explained as quite in accordance with the formation of miarolytic drusy cavities in normal grained eugranitic rocks. Moreover, it must again be remarked, that the minerals which have crystallized out in the drusy cavities have in part frequently had a different mode of formation to those of the

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[1] Compare also G. Vom Rath, l. c. p. 649. "It reminds one of the almost symmetrical grouping of the minerals of certain ore veins. Nevertheless the two phenomena are quite distinct."

[2] I must distinctly remark, that I here leave out of the question a part of the "granitic" veins described by H. Credner in his treatise; in this treatise certain mineral deposits belonging to 'regional metamorphism' are evidently treated from the same point of view as true pegmatitic vein formations. To enter here more into detail would lead too far.

[3] Compare also J. Lehmann, Granulitgebirge, &c., p. 46. "A zonal structure of our granitic veins has in it nothing exceptional and speaks neither for nor against formation by injection."

[4] In the veins of the Anneröd Peninsula this is very rare.

main vein mass; and further, in the case of the formation of pegmatite veins, as compared with that of the corresponding normal-grained massive rocks, peculiar conditions of formation, the coöperation of particular "agents minéralisateurs," have in a high degree made themselves felt along with direct separation through simple cooling of the magmatic solution.

As far as the unusual coarse-grainedness which frequently occurs in pegmatitic veins of the most various compositions is concerned, this must in some may be connected with what was recognized some time ago,[1] *i.e.* that the pegmatitic veins generally (though not always) may be looked upon as end products of the series of eruptions with with which they are connected; both when they occur in the main mass of the allied eruptive rock, and when they occur in the neighborhood—and one of the two is always the case—we may assume that the rock surrounding the veinstone was first heated to a high temperature and that therefore the cooling must have taken place unusually slowly and uniformly; and upon this fact primarily the largeness of the grains may be explained.[2]

That this explanation of the coarse grain and of the imperfect zonal structure of many pegmatite veins is correct, is rendered probable in the highest degree by the frequent occurrence of pegmatitic structure in those portions of rock bordering on the open drusy cavities of many massive granites. I interpret these as analogous to the formation of the pegmatitic veins themselves, in the following way: First, on account of the contraction due to crystallization of the rock already for the most part solidified, there were formed crystal-free *lumina*;[3] the mixture of magma and

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[1] See C. F. Naumann's Lehrb. d. Geogn. 2, 230.

[2] In the pegmatite veins at Kure, south of Moss, I have seen feldspar individuals measuring more than 10m. in length.

[3] That these ("miarolitische Drusenräume") are so plentiful in acidic rocks, while they are almost always wanting in basic rocks, may perhaps be connected, with the difference in specific gravity between the glass and the holocrystalline aggregates of the respective rocks. In the case of acidic rocks this difference is very great, in the case of basic rocks often very small: in the first case therefore the contraction during the cooling of the magma would be greater, and in the latter less.

crystals so formed, which must have constituted a somewhat solid rock, was however completely permeated by the magma (which on account of the crystallization already taken place would frequently have become somewhat more acidic), and with this these crystal-free spaces would naturally have been filled. By continued cooling this magma, beginning at the walls, also crystallized out slowly and uninterruptedly, often mixed with minerals which had been formed by special "agents minéralisateurs"; the conditions of such crystallization proceeding from the walls of the *lumina* inwards, must have been somewhat different from those of the former crystallization which took place within the mass of the whole solidifying rock-matter, where the separate individuals must have crowded upon one another, etc.; hence the ever increasing size of grain, the zonal structure (conditioned by the crystallization from the walls inward), etc. If the magmatic silicate solution were not concentrated to such an extent that the *lumina* were completely filled by its crystallization, first, open drusy cavities must have resulted, which finally through continued circulation might be filled in with minerals deposited from solutions at first still hot but later less and less hot (*c. f.* the description of the separate phases of vein formation of the veins of the boundary zone on the Langesundfjord, "Die Mineralien der Syenitpegmatitgänge.") The filling up of the drusy cavities corresponds according to this interpretation pretty exactly to the complete vein formation of the pegmatitic veins which occur outside the normal-grained rock mass; the explanation throws light in both cases upon the continuous transition from the rock formed purely by magmatic solidification to the final minerals of the druses deposited from solutions not exactly magmatic (less concentrated).[1]

This successive filling up of the drusy cavities under conditions of formation changing little by little, which in a

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[1] The difference between the explanation given above and that of Rosenbusch and others is not so very great, and is, essentially, that I consider the principal filling of the drusy cavities as also the pegmatitic veins to be magmatic, which it will be difficult to deny in face of the totality of the observations given above.

corresponding way must also be assumed in the case of the formation of the minerals in the pegmatite veins themselves, is naturally also important for the correct understanding of many veins not truly pegmatitic, but clearly very closely connected with these. Between crack-fillings, principally magmatic, of a pegmatitic character, and those corresponding only to the later stages of mineral deposit in the pegmatitic druses and veins (e.g. in the class of acid granitic pegmatite veins, as final member, the quartz veins,) all possible gradations are known, as has been correctly emphasized by earlier authors (particularly by Lehmann); it must, however, always be borne in mind, that these crack-fillings, although genetically in part related, are however in no sense pegmatitic veins. Pegmatites form only one stage in the series of vein equivalents of a massive plutonic rock; granitite, granophyre, aplite, pegmatite, are different stages in the magmatic vein formations of the plutonic rocks, the pegmatites as a rule still in the main magmatically solidified veins, therefore formed under somewhat altered conditions, and even passing into the crack-fillings which succeed them in point of time and which are not in the main, or are not at all, deposited from true magmatic solutions.[1] Although in what has been said above, the coarse-grained structure, as usual, has been very strongly emphasized, it must be remembered that this alone does not condition the pegmatitic nature of the veins, nor is even necessarily present in order to justify the

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[1] That many large-grained veins of a pegmatitic structure have been formed principally by pueumatolitic processes, and not mainly by magmatic solidification, has already been stated above many times; such are the apatite bearing basic veins, also many occurrences of cassiterite, of tourmaline and topas, &c. That also the muscovite granite pegmatite veins, containing especially beryl, topas, etc., and having as principal minerals microcline, oligoclase, albite, quartz, muscovite, are, in comparison with the ordinary granite pegmatite veins with which they frequently occur and which among fine-grained veins correspond to the genuine aplites rich in muscovite, perhaps of a somewhat later formation than these which are of a slightly different magma and to a larger extent of pneumatolitic formation, is for many reasons probable; this would also explain very well why they occur along the eruptive boundary of genuine granitite or within the granitite along with genuine granitite pegmatite veins, although massive rocks of corresponding composition are generally wanting in the neighbourhood. To enter into details would lead too far.

appellation "pegmatitic." In the boundary zone on the Langesundfjord are many veins, truly pegmatitic, which are less coarse-grained than the surrounding laurvikite, e. g. the hiortdahlite-bearing vein of Langodden, Ober-Arö. It is the habitus as a whole which determines this: the relatively irregular nature of mineral composition and structure in the different parts of the vein, the foreign appearance of the veinstone caused by the wealth in accessory pneumatolitic minerals, the intimate intergrowth with the wall rock, etc. The very indefiniteness of these limitations, which must always adhere to the definition of the pegmatite idea, is itself characteristic and gives a completely correct expression of the actual condition of things, that altogether between pegmatitic and not pegmatitic rock *formation in nature often no sharp* line can be drawn and indeed is not present.

Structure is, as Lossen[1] has so aptly said "of the first rank as an exponent of the geological relationships of rocks;" that the structural peculiarities of the pegmatite veins are in the main such as we otherwise find in the case of undoubtedly eruptive rocks only, is therefore one of the strongest evidences of their eruptive origin as veins formed principally through magmatic solidification.

4. In connection with the structural peculiarities, stand the age relations of the individual vein minerals, which may be comprehended under the common conception "order of crystallization" (Krystallisationsfolge).

One of the principal results of the study of eruptive rocks in the light of the newer petrography is that, within certain limits, a regularity in the order of crystallization of the minerals of these rocks can be observed; researches by Rosenbusch, Michel-Lévy, Iddings and numerous other investigators have determined pretty certainly the leading features of this regularity in the order of crystallization for a large number of rock-types. The sequence is dependent

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[1] K. A. Lossen: "*Uber die Anforderungen der Geologie an die petrographische* Systematik," Jahrb. d. kgl. preuss. geol. Landesanstalt f. d. J. 1883, Berlin, 1884, p. 512.

upon the composition, temperature and pressure prevailing during the time of cooling of the magma, as well as upon the alterations in these conditions, and finally upon the action of special "agents minéralisateurs." As the crystallization intervals of the different minerals separating out from the magma frequently overlap for considerable distances, the order, as every mineralogist knows, is not an absolute one, but only determined within certain limits; it is only right to mention here also that the order of crystallization has been determined mainly with regard to the principal minerals and in a less degree for a number of accessory minerals produced by special processes, although for many of the latter the period of formation is pretty sharply defined.

For the nepheline syenite pegmatite veins of the boundary zone of the Langesundfjord it was evidenced above, that the order of crystallization over large areas is, within certain limits, a definite one, and the same as in the corresponding boundary rock of the Laugenthal which is undoubtedly eruptive. Similarly, for example, for the genuine granitite pegmatite veins (with black biotite) the crystallization order is in all probability a definite one and corresponds to that of the massive granitite.

This circumstance is also one of the strongest arguments for the eruptive genesis of the genuine pegmatitic veins; it can as little be accidental for the latter as for the rocks which have certainly crystallized out from a magma, and must in both cases be explained in similar ways.

CHECK-LIST OF EUROPEAN AND NORTH AMERICAN MOSSES (Bryineæ).

By N. CONR. KINDBERG, Ph. D.

(*Concluded.*)

Series I. **PLEUROCARPOUS.**

Tribe 2. DIPLOLEPIDEOUS.

Endostome with longitudinal line.

51. *Heterophyllum* (Schimp.), C. M.

nemorosum (Koch), Kindb.

52. *Callicrgon* (Sull.), Kindb.

cordifolium (H.)
 **Richardsoni* (Mitt.)
giganteum (Schimp.)
sarmentosum (Wahlenb.)
badium (C. J. Hartm.)
cuspidatum (L.)
scorpioides (L.)
trifarium (Web. et Mohr).
stramineum (Dicks.)
 **nivale* (Lorentz).—Europe.
dilatatum (Wils.)
circulifolium, C. M. et Kindb.—America.
turgescens (Th. Jensen).
alpestre (Swartz).
arcticum (Sommerf.)
Goulardi (Schimp.)
torrentis, C. M. et Kindb.—America.
columbico-palustre, C. M. et Kindb.—America.

53. *Plagiothecium*, Schimp.

undulatum (L,), Br. eur.
neckeroideum, Schimp.—Europe.
denticulatum (L.), Br. eur.
 **subfalcatum*, Aust.—America.
silvaticum (L.), Br. eur.
Boscii (Hampe), Schimp.
 **aciculari-pungens*, C. M. et Kindb.—America.
lætum (Berggr.), Schimp.
 **attenuatirameum*, Kindb.—America.
brevipungens, Kindb.—America.
piliferum (Sw.), Br. eur.
latebricola (Wils.), Br. eur.
decursivifolium, Kindb.—America.

54. *Isopterygium*, Mitt.

silesiacum (Schiz.), Kindb.
turfaceum, Lindb.
 **pseudo-silesiacum* (Schimp.)—America.
elegans (Hook.) Lindb.
nitidulum (Wahlenb.), Lindb.
 **Muelleri* (Schimp.)
pulchellum (H.), Kinbd.
Bottinii, Breidl. Europe.
pseudo-latebricola, Kindb.—America.
subadnatum, C. M. et Kindb.—America.
passaicense (Austin.), Kindb.—America.
albulm C. M.), Kindb.—Amererica.
geminum (Mitt.), Kindb.—America.
fulvum (Hook. et Wils.), Kindb.—America.

55. *Ptychodium*, Schimp.

plicatum (Schleich.), Schimp.—Europe.
hyperboreum, C. M.—Europe.

56. *Campylium* (Sull.), Mitten.

stellatum (Schreb.), Kindb.
protensum (Brid.), Kindb.
polygamum (Br. eur.), Kindb.
striatellum (Brid.), Kindb.
Fitzgeraldi (Renauld), Kindb.—America.
elodes (Spruce), Kindb.—Europe.
 **densum* (Milde).—Europe.
subsecundum, Kindb.—America.
chrysophyllum (Brid.)—Kindb.
unicostatum, C. M. et Kindb.—America.
decursivulum, C. M. et Kindb.—America.

hygrophilum (Jar.), Kindb.—Europe.
bergenense (Aust.), Kindb.—America.
Duriaei (Mont.), Kindb. — Europe.

57. *Myurium*, Schimp.

Boscii (Schwagr.), Kindb.—America.
Hebridarum, Schimp.—Europe.

58. *Camptothecium*, Schimp.

nitens (Schreb.), Schimp.
sericeum (L.), Kindb.
Geheebii (Schimp.), Kindb.—Europe.
sericeoides, C. M. et Kindb.—America.
Philippeanum (Spruce), Kindb.—Europe.
nevadense (Lesq.), Kindb.—Am-
Amesiae, Ren. et Card.—America.
alsioides, Kindb.—America.
lutescens (Huds.), Schimp.
  **aeneum* (Mitt.)—America.
aureum (Lagasca), Br. eur.
pinnatifidum (Sull. et Lesq.)—Kindb.—America.
arenarium, Lesq.—America.
Nuttallii (Wils.), Schimp.—America.
hamatidens, Kindb.—America.
leucodontoides, Kindb.—America.
aureolum, Kindb.

59. *Brachythecium*, Schimp.

a. Eurhynchiopsis.

piliferum (Schreb.), Kindb.
Ryani, Kaur.—Europe.
Vaucheri (Schimp.), Kindb.
  **fagineum* (H. Muell.)—Europe.
cirrhosum (Schw.), Schimp.
crassinervium (Tayl.), Kindb.—Europe.
colyrophyllum (Sull.), Kindb.—America.

b. Rutabularia.

rivulare, Bruch.
  **flavescens* (Brid.), Kindb.—Europe.
  **latifolium*, Lindb.
Rutabulum (L.), Br. eur.
rutabuliforme, Kindb.—America
spurio-rutabulum, C. M. et Kindb.—America.
  **columbico-rutabulum*, Kindb.—America.
platycladum, C. M. et Kindb.—America.
cavernosum, Kindb.—America.
asperrimum, Mitt.—America.
vallium (Sull. et Lesq.), Kindb.—America.
lamprochryseum, C. M. et Kindb.—America.

c. Plumosaria.

plumosum (Sw.), Br. eur.
gemmascens, C. M. et Kindb.—America.
campestre, Bruch.
leucoglaucum, C. M. et Kindb.—America.
mirabundum, C. M. et Kindb.—America.

d. Salebrosaria.

Mildei (Schimp.), Kindb.
acuminatum (H.), Kindb.—America.
spurio-acuminatum, C. M. et Kindb.—America.
pseudo-albicans, Kindb.—America.
biventrosum, C. M.—America.
Fitzgeraldi, C. M.—America.
mammilligerum, Kindb.—America.
albicans (Neck.), Br. eur.
glareosum, Bruch.
turgidum, C. Harton.
digastrum, C. M. et Kindb.—America.
salebrosum (Hoffm.), Br. eur.
laetum (Brid.), Kindb.—America.
laevisetum, Kindb.—America.
luteolum, Kindb.—Europe.

e. Velutinaria.

velutinum (L.), Br. eur.
intricatum (H.), Kindb.
  **salicinum*, Br. eur.—Europe.
subintricatum, Kindb.—America.
trachypodium (Brid.), Br. eur.
curvisetum (Brid.), Kindb.
Teesdalei (Sm.), Kindb.—Europe.
venustum, De Not.—Europe.
californicum (Lesq.), Kindb.—America.
tenellum (Dicks.), Kindb.—Europe.

Donnellii (Aust.) Kindb.—America.
Fendleri (Sull. et Lesq.), Kindb.—America.
Hillebrandi (Lesq.), Sull.—America.

_f._ Camptotheciopsis.

oxycladon (Brid.), Kindb. -America.

60. _Raphidostegium._

Lorentzii (Mol.), Kindb. — Europe.
Roellii, Ren. et Card.—America.
recurvens (Mich.), Sauerb. et Jag.—America.
laxepatulum (Jarn.), Kindb.—America.
cylindricarpum, C. M.—America.
expallens, C. M. et Kindb.—America.
demissum (Wils.), De Not.
Kegelianum, C. M.
microcarpum (Brid.), Sb. et Jæg.—America.
*_admixtum_ (Sulliv.)- America.
subdemissum, Kindb.—America.
carolinianum, C. M.—America,
Welwitschii (Schimp.), Kindb.—Europe.
marylandicum, C. M.

61. _Limnobium_, Schimp.

ochraceum (Turn. et Wils.), Br. eur.
eugyrium, Schimp.
polare (Lindb.), Kindb.
palustre (L.), Schimp.
pseudo-arcticum, Kindb.—America.
viridulum (Harton), Kindb.
montanum, (Wils.), Kindb.
pseudo-montanum, Kindb.—America.
micans (Wils.), Kindb.
submolle, Kindb.—Europe.

62. _Hypnum_ (Dillen.), L.

_a._ Alaria.

commutatum, Hedw.
*_sulcatum_, Schimp.—Europe.
falcatum, Brid.
*_irrigatum_, Zetteryt.—Europe.
decipiens (De Not.), Kindb.

_b._ Cratoneuron.

filicinum, L.
*_curvicaule_, Jur.—Europe.
*_Vallis Clausæ_, Brid.—Europe.
*_fallax_, Brid.
fluviatile, Swartz.
*_irriguum_, Hook. et Wilf.

_c._ Harpidium.

revolvens, Swartz.
*_Cossoni_, Schimp.
*_vernicosum_, Lindb.
*_rigidum_, Kindb.—Europe.
Bambergeri, Schimp.
lycopodioides, Schwægr.
aduncum (L.), Hedw.—Europe.
Wilsoni, Schimp.
riparium, L.
*_capillifolium_, Warnst.
*_Kochii_, Br. eur.
vacillans (Sulliv.), Lesq. et Jam.
fluitans, L.
exannulatum, Br. eur.
*_pseudo-stramineum_, C. M.
Kneiffi, Schimp.
*_Sendtneri_, Schimp.
conflatum, C. M. et Kindb.—America.
hamifolium, Schimp.
uncinatum, Hedw.
*_Moseri_, Kindb.

_d._ Rhytidium.

rugosum, Ehrh.

_e._ Drepanium.

curvifolium, Hedw.—America.
*_Renauldi_, Kindb.
*_Lindbergii_, Mitt.
*_pseudo-drepanium_, C. M. et Kindb.—America.
arcuatiforme, Kindb.—America.

_f._ Ptilium.

crista-castrensis, L.
subimponens, Lesq.—America.

_g._ Hylocomium.

squarrosum, L.
loreum, L.
robustum, Hook.—America.

_h._ Cupressina.

Haldanianum, Grev.
flaccum, C. M. et Kindb.—America.

Jamesii (Sull.), Lesq. et J.—America.
pseudo-recurvans, Kindb.—America.
pseudo-complexum, Kindb.—America.
circinnale, Hook.
Sequoieti, C. M.—America.
callichroum, Brid.
Alaska, Kindb.—America.
Dieckii, Ren. et Card.—America.
fertile, Sendtner.
imponens, Hedwig.
canadense, Kindb.—America.
plicatile (Mitt.), Lesq. et Jam.
reptile, Michaux.
micro-reptile. Kindb.
pseudo-fastigiatum, C. M. et Kindb.
perichætiale, Br. eur.
reptiliforme, Kindb.—America.
molluscum, Hedw.
molluscoides, Kindb.—America.
procerrimum, Mol.—Europe.
hamulosum, Br. eur.
fastigiatum, Brid.
 **dolomiticum*, Milde.—Europe.
 **Sauteri*, Br. eur.—Europe.
filiforme, Kindb.—America.
dovrense, Kindb.—Europe.
Halleri, L. fil.
cupressiforme, L.
 **Waghornei*, Kindb.—America.
resupinatam, Wils.—Europe.
Vaucheri, Lesq.
complexum (Mitt.), Lesq. et J.—America.
subcomplexum, Kindb.—America.
depressulum, C. M.—America.
incurvatum, Schrad.

Fam. 11. FONTINALACEÆ.

63. *Fontinalis*, L.

disticha, Hook. et Wils.—America.
filiformis, Sull. et Lesq.—America.
Sullivantii, Lindb.—America.
Lescurii, Sull.—America.
squamosa, L.—Europe.
dalecarlica, Bruch et Sch.
dichelymoides, Lindb.
seriata, Lindb.—Europe.
maritima, C. M.—America.
Novæ-Angliæ, Sull.—America.
hypnoides, C. J. Harton.
antipyretica, L.
 **gracilis*, Lindb.—Europe.
 **californica*, Sull.—America.
 **Duriæi*, Schimp.
 **Kindbergii*, Ren. et Card.
 **gigantea*, Sull.—America.
Heldreichii, C. M.—Europe.
gothica, Card. et Arnell.—Europe.
mollis, C. M.—America.
biformis, Sull.—America.
neomexicana, Sull. et Lesq.—America.

64. *Dichelyma*, Myrin.

falcatum (H.), Myr.
pallescens, Br. eur.—America.
uncinatum, Mitt.—America.
cylindricarpum, Aust.—America.
capillaceum (Dicks.), Br. et Sch.

65. *Brachelyma*, Schimp.

subulatum (P. B.), Schimp.—America.

INDEX OF THE GENERA.

CONTRIBUTIONS TO CANADIAN BOTANY.

By JAS. M. MACOUN.

II.

THALICTRUM FENDLERI, Engelm.

Kicking Horse Lake, Rocky Mts. 1890. (*Jas. M. Macoun.*) Only Canadian station.

THALICTRUM OCCIDENTALE, Gray.

The western limit of this species is placed by Prof. Macoun (Cat. Can. Plants, p. 479) in the Selkirk Mts., B.C. Recent collections and a re-examination of our specimens have greatly extended its range.[1] Mountains near Kootanie Lake, B.C.; Sproat, B.C.; Mountains near Griffin Lake, B.C.; Nanaimo, Vancouver Island. (*John Macoun.*) Mountains near Spence's Bridge, B.C. (*Jas. M. Macoun.*) Dean or Salmon River, B.C. (*Dr. G. M. Dawson.*)

THALICTRUM POLYGAMUM, Muhl.

T. Cornuti, Linn.

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[1] The Geographical limits given in these papers refer to Canada only.

This species is confined to Eastern Canada and does not extend across the continent as stated in Macoun's Cat. Can. Plants, p. 15. Our most western specimens are from Flat Rock Portage, Lake Nipigon, Ont.

THALICTRUM PURPURASCENS, Linn.

Long Lake, Assiniboia; Warm Springs, Kootanie Lake, B.C. (*John Macoun.*) Not before recorded west of Ontario. References under var. *ceriferum*, Macoun's Cat. Can. Plants, p. 479 go here.

THALICTRUM VENULOSUM, Trelease.

Additional stations for this rare species are Manitoba House, Lake Manitoba; Kicking Horse Lake, Rocky Mts. (*John Macoun*).

THALICTRUM DIOICUM × PURPURASCENS.

Specimens from Eel River, Restigouche, N.B., (*R. Chalmers.*) with leaves glandular and fruit intermediate have been referred here by Dr. Trelease.

Note—All the specimens of *Thalictrum* referred to above have been examined by Dr. Wm. Trelease and our determinations confirmed or corrected by him.

ANEMONE DELTOIDEA, Dougl.

Specimens collected in the Coast Range by Dr. G. M. Dawson, were referred here by Prof. Macoun, (Cat. Can. Plants p. 13.) A recent examination of these specimens shews them to be *A. Richardsoni.* *A. deltoidea* has not been found in Canada.

ANEMONE HEPATICA, L.

A few leaves collected by Dr. Robt. Bell on the Upper Savage Islands, Hudson Straits, (Macoun, Cat. Can. Plants, p. 478), prove to be the root-leaves of *Saxifraga cernua* and not *A. Hepatica.*

ANEMONE LYALLII, Britton, Annals of N. Y. Academy of Sciences, Vol. VI. p. 227.

A. nemorosa, Linn., var. (?), Macoun, Cat. Can, Plants, Vol. I, p. 478.

A. Oregana, Macoun, Cat. Can. Plants, Vol. II, p. 295.

Slender, erect, nearly glabrous throughout, 10-40 cm. high, from a short horizontal root-stock. Radical leaves not seen: leaves of the involucre on very slender petioles 1.5-3 cm. long., 3-divided, the divisions sessile, ovate, or the terminal ones sometimes nearly orbicular, dentate-crenate, or sometimes incised, acute, or obtuse, very thin, more or less ciliate along the margins; flowers solitary white, about 1 cm. broad, its peduncle slightly exceeding the petiols of the involucral leaves, sepals about 5, oval-oblong, obtuse; young achenia quite densely strigose-pubescent

Dean or Salmon River, B.C., (*Dawson*). Near Victoria, V.I., (*Fletcher*), Goldstream, V.I., and Burnside Road near Victoria. V.I., (*Macoun*. Herb. Nos. 912, 913).[1]

ANEMONE QUINQUEFOLIA, L.

A. nemorosa, Amer. Authors.

"Readily distinguishable from the European *A. nemorosa* by its slender habit, slender petioles, less lobed divisions of the involucral leaves, paler green of the foliage and smaller flowers." (Dr. N. L. Britton.)

The western limit of this species as shown by our herbarium specimens is Wingham, Ont.

Note. See Revision of the genus *Anemone* by Dr. N. L. Britton in Annals of the New York Academy of Sciences, Vol. VI. pp. 215-238.

AQUILEGIA CHRYSANTHA, Gray.

On the portage between Hope and the head of the Similkemeen River, B.C., (*A. J. Hill.*), New to Canada.

ARABIS MACOUNII, Watson, Proc. Am. Acad. of Arts and Sciences, p. 124.

Biennial, branched from the base, slender, pubescent

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[1] Whenever herbarium numbers are given, they are the numbers under which specimens have been distributed from the herbarium of the Geological Survey of Canada.

below with mostly stellate spreading hairs, glabrous above or but sparingly puberulent, a foot high; leaves small and narrow, ½ inch long or less, the lower very rarely few-toothed, the cauline sagittate at base; flowers very small, pale rose-colour, 2 lines long; pods very narrow, 1 to 1½ inches long and about ½ line broad, glabrous, slightly curved, mostly divaricate on very slender pedicels 2 to 4 lines long, acute, the stigma nearly sessile; seeds (immature) approximately 1 rowed, apparently wingless; near *A. hirsuta.*

Gravelly banks, Revelstoke, B.C., May 13th, 1890. (*John Macoun.*)

TRIFOLIUM PROCUMBENS, Linn.

An erect form of this plant was found by Prof. Macoun in 1893, growing in fields at Comox, Vancouver Island. Not recorded before from western Canada, though the var. *minus* is common on Vancouver Island.

TRIFOLIUM INVOLUCRATUM, Willd.

Collected at Revelstoke, B.C. in 1890 by Prof. Macoun. Abundant on Vancouver Island, but not before collected in the interior of British Columbia.

TRIFOLIUM MICROCEPHALUM, Pursh.

Collected at Revelstoke and Sproat on the Columbia River, B.C. in 1890 by Prof. Macoun. Common on Vancouver Island, but not before recorded from interior of British Columbia.

LOTUS CORNICULATUS, Linn.

Recorded from New Brunswick. Collected in 1890 at Victoria, Vancouver Island, by Rev. Edw. L. Greene.

ASTRALAGUS ROBBINSII, Gr. var. OCCIDENTALIS, Wat.

Not before separated in Canada from *A.alpinus*, the western form of which it somewhat resembles. Bow River at Morley, Alberta; near the Glacier at Lake Louise, Rocky Mts.; Deer Park, Columbia River, B.C. (*John Macoun.*) Guichon Creek, B.C. (*Dr. G. M. Dawson.*) All the above specimens were found growing on gravelly shores or banks.

FRAGARIA CANADENSIS, Michx.

This plant has been separated from *F. Virginiana* by Dr. N. L. Britton. (Bull. Torr. Bot. Club, Vol. XIX., p. 222.) At the time Dr. Britton's note was written our herbarium contained no specimens of this species. In 1892, however, it was collected by Miss E. Taylor at Fort Smith, on the Great Slave River, and in 1893 by Mr. Jas. W. Tyrrell on the banks of the Black River, east of Lake Athabasca. "The leaflets are much narrower, oblong or the middle one obovate and cuneate at the base, all obtuse rather sparingly and not deeply toothed." In Miss Taylor's specimens the largest leaflet is 20 lines long and but 7 lines broad at its widest part. The plants here referred to are very much slenderer than any of our specimens of *F. Virginiana.* The stations given for this species by Dr. Britton are Lake Mistassini, (*Michaux.*) Arctic America. (*Dr. Richardson.*) Elk River [Athabasca River] (*Kennicott.*)

EPILOBIUM, Linn.

In the last addendum to his catalogue of Canadian Plants (Vol. II., p. 323), Prof. Macoun wrote: "Many additional species and varieties of *Epilobium* have been added to our flora since the publication of Part III, but our whole series of this genus is now being examined by Prof. Trelease who is unable to report upon them in time to include them in this part." Since the above was written botanical explorations in the Rocky Mountains, British Columbia, and elsewhere have added greatly to our knowledge of this genus, and the revision here given covers all the specimens in our herbarium and gives the distribution of each species as we now understand it. All our specimens have been examined by Dr. Wm. Trelease, and references to many of them have been included in his revision of this genus. (See Second Annual Report, Missouri Botanic Gardens, pp. 69-116.)

(1.) E. SPICATUM, Lam.

Common from the Atlantic to the Pacific and north to the Arctic Circle. The most northern specimens in our herbarium are from the mouth of the Mackenzie River (*Miss E. Taylor.*) and from Lat. 60° 20, Long. 104° 30. (*Jas. W. Tyrrell.*)

Var. CANESCENS, Wood.

"An albino variety with more than usually canescent pods." Marmora Village, Hastings Co. and Owen Sound, Ont. (*John Macoun.*) Lake of the Woods, Ont. (*Burgess; Dawson.*) Norway House, Lake Winnipeg. (*Otto Klotz.*)

(2.) E. LATIFOLIUM, L.

Newfoundland, Labrador and the Gaspé Peninsula; Bow River, Rocky Mts., to the Pacific Coast and throughout Canada north of Lat. 53°. Most of the northern specimens in our herbarium are the broad-petaled variety *grandiflorum*, Britton. Specimens collected by Mr. Jas. W. Tyrrell in Lat. 64° Long. 101° were just coming into flower Aug. 25th, 1893. Albinos with very large cream-coloured flowers have been collected on both sides of Hudson Bay by Mr. Jas. M. Macoun.

(3.) E. HIRSUTUM, L.

Naturalized at Niagara Falls, Ont. (*R. Cameron.*) Introduced in garden seed.

(4.) E. LUTEUM, Pursh.

Abundant by rivulets and on damp grassy slopes in the Selkirk Mts., B.C., between Beaver Creek and the Glacier House, but not known to occur elsewhere in Canada. The petals are bright yellow a little lighter than those of *Œnothera biennis.*

(5.) E. PANICULATUM, Nutt.

Abundant at Colpoy's Bay, Georgian Bay, Lake Huron. (*John Macoun.*), but not found in any other part of Eastern Canada. Rare in the prairie region, but common in British Columbia and on Vancouver Island.

(6.) E. MINUTUM, Lindl.

From several localities in British Columbia and common on Vancouver Island. The form named *adscendens* by Suksdorf, was collected on Mt. Benson, Van. Island, by Prof. Macoun in 1893.

Var. FOLIOSUM, Torr. & Gray.

Sproat, Columbia River, B.C., (*John Macoun*) and Yale Mt., B.C., (*Fletcher.*) Common on Vancouver Island.

(7.) E. STRICTUM, Muhl.

E. molle, Torr. of Macoun Cat. of Canadian Plants, p. 171 in part and p. 530.

Specimens in our herbarium are from East Pt., P.E.I., and Belleville, Ont. (*John Macoun*); Cartwright, Ont. (*W. Scott.*)

(8.) E. LINEARE, Muhl.

Common from Prince Edward Island west to Beaver Creek, Selkirk Mts., B.C.

(9.) E. PALUSTRE, L.

Common from the Atlantic to the Rocky Mts. No specimens in our herbarium from British Columbia, but found north of that province by Dr. G. M. Dawson on the Lewis River in Lat. 62°.

(10.) E. PALUSTRE × LINEARE. (*E. pseudolineare*, Hausskn.)

Specimens collected by Prof. Macoun at Ellis Bay, Anticosti, have been referred here by Dr. Trelease.

(11.) E. DAVURICUM, Fisch.

"Habit of *E. palustre;* stems terete or with occasional low decurrent lines; seeds fusiform, prominently beaked." A span or two high mostly simple, the very slender stem sparingly incurved-pubescent, otherwise glabrous; roots densely fascicled; leaves less than 15 mm. long, somewhat crowded at base, alternate and remote above, linear or oblong, obtuse, remotely denticulate, sessile 1-nerved; flowers pale not very numerous, nodding; capsules erect

40 mm., or long slender peduncles; seeds, ·4 × 1·5 mm.; coma white.

In bogs, Beaver Creek, Selkirk Mts., B.C., Aug. 14th, 1885. (*John Macoun.*) In one of these specimens "the beak of the seed is very narrow and 3 mm. long."

(12.) E. FRANCISCANUM, Barbey.

Of many of our specimens examined by Dr. Trelease, but one collected at Qualicum, Vancouver Island, has been definitely referred to this species. Of other specimens examined by him he says: "Specimens collected on Vancouver Island and in British Columbia are doubtfully referred here, though they may belong to *adenocaulon.* The smaller, more closely crisp-hairy form approaches the next species. [*E. Watsoni.*] A curious simple plant with large glossy thin leaves, scarcely to be referred elsewhere occurs from Queen Charlotte Islands, B.C. (*Dawson*, July 10th, 1878.)"

Specimens collected by Prof. Macoun on Vancouver Island in 1893 are placed here, though "too near *E. adenocaulon var. occidentale.*" The specimens now referred to this species were formerly included under *E. coloratum.*

(13.) E. COLORATUM, Muhl.

Represented in our herbarium by but one specimen from Casselman, Ont. All the eastern specimens placed under *E. coloratum*, and most of the western placed under *E. coloratum* and *E. tetragonum* in Prof. Macoun's Catalogue of Canadian Plants, (pp. 169-170) have been referred to *E. adenocaulon* by Dr. Trelease.

Specimens from Salt Lake, Anticosti; Little Flat, Rock Portage, Nipigon River, Ont., and Little Slave Lake, N.W.T., are probably *coloratum* × *adenocaulon.*

(14.) E. ADENOCAULON, Hausskn.

Common from the Atlantic to British Columbia. Dr. Trelease considers that a very small crisp-pubescent form (1½ to 3 inches in height), collected by Prof. Macoun at Brackley Pt., P.E.I., may be *E. ciliatum*, Raf.

Var. OCCIDENTALE, Trelease.

Lake Okanagan and Burrard Inlet, B.C., and common on Vancouver Island. "Sometimes comes too near *E. Franciscanum*, but differs in its usually smaller flowers less corymbosely clustered and more acute at base, and in its shorter glandular pubescence."

(15.) E. GLANDULOSUM, Lehm.

In damp places at an altitude of 5,000 feet at Warm Springs, Kootanie Lake, B.C. (*John Macoun.*)

(16.) E. BREVISTYLUM, Barbey.

Specimens from mountains south of Tulameen River B.C. (*Dawson*), have been doubtfully referred here by Dr. Trelease.

(17.) E. HALLEANUM, Hausskn.

Collected by Prof. Macoun in 1887 on Cedar Hill, Vancouver Island, and in 1893 at Esquimault, V. I.

(18.) E. DRUMMONDII, Hausskn.

Young specimens from Stewart's Lake, B. C., (*Macoun*) with leaves in whorls of 3, have been doubtfully referred here by Dr. Trelease.

(19.) E. LEPTOCARPUM, Hausskn.

A span or less high, glabrous except for some incurved pubescence on the stem; leaves less than 20 mm. long, broadly lanceolate, sparingly low-toothed, tapering from near the middle to the obtuse or subacute apex and winged petiole; flowers abundant for the size of the plant; calyx-tube narrow; petals about 3 mm. long, rosy; capsules 20 mm., on very slender peduncles of nearly equal length; seeds nearly ellipsoidal, shortly hyaline beaked, ·25 × ·75 mm.; coma at length cinnamon-colored.

Var. MACOUNII, Trelease.

Less branched, crisp-pubescent in lines, the same pubescence more or less abundant also on the flowers and capsules; leaves more ovate; seeds 1 mm. long; coma paler.

New variety first collected in 1878 near Lake Athabasca by Prof. Macoun, for whom it is named, and again by him at the head of Lake Louise, Rocky Mts., in 1891.

(20.) E. HORNEMANNI, Reichenb.

Nearly all the references under *E. origanifolium*, Lam., Macoun's Catalogue of Canadian Plants, p. 169, belong here.

In one or other of its forms from Labrador to Vancouver Island.

(21.) E. ALPINUM, L.

From Kicking Horse Lake to Vancouver Island. Generally found with the preceding species which it greatly resembles. *E. Hornemanni* is "somewhat crisp-hairy in the inflorescence and along the decurrent lines or slightly glandular at top, otherwise glabrate"; in *E. alpinum* the inflorescence and decurrent lines are more nearly glabrous. In the former species the seeds are "rather abruptly short-appendaged, from nearly smooth to very rough;" in the latter they are "smooth gradually alternated at apex with very evident beak."

(22.) E. OREGONENSE, Hausskn.

Borders of rivulets, Swamp River, B.C. (*Macoun.*) Only Canadian station.

(23.) E. ANAGALLIDIFOLIUM, Lam.

Specimens in our herbarium are from Cape Chudleigh, Hudson Strait. (*Dr. Bell.*) Rocky Mts. (*Drummond.*) Kicking Horse Lake, Rocky Mts., and Mt. Benson, Vancouver Island. (*Macoun.*)

(24.) E. CLAVATUM, Trelease.

A span high, mostly densely cæspitose, the slender stems ascending, glabrate to sparingly glandular throughout; leaves 15 to 20 mm. long, divergent, broadly ovate, very obtuse, subentire to remotely serrulate, mostly rounded to evident petioles, firm, drying brownish; flowers rather few, suberect, petals rose-colored, about 5 mm. long; capsules 25 mm., subclavate arcuately divergent, the lowest often not reaching the apex of the stem, their slender peduncles equalling the subtending leaves; seeds fusiform, tapering into a pale beak, nearly smooth to coarsely papillate, ·4 to ·6 × 1·5 to 2 mm.; coma barely dingy.

First collected in Canada by Jas. M. Macoun in 1890, at an altitude of 7,500 feet on mountains near Kicking Horse Lake, Rocky Mts. In 1891 by Prof. Macoun on several mountains near Banff and Lake Louise, Rocky Mts.

ANGELICA LYALLII, Wat.

Specimens collected by Dr. Geo. M. Dawson on the summit of the South Kootanie Pass in 1891, were doubtfully referred here by Prof. Macoun (Cat. Can. Plants, Vol. I., p. 535.) These specimens have since been examined by Coulter and Rose, who confirm his determination. This species has since been found at Sproat, Columbia River, B.C., 1890, (*John Macoun*) and at Chaperon Lake, B.C., (*Jas. McEvoy.*)

ECHIUM VULGARE, Linn.

Though well naturalized and spreading in Canada, east of the great Lakes, of very local occurrence in the west. Our western specimens are from Wabigon Tank, on the C. P. Railway, east of Lake of the Woods, (*Wm. McInnes*) and Cariboo, B.C. (*John Macoun.*)

MENTHA CANADENSIS, L.

Colquitz River, near Victoria, V. I., and Sooke, V. I., 1893. (*John Macoun*, Herb. Nos. 1054, 1055.) Not before recorded from Vancouver Island.

MENTHA CANADENSIS, L. var. GLABRATA, Benth.

Fort Simpson, Mackenzie River. (*Miss E. Taylor.*) Sproat, B.C.; Kamloops, B.C.; Sproat Lake, Vancouver Island. (*John Macoun.*) Not before recorded west of Rocky Mountains.

NEPETA CATARIA, L.

Beacon Hill, near Victoria, Vancouver Island, 1893. (*John Macoun*, Herb. No. 977.) Not before recorded west of Ontario.

STACHYS CILIATA, Dougl. var. PUBENS, Gray.

New Westminster, B.C., 1892. (*Law.*) Fishery Bay, Nasse River, B.C. (*Jas. McEvoy,* Herb. No. 1096.) Our only other specimen is from Queen Charlotte Islands.

MENTHA VIRIDIS, L.

Growing in the streets of Victoria, Vancouver Island, 1893. Naturalized. (*John Macoun,* Herb. No. 1052.)

ASARUM CAUDATUM, Lindl.

Common at Revelstoke, B.C. (*John Macoun.*) Eastern limit in Canada.

EPIPACTIS HELLEBORINE, Crantz.

First found in Canada in 1890 at Lambton Mills, Humber River, Ont., by W. & O. White, and more recently (1892) on Mount Royal, Montreal, Que., by N. D. Keith.

The only stations given for this species in the last edition of Gray's Manual are Syracuse and Buffalo, N.Y.

EPIPACTIS GIGANTEA, Dougl.

Collected by Dr. G. M. Dawson in 1877 at Osoyoos Lake, B.C., but not again until 1890, when it was found by Prof. Macoun at Lower Arrow Lake, Columbia River, and Hot Springs, Kootanie Lake, B.C.

ALLIUM NEVII, Watson.

Found growing on gravelly banks at Botanie near Spence's Bridge, B.C., by Jas. McEvoy. Found on Vancouver Island, but not before on the mainland.

JUNCUS GERARDI, Lois.

This rush, though common on the Atlantic Coast, had not been found on the Pacific Coast until it was discovered in 1887 by Prof Macoun near Victoria, Vancouver Island. It was again collected by him at Nanaimo, V. I. in 1893. As in the east it was found growing in salt marshes and is without doubt indigenous.

POTAMOGETON NATANS, Linn.

Enderby, B.C., and Shuswap Lake, B.C. (*Jas. M. Macoun.*) Griffin Lake, B.C., and Revelstoke, B.C. (*John Macoun.*) Not before recorded from British Columbia.

POTAMOGETON PAUCIFLORUS, Pursh.

Revelstoke, B.C., 1890. (*John Macoun.*) Not before recorded from British Columbia.

BOTRYCHIUM LANCEOLATUM, Angst.

Near Niagara Falls, Ont. (*R. Cameron.*) Not before found in Ontario.

PRELIMINARY NOTE ON THE LIMESTONES OF THE LAURENTIAN SYSTEM.

By ELFRIC DREW INGALL.

GEOLOGICAL SURVEY, OTTAWA.

In view of the attention which is now being directed to the above mentioned subject, in connection with the work of the Geological Survey of Canada in the Laurentian area lying north of Ottawa, it is deemed a fitting time to record the observations and conclusions of the writer on the question above denoted.

These observations were made whilst studying the mode of occurrence of the phosphate deposits of the county of Ottawa, Province of Quebec in the years 1888, 1889 and 1890, and have not before been presented to the public owing to the pressure of other duties in connection with the supervision of the division of Mineral Statistics and Mines of the Geological Survey. A fuller and more complete statement of results must even yet await the evidence to be adduced from a microscopical study of the very complete series of rock specimens collected.

At the commencement of the investigation with a view to prevent any prejudice in observation special care was taken to avoid any preconceived theoretical bias and the views arrived at are simply the result of an extended and detailed study of the phenomena observable in the field.

Apart from the chief object of the investigation—i.e. the mode of the occurrence of the phosphate deposits—it was intended to show the distribution of the rocks over a typical area which should include the chief mines of the district, and in this way it became necessary to attempt a delimitation of certain limestone areas, in doing which the following features were brought forcibly to light.

Their mode of occurrence was extremely indéfinite and irregular. Although great pains were taken it was found impossible in most places to draw any very sharp line between the limestones and the surrounding rocks.

They contained inclusions of gneissic and other associated rocks in the form of bands, nodules, etc.

The proportion of this included rock in relation to the limestone proper was extremely variable so that whilst at some places limestone with inclusions might be a fitting designation, at others one would rather describe as gneiss with intercalated ribbons or bands of calcite. Thus, in passing from a limestone area on to another rock, it became a question of percentage as to where one would draw a line between the two and in the area of gneiss, etc., proper, one would often find little scattering patches of limestone.

These limestone areas show a very constant and more or less definite striping or parallel structure which always maintained a marked parallelism with that of the surrounding gneiss in all its variations of direction.

On close observation, the inclusions in these limestone areas, show some very interesting features. In shape they are varied. One exposure might show a number of contorted bands of gneissic material running parallel to each other, separated by limestone, and much thickened at the sharp bends by doubling. At other places these inclusions form a comparatively small proportion of the rock mass showing as detached nodules, of irregular shape. These nodules are very commonly roughly lenticular, showing a tendency to taper off at either end along the striping of the enclosing limestone; at places this tapering off is seen, on closer inspection, to be due to strings of particles of felspathic and similar material arranged in line.

All these inclusions of whatever shape seem to have one feature in common. Their exterior surface it hackly, pitted and with a generally corroded appearance.

The general striping of the limestones would seem, on careful study, to be due, either to little irregular chains of such particles or to a different colouring of the replacing calcite crystals, probably marking the places where such particles have been.

The detailed explanation offered by the writer seems to him to satisfactorily and thoroughly explain these and other features of the limestones of the Laurentian. He is led to the conclusion that they simply represent areas of gneissic and similar rocks altered in place into limestones. Furthermore, that the extent and location of these areas have been largely determined by the presence of the abrupt bends and other contortions of these rocks, whose foliæ would thus be separated and opened up to the complete action of the subterranean waters. Where such contortions and crumpling of the rocks had extended over a considerable area, the alteration would have gone further and have produced the solid limestone masses so frequently found. In these the inclusions would naturally be scarcer and represent the more solid portions of the ribs of the gneiss which for this reason or owing to their mineral composition were less amenable to change than the rest of the area. These would naturally show the corroded surface already alluded to, and the tapering off along the striping of the rock. The lesser and scattering occurrences of limestone throughout the district, which are a very confusing feature on any other supposition, would thus be satisfactorily accounted for as well as the extreme irregularity of the boundaries of these limestone areas and other phenomena of their occurrence.

Doubtless also the mineral constitution of the original rocks must have been an important factor in the determination of the position, etc., of these alteration areas.

The occurrence of these limestones at the anticlinal folds of the formation has been noticed in a general way by Dr. Ells, of the Geological Survey staff, who is now engaged in mapping the general geology of a very large district north of the Ottawa River, extending from Ottawa city eastward, nearly to Montreal. The writer, however, believes that this is the first attempt to explain *in detail* the reason of this association on the basis of subsequent alteration in place, and to put forward a theory which should harmonize all the features observable both in the larger and more definite areas and in the smaller and scattering patches found throughout the district.

Since writing the above I understand from Dr. Selwyn, the Director of the Geological Survey, that in some correspondence he had with Messrs. Rowney and King in regard to their book on Rock Metamorphism, issued in connection with the Eozoon controversy in 1881, he wrote as follows: "I am led to believe that the two kinds of limestone or dolomite have had a distinct origin and that the non-fossiliferous and generally crystalline set are newer than the strata with which they are associated. Nearly if not quite all our Laurentian and Huronian limestones seem to me to have this non-contemporaneous character notwithstanding that they conform more or less perfectly with the lamination and with the larger flexures of the associated gneiss."

TERATOLOGICAL NOTES.

By D. P. PENHALLOW, McGill University.

Marked departures from the ordinary course of development in plants are interesting, and often instructive, as throwing additional light upon the morphological character of organs, the original features of which have become lost in the course of development and adaptation to special functions. This is particularly true where these changes are of the nature of reversions to the primitive type of structure The present notes are designed to draw attention to a few instances of such reversions which have lately come under notice, and which have already served an important purpose in the instruction of students. During the past winter, Mr. N. N. Evans brought to my notice a common cultivated tulip which displayed an alteration in some respects most unusual. The flower was perfectly normal as to form and size, and exhibited three normal carpels in the pistil. There were, however, seven stamens instead of six, and seven divisions of the perianth instead of six. The addition of an extra number to each of these whorls of organs was found, upon examination, to be a result of chorisis or deduplication, an alteration which is by no means rare, but which leads to the breaking up of a normally single organ into two or more organs of the same kind. The most marked change, and one which is comparatively rare, was to be found in the presence of a bract below the flower. This organ was found to arise from the scape at a distance of about one and one-half inches below the flower. It was two and one half inches long and one-half inch wide. One margin, for a width of about one-eighth of an inch, was distinctly petaloid, showing the tendency for this organ to become a true spathe. This case has more recently been paralleled by the occurrence of a double calla lily, in which a second spathe of full size and form was developed below the normal spathe at a distance of about one inch.

In a flower of the common fuchsia all parts were normal with the exception of one calyx lobe, which had developed into a perfectly normal leaf except along one margin, where it remained attached to the adjoining sepal.

In the common pelargonium one flower was completely replaced by a branch bearing well-developed and normal leaves.

Roses under cultivation often exhibit interesting conditions of reversion in the flower, less frequently do they show them in the leaves. Two specimens in our collection give a clear indication of the reversion of a compound leaf to the simple form of that organ. The specimens are of the common wild rose (*Rosa carolina*). In one case the flower is normal, and only one leaf shows reversion. Here the five normal leaflets are replaced by two leaflets. The basal one of these shows from its position that its opposite was arrested in development. The terminal leaflet shows three strong lobes, with a prominent vein running into each, so that if we consider these three lobes as three leaflets which have become united, we then have a complete correspondence with the number of parts in a normal leaf. In the second case the flower was proliferous and greatly reduced in size, while five leaves exhibited various stages of reversion. In all five leaves the three terminal leaflets had become joined so as to form a more or less strongly three-lobed leaflet. Counting these lobes as the representatives of leaflets, it was then found that there was an exact numerical correspondence with the parts, 5–7, of a normal leaf.

ANCIENT MYRIAPODS.

G. F. MATTHEW, F. R. S. C.

The Common Earwig is the best known example of a class of articulate animals, not very familiar to us because of their comparative scarcity and secretive habits. In these respects they are the opposite of some species of the immensely more numerous, and obtrusively familiar Hexapods or True Insects. Myriapods differ strikingly from the latter in their long worm-like bodies composed of numerous segments, and having equally numerous or more numerous feet.

So distinct are the Myriapods in these and other respects from the true insects, that many writers recognize them as a separate class, of equal rank with the Crustaceans, Hexapods and Arachnids (spiders and scorpions).

Though now comparatively rare, in past ages the Myriapods played an important part in peopling the land areas of the globe, and possessed great diversity of structure. Only a few species from the Palæozoic rocks have been known until of late years, but gradually the number has been increased, and as their diversity of form has been recognized, the importance of their bearing upon the classification of insects has become more manifest.

A sketch of the discoveries of fossil Myriapods which have been made from time to time, may serve to show how rare an event is the discovery of the remains of one of these little animals.

In 1854 C. L. Koch and J. C. Berendt described the Crustaceans, Myriapods and Spiders of the Amber of Vorwelt, North Germany. These amber fragments contain a rich insect fauna, admirably preserved, have yielded 35 species of Myriapods (15 Chilopods and 20 Diplopods) and are of late Tertiary age.

In 1859 Sir J. W. Dawson found and described[1] remains of a species of Millipede (*Xylobius Sigillariæ*) in erect stumps of trees in the Coal Measures at the Joggins in Nova Scotia. At a later period (1873) Dr. S. H. Scudder, of Cambridge, Mass., reviewed the Millipede remains from these stumps and found three species of the genus established by Sir Wm. Dawson and established the new genus, *Archiulus.*

In 1863 J. W. Salter described two fossils from the English Coal Measures under the genus *Eurypterus.* These specimens were re-examined by Mr. Henry Woodward and found to be of other genera. One *E. armatus* he suggested was a gigantic Arachnid, and the other *E. ferox* was plainly a species of Meek and Worthen's new genus *Euphoberia* and therefore a Myriapod.

Salter in that year also described a Eurypterus from the Plant Beds at St. John, N.B. Later discoveries lead the author to think that this species, *E. pulicaris*, should also be referred to the Myriapods, or to the Insects.

In 1868, A. Dohrn described a Millipede from the coal beds of Saarbruck, in Germany. These beds are of Permian Age.

In 1868, Meek and Worthen began to make known those remarkable Myriapods from the Lower Coal Measures of Mazon Creek, Ill., which, together with the plants found there, have made that locality famous. These remains were more fully described by Dr. Scudder at a later date with more ample material at his command, and such was

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[1] Journal Geol. Society of London, Vol. XVI. p. 268, 1859.

the extraordinary nature of these remains that their study quite revolutionized the classification of the Myriapods.

In 1871, H. Woodward discovered a Myriapod (Euphoberia) in the English Coal Measures, and a few years later (1878) P. L. Bertkau one in the Brown Coal of Rott, near Bonn, Miocene in age.

In 1882, B. N. Peach carried back a knowledge of these creatures to the Devonian, describing two forms from the old red Sandstone of Forfarshire, in Scotland.

In 1886, Dr. Scudder issued a systematic review of the Insects, Myriapods and Arachnids which remains to-day the most systematic and philosophical grouping of the Insectea. He has since made some important changes however, as for instance in recognizing Chilopods among the Carboniferous Myriapods.

The insect faunas of the Tertiary deposits are notably poor in remains of Myriapods. Prof. Oswald Heer, in 1862, described the Insect Fauna of Œningen, in Bavaria, finding no less than 844 species of insects chiefly beetles, and almost all of living families. But, as quoted by Lyell, he does not mention the occurrence of a single Myriapod. Rev. P. B. Brodie described no less than 24 families of insects from the Lower Lias, Great Britain, but Myriapods are equally wanting there.

For ten years (1881-1890), Dr. Scudder was at work on the Insect Fauna of the Tertiary lake basin of Florissant and other localities of Western North America. His results were published by the U. S. Geological Survey and fill a large quarto volume with 28 plates, representing this extensive series of fossils.

The remarkable richness of the Florissant fauna may be inferred from Dr. Scudder's statement that in one summer about 10,000 specimens were collected from these beds; whereas it had taken Heer thirty years to gather the 5,000 specimens from Œningen, on which he founded his descriptions. Yet from all the material gathered at Lake Florissant, Dr. Scudder has figured only one broken example of a Myriapod.

Modern Myriapods are divided into three orders, Chilopods, Decapods and Pauropods; the third of which, only known as Recent, is insignificant both in numbers and size. Dr. Scudder was once disposed to claim that these orders like those of the True Insects had originated in the Secondary Rocks (Mesozoic), and that all the Palæozoic Myriapods were included in his new orders, Palæosygnatha and Archipolypoda; but he has since discovered examples of the Chilopod forms in the Carboniferous beds. It follows that three if not four of the orders of the Myriapods existed in the Palæozoic rocks.

The Chilopods are distinguished from the Diplopods by the possession of only one pair of feet to each joint of the body, whereas the Diplopods have the ventral plate of each joint in two pieces and carry two pairs of legs to each joint except a few anterior joints which have only one pair; their feet therefore are twice as numerous as those of the Chilopods (except on the anterior joints). The Chilopods differ also in having the body flattened. Some small species of this order has been found in the plant beds at St. John.

Dr. Scudder has made a separate order, Protosygnatha, of that singular larva-like form described by Meek and Worthen under the name Palæocampus. It has only a few joints (12) and is covered with tufted bristles. A Myriapod with the bristles more uniformly diffused and having more numerous joints occurs at St. John.

Omitting Protosygnatha and the few Chilopods from view, the bulk of the Palæozoic Myriapods are included in the extensive order Archipolypoda, characterized by a rounded body of many joints, and having the ventral plate of each somite as in Diplopoda divided into two pieces, with a pair of legs attached to each piece. The anterior half of each dorsal plate is elevated, ridged transversely to the body and frequently bears spines or tubercles; while the posterior portion is flatter and lower. The body in the Myriapods of this order is elongated, fusiform, largest in the middle or towards the anterior end, and is composed of many segments.

A peculiar family, *Archidesmidæ*, referred by Scudder to this order has been found in the Devonian rocks of Scotland; in this family the halves of the dorsal plate of the several joints are scarcely consolidated; but the anterior half is more important, both by its size and by the expanded lateral lamellæ that ornament it. These curious Myriapods are found in the old red sandstone of Forfarshire.

The most important family of the Palæozoic Myriapods is the *Euphoberidæ*, distinguished from the last by the more or less complete soldering of the two portions of the dorsal plate; in this the elevated anterior portion is ornamented with large, often forked spines, or with tubercles. The Euphoberidæ are the typical forms of the order Archipolypoda, and some are of great size. According to Dr. Scudder some species were amphibious, being provided with organs, apparently of the nature of gills, beside the ordinary spiracles, and with lamellate legs. They appear to have been far more abundant in the new world than in the old, and in the latter are scarcely known outside of Great Britain.

The ironstone nodules of the shales on Mazon Creek, Ill., have produced the greatest number and the most remarkable forms of these archaic Myriapods, though some have been found in the British carboniferous deposits. Those found at Coldbrook Dale were at first taken to be the caterpillers of certain butterflies, and afterwards as belonging to the Merostomata. Myriapods of this family have lately been found at St. John, N.B.

A third family of ancient Myriapods is that designated as Archiulidæ by Dr. Scudder. In this group a near approach to Diplopoda of modern Myriapods is seen. The two pieces of the dorsal plate are closely consolidated, but still are distinctly visible, though the anterior is rarely elevated much above the posterior, the body is almost smooth or covered more or less abundantly with serially disposed papillæ, from which in some cases hairs or small spines arise. The members of this family resemble modern

Diplopoda in their general appearance much more closely than either of the preceding families. Sir Wm. Dawson, who first discovered their forms in the Palæozoic rocks, classed them with the Diplopoda, and spoke of them as the oldest "gally worms" known. Sir William's figures would indicate that the back (not the front part as Scudder says) was the more elevated. While first found in the erect stumps of Sigillarian trees at the Joggins, they have since been detected in the Coal Measures of Great Britain and on the continent of Europe. Possibly also some species found in the Dyas of Bohemia may belong to this family. Two species have been found at Mazon Creek.

As regards the development of the Myriapods, Dr. Scudder says that in the early life of Pauropus and the Diplopoda we have what may be fairly considered a true larval form, in which for a brief period after leaving the egg the body, much shorter than in after life, is provided with three pairs of legs, borne on the anterior segments of the body. These segments are never fully provided with legs, though most of the segments posterior to them, both those which exist during the larval state and those which originate subsequently, bear each two pairs. In the Chilopoda on the other hand, although the appendages of the anterior segment develop earlier than those behind them there is no true larval condition, or perhaps one may say a larval condition is permanent, in that the same anterior legs become early and permanently developed, as organs subsidiary to manducation, while each segment of the hinder part of the body develops only a single pair of legs.

To close these remarks it may be said that nine genera of Palæozoic Myriapods have been recognized in the Coal Measures, and two in the Devonian rocks of Scotland. While of those found at St. John and which are supposed to be older, the genera are the same as those of the Coal Measures or are nearly related to them.

The air-breathing articulates of the Plant bed of St. John so far recognized, consist of:—

Insects, nine species of eight genera..........................	9

Myriapods, six species of several genera	6
Arachnid, similar to Anthracomartus	1
Probable Pedipalp (Eurypterella)	1
Probable Arachnid or Isopod (Amphipeltis)	1
Scorpion (Palæophonus arctus)	1

Two species of land snails also have been found, raising the number to twenty or twenty-one kinds of air-breathing animals found in the Plant Beds at St. Johns.

ANNUAL PRESIDENTIAL ADDRESS.

NATURAL HISTORY SOCIETY, MONTREAL.

By Prof. Wesley Mills, M.A., M.D., etc.

In accordance with the custom of my predecessors, I present a brief retrospect of the year that has just closed, and offer a few suggestions for your consideration.

The Executive began its work with the duty before it of carrying into effect a motion passed at the last annual meeting which directed that we should ascertain the exact standing and condition of our Society, and if possible devise means for its improvement. To my own mind this was a good indication—a sign of life and a progressive spirit—for the society, like the individual, that is perfectly satisfied with present attainments is apt to be in a stage of incipient decline, if it has not already reached a condition of advanced atrophy.

The Special Committee appointed to investigate the subject, held many meetings, and with the assistance of subcommittees finally devised a scheme which was presented to a special meeting of the society, and unanimously adopted.

The principal features of this plan of improvement were: Affiliation with other local societies having kindred aims; broadening the range of subjects to be brought under discussion; making the themes presented somewhat more popular in form; and finally reporting them regularly and adequately for the public press of the city. The first part of the scheme has yet to be tried, but if the right spirit prevails we have no doubt our society will find, as all other organizations have done, that union is strength. Several of the other parts of the plan have been fairly tested this year, and I am sure you will agree with me, most successfully.

The attendance of members has not been smaller, while that of the general public has been considerable, so that perhaps never before were the regular meetings as well attended; while the notices in the press prior to the meeting and the reports afterwards, both of which emanated from the Society, were a great improvement on the scanty references of the past.

The abstracts of the Somerville lectures supplied by the lecturers, and kindly published by some of the newspapers in full, were all that could be desired.

This has entailed considerable labour, but it seems to me that it is worth while, for in a community like ours we must sow the seed of science beside all waters if we would see even a little fruit. Those of scientific tastes have no more excuse for exclusiveness or selfishness—of which there is still surely more than enough in the world—than other people.

Thanks largely to the forethought and generosity of one man, the Rev. Dr. Somerville, this society for about sixty years has been in a position to invite those who would to come to its annual feasts of popularized science.

That the courses of lectures have been the means of doing great good there can be no doubt. It may be said that without reference to age, sex, social position or any other distinction thousands have been interested listeners during the last half century to those unfoldings of nature's ways, which have been attempted in this historic lecture course.

May the Society never underestimate their importance, and never cease to welcome the poor man and the poor child, as well as the rich, who may wish to put themselves under the ennobling influence of a loving contact with nature and so attain to true science—real knowledge.

For some years the Society has attempted to have the lectures of the Somerville course not only consecutive but on subjects connected by natural affinities. Many people attend the whole course when thus arranged and receive an amount of educational benefit not possible, when the lectures, however good in themselves, are not closely related. It should be the object of every teacher—no matter what his exact position, to beget a desire on the part of his hearers to know more and to attempt to investigate in some humble way for themselves—for after all, we know just so much as we really make a part of our individual nature by personal observation or experience.

This year the Society appropriated such a sum as it could afford for illustrating the Somerville course, in carrying out which we were efficiently assisted by Mr. Williams So great is the tendency to use illustrations these days that it is scarcely possible to be up to the times without them. On the other hand we witness almost daily evidence of their abuse, and I should be sorry ever to see Mr. Somerville's noble purpose degraded into the giving of a mere show or exhibition for amusement. I cannot believe it is ever the purpose of science as science to amuse.

People who regard our domestic animals merely as objects of amusement, a sort of animated toys, never rise to proper conceptions of these creatures. On the contrary, from the student's point of view, all creatures are alike worthy of the most earnest, perhaps I may say reverent study, as illustrating great laws which apply throughout the universe.

I therefore think that the Somerville course of lectures of last winter on our domestic animals, given by persons who were thoroughly competent to treat of them, should have done much to lead to a better study of those creatures that have been most truthfully termed "our dumb friends."

It is scarcely possible to observe wild animals so closely and to study their relations to their surroundings so successfully as in the case of domestic animals. That part of natural history which we can best understand is what pertains to the working of the animal body, because we can supplement study of wild and domestic forms of life by observation on ourselves.

By a study of ourselves and those animals that live under conditions most akin to our own we are, in my opinion, best prepared for a really profitable study of wild forms. To go no further than the mere external forms of things is not to really understand nature. It was said of old, and is repeated to-day, that the proper study of mankind is man. The naturalist may grant this because it is only through our own experiences that we can understand other creatures. Man can understand animals because he is himself an animal —and but for a similarity of nature this would be impossible. I have often thought of late that our domestic animals receive far too little attention at the hands of naturalists—amateur and professional.

There seems to have been but one opinion in regard to the Somerville course of this year—that it was an unqualified success. The lantern and other illustrations were of great service, yet never abused; the serious aims of science were never subordinated to mere amusement.

We must remember, too, that the better living creatures are understood, the happier the lot of our domestic animals, if not all animals, will become. Knowledge in this case is sure to beget kindliness--true sympathy, and I know of no other way by which it is possible. I therefore think the moral effect of the course of last winter will be especially good.

We have to congratulate ourselves on the widening of our sphere of study to include physical science; and those who heard Professsor Nicolson's lecture on "The Mechanics of Haulage," as applicable to the drawing of loads by horses—coming as it did just after the close of the Somerville course, will agree that the change has been a wise one. The Society had already tried the happy experiment of a course of popular lectures a year ago on physical science kindly given by the professors of the Faculty of Applied Science in McGill University, and constituting the Somerville course of last year.

Noticing the extent to which our museum is used on the evenings of the Somerville lectures one cannot but feel that it would be well if it could be open to the public daily free of charge. It seems a pity that such a valuable collection of nature's treasures should not be more used. The museum is admirably located, and I hope that some means may be devised by which it may become a school in which nature's lessons may be effectively if silently taught.

As you all know, for two years the existence of THE RECORD OF SCIENCE, the Society's publication, with so long and worthy a history as the chief medium for the publication of general natural science in the Dominion, has been imperilled by the withdrawal of the Provincial Government grant. We are not without hope that this well deserved grant may be restored. But the Society, with an independence and a fortitude which will command admiration and respect, has resolved that this evidence of its life and progress shall not cease to exist—grant or no grant.

We have many subjects of congratulation. One of our most frequent contributors to THE RECORD OF SCIENCE—a man who has done so much to make Canada known by his long continued and valuable scientific researches, Mr. G. F. Matthew, of St. John, N.B., has added to the success of our monthly meetings by sending us a paper on a subject and in a form suitable for one of our regular monthly meetings. This action on his part has been greatly appreciated on all hands and will, I trust, be imitated by others.

It is a source of satisfaction to find that all or nearly all the veteran members still retain their connection with the Society and encourage younger men by their presence and faithful attention to the duties assigned to them.

Sir Wm. Dawson, for so many years the President of the Society, and one of its warmest friends and supporters, though incapacitated by feeble health from taking part in those many duties and enterprises which have made him so well-known and respected in this city and throughout America, has still given the Society a goodly share of the energy he has had at command. There are few things that have more impressed me in connection with Sir William Dawson than his close attendance at the meetings of this

Society for so many years, when he was occupied with matters of great importance, and often when the meetings were very poorly attended. It is to be hoped that this example will not be lost on us. In a society like ours the duty of mutual encouragement is clear.

Dr. Harrington, one of the good friends of this Society, who did so much for it in the past, when resigning his position as president, urged that the Society should consider the advisability of attempting to bring to this city some of the eminent scientific workers or teachers from the United States and offer to the public a lecture or two from them during the winter in some large hall. Considering how little is done in Montreal in the way of providing lectures for its citizens by distinguished men, this proposition of Dr. Harrington's should not, I feel, be allowed to pass into oblivion. I have myself for many years felt the great need of such lectures in this city, though it must be confessed the financial risk is considerable in attempting to carry such a scheme into effect.

In a society like ours we must never forget that it exists to increase the knowledge of science and to spread that knowledge. This implies the need above every thing else of a body of enthusiastic workers, and no material acquisition can ever compensate for the lack of such people. Without these a natural history society is poor, poor indeed.

I am, therefore, deeply conçerned as to how we shall discover and enlist the co-operation of men, especially young men, who will infuse into us some of that enthusiasm which nearly always means success in achievement and give us a promise of a fullness of the life-tide of science which will widen and deepen the channels which the same enthusiasm and the work it begets, have worn in the past.

Our superintendent, Mr. Griffin, has continued to discharge his duties with intelligence, energy, courtesy and success generally, and I have always found him ready to assist in any matter which has been brought to his notice.

From the reports of the various officers and committees read this evening you will be able to judge somewhat as to the faithfulness and efficiency of those to whom the Society has entrusted its management.

Before resigning my office, I wish to thank the officers of the Society and all with whom I have come in contact in the discharge of my duties, for their uniform courtesy and kindness, which have greatly lightened the labours and added to the pleasures associated with my office.

PROCEEDINGS OF THE NATURAL HISTORY SOCIETY.

MONTREAL, 26th March, 1894.

The fifth monthly meeting of the Society was held this evening, Dr. Wesley Mills, President, in the chair.

The minutes of the regular meeting of February 26th, and of the special meeting of March 5th, were read and approved.

The minutes of Council meetings of March 5th and 19th were read.

The Librarian reported that "Bechstein's Natural History of Cage Birds," and "Minot's Land and Game Birds of New England," were donated to the Society by Mr. E. D. Wintle.

On motion by Mr. E. T. Chambers, seconded by Mr. James Gardner, the thanks of the Society were given to Mr. Wintle for this valuable donation.

Mr. J. W. Marling, proposed by Edgar Judge, seconded by J. S. Shearer, and J. Bickertoun Williams, proposed by Dr. Wesley Mills, seconded by George Sumner, were, on motion of J. A. U. Beaudry, seconded by J. H. Joseph, elected as ordinary members by acclamation.

A letter was read from J. Thorburn, of the Geological Survey, asking regarding certain volumes sent to the Survey from Italy, and also inquiring about the affiliation of the various societies in Montreal. Referred to the Librarian and Secretary to answer.

Prof. J. T. Nicolson then read his paper on the "Mechanics of Haulage."

On motion of R. W. McLachlan, seconded by Joseph Fortier, the thanks of the Society were tendered to Prof. Nicolson for his interesting paper.

MONTREAL, April 30th, 1894.

The sixth monthly meeting of the Society was held this evening, J. H. Joseph, Vice-President, in the chair.

The minutes of last meeting were read and approved.

The minutes of Council of April 23rd were read.

It was moved by the Rev. Dr. Campbell, seconded by J. A. U. Beaudry, that the Society begs to offer its congratulations to Dr. Wesley Mills upon the success of the Somerville course, arranged by him, for the present season, and records its appreciation of the exceedingly instructive and valuable lectures delivered by him and the other professors of the Faculty of Comparative Medicine in McGill University, Dr. D. McEachran, Dr. Baker and Dr. Adami, who aided him in favoring the public with this course, under the auspices of this society.

A letter was read from Dr. F. D. Adams, enclosing one from Mr. Lamb, of the Geological Survey, Ottawa, offering to give the Society a valuable exchange for four sponges which he had borrowed from the Society's collection, some time ago, on order of Sir William Dawson. On motion, the letter was referred to Messrs. Winn and Chambers.

Mr. J. M. M. Duff, proposed by J. A. U. Beaudry, seconded by George Sumner, was, on motion that the rules be suspended, elected an ordinary member by acclamation.

Mr. J. S. Shearer reported, on behalf of the Field Day Committee, that the committee had arranged for the field day to be held on the 2nd of June; the train to start from Windsor Station at 8 a.m. for Labelle, about forty miles beyond St. Agathe, the place selected for last year's field day.

On motion by R. W. McLachlan, seconded by Joseph Fortier, the report was adopted; the price of tickets to be $1.50 for adults and 75 cents for children.

As Mr. Joseph had to leave, Mr. Shearer was called to the chair.

A paper by Mr. G. F. Matthew on "Ancient Myriapods" was read by the Rev. Dr. Campbell.

It was moved by Dr. Campbell, seconded by George Sumner, that the thanks of the Society be given to Mr. Matthew for his valuable paper, and that he be requested to furnish specimens of some of these Myriapods for the Society's museum.

MONTREAL, 28th May, 1894.

The annual meeting of the Society was held on Monday, the 28th of May, Dr. Wesley Mills in the chair.

The following reports were read and adopted :—

REPORT OF THE COUNCIL.

GENTLEMEN,—The Chairman of Council begs to report that for the session 1893-94 eleven meetings of Council were held, all of which were well attended.

The Society held six ordinary meetings and one special meeting. At the six regular meetings, interesting papers were contributed by Sir Wm. Dawson, Dr. Wesley Mills, Nevil Norton Evans, Dr. Frank D. Adams, Prof. J. T. Nicolson, and F. B. Matthew.

The Somerville Course of Lectures for the past season proved of unusual interest, and the Society is indebted to the lecture committee for arranging the course and particularly to our President, Dr. Wesley Mills, for his untiring efforts in watching over the course so faithfully and giving so much of his valuable time to make the course such a complete success. A well deserved vote of thanks was tendered by the Society to the several gentlemen who delivered the lectures. Those attending were so deeply impressed with the importance of some of the subjects brought before them, that at two of the meetings committees were named to wait upon the Health Committee of this city and urge that a proper inspection should be made of all dairies supplying milk to the city as also of all animals sold for food, with a view of stamping out the disease tuberculosis ; joint committees of the Natural History Society and Board of Trade accordingly waited upon the Health Committee of this city and urged very strongly the importance of having duly qualified inspectors appointed. The health committee received the deputation very kindly and after the subject had been well discussed, requested

Prof. Duncan McEachran and Dr. Wesley Mills to formulate a plan covering the object desired, which was done by these gentlemen, when the health committee at once adopted the proposition and asked the Council for funds to carry out this important recommendation. It is most desirable that the matter should be pressed to a conclusion.

On the arrival of the Earl of Aberdeen in Canada, he was asked to accept the position of Patron of the Society, to which he graciously consented.

In June of last year a committee was appointed to see in what manner the usefulness of the Society could be increased, which resulted in the affiliation of the Microscopical Society, the Entomological Society, and the Aggassiz Association with this Society ; and we trust that this may prove to the mutual advantage of all concerned. A full report of the committee was presented to the Society on the 25th of March last ; it has been suggested that it would be very desirable to celebrate the affiliation in an especial manner next autumn.

We were informed by the Hon. J. S. Hall, Treasurer of the Province, on the 19th of February last, that he regretted that the usual Government grant made to the Society for the publication of the RECORD OF SCIENCE, could not be given this year.

The Annual Field Day of the Society was held at Ste Agathe last year, on the 3rd of June, and proved to be one of the most successful and enjoyable ever held by the Society.

During the year the membership has been increased by the addition of three associate and twenty-seven ordinary members, being an increase of thirty for the year.

We mourn the loss of Messrs. W. F. Kay, G. Knowlton and Hollis Shorey, who died during the past year.

The whole respectfully submitted,

GEO. SUMNER,
Chairman of Council.

REPORT OF HON. CURATOR.

GENTLEMEN :—During the past season the following donations have been received and put in their places in the museum :—

Fossils from Radnor forges.
Model surf boat from Samoa.
Indian war canoe.
Bark from California giant trees.
Stone axe.
Two lizards.

One bat.

Specimens of seaweed.

Bone of Mastodon and other geological specimens from R. Felch, Esq.

Magnetic iron sand.

Two wasps' nests.

Brazilian beetles.

Exotic butterfly—*Morpho*—sp.

Also the following specimens from Bermuda presented by J. S. Buchan :—

Specimen of coral rock from Bermuda, the ordinary building material of the country.

The same hardened into limestone.

Stalagmite from the surface of the rock at Ireland Island, near the dockyard, Bermuda, taken from a surface about 30 feet above sea level, possibly the site of an ancient cave.

Specimens of Bermuda juniper.

Compared with the last few years but little work has been done at the museum. The case of mammals, which was being destroyed by moths has been thoroughly overhauled and all traces of the invaders exterminated, and when our birds have all received a similar "going-over" the museum will present a much better appearance. But this work is almost endless and it is to be hoped that the incoming Hon. Curator will be able to organize a strong museum committee and give the whole collection a general and much needed revision.

The number of visitors to the museum shows a slight falling off from last year, which is accounted for, probably, by the decrease of American travel last summer.

Respectfully submitted,

ALBERT F. WINN,
Hon. Curator.

REPORT OF THE LIBRARIAN.

GENTLEMEN :—On behalf of the library committee I am glad to report that the books of your library have been more used by members than they have for some years past. Not only have many books been taken out, but the library itself has been more used for purposes of reference than in former years.

No meetings of the committee have been called, as the work of arranging and cataloguing cannot be proceeded with on account of the large number of volumes waiting for the binder. The number requiring binding now exceeds 200.

I have to acknowledge the great assistance received from Mr. Griffin, the superintendent, who is always ready and willing to help the committee—especially in caring for and acknowledging the large and increasing number of exchanges received by the library.

The following donations have been received :—

From E. D. Wintle, Esq., "The Land and Game Birds of New England," "The Natural History of Cage Birds."

From Dr. G. M. Dawson, "Geological Notes on the Coasts and Islands of Behring Sea and its Vicinity." "On the Occurrence of Mammoth Remains in the Yukon District."

E. T. CHAMBERS,
Hon. Librarian.

REPORT OF THE EDITING AND EXCHANGE COMMITTEE.

GENTLEMEN :—During the past year the publication of the CANADIAN RECORD OF SCIENCE has continued as usual. Three numbers have already issued, while the fourth is now in press. The withdrawal of the Government grant to the Society during the past two years has made it doubtful whether the publication of the RECORD OF SCIENCE can be continued, and although the Council of the Society have decided to carry it on for the coming year the financial difficulties have rendered it impossible during the past year to issue the several numbers at the dates on which they should have appeared.

The rule of accepting only papers of merit and as far as possible original papers, for publication, has been adhered to and a high standard has thus been maintained. One or two papers which appeared in German periodicals, and which were of especial importance to scientific workers in Canada, have also been translated and published in the RECORD.

As in past years a large number of valuable exchanges have been received for the RECORD and placed in the library.

Respectfully submitted,

FRANK D. ADAMS,
Chairman.

The rules having been suspended, Mr. F. Notman was elected an ordinary member of the Society by acclamation.

Mr. Justice Wurtele, who had been appointed as the Society's delegate to the meeting of the Royal Society at Ottawa, reported that he had attended the said meeting and presented a report of the work done by the Natural History Society. This report was then handed to the secretary.

The following officers were then elected for the ensuing year:

Honorary President—Sir. J. Wm. Dawson.

President—Dr. Wesley Mills.

Vice-Presidents—Jno. S. Shearer, Sir Donald Smith, Hon. Edward Murphy, Hon. Justice Wurtele, Rev. Dr. Campbell, Dr. B. J. Harrington, George Sumner, J. H. R. Molson, Edgar Judge and J. H. Joseph.

Recording-Secretary—R. W. McLachlan.

Corresponding Secretary—Dr. J. W. Stirling.

Treasurer—F. W. Richards.

Curator—E. D. Wintle.

Librarian—E. T. Chambers.

Members of Council—Dr. Frank D. Adams, N. N. Evans, Joseph Fortier, J. S. Brown, James Gardner, Hon. J. K. Ward, Major L. A. H. Latour, A. Holden and F. Winn.

Editing and Exchange Committee—Dr. Frank D. Adams, N. N. Evans, J. F. Whiteaves, G. F. Matthews, Dr. Wesley Mills, Dr. B. J. Harrington.

It was moved by Hon. Justice Wurtele, seconded by George Sumner, that the sincere thanks of the Society be tendered to Mr. James Gardner for his services as treasurer during the past five years.—Carried.

A similar vote of thanks was tendered to Dr. Adams for his services in connection with the RECORD OF SCIENCE.

A motion was passed requesting the Council to appoint a committee to assist the Curator in rearranging the museum.

NATURAL HISTORY SOCIETY OF MONTREAL IN ACCOUNT WITH JAS. GARDNER, HON.-TREASURER.

RECEIPTS.

To Balance from last year	$ 57.47
" Rents	873.25
" Members' Annual Subscriptions	667.00
" Field-day Surplus	30.96
" Entrance Fees Museum	17.00
" Interest	9.43
" Life Membership Endowment Fund *re-transferred*	250.00
	$1,905.11

DISBURSEMENTS.

By Superintendent's Salary and Commissions	$508.00
" Sundry Expenses	234.76
" Light	180.42
" Fuel	150.98
" Taxes	45.36
" Lectures	76.09
" Insurance	52.37
" Museum	44.70
" Library	5.56
" Record of Science	606.87
	$1,905.11

Examined and found correct

J. W. STIRLING.

Montreal, 28 May, 1894.

MEMO.

Accounts Due to the Society:

Numismatist and Antiquarian Society, balance of Rent to 1 May, 1894	$50.00
Camera Club, rent	4.00
Prof. Labonde, rent	2.00
Unpaid Subscriptions considered collectable	34.00
	$ 90.00

BOOK NOTICES.

THE CANADIAN ICE-AGE. By Sir J. William Dawson, C.M.G., F.R.S. (Montreal: Wm. V. Dawson. New York and London: The Scientific Publishing Company, 1893.)

It is continually brought to the notice of geologists that the most recent period in the long history of the earth is also that which excites the greatest controversy. We can deal complacently with earth-movements, mountain-thrusts, and submergences of half a continent, so long as the organisms affected by these occurrences are less specialized mammals than ourselves; but we find it hard to believe in great physical or climatic changes within the limits of our own written or unwritten history. Moreover, our knowledge of the post-Pliocene period is burdened with an excess of detail; and broad and sweeping generalizations seem at present out of the question. And, if we go one step further, we may fairly attribute our friendly agreement with regard to the conditions of the older periods to our ignorance rather than to our information.

Sir William Dawson, › the present work, summarizes several previous papers of his own, just as M. Gaudry's detailed memoirs were summarized for general use in "Les Ancetres de nos Animaux." This handy paper-bound volume deals strictly with Canada, and is in no way a "Theory of the Earth." It is moderate in tone, and forms a serious plea for a rational treatment of the glacial epoch. Whatever caused the cold conditions in the northern hemisphere, or in parts of the northern hemisphere, it is pointed out that the land-ice in Canada radiated from two local centres, and not from the hypothetical ice-cap at the pole. Readers of *Nature* will remember the evidence brought forward by Dr. G. M. Dawson as to the "Laurentide" centre of glaciation on the east and the "Cordilleran" centre on the west (*Nature*, vol. xlii., p. 650). The conditions maintained by Sir W. Dawson as most favourable to the development of glaciers are high masses of land in proximity to cold seas; and, as he properly points out, these conditions still prevail in North America to a greater extent than in North Europe. They prevail, moreover, in Greenland, but not in Grinnell Land, to cite two closely neighbouring areas.

It will be clear, then, that Sir W. Dawson urges that differential earth-movement was the main factor in the production of Canadian glaciation. The evidence of marine shells in the drift, of the bones of whales, of the character of the deposits themselves, all points to the existence of wide areas of submergence. With regard for example, to the Cordilleran centre in British Columbia, our author writes:

"The conditions were combined of a high mountain chain with the Pacific on the west, and the then submerged area of the great plains on the east, affording next to Greenland the grandest gathering-ground for snow and ice that the northern hemisphere has seen."

Of recent years it has been far too generally assumed that we have to picture the glaciers of the ice-age moving across the features of the country as we at present know them. The views of Prof. Suess with regard to earth-movements in the historic period are perhaps only fair criticism of somewhat hasty observations; but, in face of the extraordinary evidence of post-Pliocene upheavals, it is at least irrational to believe that these terminated with man's appearance on the globe. Many English "glacialists" accept a recent submergence of their country to a depth of 500 feet, and yet postulate the most catastrophic occurrences to account for marine beds at twice that height above the sea. Yet we now have, in addition to the old Lyellian instances, such as the Astian or even later beds in Sicily, which are elevated some 3,000 feet, evidence given us by Prof. Andrew Lawson of a post-Pliocene uplift of the continental coast of California to heights of from 800 to 1,500 feet; and Sir W. Dawson's requirements to explain the distribution of the Canadian drift are such as will seem moderate and natural to every rational uniformitarian.

On page 111 of the present work, the author discusses the possibility of distinguishing striations produced by the "huge ice-islands" in shallow seas from the deeper and firmer markings of true glacier-ice. Granted the submergence, which in itself assists in the formation of snow and ice, the phenomena of the distribution of boulders receive at once their simplest explanation; and in chapter v. the local details of the drifts are taken, area by area, into consideration. Our own British islands must similarly be discussed area by area. Because it seems probable that Scotland in the glacial epoch was a local Greenland, there is no reason why England should also have been lifted above the sea. The evidence accumulating in Ireland goes far in favour of long submergence of that country, with the production of an archipelago of picturesque and snow-capped islands. Hence it is that we may welcome Sir W. Dawson's summary of results in Canada as a reminder that land-ice and enormous terminal moraines are not to be left in undisputed possession of the field. We can even sympathize with him in his final sense of irritation, when he charges some glacialists with "misunderstanding or misrepresenting the glacial work now going on in the arctic and boreal regions." "These are grave accusations," he continues, "but I find none of the memoirs or other writings of the current school of glacialists free from such errors; and I think it is time that reasonable men should discountenance these misrepresentations, and adopt more moderate and rational views."

Of course Sir W. Dawson cannot resist the temptation of stating as "an inevitable conclusion" (page 289) "that the origin of specific types is quite distinct from varietal modification"; but this is a cheerful side-thrust, as it were, in a work on quite another subject. On page 36 the use of "Neozoic" as equivalent to "Tertiary" seems unusual; and on page 51 there is a sentence on the origin of fiords, quoted from an earlier paper by the author, which describes them as "often evidences of the action of the waves." They may have nothing to do with glacial excavation, but still less can they be regarded as products of marine erosion, unless the author confines himself to the cases that he has specially examined in Nova Scotia.

G. A. J. C.

CORRECTIONS.

Vol. V., No. 6, April, 1893, p. 366, line 20 from top, for "$1.60 to $2.00" read "$160 to $200."

Vol. V., No. 7, July, 1893, p. 433, in title of article and in headings of following pages, for "Cambrian-Siberian" read "Cambrian-Silurian."

ABSTRACT FOR THE MONTH OF APRIL, 1894.

Meteorological Observations, McGill College Observatory, Montreal, Canada. Height above sea level, 187 feet, C. H. McLEOD, *Superintendent.*

DAY.	THERMOMETER.				BAROMETER.				† Mean pressure of vapour.	‡ Mean relative humidity.	Dew point.	WIND.		SKY CLOUDED IN TENTHS			Per cent. of Possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
	Mean.	Max.	Min.	Range.	Mean.	Max.	Min.	Range.				General direction.	Mean velocity in miles per hour	Mean	Max	Min.					
SUNDAY 1	.....	46.1	31.8	14.3	....	......	......		...	....	....	W.	27.9	....	..		72	0.04	....	0.04	1 .... SUNDAY
2	21.37	31.8	15.0	16.8	30.1038	30.227	29.967	.260	.0658	56.7	8.8	N.W.	17.2	0.7	3	0	93	...	....	....	2
3	29.03	35.5	15.0	20.5	30.1915	30.301	30.029	.272	.0852	51.8	14.3	W.	11.5	5.0	10	0	86	....	....	..	3
4	35.82	41.0	31.2	9.8	29.7397	29.987	29.623	.364	.1888	89.5	33.0	S.	17.9	8.8	10	4	03	0.01	1.2	0.13	4
5	39.92	45.3	33.8	11.5	29.7525	29.947	29.630	.317	.1873	75.3	32.5	S.W.	21.2	8.5	10	2	07	0.01	....	0.01	5
6	32.23	36.5	28.0	8.5	30.0538	30.136	29.998	.138	.1127	61.7	20.7	N.W.	8.6	5.3	10	0	76	....	....	....	6
7	35.45	42.5	26.8	15.7	30.1070	30.162	30.065	.097	.1020	49.7	18.7	N.	6.7	4.3	9	0	47	....	....	....	7
SUNDAY 8	.....	41.4	27.8	13.6	......	.....	......	....	.....	....	....	N.	18.8	....	....	..	14	....	....	....	8 .... SUNDAY
9	36.13	46.0	28.8	17.2	30.3570	30.379	30.331	.048	.1183	56.8	22.2	N.	22.7	0.7	2	0	94	....	....	.	9
10	38.35	47.0	27.8	19.2	30.1863	30.386	30.053	.333	.1297	56.5	24.0	N.E.	17.5	3.5	8	0	78	....	....	....	10
11	39.40	49.2	30.8	18.4	29.9885	30.051	29.912	.139	.1265	53.8	23.5	N.E.	22.1	5.5	9	0	37	....	....	....	11
12	41.97	51.8	33.0	18.8	30.1113	30.130	30.060	.050	.1353	51.8	25.2	N.E.	25.0	7.2	10	0	40	....	....	....	12
13	43.70	54.0	34.0	20.0	30.0760	30.159	30.016	.143	.1198	43.7	22.2	N.E.	26.9	4.7	10	0	91	....	....	....	13
14	43.90	54.4	32.5	21.9	30.0228	30.083	29.970	.213	.1123	42.0	20.5	N.E.	22.0	0.3	2	0	89	....	...	....	14
SUNDAY........15	.....	63.5	32.2	31.3	....	......	......	....	...	....	....	N.	8.0	....	...		95	....	....	...	15 .... SUNDAY
16	46.77	59.8	33.8	26.0	30.1078	30.166	30.044	.122	.1245	41.7	22.8	N.E.	9.8	4.8	8	0	85	....	...	....	16
17	49.60	62.0	35.5	26.5	30.1612	30.179	30.150	.029	.1550	46.2	27.8	N.	13.9	0.3	2	0	94	....	....	....	17
18	52.60	66.8	35.0	31.8	30.1170	30.258	29.981	.277	.1945	51.5	33.3	S.E.	6.5	6.2	10	0	58	....	....	...	18
19	55.90	60.8	49.8	11.0	29.9197	30.041	29.849	.192	.2820	63.3	43.3	S.	11.6	9.3	10	6	03	Inap	...	Inap	19
20	58.67	68.8	54.0	14.8	29.7983	29.906	29.681	.225	.4500	90.7	55.8	S.	7.6	9.8	10	8	06	0.38	....	0.38	20
21	53.35	60.8	48.8	12.0	29.7198	29.784	29.667	.117	.3387	83.0	48.2	S.W.	11.0	8.2	10	0	00	0.01	....	0.01	21
SUNDAY 22	....	53.5	43.0	10.5	....	.....	......	....	.....	...	....	N.	12.8	....	....	..	00	....	....	....	22 .... SUNDAY
23	46.85	55.2	40.2	15.0	29.8655	29.896	29.848	.048	.2890	89.8	43.7	S.W.	6.4	9.8	10	9	00	0.14	....	0.14	23
24	47.80	55.9	42.1	13.8	30.0342	30.152	29.964	.188	.2197	66.0	36.3	N.	18.5	8.1	10	0	11	....	....	...	24
25	47.30	56.1	34.9	21.2	30.1282	30.229	30.033	.196	.1348	42.0	24.7	N.	18.3	2.2	9	0	94	...	....	...	25
26	53.65	65.0	41.0	24.0	29.9362	30.033	29.856	.177	.2270	53.7	37.0	S.W.	28.5	2.3	8	0	94	....	....	....	26
27	58.33	68.5	47.3	21.2	29.8602	29.945	29.781	.164	.2377	50.2	39.0	S.W.	23.8	3.5	7	0	78	....	....	....	27
28	55.60	64.0	43.5	20.5	29.9042	30.113	29.829	.284	.2365	51.8	37.2	N.W.	13.5	6.8	10	0	35	....	....	....	28
SUNDAY........29	.....	55.5	35.6	19.9	....	......	......	....	.....	....	....	N.	11.0	....	..	..	96	....	.....		29 .... SUNDAY
30	58.68	69.5	39.5	30.0	30.2007	30.348	30.057	.291	.2257	46.0	37.3	S.W.	18.0	5.8	10	0	67	Inap	....	Inap	30
....Means	44.89	53.61	35.08	18.52	30.0177	....	......	.183	1840	58.6	30.1	N. 25⅔° W.	16.2	5.3	..	..	54.8	0.59	1.2	0.71	Sums ....
20 Years means for and including this month	39.94	48.43	32.22	16.19	29.9500	....	......	.204	.1688	66.1	....	......	....	6.2	..	..	51.6	1.54	6.4	2.19	20 Years means for and including this month.

ANALYSIS OF WIND RECORD.

Direction........	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	CALM.
Miles	2213	3183	346	351	756	3142	969	680	
Duration in hrs..	144	164	24	38	56	172	53	58	11
Mean velocity...	15.4	19.4	14.4	9.2	13.5	18.3	18.3	11.7	

Greatest mileage in one hour was 42 on the 1st.
Greatest velocity in gusts 48 miles per hour, on the 1st.

Resultant mileage 1,908.
Resultant direction, N. 25⅔° W.
Total mileage, 11,640.
Average velocity 16.2 m.p. h.

* Barometer readings reduced to sea-level and temperature of 32° Fahrenheit.

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ 13 years only.

The greatest heat was 69°.5 on the 30th; the greatest cold was 15°.0 on the 2nd and 3rd, giving a range of temperature of 54.5 degrees. Warmest day was the 30th. Coldest day was the 2nd Highest barometer reading was 30.386 on the 10th; lowest barometer was 29.623 on the 3rd, giving a range of 0.763 inches. Maximum relative humidity was 99 on the 20th. Minimum relative humidity was 17 on the 14th.

Rain fell on 8 days.

Snow fell on 1 day.

Rain or snow fell on 8 days.

Auroras were observed on 17th, 24th, 25th.

Lunar halos on 2 nights.

Lunar coronas on 1 night.

Solar halos on 7 days.

Thunder and Lightning on 1 night.

ABSTRACT FOR THE MONTH OF MAY, 1894.

Meteorological Observations, McGill College Observatory, Montreal, Canada. Height above sea level, 187 feet, C. H. McLEOD, *Superintendent.*

DAY.	THERMOMETER.				BAROMETER.				† Mean pressure of vapour.	‡ Mean relative humidity.	Dew point.	WIND.		SKY CLOUDED IN TENTHS.			Per cent. of Possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
	Mean.	Max.	Min.	Range.	Mean.	Max.	Min.	Range.				General direction.	Mean velocity in miles perhour	Mean.	Max.	Min.					
1	68.12	79.0	56.7	22.3	29.9192	30.060	29.816	.244	.3278	48.0	47.2	S.W.	25.2	5.7	10	0	70	....	....	....	1
2	62.82	76.0	50.5	25.5	29.8852	30.106	29.752	.354	.3913	67.7	51.5	S.W.	19.7	7.7	10	2	43	0.01	....	0.01	2
3	53.27	64.0	42.3	21.7	30.1250	30.196	30.048	.148	.2425	58.3	39.2	N.	7.4	2.2	0	0	92	....	....	...	3
4	56.92	63 8	53.8	13.0	29.9747	30.051	29.919	.132	.3922	84.3	52.2	S.	5.2	6.3	10	0	00	0.10	....	0.10	4
5	57.93	68.0	47.3	20.7	29.9700	30 076	29.806	.270	.3467	74.0	48.8	E.	6 0	5.8	10	2	59	Inap	....	Inap	5
SUNDAY.... ... 6	....	75 8	57.0	18.8	....	......	......	....	.....	....	....	S.	18.9	....	....	..	24	0.39	....	0.39	6 ....SUNDAY
7	56.72	64.5	51.8	12.7	29.5170	29.601	29.436	.165	.3378	72.0	47.5	S.W.	27.3	7.0	10	0	58	0.45	....	0.45	7
8	54.62	63.4	49.0	14.4	29.6655	29.775	29.623	.152	.2473	58 0	40.0	S.W.	23.0	3.7	10	0	49	0.02	....	0.02	8
9	53.23	60.8	45.1	15.7	29.9947	30.212	29.835	.377	.2473	61.0	39.8	S.W.	19.7	5.5	10	0	52	Inap	....	Inap	9
10	53.15	62.3	41.1	21.2	30.2643	30.353	30.130	.223	.2405	59.3	39 0	E.	12.2	1.3	4	0	98	....	....	....	10
11	55.85	64.5	49.0	15.5	30.1293	30.284	30.002	.282	.2702	60.8	42.0	S.W.	27.0	4.0	10	0	55	0.12	....	0 12	11
12	58.02	68.0	46.9	21.1	30.2260	30.372	30.040	.332	.2508	52 7	40.2	S.W.	22.7	2.8	7	0	83	....	....	....	12
SUNDAY........13	.....	63.6	44.5	19.1	....	......	......	....	.....	....	....	N.W.	24.2	....	....	..	96	....	....	....	13 ....SUNDAY
14	47.52	59.0	37.7	21.3	30.1518	30.269	30.030	.239	.1285	39.3	24.0	N.W.	17.7	2.0	10	0	99	....	...	....	14
15	52.08	64.5	38.6	25.9	29.9305	30.069	29.837	.232	.1593	40.0	28.0	N.W.	17.5	0.0	0	0	99	....	....	...	15
16	56.30	68.0	47.0	21.0	29.8022	29.890	29.726	.164	.2423	52.2	38.8	N.W.	10.0	4.0	10	0	98	....	...	....	16
17	58.45	69.5	47.0	22.5	29.7333	29.799	29 664	.135	.2547	53.8	40.7	N.	6 8	9 2	10	5	00	....	....	....	17
18	56.62	63 5	53.7	9 8	29.6332	29.681	29.592	.089	.4118	89.7	53.0	S.	10 1	10.0	10	10	00	0.57	....	0.57	18
19	57.88	64.8	52.7	12.1	29.7507	29.889	29.647	.242	.4502	93.7	56.2	N.E.	11 2	10 0	10	10	00	0.12	....	0.12	19
SUNDAY 20	....	69.1	54.0	15.1	....	......	......	....	.....	....	....	S.E.	13.3	....	...	..	59	....	....	....	20 ....SUNDAY
21	58.63	68.1	47.5	20.6	30.2465	30.301	30.199	.102	.2875	59.3	44.0	E.	11.7	6.7	10	0	96	....	....	...	21
22	59.47	70.5	46.0	24.5	30 0773	30.211	29.940	.271	.2582	52.8	41.0	S.	11.7	5 8	10	0	83	....	....	....	22
23	61.55	68.8	54.2	14.6	29.8990	29.963	29 865	.098	.3793	69.5	51.5	N.E.	11.7	9.3	10	5	36	Inap	....	Inap	23
24	58.32	69.0	51.8	17.2	29.7605	29.846	29.609	.237	.4100	83.2	53.3	N.E.	13.4	9 7	10	8	16	0 09	....	0.09	24
25	53.15	56.2	50 1	6.1	29.7168	29.772	29.665	.107	.3252	80.2	47.0	N.E.	21.7	10.0	10	10	00	0.51	....	0.51	25
26	56.82	66.5	48.0	18.5	29.8340	29.884	29.790	.094	.3398	74.8	48.3	N.	9.7	7.7	10	0	68	....	....	....	26
SUNDAY........27	.....	71.0	50.6	20.4	....	......	......	....	.....	....	....	S.E.	9.1	....	...	..	74	....	....	....	27 ....SUNDAY
28	55.57	71.0	44.6	26.4	29.7768	29.839	29.704	.135	.3927	88 0	51.8	S.E.	19.2	8 3	10	0	00	0.85	....	0.85	28
29	46.53	54.2	40.0	14.2	29.8847	29 965	29.833	.132	.2367	76.0	38.8	S.W.	19 6	6.5	10	0	49	0.32	....	0.32	29
30	51.05	59.0	40.8	18.2	30.0048	30 036	29.960	.076	.2755	75.3	42.8	S.E.	5.2	6.8	10	0	25	Inap	....	Inap	30
31	52.40	57.1	49.0	8.1	29.7925	29.927	29.633	.294	.3342	85 3	48.0	E.	7.8	10.0	10	10	00	0.18	....	0 18	31
....Means	56.04	65.92	47.91	18.01	29.9135	.....	......	.197	.3030	67.0	44.2	S. 50½° W.	14.7	6.2	..	..	51.0	3.73		3.73	Sums ....
20 Years means for and including this month	54.42	63.69	45.50	18.69	29.9318	.....	......	.168	.2833	65.5	....	......	....	6.3	..	..	50.2	2.94		2.94	20 Years means for and including this month.

ANALYSIS OF WIND RECORD.

Direction........	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	CALM.
Miles..............	1097	1429	634	733	1160	4255	556	1108	
Duration in hrs..	91	99	69	70	96	203	31	62	23
Mean velocity...	12.1	14.4	9.2	10.5	12.1	21.0	17.9	17.9	

Greatest mileage in one hour was 44 on the 25th. Greatest velocity in gusts 60 miles per hour, on the 7th.

Resultant mileage 2,828.
Resultant direction, S. 50½° W.
Total mileage, 10,972.

*Barometer readings reduced to sea-level and temperature of 32° Fahrenheit.

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ 13 years only.

The greatest heat was 79°.0 on the 1st; the greatest cold was 37°.7 on the 14th giving a range of temperature of 41.3 degrees. Warmest day was the 1st. Coldest day was the 29th. Highest barometer reading was 30.372 on the 12th; lowest barometer was 29.436 on the 7th, giving a range of 0.936 inches. Maximum relative humidity was 99 on the 18th, 19th, 25th and 30th. Minimum relative humidity was 25 on the 13th.

Rain fell on 17 days.

Auroras were observed on 7th, 13th, & 30th.

Fog on 3 days.

Thunderstorms on 4 days.

ABSTRACT FOR THE MONTH OF JUNE, 1894.

Meteorological Observations, McGill College Observatory, Montreal, Canada. Height above sea level, 187 feet. C. H. McLEOD, *Superintendent.*

DAY.	THERMOMETER.				BAROMETER.				† Mean pressure of vapour.	‡ Mean relative humidity.	Dew point.	WIND.		SKY CLOUDED IN TENTHS.			Per cent. of Possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
	Mean.	Max.	Min.	Range.	Mean.	Max.	Min.	Range.				General direction.	Mean velocity in miles perhour	Mean.	Max.	Min.					
1	50.63	55.7	45.3	9.4	29.4633	29.548	29.377	.171	.3190	86.7	46.5	S.W.	12.0	8.5	10	1	00	0.38	....	0.38	1
2	53.62	61.0	45.0	16.0	29.5860	29.600	29.567	.033	.3210	79.3	46.7	S.E.	9.9	10.0	10	10	04	0.29	....	0.29	2
SUNDAY.... 3	...	67.2	50.5	16.7	......	.....	......	....	.....	....	....	S.W.	15.7	....	....	..	43	0 15	....	0.15	3 ....SUNDAY
4	54 28	60.0	49.2	10.8	29.6337	29.759	29.506	.253	.3008	71.2	44.2	W.	15.9	5.5	10	0	44	0.01	....	0.01	4
5	50.15	60.0	46 8	13.2	29.7362	29 789	29.661	.128	.2947	81.5	44.7	W.	7.7	8.3	10	0	36	0.28	....	0.28	5
6	49.78	56.4	45.0	11.4	29.9015	29.948	29.845	.103	.2305	69.7	40.0	W.	13.1	3.8	10	0	64	Inap	....	Inap	6
7	55.58	65.0	44.8	20.2	29.7792	29.815	29.742	.073	.2562	59.5	40.8	W.	10.2	1.3	3	0	71	....	....	....	7
8	58.62	68.8	44.8	24.0	29.9177	29.940	29.885	.055	.3262	66.8	47.0	W.	19.0	5.0	10	0	68	....	....	....	8
9	63.28	71.4	53.4	18.0	29.9810	30.029	29.897	.132	.3830	67.3	51.5	W.	18.1	5.0	10	0	33	....	....	....	9
SUNDAY........10	.....	79.4	56.6	22.8	....	......	......	....	.....	....	....	W.	25.9	....	...		58	....	....	....	10 ....SUNDAY
11	72.80	84.0	64.8	19.2	29.9567	29.983	29.926	.057	.5405	68.3	61.2	S.W.	23 2	5.8	10	0	32	....	....	....	11
12	60.65	73.0	55.6	17.4	30.0347	30.090	30 011	.079	.4350	82 3	55.2	N.	11.5	8 3	10	0	03	Inap	....	Inap	12
13	64.63	75 8	50.4	25.4	30.1625	30.190	30.124	.066	.3635	62.7	50.3	N.	9.8	5.5	10	0	49	.....	....	....	13
14	68.65	79.6	55 0	24.6	30.1362	30.213	30.048	.165	.4832	70.3	57.8	S. W.	14.3	2.5	10	0	28	....	...	....	14
15	73 48	83.0	62.0	21.0	29.9600	30.052	29 900	.152	.5777	70.3	62.8	S.W.	22.1	4.3	10	0	41	....	....	...	15
16	76.97	84.6	68.0	16.6	29.8232	29.889	29.763	.126	.6813	73.2	67.7	S.W.	23 5	0.0	1	0	34	....	...	....	16
SUNDAY 17	....	83.4	64.0	19.4	....	......	......	....	.....	....	....	S.W.	9.1	....	....	.	00	0.06	....	0 06	17 ....SUNDAY
18	69.47	82 4	64 0	18 4	29.8862	29.916	29.859	.057	.6140	85.7	64.5	N.	7 9	10.0	10	5	07	0.30	....	0.30	18
19	66.05	74.6	62.5	12.1	29.9350	29.987	29.899	.088	.6062	94.3	64.5	N.	7.5	10.0	10	10	00	0.22	....	0.22	19
20	67.98	74.0	62.8	11.2	29.9308	29.949	29 918	.031	.5830	85.5	63.2	S.W.	12.4	7 0	10	2	08	0.04	....	0.04	20
21	72.87	82.0	64.0	18.0	29.9528	30.001	29.854	.147	.6158	77.0	65.0	S.W.	8.8	7.3	10	0	31	...	....	...	21
22	75.23	84.8	67.0	17.8	29 9105	29.985	29.831	.154	.6228	72.0	64.8	S.W.	21.1	2.3	8	0	34	....	....	....	22
23	74.50	85.2	68.5	16.7	29.9210	30.018	29 863	.155	.6427	76.2	66 0	S.W.	17.2	5.7	10	0	10	0 06	....	0.06	23
SUNDAY........24	.....	82.1	60.8	21.3	....	......	......	....	.....	....	....	S.E.	12.9	....	...	..	08	Inap	....	Inap	24 ....SUNDAY
25	72.60	84.8	64.2	20.6	29.8982	29.962	29.856	.106	.6423	81.0	66.0	S.W.	19.7	8.7	10	3	35	0 30	....	0.30	25
26	73.70	82 6	70.6	12.0	29.8092	29.945	29.687	.258	.7133	86.5	69.2	S.W.	13.4	7.3	10	7	20	1.00	....	1.00	26
27	70.37	76.2	66.5	9.7	29.7482	29.808	29.723	.085	.6728	90 7	67.3	S.W.	9.8	10 0	10	10	00	0 94	....	0 94	27
28	69 45	77.8	66.0	11.8	29.9787	30.011	29.908	.103	.4943	63.8	58.7	N.	9.7	3 7	10	0	65	Inap	....	Inap	28
29	71.12	81.1	57 0	24.1	29.9480	30 011	29.877	.134	.6327	82.7	65.5	S.	11 7	5.5	10	0	22	....	....	....	29
30	75.12	82.1	67.0	15 1	29 9225	29.933	29.913	.020	.6155	71.5	64.8	S.W.	17.4	0.3	8	0	61	....	....	....	30
	....	.	. ..	....	....	......	....	....	.....	...	....	....	...	....	.		..	....	....	....	
....Means	65.83	75 27	58.10	17.16	29.8805	.....	......	.113	.4991	76.2	57.5	S. 62½° W.	14.4	5.8	..	..	30.2	4.02		4.02	Sums ....
20 Years means for and including this month	64.80	73.60	56.26	17.34	29.9012	....	.....	.151	.4324	69.5	....	......	....	5 7	..	..	¶52.3	3.47		3.47	20 Years means for and including this month.

ANALYSIS OF WIND RECORD.

Direction........	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	CALM.
Miles............	970	156	179	466	638	4802	2751	378	
Duration in hrs .	91	18	34	39	45	281	174	33	5
Mean velocity...	10.7	8.7	5.3	12.0	14.2	17.1	15.8	11.6	0.0

Greatest mileage in one hour was 36 on the 11th.

Greatest velocity in gusts 40 miles per hour, on the 11th.

Resultant mileage 6,552.

Resultant direction, S. 62½° W.

Total mileage, 10,340.

*Barometer readings reduced to sea-level and temperature of 32° Fahrenheit.

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ 13 years only.

The greatest heat was 85°2. on the 23rd: the greatest cold was 44°.8 on the 7th and 8th, giving a range of temperature of 40.4 degrees.

Warmest day was the 16th. Coldest day was the 6th Highest barometer reading was 30.213 on the 13th; lowest barometer was 29.377 on the 1st, giving a range of 0.836 inches. Maximum relative humidity was 99 on the 19th and 22nd. Minimum relative humidity was 37 on the 13th.

Rain fell on 17 days.

Thunderstorms on 6 days.