Bundle 51 # 29

Mammoth remains in the Yukon

R.W. Campbell

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Notes *on the* Occurrence *of* Mammoth-remains *in the* Yukon District *of* Canada *and in* Alaska.

By George M. Dawson, C.M.G., LL.D., F.R.S., F.G.S., Assistant Director of the Geological Survey of Canada.

These notes, relating primarily to the occurrence of remains of the Mammoth in the geographical valley of the Yukon River, are the result of a correspondence between Mr. H. Moody of the Canadian Pacific Railway Co., the Assistant Secretary of the Geological Society, and the writer, respecting statements which had reached Mr. Moody from a friend resident in the extreme north-western part of the Dominion of Canada. It has been suggested that a brief notice of the facts in this connexion, so far as these are known, may be of some interest to the Geological Society.

The original discovery of bones of the Mammoth in the Yukon region is due to Mr. Robert Campbell, an officer in the service of the Hudson's Bay Company, who between 1840 and 1852 travelled through and established trading-posts in the upper valley of the Yukon, and was the first white man to penetrate this remote part of North America.

In a brief account of his explorations, printed at Winnipeg in 1885, Campbell writes:—"I saw the bones, heads, and horns of Buffaloes [Musk-Oxen ?]; but this animal had become extinct before our visit, as had also some species of Elephant, whose remains were found in various swamps. I forwarded an Elephant's thigh-bone to the British Museum, where it may still be seen".[1]

[1] 'The Discovery and Exploration of the Yukon (Pelly) River,' Winnipeg, 1885.

As Campbell's posts on the Upper Yukon were finally abandoned in 1852, the bone thus referred to by him must have been sent out before this date. It was a tibia, not a thigh-bone, and was described by Sir John Richardson in 1855 as referable to *Elephas primigenius*. Richardson states that it was identical in form with, though larger than, a corresponding bone of the same animal brought back by Capt. Beechey from Eschscholtz Bay. The skeleton of which it formed part was said to be complete when found; but most of the bones were lost by the Indians who extracted them for Campbell. According to a statement subsequently obtained from Campbell, these bones were found at some place not far from the former site of Fort Selkirk, at the confluence of the Lewes and Pelly Rivers.[1]

Dr. W. H. Dall in 1866-67, during his connexion with the Western Union Telegraph Expedition (abandoned on the completion of the Atlantic Cable), visited a number of places in the lower valley of the Yukon, within what is now the Territory of Alaska. In the volume which resulted from his explorations, and in other publications, he frequently mentions the occurrence of Mammoth-remains in this region, writing in one place as follows :—

"Wild and exaggerated stories have found a place, even in official documents, in regard to fossil ivory. This is not uncommon in many parts of the valley of the Yukon and Kuskoqúim. It is usually found on the surface, not buried as in Siberia, and all that I have seen has been so much injured by the weather that it was of little commercial value. It is usually blackened, split, and so fragile as to break readily to pieces. A lake near Nushergák, the Inglutálik River, and the Kótlo River are noted localities for this ivory".[2]

In 1886 the Geological Survey of Canada acquired from Mr. F. Mercier, who had spent many years as a trader in the Yukon region, a number of bones, tusks, and teeth of the Mammoth. These were chiefly obtained by Mr. Mercier near the mouth of the Tananá River, one of the main feeders of the Yukon on the south side. Mr. J. F. Whiteaves, F.G.S., Palæontologist to the Geological Survey of Canada, has kindly furnished the subjoined note on these remains :—

"In my judgment all the Elephantine remains collected by Mr. Mercier in the Yukon region, and now in our Museum, are clearly *Elephas* (sub-genus *Euelephas*) and not *Mastodon*.

"Four of the specimens collected by Mr. Mercier are perfect molars, essentially similar to those from Burlington Heights, near Hamilton, Ontario, which E. Billings referred to *Elephas Jacksoni* of Briggs and Foster, but which Dr. Falconer subsequently identified with *E. primigenius*, Blumenbach.

"The specific relations of the North American fossil Elephants

[1] 'Zoology of the Voyage of H.M.S. 'Herald,'' (1854) p. 142; Am. Journ. Sci. ser. 2, vol. xix. (1855) p. 132; Annual Report, Geol. Surv. Canada, 1887, p. 41 B.

[2] 'Alaska and its Resources,' 1870, pp. 238, 460, 479; Am. Journ. Sci. ser. 2, vol. xlv. (1868) p. 99.

(as distinguished from Mastodons) are treated of at considerable length in vol. ii. pp. 234–238 of the 'Palæontological Memoirs and Notes of the late Dr. Hugh Falconer,' under the heading 'Synonymy of American Fossil Elephants.'

"It is there stated that there are but two species of fossil Elephant in North America. The first of these is the *Elephas* (*Euelephas*) *primigenius*, Blumenbach, of which *E. Jacksoni*, of Briggs and Foster, and *E. americanus*, Leidy, are synonyms. According to Dr. Falconer, all the specimens from the Yukon, Alaska, and Burlington Heights are *E. primigenius*. The second species is *E. Columbi*, Falconer, of the southern part of the United States and Mexico."

The writer, in 1887, carried out an extended reconnaissance-survey in the Yukon District, in the valleys of the Pelly and Lewes branches of the main stream, but not going below the confluence of these two rivers.[1] In the whole region thus traversed no Mammoth-remains were met with, nor was their presence reported by such of the gold-miners as had worked in parts of these valleys; though some of the same men had frequently noted Mammoth-bones farther down the Yukon valley, particularly in the vicinity of Forty-Mile Creek, where rather important placer-mining has been carried on.

The above notes refer particularly to the occurrence of Mammoth-remains in the inland region of Alaska, and in parts of the adjacent Yukon District of the North-west Territory of Canada—the International boundary following the 141st meridian. The existence of similar remains, as well as those of other animals not now inhabiting the region, has long been known at various places on the coast, both to the south and north of Bering Straits. The most notable and the first discovered of these localities is Kotzebue Sound, where bones were collected by Kotzebue in 1816, Capt. Beechey, of H.M.S. 'Blossom,' in 1826, Capt. Kellett, of H.M.S. 'Herald,' in 1848, Dr. W. H. Dall in 1880, and Mr. Nelson in 1881. The specimens brought back by the three first-named expeditions were described by Eschscholtz, Buckland, Forbes, and Richardson in appendices or auxiliary works to the narratives of the several voyages.

Dall has recently given a summary of what is known respecting these localities, with full references to the published accounts of them.[2] The bones found at Kotzebue Sound and at other places on the coast are associated with what he calls the 'ground-ice formation.' The localities are indicated in a general manner on the map accompanying Dall's work; but, so far as these are described or the writer is aware, no information exists to show that such bones are associated with 'ground-ice' anywhere south of Kotzebue Sound.

The following list of species obtained in Kotzebue Sound is given

[1] Annual Report, Geol. Surv. Canada, 1887–88, Part B.
[2] Bull. U.S. Geol. Survey, no. 84, 1892, pp. 260–267.

by Dall, chiefly from Richardson's report, but with revised nomenclature [1] :—

Elephas primigenius, Blumenbach.
Elephas Columbi, Falconer [?].[2]
Equus major, De Kay.
Alces americanus, Jardine = *Machlis*, Ogilby.
Rangifer Caribou, Baird.
Ovibos moschatus, Blainville.
Ovibos maximus, Richardson = *O. cavifrons*, Leidy.
Bison crassicornis, Richardson = *B. antiquus*, Leidy.

No *Mastodon*-bones appear to have been found in any portion of the extreme north-west of North America.

Of particular interest in connexion with the general question of the distribution of Mammoth-remains in the Alaskan region is the occurrence of such remains (a tooth) on St. George Island of the Pribilof group, in Bering Sea, and on Unalashka Island of the Aleutian Chain.[3] Mr. J. Stanley-Brown further notes the discovery of a Mammoth-tusk on St. Paul Island of the Pribilof group, but appears at the same time to throw doubt on the means by which these remains reached the Pribilof Islands, writing—"As there is not a foot of earth upon either island, save that which has resulted from the decomposition of the native rock and the decay of vegetation, the value of such testimony is questionable."[4]

The precise intention of the cautionary remark just quoted is not clear to the writer. The finding of the bones upon St. George and St. Paul Islands does not appear to be doubtful. Both islands were uninhabited previous to their discovery by the Russians; they show neither traces of glacial action nor erratics; and in what way the Mammoth can be supposed to have reached these islands, except by means of a former connexion with the mainland, it is difficult to understand. We have, moreover, the Mammoth-bones already mentioned on Unalashka Island, vouched for by Dr. Stein, and a like explanation must be found for all these cases. This does not appear to be difficult, for the whole eastern part of Bering Sea is rather notably shallow, nearly everywhere less than 50 fathoms in depth. An elevation of the land by about 300 feet would thus suffice to unite the islands mentioned, with a number of others, to the American Continent, and it appears scarcely to admit of doubt that it was across such a practicable plain that the Mammoth found its way to these places.

The most important observation to be based on the foregoing notes is that the remains of the Mammoth, with those of other associated animals, are, in the north-western part of the North American Continent, abundant in, if not strictly confined to the

[1] *Op. cit.* p. 264.

[2] I have ventured to place a mark of interrogation against this species, for Falconer gives its range as being from Mexico to Georgia and perhaps farther south. See 'Palæontological Memoirs and Notes,' vol. ii. pp. 230–231. See also Howorth, 'The Mammoth and the Flood,' pp. 274–276.

[3] Bull. U.S. Geol. Survey, no. 84, p. 266.

[4] Bull. Geol. Soc. Am. vol. iii. (1892) p. 499.

limits of, a great unglaciated area there existing. With the exception of the southern mountainous sea-margin of Alaska, and doubtless also that of certain local inland ranges, this unglaciated area may be described as comprising nearly the whole of Alaska, together with a considerable portion of the adjacent Yukon District of Canada.

As the result of his explorations in this part of the continent, the writer has been able to determine the fact that during the glacial period the Rocky Mountain or Cordilleran region, from about the 48th to the 63rd degree of latitude North, was at one time buried beneath a great confluent ice-mass some 1200 miles in greatest length in a north-west by south-east bearing, with an average width of about 400 miles.[1]

This Greenland-like ice-cap was distinct from the still greater Laurentide Glacier of Eastern North America, and, because of the trend of the mountain-ranges which it covered, it moved principally in two directions—south-eastward and north-westward. The south-easterly motion of one part of this ice-mass the writer had demonstrated in 1877,[2] but it was not till 1887, and then as a result of the Yukon expedition, that he was enabled to ascertain the north-westerly movement of its northern part, and to show that there was a definite limit to its extent in both directions. Being thus clearly distinct from any extension of polar ice, as well as from the great Laurentide ice-mass, it became appropriate to designate it as the Cordilleran Glacier.[3] Further evidence respecting the northern limit of glaciation in this region has since been obtained by Mr. R. G. McConnell, of the Canadian Geological Survey (1888), Mr. I. C. Russell, of the U. S. Geological Survey (1889), and Mr. C. W. Hayes, of the same Survey (1891).[4] The area covered by, and the directions of movement of, the Cordilleran ice-mass have been approximately mapped in one of the papers above referred to,[5] and the later observations of the above-named gentlemen have not in any material degree changed the indications there given.

Within the area which was covered by the great Cordilleran Glacier, remains of the Mammoth are either entirely wanting or are very scarce. The reported finding of a tooth on the southern part of Vancouver Island, and that of a portion of a large bone (which, though not determinable, may have belonged to such an animal) in gravels worked for gold on Cherry Creek,[6] are the only possible exceptions known to the writer, and the deposits from which the last-mentioned bone was obtained may be of pre-Glacial age.

[1] 'On the later Physiographical Geology of the Rocky Mountain Region in Canada,' Trans. Royal Soc. Canada, vol. viii. (1890) sect. iv. p. 27.

[2] Report of Progress, Geol. Surv. Canada, 1877–78, pp. 136 B, 151 B; Quart. Journ. Geol Soc. vol. xxxiv. (1878) p. 119, vol. xxxvii. (1881) p. 283.

[3] 'American Geologist,' vol. vi. (1890) p. 162.

[4] Annual Report, Geol. Surv. Canada, 1888–89, p. 28 D; Bull. Geol. Soc. Am. vol. i. (1890) p. 144; National Geogr. Mag., Washington, vol. iv. p. 157.

[5] Trans. Royal Soc. Canada, *op. cit.* pl. ii. map no. 4.

[6] Okanagan District, British Columbia.

The likeness of the non-glaciated north-western portion of North America, with its abundant Mammoth-remains, to the similarly characterized northern part of Asia has already been recognized. The purport of the foregoing remarks is to indicate the existence of a south-eastern boundary to the Mammoth-inhabited portion of Alaska and the Yukon District; nor can it be reasonably doubted that the North American and Asiatic land was continuous at the time of the existence of the Mammoth, or for some portion of that time; for an elevation of the land sufficient to enable the Mammoth to reach the islands in Bering Sea, already referred to, would result in the obliteration of Bering Straits.

Many conjectures have been advanced as to the mode of occurrence and origination of the 'ground-ice formation,' in association with which the bones of the Mammoth and other animals are found along the northern coasts of Alaska. Dall summarizes these in his work previously cited,[1] and it may now be confidently assumed that the descriptions of Kotzebue and his party, of Capt. Kellett and others on the 'Herald,' of Dall and Lieut. Cantwell,[2] correctly indicate the facts of the case. The clearest descriptions of the phenomena are those of Seemann and Dall.[3] From these it appears that the lower parts of cliffs which have some extent on Kotzebue Sound are composed of solid ice, somewhat discoloured and impure, and showing indications of stratification. Above this ice rests a layer of clay, in which the bones occur, and capping the whole is a peaty layer supporting the vegetation of the region. It is further apparent that this or a very similar formation occurs at a number of points along the northern coast of Alaska, but nothing has been adduced to show that it is absolutely continuous over any great area;—there is, in fact, some reason to believe that it is confined to limited tracts, even in the vicinity of Kotzebue Sound.[4]

In the present connexion, the 'ground-ice formation' is of interest only in so far as its existence and the mode of its origination may throw light on the date and method of entombment of the Mammoth-remains associated with it. With respect to the origin of the deposits, the writer ventures to offer the following suggestions.

The country in which the 'ground-ice formation' occurs is low in its relief, and the formation occupies its lower tracts. The ice itself must undoubtedly have been produced upon a land-surface, and since the time of its production this surface can never have been covered by the sea; for this would inevitably have reduced the frozen condition of the overlying clays, and have resulted in the destruction of the icy sub-stratum as well.

With an elevation of the land by an amount of 300 feet or more (such as appears to be required by the Mammoth-remains on islands already mentioned) the warmer waters connecting with the Pacific

[1] Bull. U.S. Geol. Survey, No. 84, pp. 260–264.
[2] 'American Geologist,' vol. vi. (1890) p. 51.
[3] 'Voyage of H.M.S. 'Herald,'' vol. ii. pp. 33 *et seqq.*; Bull. U.S. Geol. Surv. No. 84, pp. 261 *et seqq.*
[4] 'American Geologist,' vol. vi. (1890) p. 52.

would be confined to the deeper western portion of what is now Bering Sea, forming there a limited gulf, without outlet to the north, from which the region where the 'ground-ice formation' is now found would be so far removed as to greatly reduce its mean annual temperature. Snow falling upon this nearly level, northern land, and only in part removed during the summer, would naturally tend to accumulate in *nevée*-like masses in the valleys and lower tracts, and the underlying layers of such accumulations would pass into the condition of ice, though without the necessary slope or head to produce moving glaciers. The evidence does not seem to imply that the Mammoth resorted to this extreme northern portion of the region during the actual time of ice-accumulation, but this animal may be supposed to have passed between Asia and America along the southern parts of the wide land-bridge then existing.

At a later date, when the land became depressed to about its present level, Bering Sea extended itself far to the eastward, and Bering Straits were opened. The perennial accumulation of snow upon the lowlands ceased, and in the southern parts of Alaska such masses as had been formed may have been entirely removed. Farther to the north and at a greater distance from the Pacific waters, while the total precipitation would probably be increased, a greater proportion would fall as rain, and floods resulting from this and the melting of snow on the higher tracts would be frequent. Thus it may be supposed that deposits of clay and soil from adjacent highlands and from the overflow of rivers covered large parts of the remaining ice of the lowlands, and that wherever so covered it has since remained; the winter temperature being still sufficiently low to ensure the persistence of a layer of frozen soil between the surface annually thawed and the subjacent ice. Over the new land thus formed the Mammoth and associated animals appear to have roamed and fed, and wherever local areas of decay of the ice may have arisen, bottomless bogs and sink-holes must have been produced which served as veritable traps.

It will be observed that this hypothesis requires a rather abrupt passage from the conditions under which the ice accumulated to those in which, before it had time to disappear, it began to be covered up by soil, but the change may nevertheless have extended over a considerable number of years. The association of the Mammoth with an animal so essentially Arctic as the Musk-Ox requires—as has frequently been pointed out—the admission that the Mammoth was capable of living in a rigorous climate, though it may be that the southern limit of the migration-range of one animal merely overlapped the northern limit of the migration-range of the other. The occurrence of the Moose (*Alces americanus*) implies the existence at that time of woodland, or at least of well-grown thickets.

In the Cordilleran region generally, the Pliocene and Glacial periods were characterized by several important changes in elevation and depression of land;[1] but it is unsafe to assume that these

[1] Trans. Royal Soc. Canada, vol. viii. (1890) sect. iv. p. 54; Bull. U.S. Geol. Survey, no. 84, p. 278.

changes equally affected the northern region here particularly treated of; for it is not only very distant from the localities which have so far been specially studied, but the physical features of the Cordilleran belt become diffuse and ill-marked to the north, and such mountain-ridges as remain assume new trends. It may, however, be taken for granted that this region shared to some extent in these great movements of elevation and depression, and as the very existence of the 'ground-ice' shows that the area where it is found has not since the date of its formation been materially lower than at present, it may reasonably be argued that it dates from a period approaching the conclusion of the series of changes in level, or subsequent to the last well-marked epoch of depression of the land.

Thus, without entering into any details respecting the sequence of these great earth-movements in the Cordilleran region of British Columbia,[1] it may be stated as probable that the uprising of the land which led to the accumulation of the 'ground-ice' was coincident with the second (and latest) epoch of maximum glaciation, which was followed by an important subsidence in British Columbia.

Discussion.

The President said that many interesting points had been brought forward by the Author. The differentiation of the glaciated from the unglaciated area, and the clear recognition of a north-western as well as a south-eastern boundary to the Cordilleran ice-mass, struck him as being of great importance.

Sir Henry Howorth remarked upon the long and careful survey of N.W. America which has been made by the Author, and upon the value of the conclusions to which he has come: firstly, in regard to the absence of ancient glaciation in Alaska and its borders; secondly, in regard to the existence of a great glacier in the Cordilleras, whose products are quite independent of and have nothing to do with the Laurentian drift; and thirdly, in regard to the distribution of the Mammoth. It was a new fact to him, and one of great importance, that Mammoth-remains had occurred in Unalashka and the Pribilof Islands in Bering Sea, proving that in the Mammoth age there was a land-bridge here, as many inquirers had argued. It would be very interesting to have the western frontier defined, where the Mammoth-remains cease to be found. It would also be very interesting to know how far south on the west of the Cordilleras the true Mammoth, as distinguished from *Elephas Columbi*, has occurred.

Regarding one conclusion of Dr. Dawson's, the speaker could not agree with his friend, namely, about the age of the strata of ice sometimes found under the Mammoth-beds in Alaska as they have been found in Siberia. The speaker was of opinion that this ice has accumulated since the beds were laid down, and was not there when the Mammoth roamed about in the forests where he and his com-

[1] For a discussion of which see Trans. Royal Soc. Canada, vol. viii. (1890) sect. iv. pp. 40–55.

panions lived. Humus and soil cannot accumulate upon ice except as a moraine, and there are no traces of moraines or of great surface-glaciation in Alaska and Siberia. Nor could either the flora or fauna of the Mammoth age have survived conditions consistent with the accumulation of these beds of ice almost immediately below the surface, or consistent with their presence there. The speaker considered that these beds are due to the filtration of water in the summer down to the point where there is a stratum of frozen soil, through which it cannot pass and where it consequently accumulates, freezes, raises the ground, and in the next season grows by the same process until a thick bed of ice has been formed. The evidence goes to show that the present is the coldest period known in recent geological times in Siberia and Alaska, and that the period of the Mammoth and its companions was followed and not preceded by an Arctic climate where its remains occur.

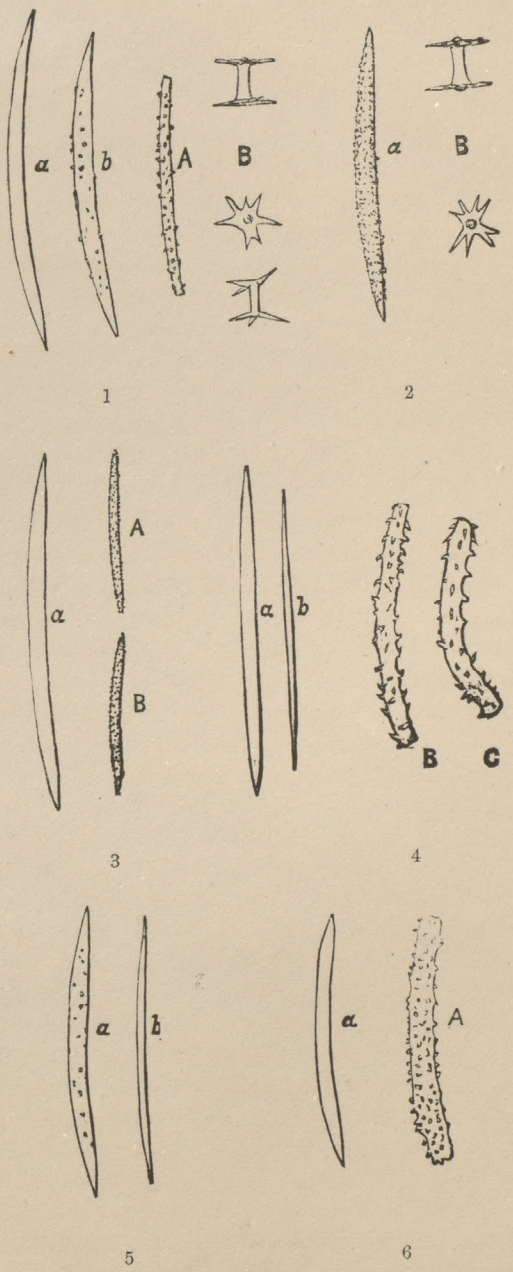
Dr. Henry Woodward mentioned that in 1850 Capt. Kellett and Lieut. Wood brought remains of Musk-Ox and Mammoth to the British Museum from Kotzebue Sound, Alaska; and in 1873 the Rev. R. McDonald (one of the Hudson's Bay Company's Chaplains) from Fort McPherson, Mackenzie River, Arctic America, gave to the National Collection, from the Porcupine River, remains of Mammoth, Musk-Ox, *Bison priscus*, and Horse. The *Mastodon* has lately been found in Kent County, Ontario, Canada. These instances prove the former abundance of the land Mammalia in high latitudes in North America. The most interesting point in Dr. Dawson's paper is the mention by him of the remains of Mammoth on the Aleutian Islands, proving that this was the old high road for this and other mammals from Asia into North America in Pleistocene times.

Prof. Hull observed that, with reference to the requirements of the large animals referred to in Dr. Dawson's interesting paper, he had seen it stated that one had been discovered in N.W. America nearly entire, and in its stomach were about seven bushels of vegetable matter. However that might be, it seemed clear that the climate of the circumpolar regions had undergone a great change since the Mammoth had become extinct; in consequence of which the vegetation had materially fallen off. He also desired to call attention to the clear evidence which the Author's paper afforded of the former wider extension of land in the Arctic regions during the Mammoth period.

On Some Canadian Species of Spongillae.

written after his work on The Boundary Commission -

Bundle 51 #49



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Figs. 1 & 5. *Spongilla stagnalis.*
" 2. " *asperrima.*
" 3. " *Dawsoni.*

Fig. 4. *Spongilla flexispina.*
" 5. " *Ottawaensis.*

ON SOME CANADIAN SPECIES OF SPONGILLÆ.

By George M. Dawson.

The *Spongillidæ* or fresh-water representatives of the marine sponges, though very widely distributed, are not yet known to be represented by a great number of species. It is probable that a systematic exploration of the great North American systems of lakes and rivers might bring many new forms to light. With the exception of *S. Lordii*, Bowerbank, from the sources of the Columbia River, the only Canadian spongilla which appears to have been described, is *S. Dawsoni*, of the same author, a form inhabiting the St. Lawrence River near Montreal, and other neighbouring waters.

Having become interested in the examination of a fine species from the Lake of the Woods, obtained in connection with the work of the British North American Boundary Commission, I have been induced, at the same time, to examine a number of other specimens in the collection of Principal Dawson. Among these, and including the Lake of the Woods form, I find four species which I believe to be undescribed. These are here defined, and though I have not the whole of the literature of the subject at hand, provisionally named.

The descriptions, from the poor state of some of the specimens, are necessarily not in all cases complete; but will, I believe, at least serve for the recognition of the species, with the aid of the figures.

The first spongillas studied—*S. fluviatilis* and *S. lacustris*—belong to two distinct types; and it has been found, on extend-

ing the knowledge of the genus, that all new forms fall naturally into one or other of these. To this rule the forms now under consideration offer no exception, though representing both groups; *S. stagnalis* and *S. asperrima*, belonging to the fluviatilis type, *S. flexispina* and *S. Ottawaensis*, to that of lacustris.

In the first series, are included those spongillas in which the gemmule, or reproductive capsule, is built up of birotulate spicula, placed side by side, and arranged with their axes radially. In the second, the capsules are more leathery, but covered, when mature, with straight or curved spicula, arranged at right angles to the radial lines.

For details concerning the classification and morphology of the *Spongillidæ*, reference should be made to Dr. Bowerbank's and Mr. Carter's Memoirs.

I append first Dr. Bowerbank's description of *S. Dawsoni*, as given in his monograph on the *Spongillidæ*.*

Spongilla Dawsoni, Bowerbank. "Sponge sessile?, branching; surface smooth, oscula and pores inconspicuous. Dermal and interstitial membranes abundantly spiculous; spicula fusiformi-acerate, entirely spined; spines numerous, short, and conical. Skeleton-spicula acerate or subfusiformi-acerate. Ovaria spherical: dermal spicula numerous, disposed in flat fasciculi, or groups of spicula parallel to each other; groups irregularly dispersed; spicula acerate or subcylindrical, entirely spined; spines numerous, obtuse, and ill-defined. Sarcode aspiculous. Colour, in the dried state, emerald-green."

Hab., River St. Lawrence, Montreal; a lake near Brockville.

Dr. Bowerbank further adds, with reference ro this species:

"The dermal and interstitial membranes abound with tension-spicula, and especially the dermal one, in which they seem to attain their fullest degree of development. Their normal form is fusiformi-acerate; but, from the abundant production of the spines at their terminations, they frequently appear to be cylindrical rather than acerate. They are disposed on these tissues rather unevenly, abounding in some spots, while they are comparatively scarce in others."

"The spicula of the skeleton are of about the same proportions as those of the European species. They are usually of the regular acerate form, but occasionally become subfusiform."

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* Proc. Zool. Soc. London, Nov. 1863, and *Canadian Naturalist*, 1864.

The spongilla is sessile, and branches much, well-grown specimens much resembling fully developed examples of *S lacustris*.

Length of skeleton-spicula 0.013. Dermal and interstitial spicula, 0.0015 to 0.0017 inch.

Fig. 3.—*a*, ordinary skeleton-spiculum. A. and B., ordinary capsular and dermal spicula.

Spongilla stagnalis, sp. nov. Sponge encrusting, forming patches several inches in diameter, and from half an inch to an inch thick; greenish; lobular, somewhat hispid. Oscula simple, key-hole shaped, or double; large, 0.25 to 0.50 in. Scattered, sub-crateriform. Skeleton-spicula acerate and fusiformi-acerate, slightly arcuate, 0.011 to 0.013 in. long. Most of the stouter spicula medially spined, the apices always naked; spines small, sparsely distributed. Ovaria, sub-globose, diameter, 0.025 in. Rotulæ, about equal in size, flat, very deeply and irregularly dentate, diameter about equal to length of shaft of spiculum, or 0.0005 in.; the rays not acute. Shaft, thick, cylindrical, generally with a boss at each end.

Hab. North-west Angle Inlet, Lake of the Woods; River St. Lawrence near Montreal.

The two forms of skeleton spicula seem to pass into each other, and in specimens from both localities, are very irregular in size. The birotulate spicula—especially in the Lake of the Woods specimens—are very apt to be deformed. A number of small, entirely spined, straight, obtuse spicula, about one-third the length of the skeleton-spicula, were found with the others after treatment with acid. They were searched for in all parts of the sponge, but finally found enclosed in some of the gem, mules, and apparently in connection with the young sponge.

This species, which is nearest the European type *S. fluviatilis*, of Johnston, was found in great abundance at the first mentioned locality, in July, 1873. It was growing on floating logs and branches, and many specimens were filled with large gemmules. It is probably the species the existence of which was suspected by Dr. Bowerbank, who says, in the conclusion of his notice of *S. Dawsoni*:—"In the preparation of these spicula for examination, I found a few birotulate ones, having the rotulæ very deeply divided. These spicula were no part of the sponge in course of description, but were undoubtedly from the gemmules of another species inhabiting the St. Lawrence."

Fig. 1.—*a.* and *b.*, ordinary skeleton-spicula. B., birotulate spicula. The middle figure shows one end of a spiculum, of about the ordinary form; the lower figure, a type of deformed spiculum which is common. All the above drawn from Lake of the Woods specimens. Fig. 5. represents skeleton-spicula of a specimen from the St. Lawrence.

Spongilla Baileyi, Bowerbank. This species appears to be indicated by a single birotulate spiculum, in the Lake of the Woods collection. It was originally described by Dr. Bowerbank, from specimens obtained at West Point, N. Y.

Spongilla asperrima, sp. nov. Sponge sessile, encrusting, thin; surface slightly undulated; oscula rather large, scattered; skeleton-spicula, fusiformi-acerate, slightly arcuate, stout, densely spined, with the exception of the extreme apices; length, 0.01 to 0.009 in. These mixed with a few smooth and more slender. Spines minute, acute. Ovaria sub-globose, diameter nearly 0.02; spicula birotulate, short; rotulæ equal in size, flat, very deeply divided, about 0.0005 in., equal to, or greater than, the length of the shaft; radii not acute; shaft with a distinct boss at each end.

Hab., River St. Lawrence, near Montreal.

This species much resembles that from the Lake of the Woods, of which, it is possible, it may turn out to be a variety. It differs chiefly in its thicker, coarser and much more densely spinous skeleton-spicula, and in the external form of the sponge. Not possessing any intermediate forms, I have referred them, for the present at least, to different species. The spicula are not unlike *S. Parfitii*, as figured by Bowerbank,* but differ from them about as much as from those of the Lake of the Woods. Many of the skeleton-spicula are deformed, having crutch-like or bent ends.

Fig. 2., *a.*, ordinary skeleton-spiculum. B., one of the ordinary birotulate spicula.

Spongilla flexispina, sp. nov. Specimens not large enough to show the general form, or appearance of the surface. Skeleton-spicula acerate to subfusiformi-acerate, very slightly arcuate to nearly straight, smooth, not very acute, length about 0.0115 in. Dermal and interstitial spicula subcylindrical, irregularly and

* Brit. Spongiadæ, Vol. III., Plate LXXXVI.

often abruptly bent, entirely spined, length nearly 0.003 in.; spines scattered, rather large, conical, acute, generally retrorse near the ends of the spicula. Ovarian spicula scarcely distinguishable from the interstitial and dermal.

Hab., River St. Lawrence, near Montreal.

This species is of the type of the European *S. lacustris*, but differs sufficiently from that species. It also differs markedly from *S. Dawsoni* and *S. Ottawaensis*. Its ovarian and dermal spicula are intermediate in size between those of the last named species.

Fig. 4.—*a.*, ordinary skeleton-spiculum. *b.*, a second form of skeleton-spiculum, smaller and perhaps not fully developed. B., C., ovarian and dermal spicula.

Spongilla Ottawaensis, sp. nov. Specimens do not show the external form. Colour in the dried state, green. Skeleton-spicula acerate, slightly arcuate, often rather abruptly and bluntly pointed, smooth, length, 0.011 to 0.008 in. Ovaria sub-globose, rather irregular, large, diameter 0.04 in.; spicula cylindrical, stout, slightly and regularly arcuate, entirely and rather densely spined, length 0.0034; spines rather prominent, somewhat obtuse. Dermal and interstitial spicula like the ovarian, but slightly more delicate.

Hab., L'Orignal, on the Ottawa River.

The skeleton-spicula are shorter than those of *S. Dawsoni;* the ovarian etc. spicula much larger than those of that species, and larger also than those of *S. flexispina*. They somewhat resemble those of *S. lacustris*, but are distinctly truncate at the extremities. The specimens are small, but densely filled with large ovaria.

Fig. 6.—*a.*, ordinary skeleton-spicula. A., ovarian spicula.