Letter of the Secretary of the Treasury, communicating a report of a geological reconnoissance of the Chippewa Land District of Wisconsin, and the northern part of Iowa. 1848

Owen, David Dale, 1807-1860
[Washington, D.C.]: [publisher not identified], 1848

https://digital.library.wisc.edu/1711.dl/27EKUYBTIKRGD8O

30th Congress, 1st Session. [SENATE.] Executive, No. 57.

LETTER

OF THE

SECRETARY OF THE TREASURY,

COMMUNICATING

A report of a geological reconnoissance of the Chippewa land district of Wisconsin, and the northern part of Iowa, by David Dale Owen.

June 22, 1848.—Read, and ordered to be printed.

June 24, 1848.—Reconsidered, and referred to the Committee on Public Lands.

July 3, 1848.—Ordered to be printed, and that 2,000 additional copies be printed for the use of the Senate.

Treasury Department,
June 21, 1848.

Sir: I have the honor herewith respectfully to submit a communication from the Commissioner of the General Land Office, under date of the 3d instant, and the accompanying detailed report of Dr. D. D. Owen, with diagrams and illustrations, of the geological survey and explorations made by him, under instructions from this department, during the past season, in the Chippewa district of Wisconsin, and the northern part of Iowa.

I have the honor to be, very respectfully, your obedient servant,

R. J. WALKER,
Secretary of the Treasury.

Hon. G. M. Dallas,
Vice President of the United States, and President of the Senate.

General Land Office, *June* 3, 1848.

Sir: I have the honor to submit for your consideration, the detailed report of Dr. D. D. Owen, with diagrams and illustrations, of the geological survey and explorations made by him under your instructions during the past season, in the Chippewa district of Wisconsin, and the northern part of Iowa.

This report is very satisfactory, being full and explicit, and designating clearly the character of the different districts within the region examined, so that the act of 3d March, 1847, for the sale of those lands, can be fully executed in all its details. It manifests, moreover, great labor and diligence in collecting information, and high scientific attainments in its preparation. The diagrams present a striking view of the geology of the whole country; and the sketches of the interesting points visited, prepared in a masterly manner, give an interest to the whole, and render it alike valuable to the traveller, the amateur, and the man of science.

Should it be determined to publish this report, it is essential to a proper understanding of it that these diagrams and illustrations should also be printed, as they are so referred to and embodied in it, that they cannot be dispensed with, without detracting materially from the scientific and practical character of the report.

With great respect, your obedient servant,

RICHARD M. YOUNG,
Commissioner.

Hon. R. J. Walker,
Secretary of the Treasury.

REPORT

OF A

GEOLOGICAL RECONNOISSANCE

OF THE

CHIPPEWA LAND DISTRICT OF WISCONSIN;

AND, INCIDENTALLY, OF

A PORTION OF THE KICKAPOO COUNTRY, AND OF A PART OF IOWA AND OF THE MINESOTA TERRITORY, MADE UNDER INSTRUCTIONS FROM THE UNITED STATES TREASURY DEPARTMENT,

BY

DAVID DALE OWEN, M. D.,

U. S. GEOLOGIST FOR WISCONSIN.

7423

REPORT.

NEW HARMONY, IA., *April* 23, 1848.

SIR: The preliminary report forwarded to the department on the 10th of October, from Prairie de Chien, contained an outline of operations as far as the reports had been received from the different companies up to that date.

I now submit a more full report of the whole observations made by the geological corps of Wisconsin, including the last month's operations in the field.

The first two chapters contain a description of the formations adjacent to the Mississippi. They embrace the observations made during the first and last three months of the expedition, condensed into general results, without detailing the daily observations. The third and fourth chapters contain the investigations made in the interior and Lake Superior regions in July, and part of June and August. These have been arranged nearly in the order of daily annotation. This portion of the report is little more than a record of facts, with but little generalization, because the data were insufficient.

The investigations of the assistant geologist in the same district of country, but along different routes, have been recorded in a similar manner, and will be found in his report, together with some information on the topography of the country, in connexion with its climate, which I requested him to draw up from his meteorological journal, thinking it might be valuable to the department and interesting to the public generally, especially to those settling in the northwest. Of course the observations of a single season will not admit of any very definite conclusions; yet D. Norwood's deductions are sufficient to show that the climate of the Lake Superior country is subject to less extremes than that of the Mississippi valley, and that it is more moderate than that of many parts of the United States in more southern latitudes.

The assistant geologist has, also, from an average of nearly a month's recorded barometrical observations on Lake Superior, and from a mean of observations on the Mississippi by himself and other members of the corps, including my own, calculated the height of Lake Superior above the Mississippi at the mouth of Lake Pepin. This I had done in order to enable me, as my instructions required, to refer the levels to Lake Superior as a standard. The result is probably very near the truth, though, in order to ascertain the exact relative levels would require much more numerous observations. His sections of relative heights of points intermediate between Lake Superior and the Mississippi, referred to either of these as a basis, are given as provisional, constructed as they necessarily were, from one, two, or three observations, they are liable to error.

Of my own numerous barometrical observations I have, as yet, been able to extract and work up such only as were required to produce the sections appended to the report, and to make calculations on the dip, relative thickness and height of rocks. The rest remain in my original note book, to be recorded hereafter.

The analyses of soils, given in the present report, have been carried out as minutely as our time would permit. To make a complete analysis, so as to convey all the information which the present state of chemical knowledge is capable of furnishing, would demand for each soil at least two weeks close application in the laboratory.

Though a detailed geological survey has been made only of about thirty townships, west of the fourth principal meridian on Black river, and about sixty townships on the St. Croix, a general knowledge has been obtained of a large portion of the Chippewa land district, as well as a portion of Iowa, situated in the Winnebago reserve and the Minesota territory; sufficient, indeed, to enable me to lay down *approximately* the general bearings and area of the principal formations over more than two-thirds of the district. Nineteen sections have been constructed at the most important points on the Mississippi, and six on the St. Croix, arranged in such a manner as to form a diagram of comparative heights. One continuous section has been constructed from the mouth of the Wisconsin river to the falls of St. Anthony; one from the Mississippi to the falls of the St. Croix; one from the mouth of the St. Croix to the falls of St Anthony, on a more extended scale than that appended to the Mississippi section; one from Lake Superior to Portage Lake; one from the head waters of Wisconsin river to the Dalles of that river; one from Lake Superior to the falls of St. Louis river; one from Lake Superior along the 4th principal meridian to Black river, and thence to the Mississippi; one along the correction line from the 4th principal meridian to the Mississippi; one from the Kinikinick in a northwest direction across the St. Croix to Bessel's farm. Also a particular section at the falls of St. Anthony.

Diagrams of summit levels show the relative elevations of ground between the Mississippi and Lake Superior in three different directions.

It has been ascertained that there extend into Wisconsin two if not three trap ranges, similar in their character to ranges in Michigan, and that these, in some places, afford ores which hold out a prospect of productiveness.

Data have been obtained which prove that the lower magnesian limestone, as well as the upper, is lead bearing.

The results of the reconnoissance of the past season are of much value in directing future observations. They clearly indicate what regions are most likely to yield ores, and where it would be a loss of time and money to search for them.

The country can also be laid off with approximate accuracy, into distinct agricultural districts; the proportion and approximate boundaries of good and nearly worthless land being known.

Statistics have been collected, which will convey some idea of the value of the pine lands.

Observations have been made which will serve to correct many topographical and geological errors, which abound in the present maps.

A few illustrations from my pencil are distributed over the report, as tending to give a more accurate idea than could any words, of the geological aspect of the district.

The geological chart accompanying this report, has been delineated on four separate sheets, because the paper procured for mapping proved to be too small to admit of its being drawn, on the present scale, on a single sheet; and because paper of a larger size, afterwards ordered, did not arrive in time.

It is to be observed, that the importance of what has yet been done is of a relative and preliminary character. Its ultimate value will depend upon following it up, with those more minute and detailed observations that are to give precision to results at present general and approximate.

It is impossible to anticipate, with precision, the exact length of time which may be required to obtain, for the whole of the extensive district covered by my instructions, and reaching north to the British line, (being twice as large as the State of New York,) all the geological information that may be practically useful to direct the operations of the land office, and to determine with trustworthy accuracy, by metes and bounds, the proper mineral reservations. If the linear surveys keep pace with the geological exploration, and the same force is continued which my instructions of this season place at my disposal, it is my opinion that two, or perhaps three, seasons beyond the present will suffice to complete the whole.

I may remark, that it has been my aim, during the conduct of the exploration, so far, as it will continue to be, while I am charged with it, to make the strictly practical and business portion of the survey the chief end and object of our operations. Scientific researches, which to some may seem purely speculative and curious, are essential as preliminaries to these practical results. Further than such necessity dictates, they have not been pushed, except as subordinate and incidental, and chiefly at such periods as, under the ordinary requirements of public service, might be regarded as leisure moments; so that the contributions to science thus incidentally afforded, and which a liberal policy forbade to neglect, may be considered, in a measure, a voluntary offering, tendered at little or no additional expense to the department.

In this connexion, and in justice to those who have aided me during the winter, in preparing the materials for this report, I here state, that but for the industry and perseverance they brought to the task, I should have found it impossible to complete it. Our working hours have generally been from twelve to fifteen per day—

frequently more. Even with such exertions, it has been with difficulty that we have executed the necessary diagrams, sections, charts, and calculations so as to be able to take the field by the first of May.

I am, sir, your obedient servant,

DAVID DALE OWEN,
U. S. Geologist for Wisconsin.

Hon. R. McYoung,
Commissioner General Land Office.

SITUATION AND EXTENT OF THE DISTRICT EXPLORED.

The seat of operations of the party appointed to explore the mineral lands of Wisconsin and a portion of Iowa was, during the summer and autumn of 1847, in a portion of country lying chiefly east of the Upper Mississippi above Lake Pepin, and extending north to Lake Superior. There was, however, also included a portion of Iowa, stretching north from the northern boundary of the geological survey of 1839, as far as the St. Peter's river; and also a tract of country north of the Wisconsin river. The principal streams which water it are Black river, the Chippewa, and the St. Croix, flowing southerly into the Mississippi; Mauvaise rivière, (Bad river,) and Bois Brulé, (Burnt Wood river,) falling into Lake Superior; and Turkey river, Upper Iowa, Hokah, Miniska, Wazi Oju, Cannon, Vermillion, and a portion of St. Peter's flowing eastwardly into the Mississippi. It comprehends so much of the Chippewa land district as lies within the boundaries proposed for the State of Wisconsin, the southern part of the country bordering on the Kickapoo, together with the chief part of the Winnebago reserve, the half breed tract and a strip of the Sioux country west of, and adjacent to, the Mississippi, and reaching north to the St. Peter's.

It lies between 43° and 47° north latitude, and between 89° and 94° of longitude west of Greenwich, and embraces about forty-six thousand square miles of surface.

CHIEF GEOLOGICAL DIVISIONS.

The geology of the above district may be conveniently considered under the following heads:

1. Formations of the Upper Mississippi.
2. Formation of the Red Cedar river.
3. Formation of the interior of the Chippewa land district.
4. Formation of Lake Superior.
5. Drift.

These formations are described in detail, in the following chapters.

CHAPTER I.

FORMATIONS OF THE UPPER MISSISSIPPI.

Plate No 1 represents a natural section of the hills at Praire du Chien.

The lower terrace or projecting ledge is the upper portion of the lower magnesian limestone which forms the base of these hills, and which extends down to the level of the plain on which the village stands; it is the same rock which has been used in the construction of the church and several other buildings in that place. Its thickness from the quarry at the base of the hill to the top of this projection is about two hundred feet; the principal part of the slope between this and the second terrace is occupied by soft sandstone, between forty and fifty feet in thickness. The second terrace marks the junction of that sandstone with the buff colored, blue, and grey fossiliferous limestone, which is upwards of a hundred feet thick, and occupies the greater part of the upper slope, capped on the summit by the upper magnesian limestone, or lea bearing rock of the Mineral Point and Dubuque districts of Wisconsin and Iowa.

The whole of these strata rest, as stated in my report of 1839, on a soft white quartzose sandstone near the level of the bed of the Mississippi.

Standing on the extensive plain on which Prairie du Chien is built, and looking up the valley of the Mississippi, one can see this range of hills stretching away for nearly four miles, and these well defined geological terraces may be observed converging in long lines of perspective. To the eye these benches of rock appear horizontal, but measured by the barometer they are found gradually to rise in ascending the valley, and a still greater rise is observed in going northeast toward the Kickapoo.

Assuming this section as a standard of comparison, the rocks constituting the base of these hills are seen to rise higher and higher going north, though the hills themselves retain nearly the same elevation; the consequence is that one after another the superior beds thin out and disappear, and before proceeding many miles the lower magnesian limestone, which occupied at first their base, is found extending even to their highest summits, while the inferior sandstone gradually emerges from beneath the water courses, and at last constitutes more than one hundred feet of their base. Such is the state of things between Painted Rock and the Upper Iowa river, and only eighteen or twenty miles northeast of Prairie du Chien, on the Kickapoo, a tributary of the Wisconsin river coming in from the north, and but three or four miles in a direct line from their confluence, the lower magnesian limestone is already found capping the tops of the adjacent hills, as may be seen from a sketch (see Pl. 2) taken near the mouth of Plumb creek.

The cliff near the summit of the hill is the lower magnesian limestone; in the slope underneath are sandstones with alternations of magnesian limestones. In consequence of the softness of the sandstones, it is often difficult to get a view of them, because they have crumbled away in the slope and are hidden from view by vegetation. Occasionally they are more indurated, and then appear in a bold and naked wall, as seen in a sketch (see Pl. 3.) taken on another part of the Kickapoo.

Travelling still further north or northeast, only thin beds of magnesian limestone surmount the hills, alternating with sandstone, as in township 9 north, range 4 west of the 4th principal meridian, about ten miles above the mouth of Plumb creek; there the hills present the outline shown on Pl. 4.

Six or seven miles northeast of the above locality, on township 10 north, range 5 west of 4th principal meridian; the sandstone extends even to the tops of the hills, without any capping of magnesian limestone.

This change in the succession of the strata is caused by the northerly rise of the rocks and their southerly dip.

But though the general tendency of the stratification is to rise towards the north, or rather northeast, it is not uniformly so; there are, in fact, local pitches of the strata, by which the beds that have been rising as one ascends the streams dip again, descending toward the river beds. While this local dip of the strata continues to prevail, the beds, which had nearly run out, again thicken and constitute, as before, the principal part of the hills. Thus, though the lower magnesian limestone at the bend of the Mississippi river above Painted Rock, nearly disappears, it again thickens further north, near Bad Axe river, to one hundred and forty-three feet, where we have the proportions given in section 1, B. Between this and Prairie a la Crosse the northerly rise again sets in, so that at Mountain island the sandstone constitutes the great body of that hill, to the height of four hundred and twenty-eight feet, (see section 1, E.) About this part of the Mississippi, or a few miles below, we have, in fact, the commencement of what, in the language of the geologist, is termed the *principal axis* of the upper Mississippi, or geological backbone, whence the strata again decline with local undulations toward the Falls of St. Anthony.

Below the entrance to Lake Pepin, the lower sandstone constitutes about three hundred and forty feet of the hills, (see sec. 1, I,) and the lower magnesian limestone one hundred and fifty feet. At the great bend of that lake, on the northeast side, the lower magnesian limestone may be seen, as in Pl. 5, forming a perpendicular wall of nearly two hundred feet, the total height above the lake being four hundred and nine feet, (see sec. 1, K.) This is a spot celebrated in Indian annals and known as the Cape de Sioux.*

A little below the Red Wing village, near the head of Lake

* The pathetic legend connected with this conspicuous point is related in Long's expedition. It is sometimes called the Maiden's Rock, or Lover's Leap.

* Doubtless the "Upper" sandstone

Pepin, is a remarkable headland—La Grange mountain—which seen from the village, presents the appearance shown in Pl. 6. Here the magnesian limestone forms about one hundred and sixty feet of the upper portion of the hill. The base, for upwards of one hundred and seventy feet, is of sandstone, (see sec. 1, M.)

About thirteen miles below the mouth of the St. Croix, and about two or three miles below the mouth of Vermillion river, the sandstone can no longer be seen, and the lower magnesian limestone extends from the level of the Mississippi to the height of two hundred and forty feet, (see sec. 1, N.) Below the mouth of the St. Croix are low ledges only of the same rocks, the whole height of the hill being only about seventy feet, and immediately at the mouth they are still lower.

Still ascending the stream the strata take a local rise, so that three to four miles above the mouth of the St. Croix, the sandstone again emerges from beneath the water, and rises to the height of twelve to fifteen feet above low water mark, (see sec. 1, P.) It very soon sinks again, however, for at Red Rock there are only low ledges of lower magnesian limestone twelve feet thick; not far beyond it disappears from the surface, so that before reaching St. Paul's it is replaced by the upper white sandstone, such as has been before noticed in the section at Prairie du Chien, occupying the slope above the terrace of lower magnesian limestone.

Between St. Paul's and Carver's cave, going up the stream, the strata dip at the rate of twenty-five to thirty feet per mile. Thence, still ascending, there is another local rise in the strata at the rate of about ten feet to the mile.

Connecting these and other observations, made along the Mississippi between the mouth of the Wisconsin river and falls of St. Anthony, I have constructed a series of diagrams of comparative heights, some of them above alluded to, and all to be found on sections 1 and 6. I have also made out a connected section of the same, (sec. 2,) in which the heights and distance are on such a scale as not to distort the geological features of the country.

For the sake of perspicuity, I have designated each formation by numbers, commencing (No. 1) with the lowest sandstone. The sub-divisions are indicated by prefixed letters, thus, No. 1 a, represents the lowest member of formation No. 1, (F 1;) No. 1 b, the next member in succession; No. 1 c, the third member, and so on. It will sometimes be convenient, in the course of this report, to designate them by numbers and letters, in conformity with the above system of annotation.

The formations laid down in these sections extend for a considerable distance on either side of the Mississippi river; the inferior members prevailing on the east side, the superior on the west side.

The lower magnesian limestone (F. 2) extends, as far as our party has yet explored, up the rivers Cannon and Vermillion; F. 1 and F. 2 compose the bluffs of Hokah, Miniskah, Wazi Oju, and of the St. Peter's rivers. F. 2 and F. 3 occupy the surface of the Winnebago reserve to near Red Cedar river. Here they disappear beneath the water courses, and are replaced by a new system of rocks of the same age as those described in my report of 1839 under the head of "limestones of Red Cedar and Wapsenonoc," and which form the surface rock in the Dubuque district on the lower part of that stream.

Ascending the northeastern tributaries of the Mississippi, the strata rise, as has already been said, F. 2 at first forming the upper hundred or two hundred feet, but gradually thinning out until it is replaced by F. 1, which then occupies the entire thickness of the ridges even to their very summits. This change takes place on the Wisconsin river some forty-five miles below its great bend, or a few miles east of Sauk Prairie; on Prairie a la Crosse river, about forty-five miles (by water) above its confluence with the Mississippi; on Black river fifteen to twenty miles; on Mountain Island river twenty to twenty-five miles; on Buffalo river from twenty to thirty miles; on the Chippewa thirty-five to forty miles, or near the mouth of its east branch, the Menomonie; on Rush river about forty miles; on St. Croix river about forty-eight miles. Allowing for inequalities in the meanders of these rivers, the approximate boundary of the lower magnesian limestone will be nearly parallel with the great valley through which the Mississippi flows, and probably at an average distance of twenty miles from that river, as may be seen by reference to the geological chart, on which the course and bearings of the formations have been laid down provisionally. They cannot be defined accurately until the lineal survey has advanced, or until we have more precise maps, constructed from a series of astronomical observations.

The area over which F. 2 is the surface rock, is colored indigo blue; that over which F. 1 extends, chrome yellow.

Towards the falls and rapids of these streams the inferior members of F. 1 reach the surface in succession, and at length are found resting either immediately upon the granite, or with some thickness of metamorphic strata and decomposed beds interposed.* These igneous rocks are colored on the map with tints of red; lake representing the crystalline rock, and red lead the trappean. To these formations I shall revert hereafter.

F. 1. LOWER SANDSTONE OF THE UPPER MISSISSIPPI.

Its lithological character. Though sandstone constitutes by far the largest part of F. 1, still the formation is not composed exclusively of that material. There are intercalations of magnesian limestone, especially toward its upper part, where it graduates into F. 2; and at certain localities argillaceous and other beds of a mixed character form a considerable portion of its lower mass.

This formation admits of certain subdivisions, some of which are

---

* At the falls of the Menomonie the intrusive rocks do not seem to have reached the surface; at least our party have not detected them. It is supposed, however, that they cannot be far beneath, for the beds which usually lie in close proximity are exposed above the waters of the stream.

important in a geological point of view, and deserve particular notice here. In enumerating these I shall follow the ascending order.

F. 1 a. In the eastern part of the Chippewa land district the assistant geologist, Dr. Norwood, found the lowest member of this series resting on the crystalline and metamorphic rocks, a coarse sandstone overlaid by a still coarser quartzose sandstone.*

In the southern part of the district, on Black river, Mr. A. Randall found the most inferior member a pebbly sandstone, with a coarse sandstone above it. On the east branch of the Chippewa Dr. Litton observed the lowest member of F. 1 to be of a similar character to that on Black river. On the main branch of the Chippewa, the lowest member of the palaeozoic strata which I could find adjacent to the granite of the falls, is a coarse sandstone with remarkable cross lines of deposition.

F. 1 b. But on the west branch of the Chippewa, or Menomonie river, on the Mississippi river between Prairie a la Cross and Lake Pepin, and especially in the northern part of the district explored, to wit: on the St. Croix at and below its falls, these varieties are not seen; at these points the lowest strata visible, and the ones immediately in juxtaposition with the trap of the falls and elsewhere on the river St. Croix, are highly fossiliferous, schistose, siliceo-calcareous layers, interlaminated with argillaceous marly beds, charged with pyrites; they are exposed some fifty feet in thickness just below the falls.

F. 1 c. Immediately superimposed on these is found usually a rather coarse sandstone varying in color from white to brown and green, containing *Lingulas* and *Orbiculas* and hence designated "the Lingula sandstone." Its thickness at Lawrence creek may be estimated at ten or twelve to fifteen feet; but at Mountain island and other places south of this it is much thicker.

F. 1 d. Grey argillo-calcareous and argillo-silicious beds containing trilobites, associated with green and ferruginous sandstones, the color of which is sometimes intensely green from the presence of silicate of iron, which enters largely into its composition. Locally this green sand deposite forms a conspicuous part of the mass, as on Lawrence creek, four miles below the falls of St. Croix. This may be seen by inspecting section III., F. At that locality it is, in part, a loose and incoherent deposite, that has been mistaken for a green sand belonging to the tertiary formation. At Marine Mills, twelve miles above the head of Lake St. Croix, part of this same deposite is unctuous and stains green everything with which it comes in contact, while other portions are schistose, soft, argillaceous sandstones, with a smaller portion of the green coloring matter; in these latter are numerous fucoidal-like casts on the surface of the layers.

At some localities, F. 1 d, terminates upwards with alternations of thin bedded light brownish and blueish sandstones of different degrees of hardness.

F. 1 e. Soft light yellow gritstones often charged with casts of trilobites and surmounted by thicker beds of the same, with hard botryoidal magnesio-calcareous concretions. At some localities this subdivision includes, near its base, beds of soft and fine grained freestones, approaching in their character to tripoli.

F. 1 f. Alternations of sandstone and magnesian limestone with botrizoidal layers of concretionary sandstone, and silicious and calcarious oolite. The upper beds of this sub-division are usually nearly white, and either soft or indurated.

Sections one, two, three, and four, will give a connected view of the sub-divisions of F. 1. Some of these are perhaps only local, or at least, obscurely marked. They vary too, in their lithological character at distant points. The above arrangement appears to me, however, their most persistent character on the east side of the Mississippi, from Prairie a la Crosse to the igneous ranges on the St. Croix river.

If we except the white sandstone, the terminating mass of F. 1 e, the one upon which the lower magnesian limestone (F. 2) rests, nothing definite was known up to the period of the present survey, of the nature or character of the underlying beds just described. Neither had any well defined organic remains been described anywhere beneath the grey and blue fossiliferous beds which form the upper portion of the sections at Prairie du Chien; so that there was an entire absence of all palaeontological evidence as to the exact place which these strata occupied in the geological series. It is, therefore, with no small degree of satisfaction that I find myself able, from the observations of last summer, to disclose a new feature in the palaeontology of Western America, and thus to furnish, not only to the geologist a key to the stratigraphical position of the rocks north of the Wisconsin river, but, at the same time, to the miner his surest and safest guide by which to direct operations in the search after mineral wealth.

More than one half of the above series, supposed at first to be quite barren of all organic forms, has already been proved fossiliferous, and subsequent search will no doubt develop others.

It is, moreover, worthy of remark that the most fossiliferous portion of F. 1 is not its upper part, but beds which lie quite low down, even seven to eight hundred feet beneath what was, up to this time, considered the limit of the fossiliferous strata of the Mississippi valley. Yet these strata prove to be as densely crowded with organic relics as any of the most fossiliferous stata of the blue limestone of Ohio, Indiana, and Kentucky. The proportion of genera and species, it is true, is not great, but the number of individuals is immense; some slabs are so covered with shells, that it would be difficult to place the finger on a spot without touching some of them. The prevalent genera are *Lingulas* and *Orbiculas;* yet associated with these are some remarkable forms of crustaceans. The specimen figured on Pl. 7, fig. 1, is the pygidium of a peculiar tribolite, armed with spinous processes projecting from its posterior margin. I obtained it in thin bedded siliceo calcarious layers near the level of low water mark below Mountain island, in connexion with schistose gritstones. The latter are charged with very perfect specimens of a small fossil shell having a nacrous lustre closely allied to *Obolus*

Appolinis of Eichwald, which are found by thousands in the inferior sandstones of the protozoic strata of Russia. Associated with these shells are also found remarkable compressed sub-conical bodies, the nature of which I have not fully determined; but they are, perhaps, spines of much larger trilobites than the one represented on Pl. 7, F. 1. Yet these beds are identical with layers near low water at Mountain island, entirely beneath a lingula sandstone which, in all probability, is the western equivalent of the lingula beds of the New York Potsdam sandstone, considered by most American geologists the oldest fossiliferous rock of the United States* The embedded species of each seem the same, as far as one can judge from mere casts. At a little higher geological level, between Prairie a la Crosse and Bad Axe, I obtained numerous casts of orthis in an impure, dark, flesh-colored, calcarious rock, associated with bucklers of a species of trilobite, which appears to be new. In a similar rock, near the foot of La Grange mountain, I also observed casts of delthyris beneath green sandstone. (F. 1 c.)

About the same geological horizon, in an argillo-calcareous rock, near the level of the head of Lake St. Croix, is a very large species of *Asaphus*, the buckler and post abdomen of which is figured on Pl. 7, Fig. 2 and 3. Finally, at Marine Mills, ten miles above Lake St. Croix, only eighteen or twenty feet higher, viz: in F. 1 e, in a soft gritstone, are abundance of bucklers and post abdomens of small trilobites, possessing some analogies in form to the genera *Aguostus*, *Trinucleus*, and *Triarthus*, (see P. 7, Fig. 4,) and probably belonging to more than one species; one of which seems to have been provided with spines, at least two inches in length, curved at the extremity into the form of a barbed fish hook. Fig. 5, Pl. 7, represents one of these, found by Mr. B. C. Macy near the mouth of Miniskah.

Mineral contents of F. 1.—The series composing F. 1, which we have now under consideration, consists, therefore, chiefly of soft sandstone, argillaceous, argillo-calcarious, and earthy deposites. Such incoherent beds are unfavorable for the retention of mineral matters, since they present to any rents, fissures, or horizontal openings which may traverse them, crumbling and unstable walls, and, consequently, do not retain that openness of fissure favorable for the reception of ores and the accompanying spars. We have seen, however, that there are intercalations of magnesian limestone interposed between these strata; these are more favorable for the retention of metallic veins; but they form, at most localities, only a subordinate part of the whole.

Judging from the experience of other mining districts, the coun-

*Professor Emmons advocates the existence of a system of rocks which occupy a position still lower than the Potsdam sandstone, named by him the "Taconic system." In it, he observes, there are organic forms, similar to those of the Cambrian system of England. If he is correct, with regard to the true geological position of these rocks of the Taconic mountains, then there may be fossiliferous strata still lower than those of the St. Croix and upper Mississippi, described in this report; otherwise, they may be considered the oldest of the stratified rocks yet brought to light in the United States.

try over which these rocks prevail is not likely to be a productive mineral region; nevertheless, between the Mississippi and Kickapoo, on the southeast quarter of section 27, township 10 north, range 5 west, of the 4th principal meridian, where the formation in question forms the adjacent country, copper ore has been discovered; not, however, in immediate connexion with the sandstone. It is true, that half to three quarters of a mile east of this locality, soft, white sandstone, capped with a band of ferruginous sandstone, extends even to within a few feet of the summit levels of the country, within sight of the hill side on which the copper ore was discovered; still the wall-rock to which the ore was traced, and which bounds it on the southeast, is a true magnesian limestone, possessing the usual characters found in the lead and copper localities of the Mineral Point district.

It is difficult, without a minuter examination than I was able to make at the time I was there, to determine whether the magnesian limestone at this copper mine is one of those beds interstratified with the sandstones of F. 1, or whether, owing to some dislocation, the sandstone has been elevated on the one hand, and the lower magnesian limestone has been depressed on the other. I incline, however, to the former opinion; for, though there is a remarkable depression of the country extending across from the Kickapoo to the Mississippi, one or two miles south of this, in the immediate vicinity of this discovery the strata bear no marks of so abrupt a fault as the latter supposition implies.

This Kickapoo copper ore is of rather a singular character; it is of a light green color, with a waxy lustre and fracture, and very brittle. It is disseminated through ferruginous earthy matter composed chiefly of the brown oxide of iron.*

It was first discovered by Mr. Sterling, in March, 1843, on the north slope of a hill, the foot of which is watered by Copper creek, a small tributary which runs west into the Mississippi, though the locality is only four and a half miles from the Kickapoo. It was subsequently explored to some extent by the same individual, and proved to be a bed from twelve to fifteen feet wide and five to seven deep, spreading out as it descended the slope to thirty feet wide, and conformable to the outline of the hill. On tracing it to the south it was followed to near the brow of the hill, where it pitches to the southeast parallel with a wall of magnesian limestone, and almost perpendicularly. The wall of magnesian limestone is quite solid and without apparent stratification. A shaft of

* The analysis of this copper ore, in the humid way, gave from a gramme:

Water	11.2
Carbonic acid	05.0
Insoluble silicates with a trace of oxide of iron	08.3
Protoxide of copper	25.0=19.87 per cent. of metalic copper.
Peroxide of iron	48.7
Protoxide of manganese	00.2
Alumina	00.6
Carbonate of lime	00.8
Loss	00.2
	100.0

fifty feet was first sunk from the surface, then a drift of ninety feet was run on the west side of the perpendicular wall of rock, and afterwards another shaft of twelve feet at the end of the drift. To the north a gallery was run forty feet, and then six feet sunk perpendicularly. The copper ore extended both horizontally and vertically as far as these excavations were carried. Below the bed of copper ore, on the slope of the hill, was a tough greenish grey earth fifteen inches thick and about the same width as the bed of ore. The whole rested on broken masses of magnesian limestone with green seams running through them.

The position of the copper ore, green earth and fragmentary rock indicates that it was once enclosed in a fissure of magnesian limestone. By decaying and denuding influences the walls seem to have parted, so that the northwest side fell down the slope towards Copper creek along with the ore and vein stuff, which seem subsequently to have been partially removed and scattered down the declivity by the agency of rains and floods. Small pieces of rock of the appearance of trap were found mixed with the ore, but none was discovered in place anywhere in this vicinity.

The mine lies well for drainage, and the ore is of a kind easily reduced in the furnace, and yields so good a per centage of copper (about twenty per cent.) that it would be well worth the expense to prove this mine further than has yet been done. At a small cost it could be ascertained whether it originated in the lower magnesian limestone, or is in connexion with one of the intercalated beds of F. 1. This is the first step towards estimating the probable value of the mine.

Mr. Sterling transported 24,000 pounds of the ore to Mineral Point and had it smelted by Mr. Preston. It yielded, according to his statement, twenty three per cent. of copper. This is only three per cent. more than the result of my analysis, made in the humid way, from a sample of ore from this Kickapoo mine, carefully averaged. The excess obtained by reducing in the furnace is probably iron and other impurities remaining with the copper.

Carson and Sterling, of Mineral Point, subsequently discovered copper of a similar quality on the same quarter section, only three hundred yards north of the ore bed just described.

Copper ore is also said to have been discovered on the Barraboo, east or south from Sterling's mine; but its geological position has not been ascertained.

Physical and agricultural character of F. 1.—The scene depicted on Pl. 8 is a conspicuous landmark on the main branch of the Chippewa, about fifty miles above its mouth. The landscape, as a whole, is by no means deficient in rural beauty; it is not, however, a country that will bear a critical examination. Based on the softer sandstones of F. 1, the surface is strewed far and wide with beds of sand, once the materials of hills, of which either no vestiges now remain, or which are gradually denuding and crumbling before the slow but sure influence of atmospheric vicissitudes. Rocks, whose particles are held together so loosely that they may be crumbled between the hands, cannot be expected to resist degradating forces that have ground to powder, corroded, or swept away hundreds of feet of solid limestone. The rounded outlines of the distant hills and scooped out valleys bear witness to the extensive degradation of the elevated lands of this region.

The Chippewa river, in making a sudden sweep, has laid bare on its north side, as shown on the right hand of the sketch Pl. 8, a bank of light yellow sand, to the depth of about forty feet. Its appearance is that of an amphitheatre of more than a quarter of a mile in length, crowned only with shallow vegetable mould of a few inches in depth; and here and there may be seen, at intervals, for several feet down the cut, dark bands, marking as many distinct soils which once occupied the surface, and have successively been covered by drifting sand as it shifted and was blown about by the winds over the plain.

The analysis of the soil* of this part of the Chippewa river gives ninety-three per cent. of insoluble matter, which is chiefly a fine white sand with only two per cent of organic matter; less than four per cent. of soluble saline matter, consisting chiefly of oxide of iron and alumina, with only a trace of calcareous earth. A soil so unstable, so arid, and so deficient in fertilizing ingredients, cannot be very attractive to the agriculturalist. Locally, however, the soil of F. 1 produces better than its appearance at first indicates, on account of an admixture of lime derived from the intercalated calcareous beds, the overlying magnesian limestone, or from drift. A belt of country, much of the same character, extends from the Menomonie or the Red Cedar branch of the Chippewa, towards Black river and Prairie a la Crosse river. The average width of the tract may be forty or fifty miles; its course for about seventy miles is nearly parallel with the Mississippi, and distant from it some twenty to thirty miles. From Prairie a la Crosse river it probably diverges more to the east, crossing the Wisconsin between Point Bass and the Dalles. From the Menomonie north, this character of country takes a north-northeasterly course towards Apple river, but it appears to be less sandy in that direction, and is of a better quality, owing to admixture of more calcareous matter.

It is difficult to explain how, in certain situations even, these easily disintegrating beds of soft sandstone have partially withstood the

* A sandy soil collected nine miles above the mouth of the Chippewa, in the region of F. 1, gave from a hundred parts as follows :

Water	1.02
Organic matter soluble in carbonate of ammonia	1.75
Organic matter insoluble	.25
Insoluble silicates	93.00
Peroxide of iron	1.65
Alumina	1.22
Carbonate of lime	.10
Phosphate of lime not appreciable	.00
Carbonate of magnesia	.01
Alkalies, not appreciable	.00
Inorganic acids and loss	1.00
	100.00

action of forces that have swept away the surrounding material down to the level of the present prairie. Instances of this occur near Chippewa and Black rivers, and isolated masses were seen in the vicinity of the Kickapoo of forty to fifty feet in height; but the most remarkable examples were observed by Doctor Norwood on the Wisconsin river, below Point Boss, and are described in his report.

I have already remarked that these sandstones, especially towards their upper part, are interstratified with magnesian limestone. Where this is the case, these harder beds, being undermined by the washing away of the intervening sandstones, form overhanging ledges. In such situations rattlesnakes delight to harbor, and, in the fall of the year, in cool weather, these reptiles may frequently be seen in these warm sandy nooks and recesses, basking in the sun. This is so common an occurrence in the bluffs on the Mississippi, below lake Pepin, in the latter part of the month of September, that great precaution is necessary in exploring the precipitous slopes of that country.

F. 2. Lower magnesian limestone.

The traveller who has visited the upper Mississippi cannot fail to have remarked the peculiar outline of hill that bounds the prospect on either side of this picturesque portion of that majestic river. He must especially have noticed the conspicuous perpendicular walls of rock, that rise from out the grassy slope, or green copse wood, in massive cliffs, and terrace the heights as with interrupted natural battlements from the Maquoketa river to lake Pepin. It is not, however, until the geology of the country has been closely inspected, that he is able to discover that the hills which present themselves to view below Turkey river do not belong to the same geological era as those which appear above the mouth of that stream. Nay, so uniform are they in their general aspect, that the miner himself, who has spent the best part of his days in excavating and exploring their recesses, is wont to regard them as identical. So they are, looking only to their chemical composition. Both are limestones, highly magnesian,* in heavy beds, of great compactness and durability; but they are separated from each other by from one hundred and fifty to two hundred feet of other strata, the upper hundred feet of which teem with peculiar races of fossil forms, constituting a distinct geological epoch, and marking a long lapse of time that has intervened between the period of deposition of these limestones. In my former report I have designated them the "lower" and "upper" magnesian limestones of Wisconsin and Iowa. This distinction, as will appear more fully hereafter, is of

* The proportion of lime, magnesia and insoluble silicates varies somewhat in different varieties, as may be seen by reference to the following table:

Analysis of four varieties of lower magnesian limestone, (F. 2,) by J. G. Norwood, M. D.

Localities.	Carbonate of lime.	Carbonate of magnesia.	Earthy matter insoluble in chlorohydric acid.	Precipitate by hydro-sulphuret of ammonia in ammoniacal solution, oxide of iron, alumina, and manganese.	Water and loss.	Total.
From the shore of Lake Pepin..........................	52	42.2	4.3	0.9	0.6	100
On Lake St. Croix, below Stillwater..................	48.3	36.8	6.9	4.3	3.7	100
Grey Cloud island	51.4	40.7	A trace	4.6	3.3	100
Thirty miles below Lake Pepin	29.4	9.7	60	0.9	....	100
mean	45.3	32.4				

the first importance in drawing conclusions regarding the mineral value of the country I have been instructed to explore.

All the conspicuous escarpments of magnesian limestone, south of Turkey river, are composed of the upper of these formations, whilst all those north of Wisconsin river, as far as Lake Pepin, are of the lower.

An inspection of hand specimens is in general not sufficient to enable even the geologist to determine from which of these magnesian limestone formations it has been taken, so like are the two in general aspect. Viewed on a large scale, however, some distinctive peculiarities can be observed; the lower magnesian limestone has both in its upper and lower portion often oolitic beds interstratified; it has occasionally green particles disseminated through it, and on the whole is rather more compact and darker colored. The only certain methods, however, of determining to which of these formations any given rock belongs, is to note the order of superposition; or, still better, to determine the nature of the imbedded organic remains, which differ materially in the two.

No very important sub-divisions have, as yet, beeen observed of the lower magnesian limestone. The lower beds have locally more chert disseminated through them; there are also drussic crystals of rose colored quartz and calc. spar either disseminated, or in veins traversing it.

An inspection of the diagram of comparative heights appended to this report will show not only the relative thickness of the lower magnesian limestone, but its elevation and depression at given distances up the valley of the Mississippi, at the more important points between Prairie du Chien and Red Rock. Where the elevation is greatest, the magnesian limestone is, as a general rule, thinnest. The variation in thickness must be regarded, however, as dependant more upon the degree of exposure to denuding agencies than upon any great difference in thickness of the original depcsite. Where it is greatly elevated, a proportional quantity of the mass has been broken down and swept away, even down with the general level of the country.

Organic remains of F. 2. The lower magnesian limestone of the west has been regarded as nearly, if not entirely, barren in fossils. This season has, however, developed some variety, among which a small species of *Lingula* and a spiral univalve are the most common. Besides these there are other forms allied to *Enompalus* and *Ophileta* of Vanuxem; and Dr. Shumard found in the same formation, in the district assigned to him for examination on the St. Croix and St. Peter's rivers, three species of trilobites and a *terrebrotula*.

Mineral contents of F. 2.—In forming an opinion regarding the mineral bearing character of a rock in a new country where no mines are in operation, and where little or nothing has previously been done in exploring for metallic veins, the geologist has to draw his conclusions from general principles, from numerous geological

* For further description, see Dr. Shumard's list in the appendix.

observations, and from comparison with other mineral regions; also, from precedents established by experience, and recognized by those best versed in the history and statistics of mining.

It has been shown, in my report of 1839, that the mineral bearing property of a geological formation depends on its lithological character, on its geological position, and on the disturbing forces which have acted on it from beneath, in lines of dislocation, especially when these are accompanied by intrusive rocks.

The lower magnesian limestone, as it presents itself north of the Wisconsin river, has many characters which indicate a metalliferous rock. It occurs, as we have seen, in thick and solid walls, massive and durable; it is traversed by rents and fissures of determinate course, of which the walls have but little disposition to crumble and give way; it is intersected by spars, crystallizations, and vein stones, such as usually accompany metallic ores. Along certain parts of its range, it bears evident marks of considerable local disturbance, the signs of an adjacent axis of dislocation; it has, as already shown, many points of analogy with the upper magnesian limestone of the Mineral Point and Dubuque districts of Wisconsin and Iowa—a rock which has proved itself to be extraordinarily productive in lead ore,* and has afforded copper ore of excellent quality, which is now smelted with profit, in the vicinity of the mines. The lower magnesian limestone may, in one respect, be considered more favorably situated than the upper, as a mineral bearing rock. It is an established fact in geology, that, all other things being equal, the lower or older a rock is, the more likely it is to be metalliferous, because nearer the sources from whence experience indicates that metallic materials find their way into its recesses; in other words, because in closer proximity to granite and crystalline rocks. But it has been shown that the inferior beds of the lower magnesian limestone of the Upper Mississippi lie at least three or four hundred feet below the lead bearing beds of the upper magnesian limestone, and are separated from the crystalline and igeneous rocks by the lower sandstones only.

By reference to my former report in 1839, (Senate Doc. 407, p. 30,) it will be seen that it was considered a remarkable circumstance that in a mining district so rich as that south of the Wisconsin river, no basalt, green stone, porphyry, or other intrusive or crystalline rocks, had, up to the time of the survey of 1839, been observed there, since these are in general found in place in the vicinity of productive mining districts; but I then expressed my belief, based upon the abundance of metallic lodes in that lead region, and upon the irregularities in the dip of the strata in some localities, that granite and trappean rocks could not be far off. This supposition has been fully verified by the present reconnois-

*My estimate of the annual produce, in lead, from the mines of the Mineral Point and Dubuque districts, for the year 1839, (Senate Doc. 407, 28th Congress, 1st session, p. 45,) was thirty millions of pounds. To the correctness of that estimate, thought by some, at the time, extravagant, subsequent shipments of lead from these mines testify.

Mr. James Carter, of Galena, has kindly furnished me with a statement of the actual resance. One of the most interesting of its discoveries has been the establishment of the fact that the lowest beds of F 1, previously described, rest either immediately on crystalline or trappean rocks, or there intervenes but an inconsiderable thickness of metamorphic beds.

There can now be little doubt that the whole mining region of the Mineral Point and Dubuque districts of Wisconsin and Iowa, is based upon a sienitic and granitic platform which would, in all probability, be reached by penetrating to the depth of from one thousand to two thousand feet.

These facts, taken together, may be considered as favorable to the metalliferous character of F. 2. Fortunately, I am able to bring several actual discoveries in corroboration of this inference.

Near the base of a bluff composed of F. 2, on the west side of the Mississippi, some ten or fifteen miles above the mouth of Turkey river and just above the French village, from seven to ten thousand pounds of lead ore were obtained from openings in the rock by Dr. Andros. More or less galena is found here, in all the horizontal openings, for the distance of half a mile to a mile.

Near the mouth of the Kickapoo, on the southeast quarter of section ten, township seven north, range five west, of the fourth principal

---

corded shipments from these mines, from February to December, in the years 1841, 2, 3, 4, 5, 6, and 7.

Shipments of lead from Galena and Dubuque, and all other points on the Upper Mississippi for the years 1841, 2, 3, 4, 5, 6, *and* 7.

Months.	Pigs lead, 1841.	Pigs lead, 1842.	Pigs lead, 1843	Pigs lead, 1844.	Pigs lead, 1845.	Pigs lead, 1846.	Pigs lead, 1847.
February	....	....	....	....	5,287	....	....
March..........	4,080	80,125	....	78,636	97,746	28,841	15,669
April...........	91,296	65,080	73,449	82,737	104,558	126,073	82,231
May............	91,233	46,515	122,224	89,982	93,623	142,489	119,391
June	57,110	37,959	74,475	80,784	87,058	113,209	185,084
July............	58,820	54,436	77,333	66,699	68,153	83,559	110,383
August	37,257	43,250	67,233	55,200	107,957	50,257	61,462
September	16,092	39,081	45,400	54,203	63,424	58,827	67,761
October.........	46,286	54,941	67,473	63,072	78,887	71,668	63,825
November.......	50,640	26,472	33,734	53,288	71,767	54,291	65,873
December.......	....	....	....	....	......	1,500	....
Total.........	452,814	447,859	561,321	624,601	778,460	730,714	771,679
1st arrival of st'm boats.........	March 22	March 9	April 10	March 5	Feb'y 26	March 10	March 29
Last departure of steamboats. ...	Nov'r 22	Nov'r 16	Nov'r 26	Nov'r 21	Nov'r 23	Dec'r 2	....

As a pig of lead will weigh, on an average, 70 pounds, it appears from the above table that the annual produce has varied, in the last seven years, from nearly thirty-two millions, to upwards of fifty-four millions of pounds.

meridian, pieces of lead ore, weighing from half to three quarters of a pound, have been obtained from cherty beds of the inferior part of the lower magnesian limestone. A company has lately commenced exploring there, and has obtained some hundred pounds of galena.

On the opposite side of the same valley, Hearn and Ward obtained about four hundred pounds of galena; some masses weighed fifteen pounds. On section fifteen, township seven north, range five west, of the fourth principal meridian, some lead ore has been found.

In the hills at the first great western bend of the Kickapoo, a little below the mouth of Plumb creek, Hearn and Miller discovered some lead ore.

Half a mile south of the aforementioned valley, on the south half of section fifteen, township seven north, range five west, of the fourth principal meridian, Burns and Miller procured about a hundred pounds of lead ore.

East of the first locality, Hearn and Miller dug sixty feet, and and followed an east and west lode, in which they obtained a small quantity of lead ore.

All these discoveries were made in the lower magnesian limestone, F. 2.

In the same vicinity, on the south half of sections thirty-three, thirty-four and thirty-five, township eight north, range five west, of the fourth principal meridian, there are vestiges of ancient diggings wrought by the aborigines.

Between Yellow River and the upper Iowa, Mr. A. L. Martin found several pieces of lead ore on the surface, weighing four to five ounces, and observed a place where the Indians must have excavated the hill in search of this ore.

On the upper Iowa river, in several places east and west, crevices were observed in the lower magnesian limestone, presenting symptoms of being galeniferous, especially at a bend of that river where the stream flows over solid ledges of lower magnesian limestone, with bold bluffs of the same on the south side. This place is eight or ten miles below the Big Spring, and by water about sixty miles above the confluence of the upper Iowa with the Mississippi.

On the Wazi Oju, Mr. B. C. Macy, of the geological corps, saw a vein of lead ore of four inches in width, bearing nearly east and west, and ranging apparently for the distance of half to three quarters of a mile through the lower magnesian limestone.

The above instances conclusively prove that the lower magnesian limestone is lead bearing; but the facts before us at present are not sufficient to enable me to say whether it exists in productive quantities.

At many of the above localities the rock is exceedingly cherty, and is consequently hard, and difficult and expensive to work, and near the surface the ore is much scattered and disseminated through the rock, rather in horizontal openings than in vertical veins; but if this surface ore should be connected with deeper seated lodes, as there is reason to believe it may be, then these would be well worthy the attention of the miner.

Physical features and agricultural character of F. 2. The constant theme of remark, whilst travelling in the region of the upper Mississippi occupied by the lower magnesian limestone, was the picturesque character of the landscape, and especially the striking similarity which the rock exposure presents to that of ruined structures.

The scenery on the Rhine, with its castellated heights, has been the frequent theme of remark and admiration by European travellers. Yet it is doubtful whether, in actual beauty of landscape, it is not equalled by that of some of the streams that water this region of the far west. It is certain that though the rock formations essentially differ, nature has here fashioned, on an extensive scale, and in advance of all civilization, remarkable and curious counterparts to the artificial landscape which has given celebrity to that part of the European continent.

The features of the scenery are not, indeed, of the loftiest and most impressive character. There are no elevated peaks, rising in majestic grandeur; no mountain torrents, shrouded in foam and chafing in their rocky channels; no deep and narrow valleys hemmed in on every side and forming, as it were, a little world of their own; no narrow and precipitous passes, winding through circuitous defiles; no cavernous gorges giving exit to pent up waters; no contorted and twisted strata, affording evidence of gigantic uplift and violent throes. But the features of the scene, though less grand and bold than those of mountainous regions, are yet impressive and strongly marked. We find the luxuriant sward, clothing even down to the waters edge the hill slope. We have the steep cliff shooting up through it, in mural escarpments. We have the stream, clear as crystal, now quiet and smooth and glassy, then ruffled by a temporary rapid, or when a terrace of rock abrubtly crosses it, broken up into a small romantic cascade. We have clumps of trees, disposed with an effect that might baffle the landscape gardener, now crowning the grassy height, now dotting the green slope with partial and isolated shade. From the hill tops the intervening valleys wear the aspect of cultivated meadows and rich pasture grounds, irrigated by frequent rivulets that wend their way through fields of wild hay, fringed with flourishing willows. Here and there occupying its nook, on the bank of the stream, at some favorable spot, occurs the solitary wigwam, with its scanty appurtenances. On the summit levels spreads the wide prairie, decked with flowers of the gayest hue; its long undulating waves stretching away till sky and meadow mingle in the distant horizon. The whole combination suggests the idea, not of an aboriginal wilderness, inhabited by savage tribes, but of a country lately under a high state of cultivation and suddenly deserted by its inhabitants; their dwellings indeed gone, but the castle-homes of their chieftains only partially destroyed, and showing, in ruins, on the rocky summits around. This latter feature especially aids the delusion; for the peculiar aspect of the exposed limestone and its manner of weathering cause it to assume a resemblance somewhat fantastic indeed, but yet wonderful close and faithful, to the dilapitated wall, with its crowning parapet and its projecting butresses and its flanking towers, and even the lesser details that mark the fortress of the olden time. Pl. 9 and 10 represent actual exposure of the lower magnesian limestone on the upper Iowa; they will convey a better idea than any written description of the nature of the scenery on that picturesque river.

Bold exposures of rock, with a grassy bank beneath, such as represented by the sketches, are, for the most part, only on the south and western sides of the hills; the northern and eastern declivities are more rounded and most generally overgrown with trees and shrubbery. Pl. 11, which represents another scene on the upper Iowa, illustrates this fact. It seems as if the alternate thawing and freezing on the sunny side has caused a more rapid decay of the rock, which scaling and splitting off, sometimes in large masses, slips down the side of the hill; this, together with the rapid transition from heat to cold on the southern exposure, probably prevents trees from coming to maturity on that side.

In some instances the hills seem as if split down the middle, one side being left standing whilst the other had been entirely carried away. La Grange mountain, at the head of lake Pepin, represented on Pl. 6, and the Cape de Killio, below the Wabasha prairie, may be cited as examples in point.

There is a striking analogy between the physical features of the country occupied by the lower magnesian limestone, and that of the district further south in Wisconsin and Iowa, where the upper magnesian limestone is the surface rock; the reason is, both rocks are so nearly alike in chemical composition, that they undergo similar changes by atmospheric agencies. There is scenery on the Upper Iowa which is almost a fac-simile of views on the Little Makoqueta river in the Dubuque district, where the rock is the upper magnesian limestone. Both regions present a combination of rural beauty characteristic of a considerable portion of the Upper Mississippi. It is such as fixes itself strongly on the feelings of its inhabitants, and tends to endear to them the spot of their nativity.

The soil derived from the decomposition of the lower magneian limestone is usually of excellent quality; rich, as well in organic matter, as in those mineral salts which give rapidity to the growth of plants and that durability which enables it to sustain a long succession of crops. The analysis of a soil, taken from a region of this formation on the Eau Galli, gave 8.2 per cent. of organic matter, 11. 2 per cent. of salts; 77.1 per cent. of insoluble silicates, and 0.8 per cent. of carbonate of lime:* this is 7.2 per

---

* *Analysis of soil from the Eau Galli, taken from the region of F. 2.*

Water	2.50
Organic matter	8.20
Silicic acid, dissolved by chlorohydric acid	0.04
Carbonate of lime	0.80
Magnesia	0.32
Oxide of iron	2.68
Alumina, dissolved by chlorohydric acid	3.04
Alumina, dissolved by sulphuric acid	1.00

cent. more salts, and 0.79 per cent. more carbonate of lime than the Chippewa soil derived from F. 1.

About the upper part of Lake Pepin and north of it the land lies generally level, at least sufficiently so for all agricultural purposes, except in the immediate vicinity of the streams, where the ground is often broken and abrupt. From Lake Pepin south to the Upper Iowa, the surface is rather more broken; those portions however, which are too uneven for other farming purposes, will afford a pastoral region of great capabilities, leaving little to be desired by the shepherd and stock farmer but a greater proportion of timber. From the base of the cliffs there often rise copious springs, cool and clear; these not unfrequently give rise to small streams which furnish abundance of delicious trout. The rivers are well stocked with bass, carp, sunfish, pickerel, pike, and catfish. The prairies abound in game, especially deer, grouse, pheasants, and partridges; wild geese and ducks frequent the streams in immense flocks. The elevated lands would furnish high, dry pasture ground for sheep, and the valleys and bottoms grain and hay for winter fodder.

F. 2 c. Superimposed on the lower magnesian limestone is another sandstone of less thickness than that previously described. It is the rock which occupies part of the slope between the first and second terrace at Prairie du Chien, and forms the base of the bluffs at St. Peter's. It constitutes also the lower nineteen feet of the *chute* at the falls of St. Anthony. This sandstone, at most of the localities where it has been observed, is remarkable for its whiteness. When examined by the magnifier it is found to be made up of grains of limpid and colorless quartz. It is even of fairer complexion than the Linn sand used by the Scotch glass manufacturer in the preparation of flint glass, and judging, both from its appearance and chemical composition,* I believe that this material would be equally well adapted for that purpose. It was rumored in the north that it had been tried by some glass manufacturer, but that the result had not fully answered the expectations. If this be the case it is probable the best quality of sand from that region could not have been selected; for the St. Peter's country certainly can afford as pure a quartzose sand as that obtained in Missouri, and now I believe extensively used in the glass-houses at Pittsburgh.

Alkalies	0.08
Phosphates of lime and iron	0.01
Insoluble silicates	77.10
Inorganic acids, combined with above bases, and loss	4.23
	100.00

* An analysis of this rock gave but two-tenths of one per cent. of foreign matter, which is alumina, with a trace of carbonate of lime.

Six parts of the purest of this quartzose sandstone, fused in a crucible, with two parts of carbonate of potash and one part of lime, produced a glass of a similar quality and color to that which was obtained from lime sand treated in the same way.

The lower beds are neither as pure nor as white as the upper; at some localities this whole division of F. 2 differs but little from the ordinary character of the purer sandstones of F. 1. For this reason a careful selection becomes necessary, in order to obtain the best material.

Carver's cave, mentioned by Nicollet, and well known by travellers on the Upper Mississippi, is situated in this sandstone. The effect of this cave is striking. The colorless aspect of the stone, contrasted with the deep shadows of the interior, the dark waters of a copious spring which breaks through the snow-white floor, together with the coolness of the atmosphere, call up the idea of an undermined glacier or icy arch, giving exit to some mountain torrent.

This sandstone varies in thickness from forty to one hundred feet.

It appears to be destitute of organic remains; at least none have as yet come to light. In the absence of these it is difficult to say whether it ought to be considered as the terminating member of F. 2, or the inferior member of F. 3. Since, however, it appears to have been produced by a repetition of sedimentary action, similar to that which occurred just at the commencement of F. 2, I have thought it best to place it, for the present, as the terminating mass of that formation.

It forms, as already remarked, part of the slope between the first and second terrace at Prairie du Chien. Beyond this locality, however, it soon runs out and is not again in place, in going north, until within a few miles of the St. Croix. Near the Kinnikinick, Willow river, and Apple river, it forms outliers, which appear in the shape of curious symmetrical, low, flat hills, which look like artificial mounds. Pl. 12, from a sketch by Mr. Lewis, represents an exposure of the upper beds composing this sandstone formation, as they appear on a hill near the Kinnikinick, examined by Dr. Shumard. He describes it as an isolated mound, surmounted by about forty feet of bare ledges of the sandstone in question, capped by a few inches of shell limestone on the summit. It is even more difficult to account for the preservation of this mass than of those formerly alluded to on the Wisconsin river, because this sandstone is of looser and more incoherent materials than the sandstones beneath F. 2. This is the most easterly outlier of F. 2 c and F. 3, on the St. Croix. Several others, with a thicker capping of limestone, are found between two and three miles west of Lake St. Croix, one of which is represented to the left of Dr. Shumard's section, No. 1, S. Ten or twelve miles west of Lake St. Croix, this formation is in place down to the beds of the stream. (See sec. 5.)

This sandstone formation appears to be destitute of other minerals foreign to its composition. Its structure is unfavorable for the retention of metallic ores, for reasons previously enlarged upon.

F. 3. St. Peter's shell limestone.

Though of no great thickness, this is not the least important or the least interesting of the formations of the Upper Mississippi.

It consists of limestones disposed in thin regular layers. The lower portion is the purest limestone of this region of country, containing nearly sixty-five per cent. of carbonate of lime and thirteen per cent. of carbonate of magnesia, and will, without doubt, afford, by burning, better lime than any of the calcareous rocks which we have yet examined north of Lake Pepin. It contains about 13.5 per cent. more lime, and nearly 27 per cent. less magnesia than the Grey Cloud island rock—a bed in F. 2—and twenty-two parts more lime and fifteen parts less magnesia than the shell limestone which forms about eleven feet of the upper portion of the same formation, (F. 3.)

A pure limestone, or at least one comparatively free from magnesia, is a great desideratum in a country like that of the Upper Mississippi, where the rocks are usually highly charged with that alkaline earth.

Between the lower and upper shell limestone are a few feet of an argillo-calcareous rock which has the appearance of a hydraulic limestone. The experiments to which it has been subjected, on a small scale in the laboratory, show, however, that it does not harden well under water. It contains more insoluble matter than the best hydraulic limestones.*

By consulting Doctor Shumard's section, (see 3 S.,) the relative thickness of these divisions can be seen as they are superimposed on the white sandstone of F. 2, c.

Section 5, constructed from observations by that gentleman and myself, shows the relative elevation of these fossiliferous limestones above the Mississippi, between Red Rock and the Falls of St. Anthony.

At that place, in consequence of the disintegrating character of the underlying sandstone, the shell limestone has been undermined, and, from unequal support, long cleavage lines have ensued, and the strata have sunk in places, giving the appearance of sudden local dips and disturbances. In such situations gravel and boulders have insinuated themselves through the rents and crevices, and worked their way entirely beneath the shell limestone, so as to make it appear, at first sight, as if a drift deposite had taken place after the deposition of the sandstone, and before the commencement

* Analysis of an earthy limestone between the upper and shell limestone of St. Peter's, by Dr. Norwood:

Water	18.
Insoluble silicates	29.
Carbonate of lime	36.4
Carbonate of magnesia	0.4
Alumina, oxide of iron, and a trace of manganese	12.4
Loss	3.8
	100.

of the formation of shell limestone. This phenomenon may, in part, be owing to disturbing forces acting from beneath; since just at this place there are sudden elevations and depressions of the strata, in short distances, even to the extent of nearly a hundred feet in half a mile. (See sec. No. 5.)

So deceptive is this appearance, that the superficial observer would certainly conclude that such had actually been the order of succession; but, in every instance where I had an opportunity of inspecting this drift, I invariably found the shell limestone undermined, split, and more or less out of place, from a partial caving in of the beds, or a more general dislocation of the strata.

The same formation which constitutes the bluffs at the mouth of St. Peters, i. e. the white sandstone F. 2, c and shell limestone F. 3 extends up that stream at least half a mile, where Doctor Shumard found them in place in the bluffs. Beyond that the strata are concealed from view by drift. The outline of the hills, however, is such as induced him to believe that the same beds form their nucleus for some miles further, before the lower rocks again reach the surface.

At the Little Rapids, about forty miles up, they are no longer in place; the bed of the St. Peter's is there formed by ledges of soft brown sandstone F. 1, f. and from this up to White Rock, eighty miles up the river, sandstones of F. 1, and magnesian limestone F. 2, alone compose the bluffs—the latter usually of buff and salmon colors, containing casts of *Euomphalus*, besides a few other lower silurian fossils, which will be found in the list in the appendix; this is the "fawn-colored carboniferous limestone" of Mr. Featherstonhaugh.

The St. Peter's limestone is rich in organic remains. The most commonly occurring species will be seen by consulting in the appendix the list of those collected by Doctor S., during his examination of the townships on the Mississippi, in the vicinity of the falls of St. Anthony.

Many species found both by that gentleman and myself, in the lower shell limestone of the upper Mississippi, are identical with forms occurring both in the sub-stratum of grey limestone at Eagle Point, in the Dubuque district—figured and described in my report of 1839—and in the blue limestone of the Ohio valley. Those of the upper division resemble rather the species found in the inferior beds of the upper magnesian limestone of that district. But all, so far as our examinations have yet extended, are of a silurian type.

Some species are perhaps peculiar to this locality, but time has not yet permitted me fully to investigate their specific character.

Mineral character of F. 3.—Some specimens of copper ore are reported to have been found in the vicinity of the falls of St. Anthony. If they have, it is not likely that they originated in veins traversing this limestone formation, since, neither it, nor the underlying sandstone, bear marks of being metalliferous. Probably they were erratic pieces transported from some copper locality lying to the north. The thickness, too, of these calcareous beds is so inconsiderable that even if they did contain metallic lodes, these could not extend to any great depth, before they would dwindle in the incoherent sandstones beneath. But the schistose structure of the rock itself is altogether unfavorable to its metalliferous character.

Physical and agricultural character of F. 3.—The heights of Fort Snelling command an extensive prospect, both up the valley of the St. Peter's river, over the surrounding country towards the falls of St. Anthony, and on the opposite side of the Mississippi. In all directions, as far as the eye can reach, a vast stretch of gently undulating prairie is in view, supporting a calcareous soil, which for upland is of excellent quality, and remarkable for the heavy crops of oats which it produces. While the greater portion of this soil is based on the limestone of which I have been treating, with more or less thickness of drift intervening, other limited tracts rest upon a white shell marl and infusorial earth, possessing fertilizing properties.

Timber is scarce on this part of the upper Mississippi, being limited chiefly to narrow belts along the water courses; the country adjacent to the Mississippi could, however, easily be supplied with wood, procured higher up on this river; or, if inhabited by a provident people, plantations would soon spread over the face of the country.

The falls of St. Anthony are at present seven miles from the mouth of St. Peter's river. It is, however, more than probable that they once occupied a position at or nearer Fort Snelling. Of course, little evidence can be gathered of the rate of wearing, from actual observation of the inhabitants recently settled there, but, judging from the condition of the strata themselves, there must have been a rapid retrocession. The cement, which holds together the particles of the St. Peter's sandstone, is so slight that it is with difficulty a solid specimen can be obtained. Yet this is the rock, with a covering only of fifteen or twenty feet of schistose limestone, to protect it from the swift current of the Mississippi, which forms the base of the falls.

The confused heaps of disjointed masses of limestone, piled together below the falls, indicate the undermining action in progress. The inclined position, too, of the ledges of limestone there, for several hundred yards above the chute, contrary to the local dip, has mostly been produced by the water which sweeps over them, entering the extensive rents which run across the strata at this place, and gradually washing out the particles of sand upon which these ledges repose, thus allowing them gradually to sink, and causing huge blocks to become, from time to time, detached and precipitated into the rapids beneath. In this way the fall will, probably, after a lapse of time, be converted into a rapid. For, in proportion as the fall shall recede, the sandstone, by reason of its dip, will diminish in thickness, and at length disappear beneath the river bed. From observations of the dip at the falls, this latter contingency will occur when the fall has been worn back some six or seven miles from its present position.

There can be little doubt that the rate of erosion at the falls of

St. Anthony must be more rapid than at the falls of Niagara, since the soft sandstone of the former locality is more easily washed away than the Niagara shale.

On the brink of the gorge, near Fort Snelling, no fluviatile remains have been yet found at a height where the waters may be supposed to have flowed in former times; but Dr. Shumard, who was instructed to collect evidence of any ancient river deposites at a higher level, observed over the limestone at the falls a bed of drift of about eleven feet in thickness, and resting on that a bed of sand containing *Cyclas, Limnea Physa and Plauorbis*, and this deposite he traced on to the same level for nearly half a mile below the present position of the falls.

The same gentleman also observed, half a mile below the falls, and about a quarter of a mile east of the gorge, on rising ground, over which runs the trail to St. Paul's, a while marl charged with the same genera of shells, but of different species.

The former of these deposites is doubtless of fluviatile origin, and affords evidence of the river having flowed, for a short distance at least above the gorge; the latter seems to be a lacustrine deposite, the bottom of some drained lake, of which these are numerous instances in the Chippewa land district.

If we except these beds and the underlying drift, no formations of more recent date than the shell limestones of St. Peter's were observed along the Mississippi from the Wisconsin river to the falls of St. Anthony. This statement will apply also to the country east of the Mississippi, as far as the water-shed between that stream and Lake Superior, except along the valley of the St. Croix above the falls.

CHAPTER II.

FORMATION OF THE WINNEBAGO RESERVE.

Returning to the place whence we commenced our description of the formations of the Upper Mississippi, let us trace the succession of the strata west through the Winnebago reserve.

The principal streams which water the eastern part of the Neutral Ground are Turkey, Upper Iowa, and Red Cedar rivers. It was along these that my examinations were chiefly directed. From the southern part of the reserve, where Turkey river crosses the line to the agency and Fort Atkinson, the rocks belong to the same geological epoch as those described in my report of 1839, as forming the surface rock in townships ninety-three and ninety-four, of ranges three and four west of fifth principal meredian, the same also which exist in the upper hundred and fifty feet of the hills at Prairie du Chien, *i. e.*, to the fossiliferous limestone and overlying upper magnesian limestone. They assume, however, a somewhat modified aspect, which stamps a peculiar feature to the elevated ground of the eastern part of the Winnebago reserve.

Pl. 13 will convey an idea of the outline of these hills; they are nearly flat on the top, with regular slopes on either side down to the general level of the surrounding country. Their shape is so symmetrical, that were it not for their height and extent, one might be tempted to attribute to them an artificial origin. So far from it, the hard ledges of rock which compose their interior can be shown to belong to a very ancient geological epoch, anterior to the great coal formation, in fact, to the age of the Silurian system of Wales.

Those of the elevated grounds near the agency on Turkey river generally present to the south and west a mural cliff of from fifty to sixty feet high, resting on level table land, the elevation of which above Turkey river is about a hundred and forty feet. Above this no well defined fossils were found, unequivocally in place, by which to determine their precise age. Judging from the order of superposition, they occupy the place of the lower portion of the magnesian lead bearing beds, but the rock assumes a peculiar lithological character; it is whiter, more concretionary, and less porous than these; it is, indeed, a nearly pure carbonate of lime, containing only two per cent. of carbonate of magnesia, and less than half of one per cent. of insoluble silicates. To this change in the chemical composition of the beds may be attributed the peculiar physical features of the landscape.

Beneath these white limestones are buff colored beds containing numerous Atrypacapax. At an elevation of from a hundred to a hundred and thirty feet above Turkey river, the rocks are more schistose and earthy, and the calcareous layers of the lower fifty feet are interstratified with a large proportion of marlite; both contain many fossils. Amongst these *Septaena Madisomensis*, *L. Serecia*, *L. Alternata*, *Orthis formosa*, *Pleurotomaria bilex*, and *Isotelus majestos* are the most conspicuous. A further list of fossils of the strata of Turkey river, in the Winnebago reserve, will be found in the appendix.

These fossiliferous calcareo-argillaceous beds may be considered the basis of the agricultural portion of this part of the Winnebago reserve, and consequently the soil of the first terrace is more argillaceous than is usual in the lands of the Upper Mississippi, and well adapted to small grains. On some portions of this geological formation, crops of wheat have been raised that gave, from seven bushels of seed, two hundred and fifty bushels of grain, equal to a return of thirty-five fold. The wheat raised here is as plump as that of the Genessee country of New York, but it does not yield quite as much flour, in consequence of the hull being rather thicker; this may be attributed to the heat of the summer being rather greater here than in New York.

Descending Turkey river the strata gradually decline. After passing the southern line of the Neutral Ground, the fossiliferous limestone appears only in low ledges, crested with cedars and surmounted by a green slope, from which the upper magnesian limestone rises in fantastic shaped cliffs, as represented on Pl. 14.

Below the mouth of the Volga, a small tributary of Turkey river, the shell limestone sinks beneath the water courses, and after passing the mouth of Red Cedar, another small tributary of the same river, precipitous cliffs of upper magnesian limestone tower to the height of three hundred and fifty feet, and are traversed by east and west crevices, some of which are charged with heavy lodes of lead ore, but this is beyond the limits of the Neutral Ground.

In this vicinity thin beds of bituminous shale are intermixed with the beds of magnesian limestone. This has given rise to numerous reports of the existence of coal in this section of Iowa. It is, however, only a partial and local deposite associated with strata, which have no features in common with the true coal formation, and were deposited long anterior to the geological epoch favorable for the production of workable seams of coal; no encouragement can therefore be given to those who have raised their expectations so high upon such slender indications.

The best body of timber which I have yet seen on Turkey river is on Peck's branch, a small creek which enters from the southwest some ten or twelve miles above its mouth; it consists chiefly of maple and oak.

After passing Red Cedar, the bottoms on Turkey river are too confined to be valuable for cultivation, but the upland is still of good quality, though the surface near the streams is broken.

Between Turkey and Yellow rivers, in the eastern part of the reserve, the soil is generally of excellent quality, well adapted to small grains, and lies well for farming, though it is deficient in timber.

The upper Iowa, for the last fifty miles of its course, flows between cliffs of lower magnesian limestone, based on the lower sandstone, which latter constitutes the greater part of the rock exposure near the confluence of that stream with the Mississippi, with an interlamination of magnesian limestone towards the upper part, constituting the sub-division designated by F 1, f. The first bluff encountered in ascending the upper Iowa is of this character, and presents the appearance represented in Pl. 15.

I have already alluded to the castellated forms which the lower magnesian present on this beautiful little stream. Pl. 16 will furnish another illustration of the peculiarity of its landscape.

The remarks in the foregoing chapter on the agricultural and physical features of F 2, apply in every respect to the great portion of the upper Iowa, which I explored up to near the bend, a few miles below the Big spring.

At that place, from two to three miles below "Little Boy's" village, there is a dislocation of the strata, which brings the upper white sandstone (F 2 ? *c* and F 3) suddenly down to the water's edge, shattering the beds of the latter, and causing considerable confusion.

The river is very deep just at this place, though there are shallow rapids immediately below. The clearness of the water permits one to see, some feet beneath its surface, a stiff blue clay, in conjunction with the white sandstone, (F 2 ? *c*,) as if underlying it. If so, it is a deposite not elsewhere observed in this position. There is, however, so much disturbance of the beds here that the appearance may be deceptive, and the argillaceous bed may belong to the æra of the fossiliferous limestone above, where such deposites are not so uncommon; or it may be derived in some way from their destruction.

Two to three miles above this locality, near the above mentioned Big spring, the base of the hills, to the height of one hundred and thirty to one hundred and forty feet, is formed of thin bedded shell limestone, containing, in addition to many of the fossils found near the agency, on Turkey river, *Pleurotomaria lenticularis*, *Bellerophon bilobatus*, *Orbitulites? reticularis*, *Atrypa hemeplicata?* besides others which may be found by consulting the list in the appendix.

At an elevation of a hundred and forty-six feet above the Spring branch, I discovered an *Illaenus crassicauda? Murchisonia subfusiformis*. Here the rock becomes more magnesian, thicker bedded, and rises into a mural escarpment seventy-two feet high. The summit of the cliff here is near two hundred feet above the Spring branch.

Just opposite, in the low ground, is the source of a large spring, which gives to this spot its name. It issues from the base of the hills in a bold fountain, and immediately forms a considerable stream of very cold water, in which shoals of fine speckled trout find a congenial retreat.

An extensive rich bottom borders the Upper Iowa at this place, which is under partial cultivation by a small band of Winnebagoes, known from the name of their chief (weighing some two hundred and thirty pounds) as the "Little Boy's Band."

The upland prairie, between the Upper Iowa and Turkey river, has a gently undulating surface for the greater part of the distance, with a good second rate soil, often quite black in the lower situations. The country, however, is very thinly timbered; only a few groves are in view over the fifteen miles portage between the two streams, and these are mostly of a dwarf growth; such, indeed, is the prevailing character of the timber in the region of the Upper Iowa.

Between Turkey river and the head waters of Wapsipinecon, and beyond that stream to near Red Cedar, the country is rather more level and has more wet and marshy places; otherwise there is but little difference between it and the prairie region lying between Turkey river and the Upper Iowa. The proportion and quality of the timber is about the same.

Limestones of the Red Cedar, equivalent to the Devonian rocks of Europe.—On Red Cedar there is a change in the geological formation of the country. Either this is the western limit of the formations of Upper Iowa and Turkey rivers, or else the southwest dip carries the formations before reaching the Red Cedar beneath the water courses, for on crossing the Red Cedar, the first ledges that came under my observation, only a few hundred yards to the west of it, were found to be charged with the large variety of *Atrypa prisca* and a *Spirifer*, very abundant in the shell beds of the falls of the Ohio, and allied to the *S. ostiolata* of the Devonian system of the *Eifel*, if not identical with it. These strata appear to be the equivalent of the rocks described in my report of 1839, as occuring lower down on the same stream in the Dubuque district, so that the line of bearing between these two formations, Silurian and Devonian, seems to run nearly parallel with that stream.

The Red Cedar limestone extends up its west branch as far as I penetrated, i. e., to near the north line of the Winnebago reserve; it also stretches away to the west as far as the limits of my observations, viz: to Willow river. On Shell Rock, the east branch of Otter, I found in it, besides *Atrypa prisca*, casts of *Lucina proavia*, and an undetermined species of *Septaena*. But the fossil which is most abundant, and most universally distributed through the rocks of this western portion of the Winnebago reserve, is a very fine structured corraline, composed of concentric layers, like the genus *Stromatopora*, but so close together that the layers can only be distinguished by close inspection with a magnifier. On Lime river, the west branch of Otter, the strata are so full of this close grained coralline that it might with propriety be called a coralloid limestone.

Some of the beds of this formation consist of very close textured and smooth calcareous beds, like the lithographic limestones, splitting with a flat chonchoidal fracture. In it I did not observe any fossils; but I had not many opportunities of examining exposures either of it, or, indeed, of any of the other members of the formation in question, along the line of my route. The geologist who undertakes to investigate the vast prairie countries of the Mississippi valley must be provided with no common share of patience and perseverance. He must be content to travel for half a day together without seeing aught but a rich black soil, covered, as far as the eye can reach, even down to the very edge of the small streams, with a thick and high growth of prairie grass, with, perhaps, a faint outline of timber cutting the distant horizon. He must be prepared to wade swamps, to ford streams waist deep, or, in times of freshets, to plunge in and breast the current. He must not shrink beneath a broiling sun, without even a bush to cast a faint shadow over an occasional resting place. He must think himself fortunate, if he can reach, at night, a few scattered oaks to plenish his fire, and boil his camp kettle; and he may consider it a special instance of good luck, if, in return, he can catch a glimpse of a rock exposure once or twice a day. He may travel for days together without lighting on any object more interesting than the hillock of the prairie dog, (*Arctomys Ludovicranus* of Say,) or the broad lair of the bison.

Such being the nature of the country through which this system of rocks extends, and my time for its examination being limited to a rapid reconnoissance, the individual members could not be examined attentively in detail; sufficient evidence, however, was obtained to prove that the rocks of Red Cedar and its branches, where they flow through the neutral ground, are of the age of the Devonian rocks of Europe, and of the shell beds of the Ohio falls.

Mineral character of the limestones of Red Cedar.—The structure and composition of the rocks which form the bases of the country in the western portion of the neutral ground are not unfavorable for the retention of minerals; the physical features of the country, however, do not indicate a mineral tract. Along the course of our route, no symptoms were observed of axes of dislocation and disturbance. The surface is comparatively level; the ledges of rocks lie low and horizontal, without any abrupt uplifts or sudden faults, as if beyond the sphere of active action that has fissured and disseminated metallic matters through the magnesian limestones nearer to the Mississippi.

CHAPTER III.

FORMATIONS OF THE INTERIOR OF THE CHIPPEWA LAND DISTRICT.

The protozoic strata pertaining to F 1 and F 2, which have been the subject of the first chapter, extend, as I have there shown, as far as the falls of the eastern tributaries of the Mississippi. The average distance of their northeast line of limit from that river may be in a direct course from fifty to seventy miles, or by the meanders of the streams ninety to a hundred miles. There the crystalline rocks emerge from beneath the water courses.

This change in the geological formation of the country is accompanied by a corresponding change in its physical features. Just before reaching the igneous ranges, the streams are usually hemmed in on either side by solid walls of sandstone, (F 1, a,) known, generally, through that country, by the name of *Dalles*. A few miles beyond these a succession of low falls and rapids commence, which interrupt navigation, and render portages necessary before the traveller can advance even with a birch bark canoe. These obstructions are formed by outbursts of igneous rocks.

The elevating forces which have brought these to the surface, through the interior of the district, have not been sufficient to produce hills of any great height, such as are usually to be found in regions of crystalline rocks, that constitute extensive water sheds. On the contrary, though we here approach the dividing ridge, whence rise, on one side, many of the most important tributaries of the Mississippi, and on the other, numerous streams emptying into Lake Superior, we find a level country, or at least merely a succession of low flat plains, rising twenty-five to thirty feet, one above another,* with intervening ridges one to two hundred feet high. It is at the commencement and termination of the former that the principal falls and rapids set in.

Many of the rocks which compose these igneous ranges, though differing but slightly from each other in the ultimate elements of their composition, are still distinct in their structure and mineral character. Within a short distance may be seen many varieties of granite and sienite, greenstone, hornblende rock, gneiss and mica slate. Along with these are sometimes found chloritic and talcous slates, with others less distinctly marked in their character, which may be classed with the metamorphic strata.

The rank vegetation, the dense forests of pine, and the accumulation of drift, effectually conceal the extension of these igneous ranges beyond the immediate cuts of the rivers, so that there is little opportunity to investigate their nature any great distance beyond the banks of the larger streams; for this reason the mode of

---

* On the upper Wisconsin, the crystalline rocks are elevated several hundred feet above the river, but this is an exception to the general rule through this part of Wisconsin.

travelling which was adopted, in birch bark canoes, was undoubtedly the best that could be devised to gain a knowledge of the geological features of the country.

The most southwesterly exposure of granitic rocks on the tributaries of the upper Mississippi is on Black river.* These were examined by Mr. A Randall, to whom I assigned the townships on that stream for exploration. In his report to me, on that region of country, he lays down the locality of their first outburst on the northeast portion of township twenty-one north, range four west, of the fourth principal meridian, between six and seven miles south of the southern line of the Chippewa land district. The predominating rock is a pure granite, and associated with it is a grey sienitic rock. South of this granitic range, that gentleman found nothing but a sand prairie, with a stunted growth of oak on the ridges. North of it, about one mile, a bed of greenstone trap, about thirty feet wide, crosses the bed of Black river, and is exposed a few feet above the water level. In contact with this are green and red chloritic schistose rocks on township twenty-one north, range four west, of fourth principal meridian; some of the latter is highly ferruginous, and passes gradually into heavy beds of brown oxide and magnetic iron. Here the magnetic needle has a considerable local variation over an area of several miles square. These magnesian slates show themselves on the river for the distance of nearly a mile, capped unconformably by a pebbly sandstone, F 1, a. (See Mr. A. Randall's section, marked B.) Though the soil of this township is sandy, from drifted materials derived from the adjacent sandstone formation, still it is of much better quality than that further south and southwest, where F 1 alone occupies the surface. It supports a growth of yellow pine.

Four to six miles northeast of the falls of Black river, in township twenty-one and twenty-two north, range three west, of the fourth principal meridian, there are outliers of the above sandstone formation, forming hills of seventy to a hundred feet in height; on sections four and thirty-three, five and thirty-two, one and thirty-six, of the above townships, some of its beds are impregnated with iron to such an extent as to render it impracticable to survey the country with any degree of accuracy with a common magnetic needle; the variation along the line between these townships is in some places even as great as 13° 35′.†

---

* The late Mr. J. L. Thayer observed a locality of granite in Dodge county, Wisconsin, on the west branch of Rock river, on section thirty-three, township nine north, range thirteen east, of fourth principal meridian. This is nearly on a parallel with Painted Rock on the Mississippi, but about one hundred miles east of these granitic ranges on Black river, and distant at least a hundred and twenty miles from the Mississippi, and between fifty and sixty miles west from Lake Michigan.

† On the line between townships twenty-one and twenty-two, of range three west, of fourth principal meridian, running west, there is a variation first of 8°; at the end of the first forty chains, a variation of 2° 15′; at the end of the next forty chains, 2° 30′; at the end of the first mile, 5°; and at the end of the next mile, 13° 35′. The average variation of the township line is 8°. This was the most remarkable variation in Mr. J. P. Cathcart's survey of the townships on Black river. The locality of greatest variation is between these ferruginous sandstones and chloritic slates.

Mr. Dunn found a remarkable variation further south on the head waters of Prairie a la

Sec 36 T 5 N R 3 W

After passing the east fork of Black river, the crystalline rocks extend with few exceptions nearly to the tops of the highest hills, with only here and there a capping of pebbly sandstone. Through this granitic range Mr. Randall found the soil much improved; the land well timbered with hard wood and white pine of superior quality.

Immediately after crossing Cunningham's creek, a gneiss formation takes the place of the granite and extends some five or six miles.

From O'Neil's creek, in township twenty-four north, range two west, to Wedge's creek, in township twenty-five north, range four west, the only rock observed was a single ledge of pebbly sand, twelve feet above the surface; even boulders, which are so numerous further north, are absent; but the character of the surrounding country is similar to that above the forks, where granites are in place. Beyond Wedge's creek the soil is more sandy, and pine timber more abundant, but not of as good quality as that north of the east fork of Black river.

In township twenty-six north, range two west, is an isolated hill one hundred and fifty feet high, composed of compact sandstone, (F 1.) Others can be seen in the distance to the west and south. On the northeast of township twenty-six and township twenty-seven north, range three west, on the head waters of the east branch of the Eau Claire, granite is exposed of similar color and structure to that on the falls of Black river. The country southwest of this range, lying between Black river and the forks of the Eau Claire, becomes gradually more sandy. This is the boundary between the inferior sandstone of F 1 and the crystalline rocks, and the northeast margin of that sandy belt of country heretofore noticed in the description of the lower Chippewa river.

Conspicuous outliers of F 1 a, can be seen stretching away to the southwest, some of which, near the Eau Claire, are capped with a lingula sandstone.

The last rocks seen in place by Mr. Randall, on the head waters of Black river, was on the northern part of township 28, between ranges one and two west. It is a low range of chlorite slate of a similar character and composition to that above the falls of Black river.

Beyond this, after passing the correction line, the country becomes flat and swampy, and, except limited spots, almost worthless for agricultural purposes.

No metallic veins were noticed by Mr. Randall traversing any of these crystalline ranges on Black river, within the limits of the Chippewa land district; indeed their elevation above the water

---

Cross river, in sections fourteen, fifteen, twenty-two, and twenty-three, township eighteen north, range three west. Between sections fifteen and twenty-two, the variation is 10° 40′; between fourteen and twenty-three, variation 5° 20′; between fourteen and fifteen, no less than 17° 30′; between twenty-two and twenty-three, 10° 40′. This locality is, most likely, the southern extension of the ferruginous sandstones of Black river.

courses is for the most part so little, that there is little or no prospect of their ever becoming valuable as mineral lands.

After the fourth principal meridian crosses Black river, no rocks but boulders appear on the surface for sixty miles; indeed, it traverses an almost continuous swamp to township 40. Here the crystalline rocks again protrude and form precipitous cliffs on the upper rapids and falls of the Manidowish, of twenty to thirty feet in height. On this stream, where the meridian crosses it, the rock differs but little from the graphic granite of the falls of the Appomatoc. The feldspar which enters largely into its composition is of a light bluish pink, with a glistening vitreous lustre; disseminated through it is only a small proportion of quartz. Two miles below, on this river, the granite is traversed by veins of gneiss. Granitic and hornblendic rocks are exposed with little interruption along the course of the Manidowish to within fourteen miles of its confluence with the Chippewa, where the pebbly and lower sandstones of F 1 crosses the river. Below this the crystalline rocks are only seen on the surface for a short distance, when they disappear beneath deposites of drift.

From the Manidowish to the north part of township 43, there are a succession of maple ridges and intervening tamerack, cedar and alder swamps, the former of greatest extent; the latter varying from a quarter of a mile to a mile in width. On the ridges, besides maple are found elm, birch, balsam-fir, hemlock and hazel.

For fourteen or fifteen miles north of the Manidowish, on the meridian line, no rocks but boulders were seen on the surface. On sections one and two, township 44, a granite is again in place, possessing the character of that on the falls of Black river. This is the most northerly outburst of granitic crystalline rocks which was observed on the fourth principal meridian.*

The igneous ranges first show themselves in the beds of the east branch of the Chippewa. This stream was explored by Dr. Litton. The substance of his report to me of his observations on the Eau Claire, is as follows:

"Dalles formed of the sandstones of F 1 a, commence almost immediately on entering the river, but extend only a few hundred yards. For twelve miles above the mouth, coarse quartzose sandstone is the only rock visible; this extends, in every case, from the level of the river to the very highest point that I found rock exposed. About fourteen miles above the mouth, the crystalline rocks are in place. They present themselves on one side or other, at distances varying from two hundred yards to a mile, up to the falls, which by the course of the river are twenty miles from the mouth. At the falls the rock is composed chiefly of hornblende, and possesses a crystalline structure; it is exposed on both sides of the river, but does not rise higher than twenty feet above the river. The general level of the country is about sixty or seventy feet

---

* For a further description of the fourth principal meridian, see chapter IV. under the head of "Formations of Lake Superior."

X T. 30431

higher. Associated with the hornblende rock above the falls are both gneiss and chlorite slate; the former in a state of decomposition. These are exposed for seven or eight miles, never rising to a height of more than twenty feet above the river bed, and frequently not more than ten feet, or even less. Everywhere, except on the river bank, these igneous and metamorphic rocks are covered with a drift of sand.

"Four miles above the falls a pink granite was observed, containing large plates of grey mica and masses of flesh colored feldspar. Sixteen or seventeen miles above the falls are Dalles similar to those below the falls. They are not formed by the crystalline rocks, but by the same coarse-grained sandstone observed below the falls, which rises to the height of sixty or seventy feet above the level of the river, and extends along the river some two hundred yards.

"Twenty-five miles above above the falls the intrusive rocks are again in place for at least eight or nine miles, and form a chain across the river, producing a succession of rapids that obstruct its navigation, known as the Little Falls.

"Two miles above the Little Falls, and about thirty above the main falls, pebbly sandstone of F 1 a rests upon decomposed green, grey, and redish clayey materials, derived from the decomposition of a rather close grained granite, destitute of mica, but containing abundance of feldspar.

"So great is the body of sand which overlies the igneous rocks here as elsewhere on the Eau Claire, that the soil can derive little fertilizing chemical principles from the intrusive rocks. The soil is generally but little better than that of the sandy region of the Chippewa above and below the mouth of the Menomonie.

"From all that was observed of the geological features of the country on the Eau Claire, there is little probability of its affording productive ores. The only metallic mineral noticed associated with the crystalline rocks on this river was yellow sulphuret of iron, disseminated through the hornblende rock."

Dr. Litton, who also explored the Menomonie, did not observe on this western branch of the Chippewa any crystalline rocks in place on the surface in any part of its course, as far as he ascended it, viz: to the forks of the two small branches which proceed from a series of lakes forming its head waters. There is, however, reason to believe, from the observation on the streams east of it, that they cannot be far beneath the surface here, especially as Mr. Randall found at the pipestone locality, fifteen to twenty miles east of the Menomonie, beds partially metamorphosed, such as we have usually found lying in close proximity to the crystalline formations.

Dr. Litton also ascended Prairie a la Crosse fifty miles above its mouth by the course of the stream, and Mountain island river ninety to a hundred miles; and Mr. B. C. Macy explored Buffalo river for about forty miles. On none of these streams were any intrusive rocks found in place.*

* The strata which prevail on the west branch of the Chippewa belong chiefly to F 1 d and F 1 e; i. e. to the lingula sandstones and trilobite grit treated of in chapter I. On Mountain island, Prairie a la Crosse, and Buffalo rivers, the same beds form, together with F 1 c, the principal parts of the hills, capped sometimes with F. 2.

On the main branch of the Chippewa, the first crystalline rocks which were observed on the surface were just above the Dalles, about ninety miles by the course of the river from its mouth.

On the east side of the Chippewa, about twenty to thirty feet above the bed of the river and a short distance below Allen's mills, is a deposite of the earthy brown oxide of iron, which appears to be extensive. It is of a variety that would be easily wrought in the furnace.

The quartzose granite, at the falls immediately above, contains but little mica. On the northwest side of the river a considerable portion of flesh-colored feldspar enters into its composition, and is disseminated in veins: its structure is rather sub-cuboidal. On the southeast side the feldspar is lighter colored and the rock of the character of gneiss, whilst other parts of it look almost like a metamorphic sandstone. In consequence of the great flood which occurred just at the time we were there, I had not an opportunity of examining the rock to advantage, since very little of it was exposed above high water. Plate 17, representing the falls of Chippewa during the flood of June, 1847, shows the exposure of the crystalline rocks as they appeared at that time.

Near the head of the portage above Ganethie's trading post, at the mouth of Cut Rock, solid ledges of sandstone F 1 a, are again in place on the west side of the river, but no crystalline rocks are visible above the level of high water. The sandstones at this locality are remarkable for their cross lines of deposition.

The beds lie in the following succession from above down, as measured by Mr. A. Randall:

1st. Drift, ten feet.

2d. Soft white sandstone with thin schistose layers between the beds, ten feet.

3d. Fine pebbly sandstone with oblique laminations, eight feet.

4th. Hard thin layers of sandstone, nine inches

5th. Sandstone with brown streaks; schistose layers interlaminated, eight feet.

6th. Hard brown sandstone in layers from 1 to 4 inches, 1 ft. 6 inches.

7th. Soft white sandstone, with remarkable oblique lines of deposition, the angles varying 15° to 45°, five feet.

8th. Fine pebbly sandstone, five feet.

9th. Fine pebbly sandstone, with oblique lines of lamination, six inches.

10th. Schistose layers of sandstone, six inches.

11th. White sandstone, with layers of fine pebbles, eight feet.

12th. Soft white sandstone, six feet.

13th. Pebbly sandstone, the pebbles about the size of a pea, 2 feet above water, two feet.

These sandstones have a dip to the south-southwest sometimes to the extent of 10°. They are seen in the cuts of the streams to within a mile of Vermillion rapids, where the pebbly sandstone is exposed for fifteen feet, overlying crystalline rocks, and shows apparent marks of disturbance and dislocation.

Three miles west of this junction, lingular sandstone F. 1 c caps the hills. Six or seven miles above Ganethie's are Vermillion rapids and portage, where Mr. Aruntiager has a trading post; the whole distance of the portage is four and a half miles. Here there is a greater variety of rocks than on the falls of the Chippewa. In the space of one mile I observed fine and coarse grained granite, with masses and veins of pink and white feldspar, hornblende rock, gneiss traversed by veins of quartz and petrosilex, mica slate passing into chlorite slate. The lamination of the schistose rocks is nearly vertical, and their bearing at different places varies from 10° to 20° north, and south of a due east and west course. At the time I was there, the high water prevented a critical examination; but Mr. A. Randall, in his descent from the Manidowish, passed afterwards over this rapid in October, when the water was quite low, and made some additional observations. He found gneiss and hornblende rock to prevail; the former much contorted and traversed by pyramidal dykes of massive quartz running into a petrosiliceous rock of a grey color. On the southeast bank resting on the crystalline rocks are drift deposites in the following order.

1st soil	15 inches.
2d. Subsoil, light yellow sand	"
3d. Fine drift, pebbles not over half an inch in diameter	4 feet.
4th. Coarse drift, pebbles chiefly crystalline and trappean rocks	4 feet.
5th. Red marly drift, pebbles, chiefly red sandstone..	4 feet.
6th. Coarse drift, with dark yellow sand	15 feet.

Two to two and a half miles above the head of this portage are rapids, where a chain of close-grained quartzose granite, not unlike that of Woodstock, in Maryland, forms the river bed. Above the head of these rapids, gneiss is in place traversed by veins of granite. Two and a half to three miles higher on the Chippewa, greenstone and hornblende schist protrude where the rapids again commence.

Twelve miles above Vermillion rapids is Brunet's portage and trading post. By water this portage is about three-quarters of a mile, by land one mile. The Chippewa is here lined on either side by a dense forest of moderate sized pines. The rocks are more elevated here than at Vermillion rapids, and the fall is greater—about thirty-six feet from the foot to the head of the portage. Hornblende predominates in the rocks of this locality. It is seen in some of the beds in distinct crystals of a quarter to half an inch long. Some portions of the rock have the appearance and sublumnar structure of basalt; other portions are schistose. At the most turbulent part of the Chippewa, at these rapids, the rock is more of a bluish pink quartzose granite, and presents the appearance seen on Pl. 18.

This is the most important axis of upheaval which came under my observation on the Chippewa. It is the locality which demands, more than any which I saw on that stream, a detailed examination;

the more so since the mineral character of the rock is very similar to the crystalline formations near Limoges and Chanteloupe, in the department of the Haute Vienne, in France, where a variety of valuable minerals have been discovered.*

Six miles above Brunet's is another portage of half a mile. Here also hornblende is the principal constituent of the rocks, only they are closer grained and more siliceous than at Brunet's; and they are associated with a kind of petrosiliceous schistose rock, with a very uniform cleavage angle of 26 degrees. The general bearing of the beds is east by north and west by south.

Above this portage some six miles, and about one mile below the confluence of the Chippewa and Manidowish, are some fine pines, intermixed with maple and other hard wood.

The drift deposites here are similar to those observed at Vermillion rapids, only No. 4 of the section is better developed. After passing the mouth of the stream no rocks were perceived in place, until two miles above the mouth of the Whip river, where there is some fine grained pink and grey granite. For two or three miles here the current of the Chippewa is very swift, and the banks lined with boulders.

A mile or two further on, and three to four miles above the mouth of Whip river, I observed some sienitic granite, traversed by viens of reddish granite. Similar rocks were in place every few miles to the mouth of Count Orville river.

Soon after entering this branch of the Chippewa, we came to rapids formed by a chain of porphyritic sienite, and the same kind of rock is seen in several places between this and the portage, two to three miles above the mouth. The sienite has much the appearance of that which occurs at St. Julien, in France.

The fall of the river at the portage of Court Oreille river is about fourteen or fifteen feet. Huge blocks of sienite, covered with different kinds of moss, may be seen here projecting amongst the pines that line the adjacent bank. On this part of the river there is no high ground in sight; the surface is mostly covered with drift composed of sand, gravel, and boulders.

A succession of rapids, with very little still water, continue for fourteen to sixteen miles. Wherever the water is swift, the bottom of the stream is covered with boulders, and huge blocks of crystalline or trappean rocks project out of the water, either in place, or not far removed from the parent mass.

This is the character of the river to within six to eight miles of the Lake Court Oreille. There the country becomes more open; the dense pine forest gives place to a more stunted growth of evergreens and aspen. A few hills of drift appear in sight; one of these measured one hundred and twenty-five feet above the level of the river. The general face of the country, however, for four

* In the granite and gneiss of the vicinity of Limoges are found emeralds, phosphate of lime, phosphate of iron, phosphate of manganese, phosphate of uranium, garnets, variegated copper, arsenical iron, oxide of tin, and kaolin.

or five miles before reaching the lake, is very little elevated above high water mark, and it supports only such growths as flourish in swampy ground. A few stunted and half decayed pines were the only trees visible.

At Corbin's trading post, near the entrance of Lake Court Oreille, the banks are elevated twelve or fourteen feet above the level of the lake, and the height beyond, inhabited by the chief of the tribe that resides in the vicinity of the lake, is still higher, about twenty feet. This spot presented a very fine appearance at the time we visited the place, in June, the green slope extending down to the edge of the water. All the elevated land around this lake is composed of drift, in which sand is the predominating ingredient.

It is said, that between the upper and lower rapids of the Court Oreille river, a copper boulder, weighing more than one hundred pounds, was found by the Chippewa Indians; this was probably an erratic mass.

The lake has a very narrow entrance; the channel is only some twelve or fifteen feet wide. The greatest length of the lake is said to be nine miles from northeast to southwest. Its waters are clear and not colored brown, like those of the Court Oreille and the Chippewa rivers.

From the lake we passed by a very narrow channel, through water lilies and bulrushes, into Lac Grit or Grindstone lake. This is also a fine expanse of water, which has received its name from a kind of grit or grindstone found on the north shore. On examining the spot where they are procured, I found the shore thickly lined with boulders, and, some distance from the bank, loose masses of a buff colored freestone. The lighter colored of these gritstones resembles some of the members of F 1; the pink varieties, and especially those that are spotted, have more the aspect of the Lake Superior formations. The partial exposure of this rock at present observed, taken in connexion with the absence of palaeontological evidence, does not admit of any positive conclusion as to the era to which they belong; this remains a matter for further investigation.

From Grindstone lake, we made a portage of half a mile to Lac Vollé or Lilly lake, a small sheet of water about half a mile in length. From this lake to the Namekagon river, is another portage between four and five miles. The trail leads over a ridge which overlooks a considerable extent of country. In consequence of a thunderstorm, which caused considerable oscillations of the mercury, I could not make very accurate observations on the relative level of Lac Vollé and the Namekagon river. The height of the ridge in sight of the Namekagon is one hundred and two feet above that stream, and a high point to the right, on the southwest of the trail near the same place, is thirty-six feet higher. Nothing but drift could be seen in any of these hills; the prevalent growth is birch.

On arriving at the Namekagon river two of our party descended

x Sec 5 T 39 R 8 W

that stream with one canoe to its mouth; the rest ascended it on the route to Lake Superior by the way of Mauvaise Revière.

The Namekagon river is about fifteen to twenty paces wide, with banks from eight to twelve feet high. The prevailing growths are pine and birch, usually of small size. The soil is thin, sandy and gravelly, not much better than that on the Chippewa below the Dalles. The undergrowth is chiefly ferns, the land level and the woods open. The only rocks visible are boulders, which are chiefly varieties of trap, from the size of a half bushel measure to that of small pebbles.

The sandy nature of the soil on this portion of the Namekagon rather favors the idea that the nucleus of the knolls and hills is sandstone.

About fifteen miles from the point where we embarked on the Namekagon is a small lake known by the name of Little Rice lake. A mile or so beyond this, low hills appear on the river on the northwest. They are from twenty-five to thirty feet high, and are composed of drift. These appeared at intervals, for four or five miles to the "Big Pine" encampment above the Snake rapids, where these hills of drift were found to be seventy-one feet high. Their summits command an extensive view. To the northeast the country is tolerably open, but on the opposite side of the Namekagon, in a southeast course, a pine forest bounds the prospect to the horizon. No ledges of rock were visible, but large boulders are strewed on the surface and also in the bed of the stream at the rapids.

Nine miles by water from Little Rice lake, and six or seven miles by the trail is Great Rice lake, which is merely an expansion of the river. It has anything but an inviting appearance. The blades of wild rice which rest drooping on its waters almost cover the surface. At the season of the year when I visited it, it had all the appearance of that green scum often seen in stagnant pools, caused by a growth of *confervae*.

The soil on the north side of the Namekagon, between these two lakes, is of the same sandy character which generally prevails the pine lands of those regions, where extensive deposites of drift have been derived from the destruction of pre-existing sandstones. On the south side it is probable that the soil is of better quality, since the timber is of larger growth.

Above Great Rice lake there is a succession of swift rapids, in which the trappean boulders are so thick that it is difficult to avoid them in navigating the stream. Some of them are of large dimensions.

The waters of the Namekagon are not nearly as highly colored as those of the principal branches of the Chippewa, but they are warmer and less palatable. The Indians who inhabit its banks are wont, before drinking it, to mix it with maple sugar.

Six or seven miles above Great Rice lake, our party left the Namekagon, in order to gain the head waters of Mauvaise Rivière, through a series of lakes which lie to the north.

The first of these we reach by a portage of about one mile. It

T 43 R 7 W

is known by the name of Leach lake, no doubt from the number of leeches which infest it; they are of a flat form and brown color. The length of the lake may be about half to three-quarters of a mile. The shores are lined with boulders of trap, granite, gneiss, and porphyry. Of the latter I observed a peculiar variety; the base is composed of a light colored feldspar, with embedded particles of quartz, about the size of the pupil of the eye; many of them are coated over with a green mineral substance which is either a kind of epidote or serpentine.

The next lake is called Island lake, on account of a small and rather handsome island in its centre, covered with small birch trees; the portage to this lake is one-third to two-thirds of a mile. Its dimensions are about the same as those of Leach lake.

The third lake is Little lake, distant about two-thirds to three-quarters of a mile north of Island lake. It is from half a mile to three-quarters long, and from a quarter to two-thirds wide. It is surrounded by a mossy swamp, in which that remarkable flower, *Saracenia Purpurea*, with its pitcher shaped leaf, grows abundantly. It was in bloom when we were there—30th of June.

Between these two lakes are to be found many mottled dark gray trappean boulders, similar to some I noticed on the Chippewa. The portage between these lakes passes over low hills, of thirty to forty feet in height, composed of the same kind of drift as all the hills along the Namekagon.

The portage from Little lake is northeast and southwest, or N. N. E. and S. S. W.

Long lake, the largest and last of the series, is six or seven miles long; it has a great many bays and inlets, with wooded promontories between. Our guide informed us that the waters of the lake flow both ways from it—from its northeast end towards the waters of Lake Superior; from its southwest extremity towards the tributaries of the Mississippi. The appearance which it presents, seen from the southwest end, where the portage trail strikes it, is represented on Pl. 19.

The only living thing which we noticed about these lakes, except a couple of Indians, who happened to be travelling the same route as ourselves, were several northern divers, *Colymbus Glacialis*, whose shrill and peculiar cry rung through the solitude, at one time resembling the screaming of children in the distance, at others, imitating the sound of loud, convulsive laughter.

T 44 R. 7 W

CHAPTER IV.

FORMATION OF LAKE SUPERIOR.

Adjacent to the northeast end of Long lake, there rises a ridge sixty-eight feet above the level of that sheet of water. This appears to be the highest ground we passed over in crossing from the head waters of the tributaries of the Mississippi to those of Lake Superior. The trail descends from the summit of this ridge for nearly four miles; then it ascends the first trap range associated with the Lake Superior formations, which reaches the surface on this route. Where the trail crosses it, it is nearly two hundred feet lower than the summit level in sight of Long lake. The time which elapsed (an hour and a half) between the two observations, prevented me from making a precise calculation of the difference of elevation.

Much of the trap of this range has that peculiar mottled appearance that was noticed in many of the boulders between this point and the Namekagon, and also, to some extent, on the Chippewa. On breaking it up, spherical pieces, about the size of a small marble, are found embedded. Though remarkably hard and heavy, it has a great tendency to decomposition, and, no doubt, produces a good soil; though the general character of the soil in the vicinity is rather more siliceous than that derived wholly from trap rocks. The growth of maple timber around is such as indicates good upland. The ground is somewhat broken, yet not so much so as to render it unfit for agricultural purposes. In some of the hollows are small ponds, or morasses, even on quite elevated situations; this is so common an occurrance through the trap ranges of Wisconsin and Michigan, that it has led to the supposition that they may once have been rents or craters for the exit of lava; be this as it may, they often have a very circular form, with no apparent outlet or inlet.

A quarter of a mile north of the trap range is an exposure of red sandstone conglomerate, a constant associate of Lake Superior formations, which now commence and take the place of the cystalline rocks of the interior of the Chippewa land district.

Adopting the general conclusions prevalent through the Lake Superior country, we might at once set down this ridge as a mineral tract, since what are considered the two essentials, trap and conglomerate, are found together. I am, however, not disposed to adopt such sweeping generalizations. With respect to this ridge, I content myself, for the present, by remarking that where we crossed it the rocks are not exposed in those bold and precipitous masses that are advantageous to the disclosure of mineral veins. My observations on it, however, were necessarily limited and superficial, the object being a rapid reconnoissance of the country, with a view to gain a general idea of its geology and agricultural capabilities, rather than a detailed examination of any particular spot.

Four or five miles beyond the conglomerate exposure the trail strikes Alder creek, the head waters of Bad river, where it winds through a strip of rich alluvial land. The stream here is a mere brook, with barely water enough to float a canoe. Though so small, it furnishes, even here, delicious speckled salmon trout. They lurk in the cool* pools of still water, under the shelving bank, and can be caught with such facility that hundreds may be taken in one day. The angler who undertakes to decoy them from their cool retreat, must be prepared to carry on, at the same time, an incessant combat with the musquetoes and gnats that swarm all through this country during the summer months.

After embarking in our canoe, which had been transported between nine and ten miles from Long lake,† we had for several miles to contend with the overhanging branches of alders and willows, which interlace across the stream, close down upon the water. After two hours *bush whacking* we reached the mouth of a stream coming in from the west, which our guide informed us came from Long lake. It is about the same size as the branch we were navigating. A few hundred yards below this, the winter trail to La Pointe crosses the stream. About half a mile further, we passed the mouth of the Mushkeg branch of Bad river on the right. The additional water, furnished by these two streams, was now sufficient to enable us to float down without much obstruction, either from shoals or trees. It is called five miles to the mouth of Long Lake river and five and a half to the Mushkeg fork. Here, as the name implies, the banks are low and marshy; the only kind of timber in sight was a species of small willow.

About eight miles below we passed another branch of Bad river, coming in from the southeast, and three or four miles further the Pike branch, below which are the first trees of any considerable size, a few elms and bass wood; the latter increase in size and number as one descends. A few miles further on, the banks were overgrown with wild roses, which scented the air for miles. This part of the river is a striking contrast to the wilderness of swamps above.

About thirty miles from the place of our embarkation are the first rapids. No ledges of rocks could be seen, but there are boulders of trap in the channel of the river. The banks begin here to rise to the height of from twenty to thirty feet. At a sudden bend

---

* The temperature was 59° Fah. on the morning of the 2d of July.

† It is truly astonishing to observe what great exertions the voyageurs of the northwest are capable of making on certain occasions. Our canoe weighed about two hundred and thirty pounds; it was transported across this portage from Long lake to the head waters of Bad river, (a distance of nine miles,) on the shoulders of *two* men. They carried it seven miles without stopping, and rested only once during the whole portage. When one considers the distance; the constrained position they have to walk in; the heat of the weather, (80° Fahrenheit;) the narrowness of the trail; the roots and swampy ground they pass over; the frequent turnouts they have to make around fallen trees, and even some times to climb over them; their power of endurance must be looked upon as extraordinary, and as enabling them to perform a feat which could only be accomplished by very robust men under long training. It is said that some of the engagés will carry from four hundred to five hundred pounds on their backs a distance of one thousand yards.

of the river a few miles further, on the right bank, is a land slide of drifted materials of from twenty to thirty feet in height, which exposes only reddish sand with a few small boulders scattered through it. The river was here obstructed by several log drifts, through which we sometimes had to cut our way, and sometimes to make a portage over them. After passing these obstructions, several other land slides afforded good sections of red marly clays and sands, which have been derived from the destruction of the argillaceous and arenaceous beds of the red sandstone formation of the Lake Superior country during the periods of oscillation and disturbance, when the trap, forcing for itself a passage through these strata, rent them asunder, elevating some portions some hundreds of feet above their original position, and tilting others at high angles. These movements of the surface, and consequent change in the level of the waters of these regions, must necessarily have produced powerful currents, which, sweeping to and fro, denuded the exposed edges of strata and scattered the sediment derived therefrom far and wide.

The same kind of deposites prevail to the Slave Rapid of Bad river from the water level to the subsoil. Some of the beds effervesce with acids, indicating a per centage of carbonate of lime.* Where these calcareous beds form the sub-stratum, the soil resting thereon is usually both rich and durable. The hills on Bad river, composed of these drifted red clays and sands, vary from twenty to a hundred and twenty feet. They support a dense growth of birch, balsam fir, hemlock, and basswood. Below the Slave Rapids beds belonging to the original red sandstone formation appear in place above water level and extend for three or four miles, whilst immense numbers of trap boulders line the banks of the river.

At a very swift rapid, which was supposed to be about seven miles above the lowest portage, trap appeared to be in place, protruded through the beds of red sandstone and marl, which here dip to the N. E. or E. N. E. and have very much the lithological character which the red sandstone of the Potomac river possesses. Part of it is a conglomerate and part an easily decomposing red marly rock, sometimes with mica and sometimes with argillaceous spots of deeper red than the mass of the rock. Some attempt is said to have been made at mining near the lowest portage, but with what success I could not learn. The surface indications, so far as my cursory examination will warrant an opinion, are unfavorable for the discovery of valuable and productive veins of ore.

After leaving the portage there are but few more rapids, and none so rough and swift as those we passed above. We had, however, to make several portages afterwards around rafts of logs and drifted trees, which entirely blocked up the channel of the river.

The banks below the last portage become generally lower, though some ten or twelve miles above the mouth of the west fork of Bad river, there are some red marly banks of considerable

---

* Dr. Norwood analyzed a marly clay of a similar composition from the *Bois Brule* which gave a little over four per cent. of carbonate of lime.

height that come occasionally up to the river; but no rock is exposed.

At the confluence of the two principal forks of Bad river, i. e., the east and west branches, is an Indian village of about a hundred souls.

The maple land in the vicinity of the east fork is of good quality and lies well for farming purposes. This branch of Bad river is clearer than the one we descended. The turbidness of the west fork seems to be due to Pike branch, the only muddy tributary which was observed.

It is four miles from the confluence of the east and west branches of Bad river to Lake Superior. On either side the land is low and subject to be overflowed, but it affords a growth of grass which supplies the inhabitants of Madeline island with their winter hay. No high land extends down to the lake shore between the mouth of Bad river and the east point of Shagwamegon bay, opposite Madeline island.

On the afternoon of the 4th of July we reached Madaline island, and were very kindly received by Mr. William Warren, the Indian interpreter. Here our canoes had to be taken to pieces to clean them from the sand and earth which had collected between the bark and frame work, and otherwise undergo a thorough repair. Our stores had also to be replenished, as the stock with which we left the Mississippi was exhausted.

During the few days' delay incident to these preparations, I hired a canoe and proceeded to the boundary line between Wisconsin and Michigan, where Montreal river empties into Lake Superior. The most interesting exposures lie in Dr. Jackson's district, on the east side of the river. I abstain from speaking of them here, as they will doubtless be described in his report.

The 4th principal meridian strikes the southern shore of Lake Superior, in Wisconsin, fourteen chains and seventeen links below the outlet of Montreal river. Just above this point are good sections of the superficial marls, sands, and drift deposites, which can be seen resting unconformably on the tilted strata of red sandstone, as shown on Pl. 20. These latter have a bearing of north 30° east, and are inclined at an angle of over 80° near the trap and 70° near the lake.

Mr. A. Randall, during his exploration along the line of the 4th principal meridian, examined in detail the individual members resting on the inclined edges of red sandstone up to the subsoil. A drift deposite of from four to six feet rests either immediately on the edges of the sandstone, or with a coarse reddish sand intervening. This drift is principally composed of small boulders of crystalline rocks, and supports a remarkably fine siliceous deposite from twenty to sixty feet thick, so free from any grit that it answers as a good substitute for the polishing powder used in the arts under the name of tripoli. Over this lies a red marl containing water-worn pieces of red sandstone and concretions of curious forms much more indurated than the matrix enclosing them. This member often appears of much greater thickness than it really is, in consequence of its crumbling away and sliding down the sloping bank, so as to cover from view more or less of the inferior beds.

The above is the usual order of these deposites along this part of the shore of Lake Superior. In some places the marl is overlaid by a drift of coarser materials than the one beneath, and containing, besides crystalline rocks, fragments of red sandstone and trap.

The tilted red sandstones extend in an uninterrupted section from three thousand to four thousand yards from Raymond's creek to the conglomerate, dipping at an angle of from 70° to 85°, and were estimated by Mr. A. Randall to be about ten thousand feet in thickness. Mr. R. assures me that along the line of section which he selected for measurement, there are no plications or folding over of the beds which could bring the same strata twice into view, and that though there is some variation in the inclination of the strata, he was careful to make his measurements from point to point in such a manner as to prevent any important error entering into the data that would materially affect the calculation. Nevertheless, this is so great a thickness, compared with that of the corresponding formations elsewhere, that it requires verification by repeated measurements at other localities.

In chapter III., under the head of "Formations of the Interior," the geological features along the 4th principal meridian from the southern line of the Chippewa land district to the summit level between the Mississippi and Lake Superior, have already been described. It remains, now, to follow them from Lake Superior south to the same point.

According to the report of Mr. A. Randall, nothing of interest occurs along this line for five miles, except the exposures of tilted red sandstone near the lake shore already referred to.

On section 6, of township 46, trap is in place for a short distance, supporting a fine growth of maple. Boulders of trap are seen for the first time on the south part of the same section, and continue then in great numbers all along the line.

On section 6, township 45, where a branch of Bad river crosses the line, trap and siliceous slate are exposed six feet above the surface, bearing northeast and southwest, and dipping 85° northwest. No conglomerate was observed in place, but detached pieces were observed among the trap boulders.

At an elevation of two hundred feet above the general level of the country, on section 3 township 45, is an outburst of magnetic iron and trap bearing northeast and southwest. It is dark colored, fine grained, and exceedingly hard. At this point there is a remarkable magnetic disturbance, causing the poles of the needle to turn nearly at right angles to the course of the range, and to deviate from the true north nearly 50°.

From the commencement of township 47 to a little south of township 45, there is an alternation of maple ridges with intervening swamps from an eighth of a mile to a mile wide. All of township 44 and sections 3 and 4 of township 43 are cedar, tamerack, and spruce swamps. In township 44 boulders increase in number, and partake more of a granitic character, until reaching section 2 township 44, where granite is in place, as previously stated in chapter III., in the description of the 4th principal meridian up to this point.

By the 10th of July the preparations for the further prosecution of my journey were completed. Before leaving I made arrangements with Dr. Norwood to remain a sufficient length of time on Madeline island to make a series of barometrical observations, with a view to obtain data from which to calculate the difference of level between Lake Superior and Lake Pepin on the Mississippi, our starting point up the Chippewa. After completing his observations on Madeline island, he was instructed to coast along the lake to Fond du Lac, and after instituting some observations at the mouth of the St. Louis river, he was to endeavor to reach the St. Croix by the head waters of Snake and Lake Pekegomag, and make a reconnoissance of the intervening country.

At ten o'clock, on the 10th of July, I left Madeline islands for the Bois Brulé, with the intention of ascending that river on my way back to the Mississippi, having appointed Stillwater, at the head of Lake St. Croix, as the place of rendezvous for the corps which were to take the field on the 1st of August, and where, also, the corps already engaged were to meet me and receive their instructions for the further prosecution of their work.

We started with a head wind, and with some difficulty rounded Point Détour a little after noon. Here there is a bold rock-bound shore. The ledges are composed of red sandstone with marly deposites. Of the former there is about fifteen to twenty feet exposed above the water level. The lower bed is some seven to nine feet thick and regularly jointed; it would make a fine building material. The color is pleasant—not too red; it reminded me of the rock obtained at the quarry on Bull Run, in the new red sandstone formation on the Potomac, in Maryland. There appears to be some local dislocation of the strata at this place; for, in a short distance, nearly on the same level, are found solid ledges of sandstone, marly beds, and thin layers of sandstone, yet the dip is not sufficient to account for this sudden change.

Six islands are in sight after passing Point Detour, all belonging to the Apostle group, and probably all composed of the same formation; at least they have a very uniform appearance. As far as I had an opportunity of observing, red marl banks, either argillaceous or siliceous, extend nearly to the water, surmounted by thick woods of birch, pine, hemlock, aspen, and cedar. Their outline is usually undulating, the most elevated point being in the centre.

The rock-bound shore continues beyond Point Detour. The masses are in considerable confusion, partly from slides, and partly, perhaps, from disturbances, yet the strata are nearly horizontal. The action of the waves, together with the vicissitudes of the atmosphere, have undermined, in places, the ledges of rock near the level of the lake, along this part of the coast, into curious forms, which present the appearance of columns surmounted by an architrave connected by intervening arches; under these excavations the water splashes and produces hollow reverberating sounds. On the east side of a deep bay the strata are very much shattered; only the more durable beds present mural faces to the lake. But little of the drifted marly deposites, which, for the most part, overlie the ledges of rocks on Lake Superior, can be seen here. In its place, beneath the soil, are only angular fragments of red sandstone.

After gaining the point on the opposite side of a deep bay, into which the Au Sable empties, the sandstones are more schistose, though there are fewer marly strata in their composition. The weathering of the rock is even more remarkable here than at the locality previously cited. Near the level of the lake, the rock presents the appearance of low arched vaults resting on short columns, resembling the crypt of a church, while, at other points, a slight stretch of the imagination discloses the interior of a cathedral, with its side aisles and clear story. At one noted point, the semblance of a weather-worn triumphal arch projects into the lake, crowned with small pines. (See Pl. 21.) Under it, we had ample space to paddle our canoe. Indeed the whole of this rock-bound shore, west of Au Sable, is novel and interesting, by reason of the variety of imitative forms which it puts on.

The ledges of rock are from thirty to forty feet high, and are overgrown with hemlock, birch, balsam fir, spruce, cedar, and maple.

Thus far the bays on Lake Superior are sandy; the points rocky; the rocks being universally sandstones and marly beds; the latter sometimes belonging to the original formation, and sometimes derived from their destruction. No highly inclined strata are to be seen, such as occur at the outlet of Montreal river; neither have I seen any appearance of trap adjacent to the lake, between Shagwamigon bay and the Bois Brulé.

The general dip of the rock seems to be towards the centre of the lake, it is however, for the most part, so slight that it is difficult to decide on its direction.

The temperature of Lake Superior, at half-past seven, a. m., on the morning of the 11th of July, three miles from the shore, a few inches below the surface, was 59° Fahrenheit.

After passing Ziskawit bay we reached Bark point, which is composed of low ledges of schistose, variegated and spotted sandstones, with subordinate beds of argillaceous and marly sandstone. At this place maple was more abundant in the woods than it was observed previously. Beyond this point are high sloping banks of red marly clay, like those previously mentioned as occurring on Bad river, and numerous other places on Lake Superior.

At the next promontory, about four miles west of Bark point, is a perpendicular section of a more sandy deposite of a similar kind, exposed by a recent slide of the bank. In the upper part of this numerous boulders were observed, distributed through it, from the size of a quarter bushel, down to small pebbles. There is no regular stratification of the mass, only irregular and rather undulating lines of successive deposition. The whole is tolerably hard, yet it can be crushed in the hand. This section is interesting, because it shows conclusively that this deposite has been derived from the destruction of the original beds, and was deposited, at least in part, during the drift period. The great mass of the boulders on Lake Superior appear, however, to have a still more recent date, since they are more superficial. Those which line the shores of the lake and rivers seem to have been originally on more elevated ground, and to have found their way into their present position by the undermining of the banks and the transporting power of the streams.

The west point of Cranberry bay is composed of solid ledges of red sandstone, from four to eight feet in thickness, which split into large square blocks that are strewed on the shore, together with some schistose red sandy marl beds. The dip here seems to be slightly to the southeast from the lake. Some of the thinner layers of sandstone show oblique laminations, whilst others contain, here as elsewhere on the lake, embedded pebbles.

Beyond Cranberry point, for about six or seven miles, are banks a hundred and fifty feet high. The slope is covered with the usual red marly earth, and crowned with a small growth of birch.

On approaching Spencer river there are again low ledges of schistose sandstone.

The bay into which Iron river enters is composed of low banks of argillaceous marl.

Near the mouth of the Bois Brulé are similar marl banks, which effervesce briskly with acids.

In order to convey some idea of the composition of the marls and red sandstones of the Lake Superior country, as well as the peculiar reddish brown soils derived from their decomposition, the following specimens were selected and submitted, this winter, to an analysis,* in my laboratory.

---

* *Analyses of two specimens of marl, two of soil, and one of red sandstone, from Lake Superior, by Dr. Norwood.*

Marl from Bois Brule.

Loss by calcination	8.0
Silica	41.1
Clay	31.1
Carbonate of lime	4.1
Carbonate of magnesia	4.7
Alumina and oxide of iron	9.0
Loss	2.
	100.

Various views have been advanced by different writers regarding the age of the red sandstone marls and conglomerates of Lake Superior. Some authors have referred them to the date of the oldest sandstones of the New York system; others believe them to be contemporaneous with the new red sandstone of Great Britain, and the *bunter Sandstein* of Germany.

In the absence of all conclusive evidence derived from organic remains—the safest and surest guide in the identification of rocks—it is impossible, at present, to decide between these conflicting opinions. Judging, however, from lithological and mineralogical character, there certainly is strong presumptive evidence that they

---

Marl west of Cranberry bay.

Loss by calcination	3.5
Insoluble matter	92.0
Iron and alumina	3.2
Carbonate of lime, (a trace.)	
Loss	1.3
	100.

Red sandstone from Madeline island.

Insoluble silicates	93.5
Iron and alumina	3.9
Carbonate of lime	1.0
Carbonate of magnesia, (a trace.)	
Loss	1.6
	100.

Soil from Madeline island.

Water	4.32
Organic matter	8.98
Insoluble silicates	75.20
Carbonate of lime	.30
Phosphate of lime	.07
Oxide of iron	4.55
Alumina	5.97
Loss and inorganic acids	.61
	100.

Coarse gravel	.926	In one decagramme.
Fine gravel and sand	6.726	

Soil from New Wood river.

Water	2.35
Organic matter	6.67
Insoluble silicates	84.45
Carbonate of lime	0.07
Carbonate of magnesia	0.04
Phosphate of lime	0.08
Oxide of iron	1.67
Alumina	1.57
Loss and inorganic acids	3.10
	100.

Coarse gravel	.958	In one decagramme.
Fine gravel and sand	5.117	

were deposited subsequently to the carboniferous era. Comparing their composition and appearance with that of the formations of the United States, hitherto described, below the coal formation, hardly any points of analogy can be traced. On the other hand, there is a strong resemblance between them and the formations above the coal measures, not only of the States, but of some parts of Europe.

Ranging through Connecticut, New Jersey, Maryland, and Virginia, there are red sandstone and marly beds that are almost a counterpart of some portion of the Lake Superior formations, as well in aspect as in composition: like them, too, they are traversed by ranges of intrusive trap, with accompanying veins of copper.

The descriptions which we have by Elie de Beaumont of part of the *Gres de Vosges*, coincides also in many of its features with those of Lake Superior.

To draw up in detail a comparison between these formations and those of the northwest, would, at this early stage of the survey of Wisconsin, be premature. Before the completion of our labors, it is hoped that sufficient geological and mineralogical facts may be collected to enable me to accomplish this in a much more satisfactory manner than it can possibly be done at present.

The Bois Brulé, at its mouth, is only about two-thirds as wide as Bad river. A succession of rapids commences soon after entering it. In the course of two hours we passed seventeen to twenty. The high banks are composed of the same red earthy materials so prevalent in the banks of the tributaries of Lake Superior. The more sandy portions have some small boulders and pebbles dispersed through them.

The growth is chiefly birch, hemlock, spruce, cedar and maple, and near the streams some pine; none of it, however, of large diameter.

As is the case with the rest of the streams flowing into Lake Superior, numerous trap boulders line its shores and fill the bed of the river.

At the first portage, which is seven or eight miles from the mouth, beds of red sandstone cross the river in low ledges, their outcropping edges pointing down stream.

Five or six miles above this portage, about fourteen miles from the mouth, a land slide has exposed red earth to the depth of twenty to twenty-five feet; some erratic blocks seem to be disseminated through it, but the sections are not so satisfactory here as those observed on the lake near Bark Point.

Within a mile we passed two more portages, where red sandstones again form the bed of the river. Near the head of the third portage, there is a perpendicular fall of two feet over a ledge of red sandstone.

In the distance which we ascended Brulé the first day, some eighteen miles, we passed about ninety-six rapids. Our guide estimated that there were three hundred and fifty in the distance of about thirty-five miles. As there are a great many short rapids, with very little still water between them, it is difficult to make any correct estimate of their number; indeed they may be regarded as almost continuous.

About nineteen or twenty miles from the mouth is the fourth portage, which, like the others, is short, one-fourth to one-third of a mile, the rapids are formed here also of ledges of red sandstone.

At the fifth portage, around a long rapid four miles further up, or about twenty-five miles by the course of the river, dark green trap is in place a few feet above the river bed, and also on a ridge eighty feet high, bearing E. N. E. and W. S. W. It has veins of calc. spar and pyrites disseminated through it. It is closer grained on the ridge than low down, and has dark particles disseminated through it like petrosilex. The growth on this trap ridge is chiefly balsam fir and cedar; such growths, as I believe, predominate on the Keweenaw Point range; below this trap range, birch seems to be the most abundant growth; aspen poplar is more prevalent above it.

From four to five miles above this is the head of the lower rapids of the Brulé, where the trail leading to Fond du Lac crosses this stream. The distance to this place by the river is estimated at thirty-three to thirty-five miles, though, in a direct line, it is probably not more than from thirteen to fifteen miles to Lake Superior. The trap range below is, therefore, from ten to eleven miles south of the lake.

Elm trees now make their appearance on the bank, for the first time, along with aspen, balsam spruce, tamerack, and pine.

The country, which up to the head of these rapids is clothed on either side by a wilderness of forest and thickets, now opens up and the scenery becomes less wild and more rural, like that of the Chippewa above the mouth of the Manidowish. No streams were observed, thus far, entering the Brulé. Red sandy and marly banks present themselves occasionally on the river, such as were noticed on the east fork of Bad river, about a corresponding distance from the lake. The soil has a reddish brown tinge, derived from admixture of these earths. Along the shores are some fine groups of elms, and the largest tamerack trees yet noticed. Sixteen stems of elm were counted, all proceeding from one general root. The undergrowth which overhangs the river is chiefly alder. This is by far the most picturesque and habitable portion of Brulé. The soil must be good, judging both from the growth of timber and the source whence it has been derived. Some of the bottoms along the river are overflowed in the highest stage of water; these would, however, make good meadow lands.

About seventeen or eighteen miles above the head of the lower rapids commence a series of "upper rapids." Here another trap range crosses the Brulé; its height near the river is about thirty feet. Its direction is nearly the same as that of the last range, about E. N. E. and W. S. W. The growth on these heights is almost exclusively young pines. In the rapids are trap boulders of all sizes, from a pound to several tons. The composition of the trap here is rather peculiar; it is more crystalline than usual;

Labrador felspar enters largely into the composition of some portions of it. It has also iron disseminated through it.

At these rapids are several ridges where trap was observed in place, having the same bearings as that previously described.

The whole extent of the upper rapids of the Brulé must be seven or eight miles by the river; they are not so continuous as those below, having in some places nearly a mile of still water intervening. At their head are open woods of pine and aspen poplar, and on the southwest large tameracks.

The river now expands itself into double or triple its former width, with very little current. It is bounded by low ridges, with a growth of small pine and aspen poplar. The soil here is of an inferior quality; light, sandy, and gravelly. A small tributary comes in here from the southwest which our guide called Black river.

About Puckwee or Flag lake the drift is quite superficial, with a thin mould scattered sparingly through it. The ridges are elevated only from six to twelve feet above the level of the lake.

After passing a narrow channel of swift water for about a quarter of a mile, we entered a larger lake of the same name, the shores or which are lined with a dense growth of cedars.

The first Flag lake may be a half to three quarters of a mile long; the second one mile. The shores are lined with boulders, chiefly of trap, and some are seen projecting above the waters of the lake, even in its middle. The whole country has a very singular aspect, with lakes of still water, connected by short and swift rapids, that meander through a dense growth of cedar and tamerack. Such lakes are very frequent near the summit levels of the trap ranges south of Lake Superior.

Though rock is not seen in place, there is reason to believe that the rapids between these lakes are caused by intrusive trap ranges, though they may not reach the surface. To judge from the direction of the elevated grounds adjacent to the Brulé, and the straight outline of the ridges, it seems probable that trap constitutes the nucleus of many of them. The vast drift deposites render it difficult to ascertain the nature of the rock formation on which they rest.

After navigating four lakes, with intervening rapids, (the latter from two hundred yards to half a mile long,) the Brulé meanders through a series of cedar swamps, separating into several channels, the main one being sixty or seventy yards wide.

Through the cedars which grow in the surrounding swamps, ridges can be seen bounding the marshy grounds. These ridges are from two to three hundred feet higher than the bed of the Brulé, bearing nearly northeast and southwest. The distance to this place from the upper rapids may be, by the river, sixteen miles; and in a direct line, about eight or ten. The current of the Brulé is sluggish, and the bottom muddy, as it winds through these tamerack swamps, nearly parallel with the ridges. Water lilies, wild rice, flags, and other aquatic plants, grow luxuriantly on either side of the channel, and trout are abundant.

The river now very soon contracts its dimensions to a mere creek, just wide enough to float a canoe between the bushes that overhang its banks. The channel is often so obstructed with boulders, that it is with difficulty it can be navigated, even with light draft, birch bark canoes. Where we left it to make the portage to the head of the St. Croix, it is a mere spring branch; the water cool and clear, though the bottom is covered with a dark muddy sediment.

The portage, from the Bois Brulé to the head waters of the St. Croix, is only two miles. The trail leads over a ridge of drift, the summit level of which is one hundred and twenty feet above the level of the upper Lake St. Croix. These heights command an extensive prospect of the surrounding country, clothed with evergreens. The landscape resembles, in its general features, the high ground of Keweenaw Point. About a quarter to half a mile east of the trail, and but little lower than the summit level, is a small lake.

The head waters of St. Croix river proceed from a lake about six miles long, and a half to three-quarters of a mile wide. The shore at the northern extremity is low, but on the east and west it is bounded by ridges twenty to thirty feet high, on which the growth is chiefly birch. Boulders of trap, granite, and hornblendic rocks line the margin of the lake. The channel, from the lake into the River St. Croix, runs for three or four miles like a canal between fields of wild rice, interspersed with bulrushes and water lilies. The temperature of the head waters of the Brulé is from twelve to fourteen degrees cooler than that of the St. Croix. This difference of temperature was found generally to hold good between the streams flowing into Lake Superior and the tributaries of the Mississippi.

Tamerack (*Larix Americana*) and cedar are the prevalent growths on the head waters of the St. Croix. Of the former, there are two species, or at least varieties; one which frequents the wet swampy ground; and the other, the low ridges. The leaves of the former are of a greyish green color, and have the appearance of moss, at a distance, and the tree has a rugged look. The latter has a dark green color, runs up into a pointed summit, and its whole outline is much more formal. I am not certain whether this is the *larix microcarpa* of Lambert.

After descending about four miles, we found the channel very much obstructed by boulders, though the current was sluggish. Seven or eight miles below upper Lake St. Croix, on the east side of the river, the trail which leads from Lake Superior strikes it. This is about two or three miles above the mouth of Schawaskosibi, or Green river, a tributary which comes in from the southeast. Soon after passing this stream, the velocity of the current increases a little, and the stream widens.

On the southeast is a ridge similar to the one crossed on the portage from the Brulé to the St. Croix, supporting a growth of the same kind of pine. This kind of timber, however, is soon replaced by tamerack. From the appearance of these ridges, they would probably afford good ground for a road up the valley of the St. Croix.

About twenty-three or twenty-four miles below the lake, at the head of the St. Croix, the river expands into a small lake, or, rather, two lakes, connected by a bend of the river. At the foot of the lower of these the first red sandstone which was observed in place reaches the surface. Here the rapids commence flowing over its horizontal ledges, which are much broken and split into pieces. The rapids are short, with slack water between. Two of these are very sudden, swift, and difficult to navigate. Trap boulders, some of which are large, fill the channel, and do not appear to be far out of place. The width of the St. Croix, at these rapids, is about the same as that of the upper part of the Chippewa, near the mouth of Court Oreille river.

The red sandstone of this part of the St. Croix has numerous smooth and almost polished spots disseminated through it, more argillaceous than the body of the rock; some of these have much the appearance of impressions of organic bodies, but they are so indistinct that no definite structure could be observed with a common magnifier.

From thirteen to fifteen miles from the head of the rapids, a dip was observed of the strata of red sandstone, in an east southeast direction, at an angle of about 13°. It was only on the river that the sandstone could be discovered in place. Nothing but sand, gravel and drift could be found exposed on any of the ridges which I had an opportunity of examining, even to the height of one hundred or one hundred and twenty feet.

All the rapids above the mouth of the Namekagon seemed to be formed by ledges of the same red sandstone, varying from its usual appearance to that of a schistose argillaceous rock.

After passing the Namekagon a mile or two there are no more rapids of any consequence, until after passing Yellow river.

The ridge over which the portage leads from the St. Croix to Yellow lake I found to be from eighty to a hundred feet high. Its direction is E. N. E. and W. S. W., which, indeed, is the course of most of the ridges on the St. Croix, they being parallel with the trap ranges of the upper part of the Brulé. No trap can be seen here in place, nor, indeed, thus far on our descent down the St. Croix, probably on account of the thickness and extensive range of the drift deposites. The size and number of the trap boulders on the rapids, and lining the shores, induce the belief that they are not far removed from the range of intrusive rocks from which they have been derived, and which probably constitute the nucleus of many of the ridges of the upper St. Croix.

About four miles below the Yellow lake portage trail, a small stream flows into the St. Croix from the north-west, the Eninandigo river? of Nicollet, and two or three miles further, Turtle river enters from the south-east, (Kayesikang or Shell river of Nicollet?) A mile or two below this are banks of sand and gravel, similar to those described on the lower Chippewa, but of a redder color; and from twenty to seventy-five feet high.

+ Clam R

There are many fine unios in the St. Croix; most of the species seem to be the same as those found in the streams of the western States, though they have a slightly modified outline of form. Among them I noticed *U. undulatus*, *siliquoides*, *crassus*, *cuneatus mytiloides*, *gibbosus*, *alatus*. These kind of fresh water molusca seem to be more abundant on the St. Croix than on the Chippewa, Bad river, or the Brulé. A few were observed even as high up as the outlet of upper lake St. Croix.

This part of the St. Croix is about the size of the Chippewa below the falls. It flows smoothly along without rapids or ripples. The bottom is sandy, and there are much fewer boulders along the shore.

The adjacent ridges seem composed chiefly of sand and drift, and are clothed with pine openings. Four or five miles above the mouth of Kettle river is a beautiful stretch of bottom land, with picturesque groves of white oak and aspen, above the reach of high water. The soil, however, is light and sandy.

Just below this, a few boulders appear again in the bed of the stream, and rapids, with a slight fall, set in three and a half miles above the mouth of Kettle river. At the head of these is the first range of trap which I noticed, unequivocally in place. It is of a cuboidal, or almost columnar structure; some of it is quite dark colored, almost black, with ferruginous stains; other portions dark green and brown. A few hundred yards below this exposure, on the south side of the St. Croix, red sandstone is in place in a very shattered condition, resting on a conglomerate, which is slightly calcareous, its aspect having much the appearance of the Potomac marble, but the fragments of which it is composed are siliceous, with only a small proportion of calcareous cement. At a bend just below is a protrusion of trap, crossing the river obliquely, with a bearing nearly E. N. E. and W. S. W. The upheaval of the trap has caused rapids here in the river, and has shattered the superincumbent beds, which are in a very broken condition. Below the bend on the same rapids, trap is in place, and can be traced to the height of fifteen to twenty feet above the river bed in the adjoining bank. The igneous outburst on this part of the St. Croix has not been sufficient to produce hills of any great elevation, twenty or thirty feet being the general height of the ridges here. Part of the rock of this range has an amygdaloidal structure.

This is doubtless the same trap range which Mr. J. Evans's party found crossing Kettle river, a few miles above its confluence with the St. Croix, and where some rich copper boulders have been found.

Three and a half miles below Kettle river, Snake river disembogues on the west side; and one and a half to two miles further, horizontal strata of white and light yellow sandstones appear fifteen feet above the river, on the east side of the St. Croix, covered with twenty to twenty-five feet of drift. No organic remains were discovered in these sandstones by which to determine their age; but the lithological character is like that of the sandstones belonging to F. 1, and does not resemble that of the red sandstone three miles above Kettle river. The most southern limit of the red sandstones of the Lake Superior country must be somewhere in the vicinity of Snake or Kettle rivers. This formation extends, therefore, much further down the valley of the St. Croix than down that of the other tributaries of the Mississippi. Its southern boundary, in a direct line, cannot be here over sixty miles from the Mississippi river.

Similar sandstones to those mentioned above, as occurring two miles below Snake river, are exposed at intervals for the distance of several miles below, on the banks of the St. Croix. About eight miles below this first exposure, there is an outcrop on both shores; on the east side they are weathered into low arches. Some fine springs issue from the bank a few miles further; these are the first cool springs of water that we have noticed in our descent of the St. Croix.

Below this no rock exposures were observed immediately on the river, only trap boulders occasionally lining the shores.

On both sides of the river above Rising Sun are some fine sites for farms; the ground is level, the soil light, but rather siliceous.

Eight or ten miles below Rising Sun the pines are replaced by a growth of hard wood.

The best pines for lumber are procured on Snake and Kettle rivers and other tributaries of the St. Croix. Those on the main stream are, for the most part, small.

Sixteen miles below Snake river rapids commence again, and trap boulders become more numerous—some of them of large size. These rapids mark the place of the last range of intrusive rocks, viz: those which form the rapids, falls, and dalles of the St. Croix, about thirty miles above its confluence with the Mississippi. It consists of several subordinate ranges belonging to the same general outburst, which vary from a hundred and fifty to three hundred and sixty feet in elevation—one which crosses the river at the falls, two or three above the falls, and three or four below. Half a mile below the falls one of these ranges rises into perpendicular walls on both sides of the river, and constitutes the *dalles* of that stream. Between these the St. Croix rushes, at first, with great velocity, forming a succession of whirlpools, until it makes a sudden bend—then glides along placidly, reflecting in its deep waters the dark image of the columnar masses as they rise towering above each other to the height of a hundred to a hundred and seventy feet. Pl. 22 will convey an idea of the appearance of this range of trap below the dalles of the St. Croix. It is one of the finest expositions of that kind of rock which I witnessed in the Chippewa land district.

On the west side of the St. Croix, at the dalles, forty or fifty feet above the present level of the river, are large *pot-holes*, some of which are twenty to twenty-five feet in diameter, and fifteen to twenty feet deep. These seem to have been worn into the solid rock by sand, gravel, and loose rocks, kept in motion by circular currents of water, similar to those now observed in the river at the head of the Dalles. They afford evidence, either of successive upheavals of the trap, or of the waters of the St. Croix having flowed formerly at a higher level.

Immediately at the Falls of St. Croix the trap rock has nearly a homogeneous character; but on the high ridges on the west side of the river it is porphyritic, more so than any of the trappean ranges which came under my observation in Wisconsin. On Partridge Ridge, one mile west of the falls, I observed a variety, the base of which is of a rich dark green, with embedded light pink lenticular crystals of feldspar, and disseminated spots of epidote. This porphyritic trap differs but little from the Norway porphyry, found on the west side of the Christiana Fiord, near Bogstadt.

I caused a specimen of the St. Croix porphyry to be polished. It cuts easily, and its colors show beautifully; but in consequence of the epidote being softer than the basis of the rock, it receives an unequal polish, which diminishes its value for ornamental purposes.

Including the intervals between these trap ranges, they occupy a belt of country from fifteen to twenty miles in width. They differ from the trap ranges of Lake Superior in the being associated with stratified rocks, that differ lithologically from the red sandstones and marls of Lake Superior, and which belong to a system of, probably, far greater antiquity. The outburst at the Falls of St. Croix has forced its way through highly fossiliferous strata, breaking up the beds immediately overlying it—entangling and partially indurating the fragments, without, however, tilting or metamorphosing the adjacent beds in any perceptible degree. The fossils even of the beds almost in contact with the trap dykes are in a perfect state of preservation,* and the strata themselves have no dip perceptible to the unassisted eye in the hill side where they are exposed.

The fossils of the beds in question are *lingulas* and *orbiculas*, which belong to some of the lowest members of the protozoic strata of the upper Mississippi, inferior even to a sandstone that is probably the equivalent of the lingula beds of the Potsdam sandstone of New York, and as low, if not lower, than the sandstones below Mountain island, near the bed of the Mississippi, which, as I have already remarked, are charged with shells analogous in form to *obolus appolinis*, figured by M. Ed. de Verneuil in his Palaeontology of Russia, and described as characterizing the inferior sandstones of the protozoic strata of that country. Section No. 4, showing the succession of the rocks as they occur from the mouth of the St. Croix, terminates with the above trap ranges on the north, and exhibits their position in connexion with the adjacent fossiliferous strata above described.

This portion of the St. Croix has no bottom land of any extent, but the upland soil, over the trap is of good quality and produces very fine crops of oats. An analysis of a soil taken from the elevated table lands east of the falls, gave 81.44 per cent. insoluble

* In some the nacre is entire. Remains of the same kind of shells can also be detected in fragments enclosed in the trap, and so much altered as to be distinguished with difficulty from the surrounding greenstone.

silicates; 7.23 per cent. saline matter, soluble in chlorohydric acid; 1.40 per cent. calcarious matter.*

The table land is much more level than could be expected in a country based upon eruptive volcanic dykes that have attained a height of from two hundred to three hundred and fifty feet above the water courses. But little of it is so rolling as to be materially injured by washing. There are limited spots of upland marked by a growth of aspen poplars, where the soil is of inferior quality; but the larger proportion of the upland may be considered good second rate land, and some first rate. Even the sandy soil of the surrounding country produces better than its appearance at first indicates, by reason of saline intermixture.

Pieces of native copper have repeatedly been obtained in the vicinity of this trap range. During the excavations and blastings for the improvements at the falls, Mr. Burlow informed me, several fragments were found, some of which he supposed to be black oxide. On the 8th of last August, after a heavy rain, five pieces of native copper were picked up. In 1841, Mr. Crosby found a mass, within a mile of the falls, weighing nine pounds; and about the same time S. McKane found another piece weighing seven pounds. At various other times numerous smaller pieces have been discovered on the surface in the neighborhood.

Just above the mill, on the east side, is a crevice eighteen inches wide, the earthy matter of which is intermixed with copper. Selecting, as nearly as I could, an average sample of this copper earth, by detaching fragments from a variety of specimens taken from the crevice, and mixing and grinding them intimately together, I subjected it to an analysis in the humid way, and found it to contain 4.28 per cent. of metallic copper.†

---

* Analysis of soil from the vicinity of a trap ridge, near the falls of St. Croix:

Water	2.25
Organic matter	7.25
Silicates insoluble in chlorohydric and sulphuric acids	81.44
Alumina soluble in chlorohydric acid	1.14
Oxide of iron soluble in chlorohydric acid	1.50
Silica, soluble in chlorohydric acid	0.05
Carbonate of lime	1.40
Magnesia	.37
Chloride pottasium, with a trace of chloride of soda	.15
Alumina, soluble in sulphuric acid	1.83
Loss and inorganic acids not determined	2.61
	100.

† Analysis of an average sample of copper earth from a crevice at the Falls of St. Croix:

Loss by ignition	6.
Earthy matter, insoluble in chlorohydric acid	68.5
Protoxide of copper	5.4
Oxides of iron, manganese, and aluminum	15.5
Carbonates of lime and magnesia, and loss	4.6
	100.

A sample of copper, said to have been obtained from the same vein, was carryed to Boston and assayed. It yielded 19.72 per cent. of pure copper, according to the report of Mr. Hayes. The specimen examined by that gentleman must have been much richer than any which I obtained; even the purest samples would not produce anything near nineteen per cent.

As the lineal survey of this region was not commenced when our operations in the field terminated, nothing could be done in the way of minute examination, with reference to sections and quarter sections. Until this shall be accomplished, of course no accurate locations can be made, nor can an opinion be advanced as to the value of the country as a mineral region.

CHAPTER V.

DRIFT OF THE INTERIOR OF WISCONSIN.

In the two preceding chapters I have had frequent occasion to mention the position and composition of the drift deposite of the interior of the Chippewa land district. At present only a few general remarks on this subject remain to be made.

The sand which constitutes the most bulky part of the drift of the interior of Wisconsin north of the 43d degree of latitude, has evidently been derived from the denudation of beds pertaining to F. 1. Most of the ground elevated above the swamps and the overflow of the rivers, south of the great water-shed, is composed of this material. Where it rests on the igneous rocks it supports the pine forests that constitute one of the principal sources of wealth in the northwest. The trees seem, however, not to attain any great size, except where the siliceous earth is enriched and improved by an admixture of saline matter from some other formation. The source whence these fertilizing elements are derived is usually, if not always, the subordinate hypogene rocks.

Blocks of these rocks, of sizes varying from a few inches to six or eight feet in diameter, form the next most conspicuous material of the drift, often so thickly strewn that they either touch, or are not separated more than a foot or two from each other. Among these, trappean rocks are much the most common. The position in which they are now most frequently observed is in the bottoms and lining the shores of rivers, lakes, ponds, and swamps. Many of them have no doubt found their way into their present position from more elevated situations, by the undermining and transporting power of water, and perhaps ice; yet they do not bear marks of having been removed any great distance from the parent mass; since the great body of them is confined to belts of country adjoining to rapids where trap rock is either found in place, or where there is reason to believe that it is only hidden by a superficial covering of the detached blocks in question.

They originated at the time of the upheaval of the trap. To decide upon the *period* of elevation requires more extensive observation than has yet been made; but there are facts already ascertained which render it probable that a large area of the northwest territory has been raised during very modern periods; even since the present fauna inhabited its rivers and lakes. Below Parkhurst, on the west bank of the Mississippi, I have observed, over a considerable tract, multitudes of unios, besides a variety of other fresh water molusca, of the same species as those now inhabiting the Mississippi and its tributaries, elevated far beyond reach of the highest freshets; and I am informed that the same deposite can be found extending, in some places, as much as a hundred feet, or more, above high water mark. It is well known to those who have travelled much in the swampy and undine regions of the Mississippi valley, that there is a gradual drainage of its waters taking place, even at this time; so that land which was formerly covered with water is now completely dry; and shell marls found through portions of the prairie country show that many of these plains are but drained lakes, or expansions of the great water courses.

Finally, the fine siliceous and loamy marls, widely distributed in the valley of the Mississippi, at an elevation of a hundred to two hundred feet above the present rivers, containing *cyclostoma*, *physa*, *succinea*, *helices*, *helicina*, and *planorbis*, with occasionally *unio*, *paludina*, and *melanea*, and considered to be of the age of Loess, of the Rhine, in Germany, afford evidence either of a modern rise of the lands of the interior of the United States, or, a subsidence of the waters by an excavation of the fine fresh water mud deposite, which may have choked up the valleys.

Drift of the prairies.—On the west side of the Mississippi, in the vast prairie region of Iowa, the attention of the geologist is frequently arrested by erratic blocks of enormous dimensions, scattered here and there, and half sunk in the ground. Unlike the boulders we have just been considering, they are far from their original situation.

As they rise amid the ocean of grass, they may be seen for miles; and, in the absence of more conspicuous objects, they form the principal landmarks of the traveller. The larger of them might, in inhabited country, very well be mistaken for cabins in the distance. The one represented on Pl. 23 was measured, and found to be fifty feet in circumference, and twelve feet high. It is probable that at least one-half the rock is commonly buried beneath the ground. Hence may be gathered some idea of their huge dimensions.

These boulders appear to be most abundant along the route which I travelled between the head waters of the Wapsipinicon and Red Cedar, and some ten to fifteen miles beyond the latter, along a belt which may be twenty to thirty miles in breadth.

Among the smaller of these erratic blocks there is considerable variety; it is, however, somewhat remarkable, that almost every large boulder which I examined in this region is a peculiar variety of porphyritic granite, in which the feldspar is of a flesh color, and often in large, regular crystals. Of the granite which I found in place, in the interior of the Chippewa land district, along my route to Lake Superior, that which was found in place at the first rapids of the Court Oreille river comes nearest to the composition and appearance of these prairie boulders. This, however, can hardly be the source whence they have drifted; for the direction of the belt of erratics does not appear to be transverse to the streams; that is, from northeast to southwest, but rather parallel with them from northwest to southeast.

The only explanation that is at all satisfactory in accounting for the transporting power which has brought these detached masses of granite rocks into their present position, is floating ice—ice drifted by currents setting in from the north, before the land emerged from the ocean, in the same manner as, at the present time, thousands of tons of rock are precipitated on the bed of the Atlantic ocean from icebergs, which annually work their way from the north, and melt in southern latitudes. No mere currents appear at all adequate to convey such heavy blocks across valleys, and over hills, to a distance of hundreds of miles from the parent rock. Their isolated position in the prairie also indicates that they were dropped into their present situation, rather than rolled into it. Under the latter supposition, even if it were possible, they would probably be closer together, and more regularly assorted, as to size.

REMARKS IN CONCLUSION.

In my preliminary report to the department, I stated that so far as the reconnoissance had then been carried, no indications of coal had been observed in the Chippewa land district; nor yet in the part of Iowa examined up to that time. Subsequent observations, made after that report was written, have not disclosed the existence of any carboniferous rocks.

The reconnoissance of the assistant geologist along the Michigan line and the head waters of the Wisconsin river, shows that the formations there are but an extension of the same igneous ranges which traverse the interior of the Chippewa land district, covered, over a great part of their area, with the usual drift deposits.

The only region, therefore, which holds out any prospect of a supply of mineral fuel to the Upper Mississippi, is the country watered by the southern tributaries of the St. Peter's river, to wit: that bordering on the Blue Earth and Maukato rivers, where, I am informed, Mr. Nicollet was lead to believe that coal might be found. The coal and iron formation of the Des Moines may perhaps extend in that direction. Or, it is possible, that a separate basin of carboniferous rocks may succeed to the Silurian and Devonian limestones which we have found east and southeast of that tract of country.

The statistics of the lumber trade collected by Mr. A. Randall will convey an idea of the present income from the pineries of Wisconsin territory.

The lumber is chiefly manufactured on the Wisconsin, Black, Chippewa, and the St. Croix rivers, and their tributaries.

On the Wisconsin river are twenty-four mills, running forty-five saws, and sawing about nineteen and a half millions of lumber, worth, at the mills, about six dollars a thousand; and three millions of shingles, worth two dollars a thousand. The total value of the lumber on the Wisconsin is, therefore—

19,500,000 feet, at $6 per M feet..............	$117,000
3,000,000 shingles, at $2 per M feet..........	6,000

On Black river and its tributaries there are thirteen mills, running sixteen saws, and turning out six millions three hundred nd fifty thousand feet of lumber annually; one and a half million of shingles, and forty-five thousand feet of square timber, say—

6,000,000 feet, at $6 per M....................	$36,000
1,500,000 shingles at $2 per M................	3,000
45,000 feet square timber at $25..............	1,125

On the Chippewa and its tributaries there are five mills and seven saws, which manufacture five millions three hundred and fifty thousand feet of lumber; three millions one hundred thousand laths; one million three hundred thousand shingles, and fifty thousand feet of square timber; there are also sent to market about two thousand logs, say—

5,350,000 feet of board and plank at $8 per M.	$42,800
3,100,000 lathing at $2 per M.................	6,200
1,300,000 shingles at $2 per M................	2,400
50,000 feet of square lumber at $30 per M....	1,500
2,000 logs at $2 each.........................	4,000

On the St. Croix and its tributaries five mills and twelve saws are in operation, which cut, during the last season, seven million seven hundred thousand feet of boards and plank; six million laths; one hundred thousand shingles, besides fifteen thousand logs taken to market without sawing;* say

7,700,000 feet, at $8 per M....................	$61,600
6,000,000 laths, at $2 per M...................	12,000
100,000 shingles, at $2 per M.................	200
15,000 logs, at $2 each,......................	30,000

By the time this reaches the St. Louis market its value is nearly doubled, so that the actual income to the inhabitants is upwards of half a million of dollars.

According to the calculation made in the pine regions of New York and the New England States, of the quantity of lumber which one acre of ground will produce, *five thousand* acres of land must annually be denuded of its timber to produce the lumber sent into the market from the Chippewa land district. A portion of this land, when deprived of its timber, is almost worthless.

The Chippewa land district is the country which must ultimately supply, with pine lumber, the whole Mississippi country below the Wisconsin river, and north of the mouth of the Ohio, for, south of the Wisconsin, there are no pine lands of any extent. The future importance and value of the trade can well be appreciated by those who have witnessed the rate of immigration into these vast and fertile plains of the United States, particularly when they consider the preference given to wooden buildings in the west, and the immense consumption of building material, not only in the larger cities, but also for the construction of those numerous towns and villages which spring up, as if by magic, along the shores of the Mississippi and its tributaries.

---

*The steamboat War Eagle towed out of Lake St. Croix, at one time, a raft of logs and sawed lumber which covered eleven acres by measurement.

In concluding this report, which has already extended itself to a greater length than I at first anticipated, I beg to acknowledge the hospitality and attentions which our party received from many of the citizens of Wisconsin and Iowa, from the government agents, and also from the officers of the dragoons stationed at Fort Atkinson, who kindly furnished to the expedition, during its examinations in the neighborhood, several mules without charge.

I desire, also, to express my satisfaction with the prompt and persevering manner in which the members of the geological corps undertook and accomplished the long and arduous routes assigned to them, exposed, as they were, not only to the inclemencies of the weather, to the incessant attacks of mosquitoes, gnats, and other insects, but to the dangers and difficulties incident to travels in a country, a great portion of which is uninhabited, destitute of game, inaccessible to vehicles of any description, or even to horses; and in which the only practicable method of reaching distant points is on foot, or in birch bark canoes, which have to be transported, with all their freight and provisions, on the backs of pack-men, from the head waters of one stream to those of another, around rapids, falls, and other obstructions.

All of which is respectfully submitted.

DAVID DALE OWEN,
United States Geologist for Wisconsin.

REPORT

OF

J. G. NORWOOD, M. D.,

ASSISTANT GEOLOGIST.

REPORT.

New Harmony, *April* 23, 1848.

To David Dale Owen, M. D., *Principal Geologist for the exploration of Wisconsin and Iowa :*

Sir : In accordance with the instructions received from you at La Pointe, on the 5th of July, I remained at Madeline island, after your departure for Stillwater, until the 26th of that month, for the purpose of making a series of barometrical observations, in order to determine, as nearly as possible, the elevation of Lake Superior above the Gulf of Mexico.

Previous to leaving La Pointe I made arrangements with Mr. Jeremiah Hughes of that place, whose acquirements and zeal for scientific investigation well qualify him for the task, to institute, in connexion with a meteorological register, a series of observations on the so-called "tides" of Lake Superior, (the periodical or accidental changes in the level of the lake,) a phenomenon so frequently observed, but the cause of which is veiled in so much obscurity. Since my return to this place he has forwarded the results of daily observations for four months. As it will be impossible, however, to prepare the meteorological data of last season in time for this report, the only use made of his tables as yet, has been in instituting a comparison between the northern and southern parts of the territory with respect to climatology.

Through the kindness of Mr. Rice of the Missouri Fur Company, I took passage in his boat for Fond du Lac, or, rather, for the trading post of the American Fur Company on the St. Louis river. We left La Pointe on the 26th of July, at 10 o'clock, a. m. During the passage I availed myself of every opportunity for making observations on the lake shore, and thus adding to the barometrical series begun at Madeline island.

Between Madeline island and Bark point the red sandstone shows itself on the lake shore for nearly the whole distance. At Point Detour, and many other places, the bluffs are perpendicular and from forty to sixty feet in height, and are overlaid by beds of sand and red marl. Beyond the mouth of the small river opposite Oak island the rock has been worn, by the incessant action of the waves, into most singular and interesting architectural forms. Among these the pillar and arch predominate. These *Pillared Rocks* extend for many miles and are interesting, not only on account of their picturesque appearance, but also as illustrating the means by which the lake is gradually enlarging its southern boundary. Some of the arches are circular, but most of them are pointed. In the space of two hundred yards, at one point, I counted over fifty arches, all possessing great regularity, and resting upon pillars almost as symmetrical as though they had been subjected to the chisel of the artizan. Through these arches the waters of the lake dash with every swell, and their unceasing play has hollowed out numerous caverns of great depth. Two caves were particularly noticed, each more than an acre in extent, and supported at intervals by pillars of all sizes, from twelve feet to half the number of inches, in diameter, and forcibly reminding one of the descriptions of the celebrated cave of Elephanta. Regular architraves, friezes, and cornices are constantly seen, but it is only occasionally that a pillar shows a base, as they are sunk beneath the waters of the lake. Some of the arches are large enough to permit the passage of a Mackinaw boat. There is generally from twenty-five to forty feet of sandstone resting on the arches, the layers being nearly horizontal, and supporting a capping of majestic forest trees, giving to the whole scene an indescribably grand and picturesque appearance.

Beyond Bark point, the shore is bound by hills of red clay, with occasional exposures of red sandstone at various heights. In the vicinity of Rush river, the banks of sand and red clay are high, with seams of gravel and small boulders running through them, horizontally, near their summits, while numerous boulders of crystalline rocks are embedded in the upper stratum. This is the character of the shore to the mouth of Bois Brulé river.

Nine miles beyond the mouth of the Bois Brulé, Poplar river comes in. About eight miles from its mouth, it is crossed by a trap dyke, bearing northeast and southwest, and, a few miles further south, another broken trap range crosses it. Owing to the numerous rapids on it, Poplar river is not navigable for canoes. Nine miles east of the "Entry," or mouth of the St. Louis river, Spawn river enters the lake. On this river a vein of copper ore has been discovered by Mr. C. H. Oakes, of La Pointe. It is, however, below low water mark. The same gentleman informed me that specimens of native copper have been taken from the bed of Rush river. At the mouth of the Bois Brulè, I met a man from the St. Croix with specimens of carbonate and black oxide of copper, and a large boulder of native copper, containing grains of silver as large as bird shot, all taken from the trap range which crosses near the mouths of Snake and Kettle rivers. I mention these facts to show the necessity of making detailed examinations at these points.

The lake shore, for the entire distance between the mouth of the Bois Brulé and the "Entry," is a clay bank, varying in height from six to forty feet, and without any exposure of the red sandstone.

The mouth of St. Louis river is narrow, with a sufficient depth of water, however, to admit boats of large size to pass the bar at all times. It lies between two narrow strips of land which run from the highlands on either side to the "Entry," and divide the waters of the lake from a small bay formed by the widening of the river. On the northern tongue of land, the Missouri Fur Company has a trading post. On the north shore, the hills are from four to five hundred feet in height, and approach very nearly to the lake. On the south side, they are distant several miles, and not over two hundred and fifty feet high. On the south side of the small lake within the "Entry," Left Hand river comes in. On this stream and its tributaries copper ores have been discovered in considerable quantities, and several locations have been made. Two specimens of ore from the mines here, one of which was received at La Pointe and the other at the trading post above Fond du Lac, were examined in the laboratory this winter, as you requested, and yielded each, upon analysis, a little over ten per cent. of copper. They were said, however, to be inferior specimens.

From the "Entry" to the fur company's post, a distance of eighteen miles, St. Louis river is wide and of sufficient depth to admit the passage of the small craft which ply upon Lake Superior. It runs through a rich alluvial bottom from one to three miles in width, which is partly timbered and partly covered with natural meadows. It is somewhat crooked, with reaches from a quarter of a mile to a mile in length.

The trading house of the American Fur Company is situated on the north shore of the river, and immediately opposite is the corner, not only of the Chippewa land district, but also of the proposed State of Wisconsin. It is also the corner of the boundary lines, running south and east, between the lands ceded to the general government by the Chippewas, in 1842, and those still held by that tribe east of the Mississippi.

At the time I visited this place, the chiefs of the Chippewa Indians, from all parts of the territory, were assembled for the purpose of hearing proposals for the purchase of their unceeded lands east of the Mississippi. In consequence of the country through which I had to pass being almost totally unknown, except to the Indians, I availed myself of the opportunity offered by so great an assemblage, to acquire from them as much geographical knowledge as possible. Every one to whom application was made appeared quite as willing to afford information as I was to receive it, and much of the new matter introduced into the map of Mr. Nicollet was obtained at this time. The degree of reliance to be placed on information so obtained will be treated of when I come to speak of the general topography of the country.

In order to obtain a general idea of the geological structure of the region upon which I was about to enter, as well as of the bearing of the great ranges which traverse it, it became necessary for me to leave the district, and proceed a short distance into the Indian country. Accordingly, with two Indians for guides and voyageurs, I ascended the St. Louis river as far as the Upper Falls, partly by water and partly across the country. After making the desired observations, I returned to the trading house, following the bed of the river the whole distance, and was thus enabled to procure measurements at every desirable point between the Upper Falls and Lake Superior. A number of observations, made at the fur company's establishment, also afforded me a mean by which to test the probable accuracy of those to be made between that point and the Mississippi river, and referred to the level of Lake Superior as a base.

CHAPTER I.

RECONNOISSANCE OF A PORTION OF ST. LOUIS RIVER, BETWEEN LAKE SUPERIOR AND PORTAGE AUX COTEAUX.

August 1.—Immediately after leaving the trading house the red sandstone shows itself in the left bank of the river, about ten feet in height, and overlaid by a very heavy deposite of sand and red marl. It gradually increases in thickness for the next three miles, when it attains an elevation of 187 feet above the water level. The upper beds are thick and compact, while the lower ones are thin, slaty, and covered with impressions, such as were seen in the same rocks at one or two points on the St. Croix and Bois Brulé rivers, and at the mouth of Montreal river. At first they were mistaken for organic remains, but a close examination showed them to have been produced by smooth quartz pebbles disseminated through the bed resting on the one containing the impressions.

A short distance above this point there is an exposure of conglomerate in the bed of the river, for the distance of over half a mile. It is very coarse, and is composed of smooth rounded fragments of crystalline rocks, very firmly cemented together. In the bed of the river, it is broken into numerous fissures, filled with veins of iron pyrites, from an inch to three feet in width. Half a mile higher up is an exceedingly interesting point, the conglomerate being suddenly elevated at an angle of 18°, and exposing the lower slates, upon which it rests unconformably. At this place is exposed, in one view, the junction of the slates with the conglomerate, together with the overlying silicious shale, fine grained conglomerate, and red sandstone. (See No. 4 of the geological section accompanying this report.) At this point the rocks exposed are, in descending order:

1. Sand and marl beds	188 feet.
2. Red sandstone	31 "
3. Fine conglomerate	3 "
4. Silicious shale	10 "
5. Coarse conglomerate, with metallic veins	73 "
6. Greenish colored argillaceous slate, dipping almost vertically, and with edges like knives	4 "

The most elevated point of the arch of uplift is about twenty-five feet above the water level—is four hundred yards in extent, and bends regularly to the water on either side.

From the trading post to the lower falls, a distance estimated at nine miles, following the river bed, great numbers of boulders are met with, some of them of enormous size. The portage trail across the great bend begins about three miles above the post, and from this point the river presents a succession of rapids, almost impassable for canoes. By great exertions, however, they may be got nearly to the foot of the lower falls, but beyond that point they cannot pass, in any stage of water.

From the lower falls to the point where my examinations ceased, estimated to be about thirty-six miles, following the meanders of the river, above the "Entry," the only rock exposed is a very dark colored, compact, argillaceous slate, with numerous small scales of mica disseminated through some of its layers, while others are, apparently, talcose. The general bearing of the rocks is east and west, the slates having a dip varying from 30° to 65°, south-southeast.

The falls and rapids above the exposure of conglomerate, as far as the Portage aux Coteaux, are all made by this slate, which projects, at many points, for some distance into the bed of the river, in ledges more than forty feet in heighth.

The lower falls are a series of cascades, ten or eleven in number, and from six to ten feet in height, running obliquely across the stream, and extending for the distance of half a mile. The water falls in this distance, including the rapids immediately above and below the upper and lower cascades, 103 feet. At no one point, however, does the water fall more than ten feet, and then it glides, rather than falls, down the inclined layers of slate.

The second falls are about one mile and a half above the first; and while the descent from top to bottom is not nearly so great, they present a much more imposing appearance than the lower ones. Enormous walls of slate, from 30 to 40 feet in height, project from either bank, and run nearly across the river, like huge dams. At one point, the channel through which the water flows, is forty feet in width, and at another dam, it was found to be only 25 feet wide, the width of the river above and below being from one hundred and fifty to two hundred yards. During the floods which sometimes occur in this region, there is no doubt, a perpendicular fall of water at this place of over forty feet; that the river flows over the dams at such times, being abundantly proved by the drift wood lodged on t eir tops. At present, however, there is a fall nearly perpendicular, at one point, of fifteen feet in height and twenty in width, and this is the only place at which any thing like a perpendicular fall was observed on the whole river. The height of these falls, including the upper and lower rapids, is nearly 76 feet.

The third falls, like the others, are made up of a series of cascades, and for grandeur and beauty, surpass any scenery of the kind I have met with in the territory. Although the fall, including the rapids, is only 45 feet, the disposition of the rocks, and the surrounding scenery, combine to render the effect indescribably beautiful.

The fourth falls are made up of a series of five large cascades, and numerous smaller ones. The ledges of slate cross the river nearly at right angles, and are cut through, as at the second falls, into deep narrow chutes, sufficiently wide, however, to afford a passage for the waters, except during freshets, when they flow over the highest barriers. The whole height of the fall is a little over 100 feet.

The descent from this point to Lake Superior, including all the falls and intermediate rapids, is 389 feet. A very correct idea of the general descent of the river may be formed by tracing the line of separation between the shales and clay beds, and the shales and sandstones, on the geological section before referred to.

There is a remarkable thickness of sands and red marl overlying the metamorphic rocks and red sandstone series on this river. Immediately in the rear of the fur company's store, these beds are 168 feet above the level of the river, and 158 feet above the plat upon which the village is situated. There is a government farm at this place, and I was informed by the farmer that the soil of the river bottoms is exceedingly productive. The tillable land, however, is limited in extent. On the south side of the river, immediately opposite the farm, the bottom is about a mile and a half broad. Its general width from here to the lake I did not ascertain. On occasion of freshets much of this bottom is subject to overflow. A large island which stood a short distance above the trading house, and had been under cultivation a long time, was washed away during the last high rise in the river, and now not a vestige of it remains, except a rocky bar at low water.

I shall reserve such remarks as I have to make on the red sandstone series and underlying rocks of Lake Superior until my next annual report; my object, at present, being more to note the geographical position of the rocks, than their mineralogical characters or geological associations.

CHAPTER II.

RECONNOISSANCE OF A PORTION OF THE DISTRICT LYING BETWEEN FOND DU LAC AND THE FALLS OF ST. ANTHONY.

After remaining six days on St. Louis river, I started on foot, with two half-breeds, Joe Cadotte and Pierre Le Meur, for pack-men to cross the country lying between St. Louis river and the head of Lake St. Croix. Neither of these men had ever been in that section, or knew any thing of the route, and our sole reliance was on the Indian map and my compass to lead us to our destination. From the best information which could be obtained, it was expected that the journey would not occupy more than five days, allowing ample time for making all the observations necessary in such a reconnoissance. In addition, therefore, to the specimens collected on St. Louis river, and the necessary camp equipage, provisions for that length of time were added to the packs;* and on the morning of the 5th of August we crossed the river and started on our journey.

Nearly two miles south of the river, we ascended the high range of hills which bear off towards the south shore of Lake Superior, and entered on what we supposed to be the trail to Lake Pokegoma. Owing to the heavy rains which had recently fallen, the swamps were rendered almost impassable; this, together with the weight of the packs, made our progress necessarily slow.

The bluffs south of the trading post are composed of red sandstone, which crosses St. Louis river between the lower rapids and the post, with a dip to the northeast, and is continued eastward to the boundary line of the district. It was impossible to ascertain the precise dip at this place, nor was it possible to do so at any point on the lake shore between Fond du Lac and Madeline island. It must be very irregular, however, in consequence of the disturbance which has been caused by the protrusion of numerous trap dykes between those points. The thickness of the sandstone at the bluff is 269 feet. It is overlaid, as on the north side of the river, by sand and marl beds.

As no rocks were seen in place between the hills near St. Louis river and Kettle river, and the general features of the section will be described in the chapter on Topography, I shall not transcribe my daily observations on this part of the route, but only allude to some of the incidents which delayed my arrival at Stillwater so much beyond the appointed time, and to some special characteristics along this line of observation.

---

* I must here acknowledge the many favors received of Mr. H. M. Rice, who, on this occasion, furnished me with all the provisions for my journey. I am also indebted to General Verplanck for various kindnesses.

On the morning of the 7th, one of my men was attacked with fever, and was unable to travel from that time more than from five to ten miles a day. And, to add to the difficulty, the trail disappeared that day and no trace of it could be discovered. The route from St. Louis river to Pokegoma has been used principally for winter travel; few even of the Indians passing it at any other season. It runs directly across swamps and lakes, which are impassable except when bridged by ice; while in the most favorable situations, the path is easily obscured by vegetation, and, if disused, soon becomes entirely obliterated.

About twenty miles south of the St. Louis river, quite a number of first rate pines were observed along the route, and, from the indications, it is probable that they extend over a considerable extent of country. The value of the timber here will depend entirely upon the natural facilities for conveying the lumber or logs to Lake Superior. Nothing was ascertained regarding this point. The high grounds in this neighborhood are covered with an excellent growth of sugar maple.

About thirty-five miles, as nearly as I could judge, south of Fond du Lac, our trail crossed a high, rolling section of country. A good deal of it is prairie, covered with whortleberry bushes and strawberry vines; while, in the low grounds, hazel abounds. On parts of the route the ground is literally covered with boulders, mostly of white, fine-grained granite. Small pine, birch and shrubby oak succeeded, with strips of sugar maple. This brought us to the top of the water shed. From this point to Kettle river the country presents a succession of small lakes, swamps, meadows and ridges, covered with birch and small pine.

We reached Kettle river on the evening of the 9th, entirely destitute of provisions, my men having imprudently given a portion of the small stock with which we started to an Indian met with on the way. My gun was now the only dependence for food.

Kettle river is about sixty years wide at the point where we struck it, and is, apparently, deep enough to float a steamboat. It is full of boulders, however, and hardly navigable for canoes.

At this place the sandstone shows itself on the right bank of the river, twenty feet in thickness. According to information derived from an Indian, this point is six miles above the falls of the river. The sandstone continues to show itself in the hills for several miles; and then our way lay through swamps and wet meadows for some distance. About ten miles south of the river a succession of maple ridges were passed, with a deep rich soil. This strip of land, however, is believed to be narrow.

Beyond these ridges the sandstone again comes to the surface, and shows itself, at intervals, for the space of several miles. It is covered, generally, by a soil equal to any in the lake region.

About sixteen miles south of Kettle river I passed through a fine pinery, which extends as far as lake Pokegoma. A great portion of this pinery remains untouched; many fine trees, however, have been cut on the small tributaries of Snake river. Some of the valleys in this region are literally covered with boulders, while the ridges bear a dense growth of birch, linden, box-elder, and fir, with large pines.

At 2 o'clock, p. m., on the 12th, we reached lake Pokegoma, having been seven days in traversing a country which, I have been told, has been passed over by Indians in thirty-six hours' constant travel, when the lakes and swamps were frozen. Our route, so far, was an exceedingly winding one, having often been turned aside from our course by lakes and swamps, and compelled to walk many miles to avoid them.

When we reached Pokegoma my sick packman was entirely exhausted, and he was left on the north shore of the lake, while I went on to the Indian village for the purpose of procuring a canoe to transport him across the lake. After considerable delay, the Indians all being drunk, a canoe was obtained, and we crossed the lake to a house belonging to Mr. Russell, who was formerly government farmer at this place. Mr. Russell's agent supplied me with pork, flour and potatoes.

Next morning I procured a passage in a canoe about to descend Snake river for my sick man, and having hired a half breed youth to carry a part of his pack to the mouth of Sunrise river, while I added the remainder to mine, at 2 o'clock, on the 13th, we entered on the trail to St. Croix river. The country between Pokegoma and the St. Croix, along this route, is an excellent one. The principal timber is sugar maple, poplar, oak, ash, walnut, elm, hornbean, and some birch and pine. Between some of the low ridges wet meadows occur, but most of them are sufficiently dry, at the proper season, for mowing.

Four or five miles south of the crossing of Reed creek, small prairies began to appear, interspersed with occasional wet meadows; the high intervening prairie lands supporting a thin growth of oak timber. About five miles before reaching the mouth of Sunrise river, the character of the country is entirely changed; and, from the nature of the soil and vegetation, I judge this to be on the northwestern boundary line of the lower sandstone region.

At this place I had the pleasure of meeting one of the sub-agents attached to the geological corps, Mr. A. Randall, on his way to Lake Superior. He returned with me to the falls of the St. Croix, from which point I hastened to meet you at Stillwater.

After receiving further instructions from you at Stillwater, I crossed the country to St. Paul's, St. Peter's, and the falls of St. Anthony, for the purpose of making barometrical observations. I returned to Stillwater on the 25th of August, and on the morning of the 27th started on my return to Lake Superior, with the view of examining the eastern line of the district, from Lake Superior to its southern termination. In this reconnoissance I was accompanied by Mr. W. F. H. Gurley; and I take great pleasure in mentioning here his uniform gentlemanly deportment, and attention to the duties assigned him, while associated with me.

We proceeded by land to the falls of the St. Croix. At that place we procured a canoe, and ascended the river to Upper St.

Croix lake. From thence we made a portage to the head of the Bois Brulé, and descended that river to its mouth. Here we were detained two days by high winds, and then proceeded to Madeline island, where we arrived on the 11th of September.

During this journey I made a great number of barometrical observations, the result of which is laid down on the chart of elevations. The geological observations made between the falls of the St. Croix and the mouth of the Bois Brulé, cannot be prepared in time for this report; nor is it essential that it should be done now, as you had previously passed over the same ground yourself.

NOTE.—In the following chapter, in obedience to the suggestions of the department, I have incorporated a great deal of matter, such as is not usually introduced into scientific reports. The object is, to give as much information as possible with regard to the character and capabilities of the country.

CHAPTER III.

RECONNOISSANCE FROM THE MOUTH OF MONTREAL RIVER, VIA LAC DU FLAMBEAU, AND THE HEAD WATERS OF THE WISCONSIN RIVER TO PRAIRIE DU CHIEN.

We remained at La Pointe five days; the time being devoted by the men to rest, and by ourselves in procuring supplies for our journey to the Mississippi.

On the 18th September we left La Pointe for the head waters of Wisconsin river, carrying with us provisions to last us to Prairie du Chien; or, at least, until we could reach the first settlement, which, we were told, was at "Big Bull falls." X I camped at the mouth of Bad river, and sent one of my men to the mission, four miles above, for the purpose of procuring another man. He returned after dark, with the intelligence that an Indian would be down in the morning, to assist in making the portage. It was with great difficulty an extra packman could be procured, to assist in making the portage of forty miles, from the mouth of Montreal river to Portage lake. At this season of the year, the fur company employs all the voyageurs to be had, in carrying goods to its trading posts in the heart of the country.

September 19.—After leaving the mouth of Bad river, the lake shore consists of sand banks for about three miles. Back of the sand hills, meadows, swamps, and lagoons extend for some distance, until the general level of the Bad river bottoms is reached. Some of the meadows are regularly mowed for hay by the citizens of La Pointe and of the mission. The marl banks then approach the lake shore, and gradually increase in height to the mouth of Montreal river, which we reached on the 19th, at 11 o'clock.

At this point is a fine exposure of sandstone, conglomerate, trap, and amygdaloid, exhibiting every indication of the most violent disturbance. The bearing of the range is N. W. and S. E. The intrusion of the dyke has thrown the sandstone strata into a nearly vertical position, the dip ranging from 71° to 85°.

Following the windings of the river, the shores are made up of perpendicular walls of red sandstone, shale, conglomerate, compact trap, and amigdaloid, for the distance of three miles. At the shore of the lake there are alternations of shale and compact sandstones, the first in beds of from thirty to sixty feet, with laminæ from half an inch to two inches in thickness, of greenish colored bands, from one to three inches thick, running through it in the plane of stratification, and all degenerating into "marl," upon exposure to the weather. The second, or compact variety, occurs in layers from five to eighteen inches in thickness. The compact beds are from two to four feet thick, and show "ripple marks" between all the layers.

The red sandstone effervesces in contact with acids, as does, also,

X now Wausau! : T 29

the red marl, which overlies it. The green bands, both soft and hard, show no reaction with acids. The green sandstone is coarse, and occasionally pebbly, with very deep red spots disseminated through it.

About two yards from the lake shore the river falls in two cascades, of about forty feet each, over the edges of the tilted sandstone. The cascades are about sixty feet apart. There is little or no variation in the dip of the strata as far as the top of the falls. From this point to the Upper Falls, a distance of nearly three miles, following the windings of the river, and about a mile and a half in a straight line, the banks are made up of alternations of sandstone, shales, conglomerate, amygdaloid and trap, ranging from thirty to ninety feet in width, with a dip of from 75° to 85°, and in some places the rocks are vertical. The Upper Falls are very picturesque, and consist of two cascades, about forty yards apart, each cascade having a fall of thirty-six to thirty-eight feet.

As it was not designed to make a detailed examination of this region the present season, I sent the packmen on the trail, as soon as possible after reaching the mouth of the river, with instructions to camp at the most convenient spot near the crossing of Montreal river, while I remained to make barometrical observations. On hastening to reach camp late in the evening, I fortunately left the trail by a path leading to the copper mine near the Upper Falls, and by this means fell in with Mr. Whitney and corps of the Michigan survey. It was now dark, and I heard signal guns from our camp. I started without a trail, or a ray of light to have seen one had it been there, through the woods in the direction of the signals. After an hour's wandering through a very dense forest, with undergrowth and fallen timber, in which I had, literally, to feel my way, I reached the camp at the "crossing" of the river. The Indian from Bad river had reached our party soon after I left in the afternoon, so that we had now a sufficient force to make a single portage, by which two-thirds of the time required for a double portage would be saved, as the ground would only have to be passed over once instead of three times.

September 20.—After an early breakfast, Mr. Gurley with the men started in the trail to Portage lake, while I remained behind for the purpose of seeing Mr. Whitney, and of making measurements. At 11 o'clock I crossed the river and started for the head waters of Wisconsin river. At the crossing, the trap is exposed in the bed of the river, crossing it in a low range, bearing N. W. and S. E.

The country ascended all the way to-day in a series of ridges, with wet, and, in some instances, swampy valleys intervening. The soil of the hills is of a reddish black color, and looks rich, while that on the slopes and in the valleys is deeper, and has every appearance of being equal to any trap soil in the district. It is all derived from the trap and red sandstone rocks.

Although the low lands are now wet, yet with drainage, which might be easily accomplished, they would be dry, and fit for all agricultural purposes suited to the climate. The principal timber is pine, of good size, sugar maple, ash, poplar, box-elder, oak, spruce and hemlock. Two creeks were crossed to-day, at the second of which, *Rock creek*, we camped. About fourteen miles south of the lake, the trail winds around the base of a ridge called Spruce hill, five ~~thousand~~ and sixty-one feet above the level of Lake Superior, and forms part of a range in which sandstone, amygdaloid, greenstone, and sienite, show themselves. The soil is covered for the space of a mile, with fragments of these rocks, with sharp points and angular edges. A sparse growth of bushes, with a few scattering pines, is the only vegetation on it. Our camp at Rock creek was six hundred and sixty-four feet above the level of the lake.

September 21.—Rock creek is full of boulders; hence its name. The country after leaving camp is well timbered, with hard and soft woods of good size. On the gentle slopes, and in the valleys, a good many boulders are met with; but not in sufficient numbers to interfere materially with cultivation, should the land be wanted for that purpose. It may be remarked, as a general thing in all this section, that the north sides of the hills and ranges are much steeper than the south. In many places the north side exhibits mural escarpments, from thirty to forty feet high at the base, with a slope to the summit, but always more abrupt than the southern exposure.

About four miles from camp, came to an exceeding bad tamerack swamp, and half a mile further on, to a range one thousand and seven feet high, bearing northeast and southwest, with a dip of 53° to the southeast. This range is made up of altered or metamorphosed sandstone, hornblende, and trap. The southern slope of the ridge exhibits hornblende slate, altered sandstone, greenstone, and granite. This range is one thousand one hundred and fourteen feet above the level of the lake. Four miles south by east, we crossed a small stream, called "Bare Rock" river, running at the northern base of an outburst of trap through sienitic granite, bearing northeast and southwest, and parallel with a range on the other side of the stream, which is well defined when seen from the top of this range. Numerous veins of quartz traverse the granite, running, generally, east and west. Some of these veins are colored by oxide of iron, and in one of them many small crystals of galena were seen. The granite is overlaid on the north by hornblende slate. In the next two miles two other ranges cross the trail, the structure of which is in every respect similar to that last described, the prevailing rocks being sienitic granite, with dykes of greenstone traversing it. Half a mile further, there is an outburst of feldspathic granite, overlaid by gneiss. The gneiss has a dip of 40°, and is traversed by many nearly vertical granite veins, from three to fifteen feet wide at different points of exposure. This point is nine hundred and fifty-four feet above the level of the lake. The principal growth seen to-day was sugar maple, with undergrowth of the same; a few oaks were scattered through it, with some soft woods; and in the swamps and low grounds, tamerack and cedar.

September 22.—Soon after leaving camp this morning, I passed over numerous fragments of amygdaloidal trap, and large angular fragments of red sandstone, in such quantities as to show that the rocks from which they were derived cannot be far distant. The country ascends gradually from this point, for the distance of four miles, over a succession of low granite ridges, some of the granite being finer grained than any before met with. Numerous fragments of red sandstone were scattered over the hills and valleys.

About seven miles from the camp of last night, we came to a deposite of "drift," from fifteen to twenty feet high, composed of sand, with pebbles and small polished boulders disseminated through it. It rests on the southern slope of a granite range, north of Spruce river, and appears to dip conformably with the rocks on which it rests.

Spruce river is twenty feet wide at the crossing place. There is a fine exposure of reddish granite on the south bank, in a hill one hundred and seven feet above the level of Lake Superior. On the north shore, at the water level, it is grey, very micaceous, and contains but little feldspar.

Two miles from Spruce river brought us to the crossing of the west fork of the Montreal river, where we concluded to camp.

Most of the route to-day was over a rolling country made up of rather low granitic ridges, with almost innumerable fragments of disintegrating sandstone scattered over it. The prevailing growth was sugar maple, with undergrowth of the same; oak, poplar, birch, and linden, on the ridges; with tamerack and cedar in the wet valleys. Just before reaching the river, a ridge one hundred and seven feet high crosses the trail, covered by a growth of small pines. Except on the summit of the ridges, the soil is at least equal to second rate. Although, as a general rule, soils derived from granitic rocks are thin and unproductive, in this section they are rendered comparatively rich by transported materials, and by the decomposition of the red sandstone, which is scattered over nearly the whole route travelled from the lake to this place. The crossing of Montreal river is nine hundred and sixty-three feet above the level of Lake Superior.

September 23.—Montreal river is about twenty-five feet wide at this point, and three feet deep. It has been bridged in a rude manner by the engagés of the American Fur Company, who have, for many years, transported goods over this route to the small trading posts established among the Indians at Lac du Flambeau and other points in this direction. We crossed at 7 o'clock, and commenced ascending hills of slight elevation, apparently made up of granite boulders, until we reached a ridge one thousand and seventy-eight feet above the lake.

One mile beyond this station we reached the summit of the highlands, dividing the waters of Lake Superior from those of the Mississippi. At least it appeared to me to be the highest point on the route. I could not verify this opinion, however, for, half an hour before reaching it, I was so unfortunate as to slip from a root in the trail, and in the endeavor to save my barometer, struck it against a tree and broke it. No one except those who have met with similar misfortunes under like circumstance can imagine the feelings experienced by me when this accident occurred. It was a great gratification, however, to reflect that I had preserved it long enough to get measurements from the lake to this point.

The ridge which I supposed to be higher than the one on which the last barometrical observations were made, exceeds that, as near as I could judge, by about forty or fifty feet, and I have so estimated it in the section of this route. The level of Portage lake, which we reached a few minutes before 10 o'clock, is, of course, a mere estimate, made from observing the general slope of the ridge, and noting the distance walked in reaching it.

From Montreal river to Portage lake, a distance of six miles, no rocks were observed *in situ*. Both hills and valleys are covered with boulders of crystalline rocks, principally granite, intermingled with fragments of red sandstone and hornblende slate. The hills are covered with a growth of small timber, mostly pine, with some maple, oak, and a few aspens, while the valleys support a tolerably good growth of sugar maple, with undergrowth of the same. Within the last two miles, a number of small ponds were seen, a feature which, though very common in other sections, had not been observed before on any part of this route.

At this point the long portage ended, and, after discharging the extra packmen, and furnishing them with provisions, we set about preparing for our journey to Lac du Flambeau. We expected to obtain here a canoe belonging to a man living on Wisconsin river. He was at La Pointe when we left, and obligingly offered us the use of it as far as the mouth of Maple river, stating, at the same time, he would send an Indian who knew its place of concealment, and would discover it to us. Early in the afternoon the Indian arrived, with the intelligence that our obliging friend had instructed him not to show us the canoe, but to *cache* it in a new place, where we could not find it. We were thus deprived of the means of transportation upon which we had relied from the moment of leaving Lake Superior. We had now left the alternative of making a further portage to Lac du Flambeau, over a region only traversed by the Indians in the winter, when the rivers, swamps, and lakes are frozen and passable, or of waiting until some straggling Indians should arrive with a canoe which could be purchased.

Fortunately, however, the men, in examining the lake shore, discovered a small canoe concealed among the bushes, and, under the circumstances, we determined to follow the custom of the country, in like exigencies, and appropriate it to our own use without waiting to consult the owner, who was supposed to be an Indian left sick at Madeline island. The canoe, though entirely too small for our purpose, being intended for only two persons, was perfectly new, and of excellent model, and by judicious stowage, it was supposed capable of answering our purpose until we could procure a larger one.

September 24.—The early part of the morning was spent in arranging our provisions and luggage to the best advantage in the small canoe. About 8 o'clock, we left the head of Portage lake, which is from two hundred to four hundred yards wide, and four miles long. We had proceeded about two miles, when we observed a canoe approaching us containing a young Indian. Contrary to the usual custom, he gave us no salutation as he approached, but, paddling swiftly along side, grasped the canoe, and claimed it as his property. After being made acquainted with the circumstances which induced us to take it, he expressed himself satisfied, and, after considerable hesitation, agreed to sell it for about three times its value, which we declined giving. Whatever may be thought of the simplicity of the Indians when bartering in the frontier villages with the whites, I have always found them not only acute dealers on their own soil, but ever ready to seize the slightest occasion for extorting money or provisions. In the meantime two other canoes came up, and we finally succeeded in purchasing an old one, a little larger than the one we were in, for the price of a new one. It took but a few minutes to exchange loads, and we were soon floating down the lake in our own vessel, secure for at least as long a time as the bark would hold together.

After leaving Portage lake, we passed a series of small lakes, connected by shallow, winding streams, with numerous granite boulders in their beds, and finally entered Big Turtle lake, from the east side of which there is a portage of about six hundred yards to Little Turtle lake. At this place we camped just in time to escape the rain, which had been threatening to fall all day, and now came down in torrents.

The country around these lakes, in its general features, differs from that north of the dividing ridge, in having a more sandy and lighter soil, while the conical hills have disappeared, and in their stead there are gentle swells, with dry valleys intervening, and all covered with a dense growth of hard and soft woods, showing the capability of the soil for supporting a luxuriant vegetation of a character suited to the climate.

September 25.—Turtle portage is an excellent one, over the plain lying between the two Turtle lakes. At the east end of it is an Indian village, inhabited during the summer months by one of the Chippewa bands. At present it is deserted, the band having gone north to their winter hunting grounds. Potatoes and corn are raised at this village. The soil is underlaid by fine drift, with occasional large granite boulders disseminated through it. Along the shores of the lakes, sections of drift from ten to twenty-five feet in thickness are exposed.

The outlet from Little Turtle lake is through a very narrow channel connecting it with another lake, which we crossed, and came to the beginning of what is known as "Six Pause portage." As the voyageurs had to make a double portage, we took our packs and walked on to its termination, at the east branch of the Chippewa river, or as it is commonly called the Manidowish, where we arrived at noon. The trail runs over a sand barren, with the exception of the last half mile, which runs through one of the worst tamerack swamps I have ever seen. A few stunted pines, with occasional patches of coarse grass, is the only vegetation supported on the high grounds.

The Manidowish river at this point comes from the northeast, is deep and clear, about thirty feet wide, and winds through the centre of a broad wet meadow, with grass from two to five feet high. After the portage was made, we descended the river four miles, though probably not more than one mile in a direct line from the portage to a favorable place for a camping ground.

September 26.—The river is exceedingly crooked, and from forty to fifty feet in width from the camp to the mouth of Lac du Flambeau river, a distance of about three miles. Where the bends of the river approach the margin of the meadows, the banks are from four to six feet high, and composed entirely of a yellowish coarse sand resembling very much that found on the Chippewa below the Dalles. Soon after entering Lac du Flambeau river, which we ascended to the lake of which it is the outlet, large boulders began to show themselves, some of them of great dimensions. One which was examined measured fifteen feet in the long diameter, twelve feet in the transverse, and stood seven feet out of the water. It was composed of mica slate, and studded with garnets of small size.

Just before reaching a range of hills, the river runs through what was once evidently a large lake, now elevated and overgrown with aquatic grasses. Through this the river flows in many channels, some of them fifty yards wide. This alternate widening and narrowing of the river occurs all the way to the lake. The trunks of hundreds of dead tameracks are standing in all the spaces between the channels, and give a peculiar air of desolation to the scene, only partially relieved by the evergreens on the distant highlands.

About three miles above the mouth of Lac du Flambeau river, in a direct line, we came to a range of low hills on either side of the wide meadows through which it flows, which gradually recede until they reach the height of from forty to eighty feet. One mile higher the rocks show themselves in place, and are composed of quartz rock, granite, and mica slate, with innumerable garnets disseminated through them. Disthene, tremolite, and crystals of hemalite were also abundant in the schist. The slate dips 37° to the southwest. The rocks are in parallel ridges, the summits of which are from one to two hundred yards apart, and becoming more elevated as they trend to the northeast and southwest. The ridges are bare, with the exception of an occasional bush, and in the intervening valleys only a little coarse grass is found.

Shortly after passing this range the swamps again show themselves, and continue on either side of the river up to Lac du Flambeau. The river is exceedingly crooked, its general course being S. S. E. We reached the lake late in the afternoon, and, crossing its north-west arm, camped near the old trading house of the American Fur Company, now deserted.

September 27.—From this point we had to find our way to the head waters of Wisconsin river, without a guide, or the slightest knowledge of the country through which we were to pass. The aid afforded by Mr. Nicollet's map not being of a reliable character for this region, I sent Baptist to the Indian village to procure such information as would enable us to reach Vieux Desert lake, or its vicinity, with as little delay as possible. While he was gone, an Indian whom I knew very well, having met him at Madeline island in July, and afterwards at Fond du Lac, came to our camp; and from him we learned that there are three routes from this lake to Wisconsin river. One of them is by a chain of lakes south of this point, and leading into the Little Wisconsin through White Squirrel creek; another by way of Leech, Kewaykwodo and Swamp lakes; and a third through a series of lakes towards the head waters of Manidowish river, and thence, *via* Trout lake and a series of small lakes, to Vieux Desert lake; which last route might be changed about twenty miles southwest of Vieux Desert, so as to enable us to strike the Wisconsin ten miles south of that lake. The first route is the one usually followed by the traders in their journeys from the posts on the Wisconsin to La Pointe. As it would, however, lead us into the Wisconsin too far south to subserve the purposes of the survey, we decided upon the route by Trout lake.

Finding "Puzigwingis," the name of the Indian alluded to, intelligent, and willing to impart any information we might desire with regard to the country, in order to test his abilities I got him to draw a map of our route from Lake Superior to this place, and finding it agreed in every respect with our own observations, I determined to remain in camp to-day, for the purpose of procuring from him an outline map of the surrounding country, and particularly of the part to be traversed by us. He spent about half the day in executing our wishes, and so far as I am able to judge of the whole by the part that fell under my immediate observation, it is quite as accurate as it could possibly have been made by any one having no knowledge of the principles upon which maps are constructed. The only valuable purpose which it can subserve, however, is that of a guide through a very intricate wilderness, until accurate surveys are made; but even that is a desideratum in a country where there is such a multitude of lakes and impassable swamps to impede and turn one aside from a course which might otherwise be followed from a knowledge of the general bearing of known points.

Lac du Flambeau is the largest body of water we have seen in this region. It is exceedingly irregular in its outline, resembling rather an assemblage of several small lakes, united at one point by short narrow channels. It has a number of thickly wooded islands dotting its surface. The shores recede with a gentle slope, to the height of twenty and thirty feet, and are covered at some points with bushes and grass, and by a dense forest at others. The soil, like that in the neighbourhood of Turtle lake, is a light sandy loam; and, judging from its general appearance, would hardly attract the attention of a cultivator. The Indians, however, who have a village on one of its shores, raise excellent potatoes, better indeed, than are usually grown, with all the aids of cultivation, in the valley of the Ohio The arm of the lake, near which we encamped, is called by the Indians, *Pokegoma*; a name given to any lake connected with another, or with a running stream, by a very short outlet.

September 28.—The Pokagoma arm of Lac du Flambeau, which we crossed this morning, is about three and a half miles long by half a mile in width. It abounds with fine fish, which the Indians take in great numbers in gill nets and with the spear. From the northeast shore of this lake a portage of half a mile, over sand hills, covered with small pines and elevated about thirty feet above the general level of the small lakes, leads to Lake Wepetangok, which we crossed in a high wind. This lake is about two miles long, and our course across it was northeast to a small channel, four feet wide and eight yards long, which led us into another small lake three-fourths of a mile long and half a mile wide, which we crossed northeast to a portage of one mile in length, leading to Mashkegwagoma lake. This portage passed over hills of the same character as those seen in the morning.

We waited sometime on the shore of this lake for the wind to subside, and at noon started across. By the time we had made two-thirds of the passage the wind increased to a perfect gale, and wave after wave, which ran almost as high as I have ever seen them in Lake Superior, broke over our canoe until it was more than half full of water and in momentary danger of sinking. By great exertions the men succeeded in reaching the borders of a small island, and we dragged the canoe into a marsh. Everything was thoroughly soaked, with the exception of my note books, which, very fortunately, were secured on my person. A fire was built in a spruce thicket, the highest part of the island, and we set about drying our persons, clothes, maps, and instruments. As the wind continued high all the afternoon we were forced to camp on the island. The lake is about two and a half miles long and one mile and a half wide, a very small sheet of water to afford so heavy a swell. Our misfortune is to be attributed, however, more to the size of our canoe than to the roughness of the lake.

September 29.—Crossed to the main shore, and made a portage of a mile and a half, to the Chippewa or Manidowish river. The trail, for nearly the whole distance, leads through swamps flooded with water almost ice cold. The river at this point is about forty feet wide, winding to the northwest through marshes like the one just passed.

Had it not been desirable to visit Lac du Flambeau, we might have reached this point by ascending the river from "Six Pause portage," through "Cross" and other small lakes; and this was the route pursued by Mr. A. B. Gray and party in 1846, as I have since learned. I knew nothing of the route, however, until I reached Lac du Flambeau, when I learned it from Puzigwingis. It is the one commonly followed by the Vieux Desert and Trout Lake Indians in passing from their villages to La Pointe, and is in every respect preferable to the one pursued by us, for persons wishing to pass from the head of Wisconsin river to the neighborhood of Montreal and Bad rivers, or to any point northwest of Lac du Flambeau.

While the men were sent up the river with the canoe, Mr. Guerley and myself took the trail for Trout lake. The portage is an excellent one, about four miles and a half long, and passes for distance over a sandy plain supporting a few scattering pines. The surface of the ground is literally covered with the wintergreen, and the general features of the landscape resemble very much those seen in the neighborhood of Lac Court Oreille. About half way the portage we ascended a hill of drift between forty and fifty feet in height, with a great number of crystalline boulders and a few large fragments of sandstone scattered over it. From the top of this hill a range of highlands were seen in our rear, distant eight or ten miles, bearing northeast and southwest. From their position and course we judged them to be a continuation of the range seen in ascending Lac du Flambeau river. The drift continues on the Trout lake.

About one mile before reaching the lake, the river becomes very shallow, and is so much obstructed by boulders as to require a portage to be made. There is an Indian village at Trout lake which is only occupied, however, during the summer and fall months. They have gardens for corn and potatoes at this place, though their principal dependence for food is upon the lake, which yields them a plentiful supply of fine fish. The few Indians now here were preparing to depart for their hunting grounds. Oshtawabanis, head chief of the Wisconsin band, came to our canoe and begged some flour, in return for which he sent us a lot of very fine potatoes, a most acceptable present, as more than two-thirds of the provisions which we had brought with us from La Pointe were consumed, and we had not yet performed more than one-third of our journey.

Trout lake is seven or eight miles long by about four miles wide, and contains a number of small islands. It is surrounded by drift hills, from twenty-five to forty feet high, supporting a sparse growth of small pines and birch. Our course across it was northeast, to a trail leading to Lower Rock lake. We camped on the trail a short distance from the lake. At six o'clock, p. m., the thermometer stood at 31° Fah., and our tent and baggage, which had got wet in crossing the lake, were frozen.

September 30.—Ice formed one-fourth of an inch thick last night. The portage between Trout and Lower Rock lakes is about two miles and a quarter in length, and runs along the base of drift hills. These lakes are connected by a small stream, not navigable for canoes. The lower lake is about half a mile in diameter. A portage of three hundred yards leads to Upper Rock lake, which is one mile in its largest diameter, and contains a number of small islands. These lakes are also connected by a small stream. They derive their name from the immense number of boulders which line these shores, and show themselves above the water in the shallow parts. The islands in the upper one are made up almost entirely of boulders, with a thin soil covering them, and supporting a few small trees. Some very large masses of sienitic granite,

T 41 R 6+7 E

hornblende, and greenstone, with smaller ones of amygdaloid, were seen near the east end.

We had great difficulty in finding the portage from this lake. It begins on the northeast shore, and is about two and a half miles long. Its course is nearly due east, passing a good part of the distance along the margins of cranberry marshes. Three small ponds were passed in the first two miles. They are connected by a small stream flowing into Upper Rock lake, and which is navigable for canoes up to the second pond. From this point a portage of every thing has to be made to Lower White Elk lake. The country passed over yesterday and to-day is made up of drift hills, from twenty to sixty feet high. The sand is white and coarse, while the boulders, which are disseminated through the upper part, were derived almost entirely from granitic rocks. The soil is thin, but supports a growth of small pine, poplar, birch, spruce, hemlock, fir, a few oaks, and some bass wood; the swamps, as usual, being filled with tamerack, or, where that is wanting, over run with cranberry bushes.

Lower White Elk lake, where we camped, is about three-quarters of a mile long, and a quarter of a mile wide. Here we found a number of deserted wigwams and the remains of a garden. The lake affords great numbers of fish, and the quantity of their remains scattered around shows they are the principal article of food among the Indians who occasionally inhabit it.

October 1.—A very heavy frost this morning; the thermometer standing at 25° Fah. at half past six o'clock, We crossed first White Elk lake, and, by a stream twenty feet wide and a quarter of a mile long, passed into second White Elk lake, which is about two miles long and one mile wide. From this we passed into third White Elk lake, by a river ten yards wide, and three hundred yards long. This lake is nearly circular, and about one mile in diameter. It is very shallow, not having a depth of more than three feet at any point, with a mud bottom. We noticed here a phenomenon, not hitherto observed in any of the great number of small lakes we have seen in the territory. The whole surface of the lake was covered with bubbles of light carburetted hydrogen gas, which was constantly ascending from the bottom.

From this lake, a portage of a quarter of a mile brought us to the fourth White Elk lake. The portage leads due east, over drift, covered with a better soil than any met with for several days past. It supports a tolerably good growth of sugar maple, birch, oak, poplar, and a few pines. This lake is a beautiful sheet of water, about one mile long and three-fourths of a mile wide. The bottom is covered with pebbles and the shores with boulders, some of which are very large; one of them being over fifty feet in circumference. This is the source of the east or Manidowish branch of Chippewa river; all the lakes and streams beyond this point, which send their waters to the Mississippi, being tributaries of the Wisconsin. The hills, bounding the north and east shores, are about one hundred and fifty feet high, and are composed of white sand, with occasional boulders scattered over the surface. Almost all the boulders seen, for the last three days, were granitic and small. To-day, however, at the fourth Elk lake, boulders of other rocks were plenty, and, from the size of some of them, I infer that the source from which they were derived is not very distant.

The portage to the head waters of Wisconsin river starts due east from this lake. In about half a mile the trail divides, the left hand branch leading directly to Vieux Desert lake, the other to a small lake which discharges its waters into the Wisconsin, about ~~ten~~ 8 miles in a direct line south of Vieux Desert. We determined to take the shortest route, principally on account of the little provisions we had remaining, and the certainty that they would be exhausted before we could reach any point where supplies could be had.

The portage is about six miles long, over a high, rolling pine country, which does not afford a drop of water, from the upper White Elk lake to within a quarter of a mile of the end of the portage, where a small stream, ten feet wide, from the northwest, crosses the path. I did not reach Muscle lake until sunset, and before I came in sight of it I heard the voyageurs singing and firing guns. They were rejoicing on account of having reached a tributary of the Wisconsin, and that long portages were over for this year.

The high and broad strip of land which divides the waters of the Chippewa from those of the Wisconsin is made up of white sand, with small boulders thinly scattered over the surface. The pines with which it is covered are small, but very tall and straight, many of their trunks rising fifty or sixty feet without a branch. On some of the higher hills a great many small birch were seen; and in the vicinity of Muscle lake, the sugar maple began to appear.

October 2.—The ground was whitened by a heavy frost, and the atmosphere cool and bracing. Muscle lake, upon which we began our voyage to the Mississippi, is about one mile long and rather more than half as broad. A small stream, about one hundred and fifty yards in length, led us into another lake, rather more than half a mile in diameter. It discharges its waters into the Wisconsin river, through a small creek, from one to five yards wide, running east. The creek is very shallow, very crooked, and much obstructed by drift wood, but without a rock of any description. Its whole course is through swamps, bordered by sand banks, covered with pine. The banks have quite a reddish appearance, although the sand in the bed of the river is white. The entire bed of the creek, in many places, is covered by several species of unio.

At half-past 12 o'clock we entered Wisconsin river, which is twelve yards wide at the junction and from three to four feet deep. Its course is south for several miles, but gradually changes to southwest, which was the prevailing course during most of the afternoon. We encamped about eighteen miles below the mouth of Muscle river, although in a direct line, probably, not more than six or seven miles, as the river is remarkably crooked. It is from ten to fifteen yards wide, and is occasionally obstructed by driftwood. We did not see a rock or pebble of any kind, until just before reaching our camping ground, when a solitary boulder showed itself; and, a few minutes afterwards, the shores were found lined with pebbles, washed out of the banks, which are composed of sand, and are from three to twenty feet high, and covered with pine, fir and spruce, with a few aspens and small birch. The low grounds, which frequently intervene between the river and the high banks, support elm, and, where very low, tamerack in abundance. The margin of the water is overhung by alders and the bush cranberry. At one point the drift was seen resting on a bed of reddish colored indurated clay. The banks, where slides have taken place, present all the appearance of stratification, with a dip to the south greater than the fall of the river. A few first rate and many second rate pines were seen.

October 3.—We left camp at 8h. 30 min. this morning, and at 1h. 30 min. reached the first rapids. They are made by a low range of gneiss and gneissoid granite, bearing northeast and southwest, and are half a mile long. The fall is not very great, but the navigation was rendered rather difficult by the great number of boulders, some of them very large, which cover the bed of the river for nearly the whole distance. Above the rapids the river is fifty yards wide, below them it contracts again to thirty yards in width.

Three other rapids occur in the distance of one mile and a half. The first one is short, but difficult to pass. The river is divided by a small island at the foot of the rapid. The channel for canoes is on the east side of the island. The second one is made up of granite, with gneiss resting on it; and the third of gneiss and hornblende. In the forenoon the river was much obstructed by drift wood, and very crooked, except in the vicinity of the rapids, where its channel lay, for some distance, between the elevated ridges of rock. The country for a short distance above and opposite these rapids is open, bearing thickets of small birch, and a few stunted pines scattered through them. Occasionally, a solitary large pine was seen standing on a sandy knoll, twenty or thirty feet above the level of the river. Below the last rapids the country is made up of sand, apparently destitute of pebbles, with sandy loam on top, and supporting a tolerably good growth of pine, birch and aspen.

October 5.—Ninety-six miles (according to our estimation of distances) below the mouth of Muscle river, we came to a high range of rocks, consisting of hornblende, gneiss, and gneissoid granite. This range is about one hundred and fifty feet high, bearing northeast and southwest. The rapids formed by it have a descent of about thirty feet in a quarter of a mile. The portage path is on the east side of the river, and is about five hundred yards long. At this place we found a squaw with a quantity of dried fish, a most fortunate circumstance, as we had had no meat for the last two days, and the men had been unsuccessful in their attempts to spear fish.

On a small prairie, half a mile from these rapids, I measured a granite boulder seventy-eight feet in circumference, and ten feet high.

The rocks continued to show themselves until, ten miles below the last range, we came to one about three hundred feet high, composed of sienite and greenstone trap, traversed by veins of feldspar, quartz, granite, and titaniferous iron. The granite veins are from two to three feet in width, and porphyritic.

The average width of the river yesterday was from forty to fifty yards. The banks were of sand, from ten to thirty feet in height, and exhibiting, at some points, extensive slides, similar to those seen on the Chippewa, below the dalles of that river.

I made an excursion into the country yesterday, commencing at the foot of a large island, the first one of any size met with in descending the river. I proceeded directly west, and found the country to present a succession of low ridges and tamerack swamps. The ridges are sandy, with a thin soil, and from a quarter to half a mile wide. On the more elevated grounds are some first rate pines, and a great number of second rate ones. I also noticed a greater number of large white birch than I have met with in any other part of the district.

A few miles south of this, the Kewaykwodo portage begins. It passes, for some distance, over a rolling sandy country, which is the general character of the region bordering the river for some miles above and below the beginning of the portage. A narrow strip of small pines lines the banks of the river at intervals; but, as you recede into the country, there are few trees of any size to be seen. Clumps of very small birch and pine are scattered over it. This portage leads to Lac du Flambeau, by way of Swamp Kewaykwodo, Leich, Sheshebagomag. Mishekun, and La Roche qui Traine lakes. Just below the Kewaykwodo portage, the river is filled with boulders, some of which are very large. The portage may be found half a mile above the point at which the boulders first show themselves in descending the river.

The banks of the river to-day were of fine drift, generally from three to eight feet high, and resting on a bed of red clay, the thickness of which is not known, as it only rises from twelve to eighteen inches above the water level. It is stratified, exceeding compact, and in seams about an inch thick. Some of the ridges, sections of which are made by the river, are from fifty to sixty feet high, and composed entirely of sand, with pebbles and a few small boulders near the top.

October 6.—About eight miles below the last high range, we came to one about one hundred and fifty feet high, composed of the same kind of rocks—sienite and hornblende. The rapids at this place are half a mile long, with an island dividing them at the lower end. At the foot of the island the water falls two and a half feet perpendicular. There is a portage path on the east side of the river. One canoe, however, descended the rapids without much difficulty.

There is a succession of small rapids for the next four miles, the rocks showing themselves in the borders of the river, at short intervals, the whole distance. The river is very shallow, very wide, and the bed covered with boulders, many of which are from thirty to fifty feet in circumference. In the afternoon, we reached a point where the river is from four hundred to five hundred yards wide. Up to this point it has been so shallow, below the last rapids, as to allow the canoe to pass with difficulty. Here it is deep, with no perceptible current, and continues so for about six miles, when it is again obstructed by boulders and a succession of rapids, which continue for about eight miles, the rock showing itself in place, at several points, in the middle of the river. The rocks are fine grained granite, hornblende, trap, and porphyritic sienite, in low ranges, all bearing northeast, and traversed by wide quartzose veins. The country, with the exception of the primitive ranges, is, in the immediate neighborhood of the river, mostly broken sand prairie, with a few small pines scattered here and there; occasionally a few shrubby oaks, small birch, and aspen, show themselves. The ridges are densely timbered with hard and soft woods; among which, when the rocks approach the surface, a great deal of fine cedar is found. The river bottoms, which are sometimes from a quarter to half a mile wide, are timbered with oak and elm of good size, or covered with a luxuriant growth of grass.

October 7.—We left camp this morning at 7 o'clock, and two miles below came to a low range of trap rocks, bearing northeast and southwest, and making rapids. One mile below this, we reached the largest rapids of Wisconsin river, known among the traders and lumber men as Grandfather Bull falls. A fine section is exposed at this place. The top of the range is about one hundred and fifty feet above the level of the water, which cuts through the rocks for the distance of one mile and a half. The fall of the water in this distance I have no means of ascertaining. At the upper part of the rapids the river is divided into three chutes, by two chains of rocks, which rise from ten to fifteen feet above the water, and continue for some distance below the commencement. The rocks on the north side of the range are greenstone trap, overlaid by gneiss and hornblende slate, while the lower part of the rapids is made by gneiss, interstratified with mica slate and talcose slate. The stratified rocks above the rapids have a dip of 20° to the northwest. The river falls, for a greater part of the distance, in a succession of small cascades, made by the tilted strata extending across the river in the line of bearing. A few of the cascades are seven or eight feet high, but generally from two to five feet, and from sixty to eighty yards apart. At the foot of the falls, the gneiss and mica slate dip 57° S. S. E.

Four miles below the falls, we reached the mouth of Skakweya or New Wood river; and, much to our joy, found a trading house established there. The person who occupies it intends opening a farm, and has already made a small clearing. We obtained from him some pork and a lot of fine potatoes. As we had been without meat for several days, we found the sour pork quite palatable. The potatoes, which were raised here, are equal to any I have ever seen.

About one mile and a half below the mouth of New Wood river, a number of springs, strongly impregnated with iron, burst out of the west bank of the river. As the springs are but a few feet above low water mark, every rise of the river carries away most of the ferruginous matter deposited; still there is a deposite of considerable thickness lining the shore for the distance of a quarter of a mile. The hill in which the springs originate is about eighty feet high, and extends back from the river from a quarter to half a mile, to a deep ravine, into which springs discharge from the same hill, but present no indication of iron whatever.

At the mouth of Copper Rock river, five miles below the mouth of New Wood river, a trap range crosses the Wisconsin, making an island in the river thirty feet high, known as "Rock island." This range makes dalles on Rock river, several miles above its mouth. The walls of rock at the dalles are from forty to fifty feet high, and, at one point, approach within six feet, through which contracted space the water rushes with arowy swiftness. There is a portage of twelve miles from the mouth of the river to a point above the dalles; the river is then navigable for canoes to the lake, of which it is the outlet, a distance of about forty miles. Greenstone continues to show itself in the river, without forming rapids, for the next three miles.

Five miles below the mouth of Rock river, a farm has been opened by a Mr. Goodrich, on the east side of the Wisconsin. We camped at this place, and were indebted to the proprietor for the first good supper we had had for nearly a week.

October 8.—One mile below Goodrich's, Prairie river comes in from the east, and just below its mouth a range of hornblende trap crosses the Wisconsin, having a local bearing east-southeast and west-northwest, and forming "Beaulieux's rapids. At one point in these rapids there is a fall of four feet, affording excellent facilities for driving machinery. A saw mill is now in process of erection at this place, which will be completed during the winter, and go into operation next spring.

Seven miles below these rapids, near the mouth of Pine river, trap shows itself in the bed of the river, without obstructing navigation. About four and a half miles below the mouth of Pine river, "Trap" rapids begin, and immediately below them a reddish colored, compact, fine-grained granite, shows itself in the banks of the river. Three miles further, a range of hills, from three hundred and fifty to four hundred feet high, and bearing northeast and southwest, skirt the river for some distance. They are, so far as observed, made up entirely of a greenish colored compact, petrosiliceous trap, fusible, with difficulty, before the blowpipe into a colorless enamel, resembling very much some trachytic specimens brought from the Euganean hills, and from the Cantal. This rock extends to within a short distance of "Big Bull" falls, and forms the most southerly range of hills in the eastern part of the Chippewa land district, the corner of which strikes Wisconsin river in latitude 45°, and about six miles above the falls.

We got to the falls a little after 3 o'clock, p. m., and having made the portage around them, which is about one mile, devoted the remainder of the afternoon to procuring supplies for the further prosecution of our journey. It was with the utmost difficulty we could procure a pound of pork, and it was only after having made a number of unsuccessful applications that we found one individual willing to accommodate us. The reason assigned for refusal was the scarcity of provisions at this particular season,—the spring supply being nearly exhausted, and the fall one not having arrived. I was informed that the cost of mess pork at this place, including first cost and the expenses of transportation, is about thirty dollars per barrel, while flour costs from ten to twelve dollars.

The village at the falls consists of a number of very good framed houses; and from its position, with regard to the lumber trade, in connexion with the productiveness of the soil in its vicinity, bids fair to become a place of considerable importance at no distant day. An ffort is being made to lay out and open a road from Green Bay to this place, which, when completed, will materially accelerate the settlement of the country, not only by affording facilities for emigration, but also by reducing the cost of provisions, which, at present, is a serious matter to new comers, who have to purchase almost everything for the first year.

One of the finest pine regions of Wisconsin enters the district at this point, from the south, and extends for some distance above Spirit river. The general character of the lands bordering Wisconsin river from near its source to the neighborhood of "Grandfather Bull's falls" has been indicated. Below that point, from a quarter of a mile to a mile back from the river, ridges, bearing maple and other hard woods, begin and extend back into the country for many miles, while between the river and maple lands good pine is abundant.

The rivers originating in the Chippewa land district, down which logs can be run, are "Rib," "Trap," "Rock" and "New Wood" rivers. On all these streams first rate pine abounds, and on all of them "logging companies" have been established. The country between them is made up of maple ridges, interspersed here and there with marshes. No pines have yet been cut on this portion of the district above New Wood river, but it was expected that a "logging company" would commence operations on it the coming winter. There are from one hundred and fifty to two hundred men engaged in "logging" on the Wisconsin and its tributaries, above "Big Bull" falls, many of them, however, being employed in the land district east of the Wisconsin.

It is impossible to estimate satisfactorily the amount of timber which has been taken from the public lands in this neighborhood, as much of it is cut by the various mills situated below "Big Bull," but some idea may be formed of the pine trade of this region, from the statement that the three mills at these falls have, together, averaged about 17,000 logs a year, for the last six years. As already intimated, much of the timber cut on the Wisconsin and its tributaries above "Big Bull" is floated to the lower mills, while none of that which passes down "Rib" river, which is said to run through excellent pineries, is cut at the upper mills, that river coming into the Wisconsin below that place. I was informed by the oldest mill owner at the falls, that the mills have never been "stocked" until this year, owing to the insufficiency of hands in the pineries. They consequently have not only remained idle during winter, but also a portion of each year during which they could have operated, had sufficient material been afforded. During the last year, however, the influx of hands has been such as to warrant the belief that the mills will be kept in active operation during the whole running season; and the owner already referred to expects to run his mill through the winter, having erected a "percussion wheel" with that view.

Within the last two years, five farms have been opened in the neighborhood of Big Bull falls. The principal crops, so far, have been potatoes, turnips, and oats, all equal in point of yield and quality to any produced in the Union. Wheat has not yet been tried, but the "settlers" seem to think both climate and soil admirably adapted to its cultivation. The farmers meet with ready sale for all their surplus produce at good prices. Potatoes are worth this season from 75 cents to $1 per bushel; turnips 50 cents per bushel, and oats $1 per bushel. Wages in the pineries are from $15 to $20 per month.

"Big Bull falls" are made by a range of sienitic granite, overlying greenstone trap, about 30 feet high, and crossing the river with a bearing E. N. E., and W. S. W. The river is divided by an island, upon which two or three mills are erected. The perpendicular fall of the east chute is about four feet, that of the west chute about eight feet. The rocks have a dip of 24° to the N. W. Camped just below the village.

October 9.—Seven miles below "Big Bull," a high granite range shows itself on the west side of the river, and at several other points, between that and "Little Bull falls," a distance of 13 miles, are exposures of the same rock.

At "Little Bull" there is usually a portage made, three quarters of a mile long, on the west side of the river, but our voyageurs descended the whole rapid in the canoe, with the exception of a few yards at the mill dam. There is no perpendicular "fall" at this place; it is a mere rapid, falling, in its whole length of over half a mile, as nearly as I could judge, about eight or ten feet. The rock is a dark greyish and greenish colored compact sienite. This range is rather low, the rock being elevated, at the highest points observed, only about 10 feet above the water level.

At this place there is a mill which runs four saws. It has been built seven years, and one of the proprietors informed me that the average number of logs cut in a year has been about 6,000. The trees in the pinery here average three logs of ten or twelve feet in length. The country adjacent to the river is rolling pine lands, with oak and elm on the low grounds along shore. Camped about four miles below "Little Bull." From "Big Bull" to this place the shores are lined with logs, nearly all of them clear timber, though second rate in size.

October 10.—Nine miles below "Little Bull" a low range of gneissoid granite is exposed, extending along the western shore of the river for the distance of 150 yards, bearing E. N. E. and W. S. W with a dip of 6° to the S. S. E. The rock is traversed by numerous quartz veins, from one to four inches wide, and running in the direction of the line of strike. The direction of the clearage joints is 15° west of south, and due east and west. The rock is overlaid by twenty feet of fine drift, with a thin soil of sandy loam.

The country is gently undulating prairie, with clumps of very small pines scattered over it.

One mile below this we reached Du Bois's trading house, where we expected to replenish our small store of provisions, but were disappointed, in consequence of the "fall supplies" not having arrived. About five miles below Du Bois's, the greyish colored gneissoid is again exposed for some distance along the west bank of the river, succeeded by a very fine grained reddish granite. The rock is covered here with about ten feet of fine drift, with a thin soil, supporting a small growth of oak, elm, and aspen, on the west side, while east of the river a beautiful undulating prairie extends as far as the eye can reach.

We got to Stevens's Point at 2½ o'clock. The village contains about twenty very good framed houses, several of which are stores. There is also a saw mill here, erected this year. All letters for the upper Wisconsin have to be sent to the post office at this place, from which they are carried to the mills and pineries above by private conveyance.

One mile above Stevens's Point there is an exposure of hornblende slate for half a mile, succeeded by gneissoid granite, which extends for some distance below the village, forming rapids. The bearing of the rocks is N. E. and S. W.

The country in the vicinity of this place is undulating, with a tolerably good soil, supporting a growth of oak, elm, maple, and a few pines.

Two miles further, brought us to Connaught rapids. This point is exceedingly interesting, not only on account of the great exposure of rock, but also in consequence of the foldings and contortions which have been produced in the stratified rocks, at the time of the intrusion of the lower mass. The prevailing rock is a very decompoundable amphibolic gneiss, passing into a highly ferruginous mica slate, green, brown, and reddish grey, in different localities, and associated also with a very light colored granitic gneiss. These rocks all have a vertical dip, and are compressed by lateral force into almost every possible wavelike form. Between the layers of gneiss, veins of feldspathic granite, or leptynite, from six inches to twenty-five feet in width, have intruded at intervals, and, at many points, overlies for a long space the vertical edges of the gneiss. Some of the veins are porphyritic. The direction of the plane of stratification N. W. and S. E. Numerous veins of quartz and of feldspar, from an inch to an inch and a half in width, traverse both the stratified and intrusive rocks, and have a N. E. and S. W. direction. Camped one mile below the commencement of the rapids.

October 11.—There is a fine display of gneiss on an island opposite our camp. It is a grey colored, very fine grained, compact rock, with a few crystals of glassy feldspar disseminated through it, bearing E. N. E. and W. S. W., with a dip S. S. E. of 19°. It is traversed by many granitic veins, following the curvatures of the strata; and these veins are traversed in turn by veins of quartz, from half an inch to an inch wide, having a N. E. and S. W. direction. The gneiss is overlaid for a considerable space, at many points, by a very fine grained reddish colored granite.

About two miles below the Connaught mill, and about one-fourth of a mile below the mouth of Plover river, the gneiss is again exposed, bearing N. E. and S. W., with a dip of 45° S. E. There is no bending of the strata at this place, nor did I observe any intrusive rock. Below the mouth of Plover river, the drift banks rise on the east side of the Wisconsin to the height of thirty and fifty feet above the level of the water; and, at the bends of the river, sand slides occur, precisely like those seen on Chippawa river, some of which are more than half a mile in length. Very few pebbles are mixed with the sand. The country is a rolling sand plain, with a few pine bushes and dwarf oaks scattered over it.

The next exposure of rock is at the commencement of the Grand rapids, about twelve miles below the mouth of Plover river. These rapids are nine miles long. Their "grandeur" consists not in cascades or bold escarpments, but in their length, and the great number of low picturesque rock islands, covered with trees, which dot the river and divide it into numerous narrow channels or chutes. The rock is a very compact feldspathic gneiss, with occasional wide veins of granite traversing it; gradually assuming a true porphyritic character about the middle of the rapids; and, toward their termination, merging into a gneissoid granite; and, finally, at the village of the "Grand rapids," into a fine grained reddish colored granite of precisely the same character with that which overlies the gneiss at Connaught rapids. The bearing of the rocks is E. N. E. and W. S. W.

The village at this place containes a number of good houses, and, from the air of business and comfort about it, I should judge it to be a prosperous one. There are three mills on these rapids, which give employment, directly and incidentally, to a large number of men. The river banks in the vicinity are low. The country is covered with a good growth of oak, elm, poplar, birch, sugar maple and pine.

October 12.—There was a light fall of snow last night, and the sprinkling of pure white on almost every variety and shade of color of autumnal folige, intermingled with evergreens, combined with the wooded island in the distance, the rapids with their rocky projections in the foreground, and the dense forest on either shore, to make up one of the most picturesque and fairy-like scenes imaginable.

The river, for some distance below this point, is full of rock islands, rising from ten to fifteen feet above the water level, and made up of a reddish colored rock, composed of quartz and feldspar, bearing N. E. and S. W., with a dip of 39° to the S. E.

About eight miles below the camp of last night, we reached Whitney's rapids; the rock, during the whole distance, being a feldspathic granite, with little or no appearance of mica in its composition; and, as the rapids are approached, showing a great disposition to decompose on exposure to atmospheric inflence.

The last exposure of granite on Wisconsin river is seen a short distance above the old mill dam, at these rapids, and extends down the river for the distance of a quarter of a mile, gradually becoming more quartzose in character, and at the point where it disappears is traversed by many feldspathic veins, from one to eight inches wide, having a N. W. and S. E. direction.

Above the granite at the old mill dam is a bed of ferruginous argillite, four feet thick, succeeded by five feet of decomposing feldspar, above which is a bed, two feet thick, of well digested kaolin, or porcelain clay, with large amorphous crystals of quartz disseminated through it in veins, and containing a notable quantity of pyrites. Then succeeds a variegated white and yellow sandstone in their laminæ, from the sixteenth of an inch to an inch in thickness, rather coarse grained, somewhat micaceous and weathering easily. Some of the laminæ are green, and the whole dips 4° to the southeast.

A quarter of a mile below the old dam, on the east side of the river, the sandstone forms a mural escarpment of thirty-five feet in height, in strata of from two to eight feet thick. On the west bank, opposite this section of sandstone, the most southerly exposure of crystaline rocks on this river rises to the height of six feet above the water, and is composed of a quartzose granite, containing magnetic oxide of iron.

Two miles below Whitney's rapids is the foundation of a town called "Point Boss," consisting, at present, however, of only two houses. This is a somewhat important place, in a geological point of view, as it is situated near the margin of the great sand region where it crosses Wisconsin river.

October 13.—At 1 o'clock we reached *Petenwell Peak*, thirty miles below Point Boss. The country between these two points resembles, in almost every respect, that seen below the dalles of Chippewa river. The river winds through sands, rising forty and sixty feet above its level, and presenting in its bends extensive slides, from a quarter to half a mile in length. It is very crooked, and the channel rendered somewhat intricate by the great number of sandbars, which change their position with every rise and fall of the river. Not a boulder, nor scarcely a pebble, is to be seen after passing the first ten miles below Whitney's rapids; showing, conclusively, that the forces which transported the immense numbers of erratic blocks, met with in other sections of the territory, did not tend in this direction. Like the region alluded to on the Chippewa, the country is a succession of sand plains, rising in low steppes, covered with a short coarse grass, and having a few small pines and shrubby oaks scattered over it.

About half a mile before reaching Petenwell Peak, that huge mass of rock suddenly presented itself down a reach of the river, rising above the level sands to the height of two hundred feet, or more, and presenting, in every respect, the semblance of a work of human hands, now dilapidated and in ruins. It required no excited imagination to see, in this extraordinary mass of rock, the remains of some ancient stronghold. There were the massive walls, defined and regular in their outline, battlements, towers, buttresses, surmounted by towering pinnacles, deep, dark windows, and, in short, everything necessary to render the delusion perfect.

The base of the peak is an oval, about three hundred yards in the long, and one hundred yards in the short, diameter. On the east side, the rock is almost perpendicular, and is washed at its base by the river. On the north side, a small creek comes in from the west, close to the rock. On the south and west sides, there is a very abrupt slope from two-thirds the height of the rock to the general level. This slope is made up of sand and huge fragments of stone, with small pines scattered among them. The upper third is a perpendicular wall of rock, split into towers and turrets, and which I found it impossible to ascend. The prospect from the point which I reached is very extensive, embracing an expanse of country probably from forty to fifty miles in diameter.

The general appearance of the country from this elevation is that of a level or gently undulating plain, dotted here and there with forests of small oak and pine. But on every side, as far as vision can reach, other isolated peaks are seen rising from the plain. One towards the northeast, and distant probably twelve or fifteen miles, is apparently higher than Petenwell; and others, in different directions, from their appearance in the distance, no doubt equal it in height. To the southwest, on the verge of the horizon, there appears to be a connected chain of hills. In no other direction, however, is there the slightest appearance of connexion between the elevated masses, each one standing "solitary and alone," and miles from its fellows.

The rock is a light colored, coarse grained sandstone, made up of perfectly rounded grains, many of which are limpid quartz, and cemented together with considerable firmness. Some of the strata are banded with white and brownish yellow stripes.

About six miles below Petenwell Peak, there is an exposure of fourteen or fifteen feet of sandstone, in the east bank of the river. Seen from a distance, it reminded me forcibly of the "pillared rocks" of Lake Superior. Some of the layers are soft and friable, while others are hard, and weather with difficulty. The current of the river, which continually washes the rock, has cut away the softer layers, leaving the harder ones standing out in relief, in the shape of rude cornices, while the rills produced by rains falling on the sandy slope above, and trickling down the rock at intervals of from five to twenty feet, have divided the cornices into capitals, and the rock below into pillars, so that it has, when seen from a distance, altogether the appearance of a magnificent colonnade, nearly a quarter of a mile in length, with the base of the columns resting in the water. There is a great difference in one respect, however, between the pillared rocks of the lake and those of the Wisconsin. While the first, generally small in diameter and graceful in form, support an entablature often forty or fifty feet in depth, and crowned with noble forest trees; the latter, huge and massive in proportions, are capped by three or four feet of sand, bearing a few stunted shrubs as worthless as the soil from which they spring.

October 14.—Nine miles below the last exposure of rock, thin shaly layers of sandstone appear just above the margin of the river, for the distance of half a mile. And four miles further, the rock rises to the height of twenty-five feet, in layers from six inches to five feet in thickness, variegated with red and yellow bands, and having very soft pulverulent nodules of oxide of iron, as large as walnuts, disseminated through some of the layers. The rock dips 4° to the southeast, is rather fine grained, and contains a considerable proportion of greenish colored grains, not, however, in sufficient quantity to impart a greenish hue to any of the layers.

Two miles below this place, Fortification Rock rises to the height of more than a hundred feet above the general level. It stands on the west bank, about one hundred yards from the main channel of the river. The northwest side, which is one hundred and twenty feet long, is perpendicular, while it descends, on the southeast side, by a succession of narrow terraces, to the general level. The top presents an almost unbroken outline, while the front has singularly weathered, at a number of points, into semblances of windows and loopholes.

Below this place, the rocks are almost constantly exposed, on one or the other side of the river, rising to the height of forty or fifty feet, sometimes pillared, generally mural, and with a constant dip to the S. E. of from 3° to 4°. Some of the strata are laminated, and present a very remarkable appearance; the angle formed by the joints of the laminæ and those of stratification, ranging from from 10° to 23°. In some of the layers, the laminæ are parallel with the plane of stratification; in some they are waved, and in others oblique; in some the materials are fine, in others coarse; showing the changeable direction and force of the currents by which they were deposited. I observed strata of precisely the same character in the sandstone of Chippewa river, and occupying, apparently, the same position in the series.

At 2 o'clock, we reached the chain of hills descried from Petenwell Peak. They consist of sandstone of the same character with that seen yesterday and to-day, with the exception of the upper layers, which, for the thickness of twenty-five or thirty feet, are white and sugar-like, and when struck with the hammer crumble into sand, rendering it somewhat difficult to procure and transport specimens. These cliffs differ from those seen yesterday, in presenting on one side a nearly perpendicular face, from two hundred to three hundred feet high, while on the opposite side they descend, by long and very gradual slopes, to the general level. They rise at long intervals, being separated by wide ravines, sparsely wooded, and are distributed along the country like a cordon of forts. Many, indeed most of them, resemble, when seen from a distance, artificial works, and one who has seen them feels no surprise that the superstitious Indian should consider them dwelling places of superior intelligences, and look upon them with awe and reverence. Although the materials of which they are composed possess little coherence, and are separable by a slight force, they will resist the siege of the elements for centuries yet, and remain to mark the boundaries of cultivation, which can never encroach upon the sterile wastes encircled by them.

Two miles further brought us to the *dalles* of the Wisconsin. The walls of sandstone forming the dalles are from twenty-five to eighty feet in height, and from fifty to one hundred feet apart. Between these perpendicular walls the river flows for some five or six miles, its average width being about one hundred feet.

Although it is quite as low as it was ever known, scarcely affording, in many places, sufficient water to float a canoe, in the dalles it is deep, and the shadows of the rocks give the water an almost black appearance. The current at the present stage is gentle, and often almost imperceptible, and the bed, so far as I could judge, is free from loose masses of rock. When the river is high, and especially during freshets, it is a passage of great dread to the "raftsmen," in consequence of the many short turns and projecting points around which the raft is swiftly hurried by the current, which then forces its way through the long defile with the speed of an arrow, being greatly accelerated by the great head of waters accumulated above the entrance, forming quite a lake, and pressing to enter the narrow gorge.

The weathering of the laminated strata before alluded to, with their exposure to the action of the current in different directions, and the cutting of the joints in varying lines are productive of singular and beautiful effects. Architraves, sculptured cornices, moulded capitals, scrolls, and fluted columns are seen on every hand; presenting, altogether, a mixture of the grand, the beautiful, and the fantastic.

The dip of the rocks here is 3° to the SE. The country is rolling, and the sands are covered by a thin soil, supporting a growth of small oaks.

October 15.—Eighteen miles below the dalles, we passed "Winnebago portage," which leads to Fox river of Green bay, and was for many years the route by which all the goods intended for the trading posts at Prairie du Chien, and other points on the Mississippi, passed, in their transportation from Mackinaw. It is now considered the head of steamboat navigation on this river. Occasionally fine sections of sandstone were displayed in the bluffs to-day, rising from thirty to one hundred feet above the water level.

October 16.—At 11 o'clock to day, we reached "Sauk Prairie," a village containing some fifty or sixty good houses. It is beautifully situated on the north bank of the river, and extends along shore for nearly a mile. The houses are mostly substantial neatly painted frames, though there are several brick buildings, and I noticed one beautiful structure of magnesian limestone. The distance from this place to the mouth of the Wisconsin is about eighty miles.

A short distance above Sauk Prairie, I noticed, for the first time on this route, the lower magnesian limestone, overlying the sand-rock which reaches, in the course of the river, from Whitney's rapids to this place. At the junction of the two rocks, they present a very peculiar banded appearance, when exposed in mural cliffs, owing to the intercalation of thin layers of the two formations.

At this point my geological observations ceased; the object of the reconnoissance having been to trace the rocks from Lake Superior to their junction with the survey of 1839, and make incidental observations on the topography of the country. Having accomplished these objects to the best of my abilities, I hastened toward the rendezvous at Prairie du Chien, where we arrived on the morning of the 19th October.

CHAPTER IV.

GENERAL OBSERVATIONS ON THE TOPOGRAPHY AND CLIMATE OF WISCONSIN.

In estimating the value of a country, or, rather, its fitness for sustaining a comparatively dense population, upon which its value mainly depends, many circumstances have to be taken into consideration; all of them requiring an amount of patient and accurate investigation, for which neither time nor opportunity have been afforded since the commencement of the survey.

Among the objects of inquiry connected with topographical and climatic considerations, may be enumerated—

The general features of the country, including the relative proportion of its plains, valleys, and hills, and their elevation above the level of the sea:

The number, length, breadth, and depth of its rivers, and the relative supply of water which they afford at different seasons of the year:

The presence of lakes, or large bodies of water, their distribution, and the influence which they exercise over the soil and in modifying climate:

The form and distribution of elevated lands or mountain ranges, their reflecting power in summer, and the quantity of snow which covers them in winter:

The relative proportion of land and water:

The relative proportion of forest and prairie lands, and their general distribution:

The physical character of the countries by which the district under investigation is surrounded:

The relative length and temperature of the seasons; upon which will depend not only the character of its vegetation, but also the occupation of its inhabitants:

The prevailing winds:

The quantity of moisture in the atmosphere, together with its usual electrical condition.

The action of the direct rays of the sun, and the nature of the soil upon which they act.

Many other points have to be investigated, in order to insure accurate climatic deductions; but it it will be perceived, from those already enumerated, that a great amount of observation is required, in order to speak with any certainty of the climate of a particular region, and to warrant a comparison between it and countries already known.

The amount of information collected on these points in a single season, by even the most assiduous observation, could not, of course, afford such a knowledge of the topography and meteorology of so large a district of country as would warrant any positive conclusions with regard to its climate, and its fitness for certain lines of agriculture; especially when much time had to be devoted to other subjects. A starting point, however, has been gained for future extension.

Where little is known respecting a country, the slightest addition to the general stock of knowledge becomes a matter of importance. This consideration, together with the anxiety manifested by those who are turning their attention to the northwest, to be put in possession of all that is known with regard to its climate and capabilities, form, perhaps, a sufficient apology for reporting crude and imperfect materials.

A knowledge of the climate of a country is quite as important as an acquintance with the distribution of its rocks, and the character of its soils. Almost everything connected with physical existence depends upon it. Whatever may be the constituents of a soil, without a climate suited to bring forth its energies, and mature its efforts, it must always remain unproductive. Of the two, indeed, climate seems to be of the first importance; because, the one may be changed and improved by art, while the other cannot be subjected to such influence. This is constantly exemplified in every country where agriculture is based upon a knowledge of the properties and capabilities of soils. In some parts of our own country, exhausted and abandoned fields, whole districts, indeed, have been regenerated, and restored to their original productiveness, by proper soiling, manuring, and a judicious succession of crops; but this has been done under the genial influence of a climate in every way calculated to develope the natural resources so skilfully aided and called forth by the labor of the agriculturist. In other sections, where all the elements of productiveness reside in the soil in profusion, that due succession and duration of the seasons, so requisite for the development of vegetation is wanting, and all the efforts of art cannot change the order of things, or render them a fitting field for agriculture. It becomes, then, a matter of the first consequence to know the climate of a country, as well as its physical structure. Upon the temperature and duration of the seasons, depends the productions of a soil, and upon the transitions from season to season depends, in a great degree, the health of its inhabitants, and the comforts of life.

Little more can be done, at this time, than to give a general outline of the topography of Wisconsin, so far as it has been ascertained, and to indicate the principles upon which deductions relating to climate are usually founded. Few data exist, by which to institute a comparison between this and other portions of the United States, and these are, most of them, inaccessible at the present moment. What data we have are, principally, the results of observations made at the different military posts, by direction of the surgeon general, and can only be used in a very general way for the elucidation of the subject in hand.

It is the more necessary to pursue this course, because, under the most favorable circumstances, many years must elapse before a sufficient number of observations can be made in the territory itself, from which to derive accurate ideas with regard to its climate and productions. As yet, we are in possession of little more than a general knowledge of its physical characters. Meagre as the data are, however, they will be found useful, to some extent, in enabling those at a distance to form a more correct estimate of the character and capabilities of a very large and unsettled portion of our territory. This is highly important in an economical point of view; without such information, the occupation of a country, and the consequent addition to the national wealth, would be postponed to an indefinite period.

So far as my observation extends, the idea is very prevalent among those who have not examined the subject, that climate is mainly determined by latitude, leaving out of view other and more controlling influences. Up to a comparatively recent period, the term climate was commonly applied to what is now meant by latitude; and thus the popular opinion originated and grew, that the climatic elements of a particular latitude are the same, or nearly the same, at all points, and that the productions of a parallel on one side of a continent will be found occupying the same parallel on the other, following its direction across the country like a belt. Almost the only thing taken into consideration, when treating of climate, was temperature, and this was supposed to depend entirely upon the number of degrees intervening between the particular latitude and the equator. Hence the disposition so generally manifested by persons removing from the old States to unsettled territories, to seek the same parallels they formerly resided in.

While latitude may be classed among the elements of climate, it is well known to all who have examined the subject, that the estimate of the climate and productions of a country which only takes this element into account, must be altogether erroneous. And, it is believed, that when a knowledge of this subject comes to be more generally diffused than it now is, great numbers of those who push westward every year will not be deterred by the fancied rigors of a climate which does not exist, from penetrating a few degrees north of their old latitudes, into sections where all the elements essential to the successful prosecution of the ordinary pursuits of life, and their healthful enjoyment, abound to a more than ordinary extent.

Temperature, upon which so much depends, both as regards productiveness and health, is not determined by latitude alone. Latitude exercises an influence only so far as the action of the direct rays of the sun is concerned; and their effect is variously modified according to the physical structure of the country. Other causes, some of them already alluded to, have to be taken into account when inquiring into the climate of unsettled regions, in which no observations, or but a limited number, have been made, and an estimate formed by the application of general laws to the known facts. By reasoning from established principles, we may arrive at a considerable degree of accuracy, with the aid of a comparatively limited number of observations. Thus, if we know the topography of a country, with its geographical relations, we may infer its climate by the application of principles deduced from a long series of observations made in other countries, the topogrhphy of which is well known.

Again, places having the same mean annual temperature differ widely in climate. The mean annual temperature being deduced from the mean temperature of all the seasons, it follows that a place having an exceedingly low temperature in winter and a very high one in summer, which is the case at many points in high northern latitudes, may give the same annual mean with other places where the thermometer has not nearly so great a range. Climate, then, does not depend upon latitude, nor can it be judged of from mean annual temperature. Other elements have to be ascertained, and these will now form the subject of inquiry so far as Wisconsin is concerned.

That portion of the territory in which observations were made during the last year, extends from latitude 43° to 46° 47′ 10″, and from longitude 89° 30′, to 93° 10′ 30″. It is very irregular in its general outline, and is bounded by a line commencing at the mouth of Wisconsin river, and following thence the Mississippi to the Falls of St. Anthony; from that point to the falls of St. Louis river; crossing in its course the head waters of Snake and Kettle rivers; thence following the coast of Lake Superior to the mouth of Montreal river; from that place to Lac du Flambeau; thence, in a northeast direction to a point on Wisconsin river, about ten miles, in a direct line, south of Vieux Desert lake; and from that point along Wisconsin river to its mouth. These boundaries include an area of about 33,000 square miles; and it is to this portion of the "Chippewa land district" that all our observations refer.

As might be expected of such an extent of territory, there is very great diversity in its physical features, so great, indeed, as to produce a variety in productions and climate seldom found in countries destitute of mountain ranges, or, at least, of plateaus greatly elevated above the level of the sea. It is divided by nature into three well defined districts, which, while they differ materially in their geology, present also considerable modifications of climate, the result of local influences peculiar to each division.

The first division, or that bordering on the Mississippi, extends through two degrees of latitude, in a direction nearly northwest from the mouth of the Wisconsin river. It is narrow, having an average breadth of only fifteen to twenty miles, except near its northern and southern terminations, where it is deflected east between Prairie du Chien and the mouth of Bad Axe river, and north between the middle of lake Pepin and the Falls of St. Anthony.

The second division, which has an average breadth of thirty to forty miles, crosses Wisconsin river between Whitney's rapids and Winnebago portage, and extends in a northwesterly direction along the line of the first division. Its northeastern boundary crosses the large tributaries of the Mississippi a short distance below the falls of those rivers, and is continued until it reaches the head waters of

Rush river, when it turns directly north, and terminates somewhere between the sources of Red Cedar and Shell rivers.

The third division includes all the country between the north-eastern boundary line of the second division and the shores of lake Superior, embracing all the northern chain of highlands and the sources of all the great streams.

The first division is based on magnesian limestone, has a good soil, and is covered with vegetation. Throughout its whole extent the surface is undulating, with few very high hills or deep valleys, and is about three-fourths prairie land. Within its limits are included the mouths of the Wisconsin, Bad Axe, Prairie á la Crosse, Black, Mountain island, Chippewa, Rush, Buffalo, and St. Croix rivers. It is well watered by branches of those streams, and many smaller tributaries of the Mississippi. It contains few lakes, or large ponds, until it crosses St. Croix river, when they rapidly increase in number, and marshes and wet meadows are frequently met with. In this section, also, springs occur. Some of them are, no doubt, the outlets of lakes on the neighboring highlands, and afford a large and constant supply of water. At several points advantage has been taken of the elevation of their source above the river level, and the streams flowing from them have been applied to manufacturing purposes.

The second division embraces a section of country made up almost entirely of barren sands, the debris of the lower sandstone of Wisconsin, with occasional patches of drift from more northern regions. It is generally "rolling," or rises in steppes, from the margins of the rivers which pass through it to the height of forty and one hundred and fifty feet above the water level. It supports, at intervals, thin clumps of stunted trees, and a few short coarse grasses. Along the borders of some of the streams, however, occasional patches of a better sort of vegetation occur. While this division affords a passage for the rivers which rise in the highlands of the third division, few or no streams have their origin in it, the sands absorbing the rains as they fall, and thus preventing their accumulation into streams.

The loose sands, which are of great depth in many sections, are easily acted upon by prevailing winds, and give rise, by their shifting, to constant local changes of level. Along the banks of the rivers a great number of sections were observed, showing a line of former vegetation, now covered by from ten to twenty-five feet of sand. These circumstances must always render the sandy district barren. Whether the sands are likely to encroach upon the present arable lands, to any serious extent, is a question of great moment, and one which will require further investigation for its solution.

The 3d division, which includes at least three-fifths of the territory under consideration, differs, very widely, from the other divisions in all its general features.

Throughout a great portion of it, south of the water-shed, crystalline and metamorphic rocks either show themselves in the slopes of the hills or from the beds of the streams, underlying the soil and drift, while north of the ridge which divides the waters of Lake Superior from those of the Mississippi, they either come to the surface or are met with under the red sandstone series of that region.

The water-shed is formed by a series of hilly ranges, which, on the south side, commence at an average distance of forty to sixty miles from the Mississippi, and form successively the falls and rapids of all the rivers above the northeast boundary of the 1st division, as well as of the small streams tributary to them. The ascent is, at every point where observations were made, very gradual, and, occasionally, for long distances, not noticeable except by actual measurement. On the north side the descent is much more rapid, the middle of the highlands approaching, generally, within twenty-five or thirty miles of Lake Superior, and in some places much nearer.

These ranges are made up of successive chains of rounded hills or knobs, with an elevation of from thirty to two hundred feet above the intervening valleys. Many of the hills are dome-shaped, and possess great regularity of outline. Most of them, however, are either oblong or irregular and ridge-like. The tops of the principal ranges are from three to ten miles apart, and have an almost constant strike northeast and southwest, though many spurs are given off having various other bearings. The width of the base of the ranges is from one to three miles, while their summits present, almost uniformly, an assemblage of low dome-shaped elevations, with occasional exposures of trappean and granitic rocks.

This description applies to all the northern ranges between the waters of Montreal river and those of the Bois Brulé. The highlands south of Fond du Lac, in the direction of Lake Pokegoma, differ from those just described, in the almost total absence of any distinctly marked ridges or chains of hills, after leaving the immediate vicinity of Lake Superior. After passing the high hills south of the great bend of St. Louis river, and which approach it very nearly opposite the trading house, eighteen miles above its mouth, the country is undulating but not knobby; and occasional small prairies ,with numerous wet meadows, and tamerack, spruce, and cedar swamps, present themselves in every direction until the head waters of Kettle river are reached. This portion of the country resembles, in many respects, that lying along the line separating the 1st and 2d divisions in the neighborhood of St. Croix river. It is based upon the red sandstone, which is the only rock to be seen in place between St. Louis river, at the point designated, and Kettle river, and that rock is only visible at a few points, being covered with a great depth of red marl in the north, and of drift further south. In some places crystalline boulders are so numerous that, with little trouble, a person could step from one to another for the distance of half a mile or more. The general elevation along this line is also much less than along any other line of country traversed between the Mississippi and Lake Superior.

On no other line than the one just mentioned, are the highlands at any point destitute of a good growth of timber. Between the Bois Brulé and Montreal rivers the ridges support a dense growth of both hard and soft woods, while the valleys and low grounds are covered with tamerack, spruce, and hemlock. So dense is the forest over most of this region that it is difficult to see from the top of one range to that of another, except where the summits happen to be formed by the protrusion of trappean or granitic rocks. Such points occur sufficiently often, however, to allow a very satisfactory knowledge of the general outline of the intervening country to be obtained.

Although this section is, as just stated, covered with vegetation, yet there is much inequality in the soil of the hills, owing to the diversity of rocks from which it has been derived; and this gives rise to considerable inequality of vegetation, some of the ranges being covered with a much heavier and finer growth of timber than others. Still this inequality is much less than in other sections of country of the same extent, and less than it otherwise would be here, in consequence of the liberal dissemination of the marls of the red sandstone formation, which are distributed not only in the valleys, but up to the very summits of most of the ranges south of Lake Superior. Throughout this whole region but few precipices occur, and these only among the granitic rocks, and are then of no great height, never reaching at any point measured over thirty feet. The sections cut through by water courses are not here taken into account.

The valleys between the ranges east of Bois Brulé river are mostly narrow, possessing often only sufficient width to carry off the drainage of the neighboring high grounds. Where they are wider, the central part is generally occupied by tamerack swamps, and by fragments of rock derived from the neighboring ranges. The smaller valleys, which wind among the chains of low hills which make up the main ranges, are dry, and like the hills are well wooded, have a good soil, and are sufficiently free from boulders to allow of cultivation.

West of the Bois Brulé, and south of the great bend of St. Louis river, the valleys which are depressed but little below the general level of the country are occupied, in most localities, by either swamps or natural meadows. Some of these meadows are very extensive, and bear a luxuriant growth of grass, often five or six feet in height. It is coarse, but sweet, and is said to make an excellent hay, being much used as a provender for cattle in all the pineries, and in the settled parts of the territory where it grows. The soil of these valleys is generally lacustrine. Many of them present every indication of having been uncovered or drained at a comparatively recent period; while some of them are evidently in process of drainage at the present time, and so rapidly, that a large addition to the tillable land of the territory may be safely calculated upon at no very distant date. Should it become desirable to do so, the process of drainage might be easily accelerated by art, and at inconsiderable expense.

A very interesting and important characteristic of the third division is the number of small lakes which abound throughout almost its whole area. The surface of the country is literally studded with them. In some sections it would be impossible to tiavel five miles, in any direction, without striking a lake. Although, on the eastern and western boundaries of the district, they extend farther south than the forty-fifth degree of latitude, the great body of them is situated north of a line drawn from the mouth of Little Wisconsin river to the falls of St. Croix river. West of the Bois Brulé they extend from the highlands south of lake Superior south and west to the Mississippi; and, crossing that river from near the Falls of St. Anthony to lake Winibigoshish, form, about the head waters of the Des Moines, and of the Mankato, Waraju, and Le Sueur branches of St. Peter's river, the "Undine Region" of Nicollet; and, further north, the still greater assemblage of lakes which include the sources of the Mississippi and of Red river of the north.

For description, these lakes may be divided into two classes, or, rather, varieties.

The first variety includes those which belong to chains, and are the sources of all the rivers of the territory. They are generally connected by small streams, often mere rivulets, possessing scarcely sufficient depth and breadth to permit the passage of light canoes; while, in other instances, they are formed by the expansion of the waters of larger streams in basins, from one to two miles in diameter. Examples of this variety may be seen by referring to the head waters of the Nemakagon, Red Cedar, Chippewa, Manidowish, Labiche, and Little Wisconsin rivers, as laid down on the accompanying map. Among these lakes may also be mentioned those which have no connexion except in long rainy seasons, or in the spring of the year, during the melting of the snows, when they are joined by streams which flow along valleys, once, evidently, the beds of large water courses, but now elevated above the general level of the lakes, and converted into meadows, cranberry marshes, or swamps. Between a great proportion of the now isolated lakes west of the Bois Brulé and St. Croix rivers, from St. Louis river to the Falls of St. Anthony, old connexions of this kind may be traced; and most of the rich valleys of that portion of the district owe their soils to lacustrine deposites, made during the long period of elevation, during which the beds of large rivers were first converted into chains of lakes, and subsequently drained, as the process of elevation continued.

Many of the largest lakes are situated on the very summit level of the great water shed, and in all cases where examinations have been made, or reliable information obtained, these lakes have been found tributary both to lake Superior and the Mississippi. Connexions of this kind exist between the St. Croix and the Bois Brulé, at upper St. Croix lake—the west fork of Bad river and the Nemakagon, at Long lake—and the Wisconsin and Menomonie of Green bay, at Vieux Desert lake. It is also believed that a similar interchange exists between the waters of Left-hand river and Kettle river, somewhere in the vicinity of Hornangle lake. These junctions are always formed in swamps, some of which are very extensive; and although the amount of water afforded to both the northern and southern streams is sufficient to render them navigable for canoes in the dryest seasons, still in no instance has it been found practicable to conduct canoes, from one stream to the other, through the swamp in which the interlockage is made.

The second variety of lakes are wholly isolated, having no apparent outlet, nor any visible source of supply other than the drainage of the hills which surround them. They are, probably, more numerous than those included in chains, although fewer of them fell under observation, as our routes were generally along the courses of streams. Aside from their want of communication, they differ from the first variety, principally, in size, being much smaller. They are most frequently met with in the sections based upon sandstone, or where the country is covered with heavy deposites of drift, resting on metamorphic rocks.

There is great variability in the size and configuration of both varieties of lakes. The largest which fell under my observation, among which may be enumerated, Court Orielles, Flambeau, Long, Trout, Moose, and Pokegoma, are from five to eight miles in their longest diameter, and from two to five miles wide.

While the first variety of lakes present almost every possible irregularity of outline, those included in the second variety are generally oval, or circular, or crescent shaped. Many of the small circular lakes, from a quarter of a mile to a mile in diameter, are from sixty to one hundred feet below the general level, the ground sloping down to the water on every side with great regularity, like the descent of an amphitheatre, and covered with grass.

The lakes are generally shallow, and many of them are dotted with small wooded islands. In several instances these islands were found to be based upon accumulations of boulders. Those formed by the widening of rivers, or connected in chains, are filled with aquatic plants, many of them containing large fields of the *zizania aquatica*, the wild oat or northern rice plant. The rice lakes are most liberally distributed in the sections about the head waters of the Red Cedar, Nemakagon, St. Croix and Snake rivers, and afford a principal source of support to the Chippewa Indians; the distant bands making annual visits to the rice regions, toward the end of August, for the purpose of gathering a supply for the winter. These fields also attract great numbers of water-fowl.

The borders of the lakes differ greatly in appearance. Some of them are surrounded by gentle grassy slopes, with occasional trees scattered along them; while others are surrounded by extensive marshes, often overrun by the cranberry plant; and again the shores are rather abrupt, with a dense, dark forest, skirting the very margin. Their beds are generally pebbly or covered with small boulders, which peep out along shore, and frequently show a rocky line around the entire circumference. Very few of them have mud bottoms. The water is generally sweet and clear, and north of the water shed is as cool and refreshing during the heats of summer as the water of springs or wells. All the lakes abound with various species of fish, of a quality and flavor greatly superior to those of the streams of the middle and western States. The shores of many of them are chosen as sites for villages by the Indians, who show their taste by selecting the most beautiful and picturesque, in sections where the soil is of a quality suitable for gardens.

Although a great number of lakes have been laid down on the map along the lines of observation, still but a faint idea can be obtained from consulting it of their number and distribution. These are matters of considerable interest, in consequence of the influence which the presence of so great an assemblage of waters must exercise on the climate and productions of the region in which they are situated.

The principal rivers which have fallen under my own observation are the Wisconsin, Chippewa, St. Croix, Bois Brulé, St. Louis, and the west fork of Bad river. St. Louis river was only examined from its mouth to the falls immediately below Portage du Coteau, a distance, following its meanders, of about thirty-six miles; the Chippewa, from its mouth to Lac Court Oreille river; the St. Croix, Bois Brulé, and Wisconsin, from their sources to their mouths. A detailed description of these rivers, in connexion with economical purposes, must be deferred until the next annual report, as the materials collected last season respecting them are not now in a shape to be used.

The general level of the country between Lake Superior and the Mississippi is shown in the accompanying section of levels, Lake Superior being taken as a base. These lines of level must be received as approximations only, as, in many instances, time would only allow of one or two barometrical observations being made for the purpose of ascertaining heights. At most important points, however, the mean of from five to twenty observations was used in making the calculations; and in every calculation the mean of one month's observations, at a single station on Lake Superior, was employed. The following table exhibits the elevations, as determined along the lines of observation.

Section No. 1. From the mouth of the Chippewa to the mouth of Bad river.

	feet.
Mouth of the Chippewa	25
Dalles of the Chippewa (hill top)	722
Chippewa falls	403
Vermillion falls	307
Brunet's rapids	382
Mouth of Lac Court Oreille river	493
Lac Court Oreille (Corbin's store-house)	581
Lily lake	702
Nemakagon portage	585
Four miles above Nemakagon portage	675
North shore of Long lake	721
Alder creek (portage)	234
Lower rapids of the west fork of Bad river	75
Six miles above Bad river mission	54

Section No. 2. From the Mississipi, at St. Paul's, to the trading house on St. Louis river, 18 *miles above Fond du Lac.*

	feet
Mississippi, at St. Paul's	0
Six miles south of Stillwater	173
One mile north of Stillwater	250
Nine miles north of Stillwater	146
Fourteen miles north of Stillwater	120
Twenty-two miles north of Stillwater	122
Top of Trap dyke, nine miles above the falls of St. Croix	466
Three miles north of the mouth of Sunrise river	334
Red creek, Pokegoma trail	324
Lake Pokegoma	369
Kettle river, Fond du Lac trail to Pokegoma	363
Moose lake, Fond du Lac trail to Pokegoma	319
Hornangle lake	439
Fond du Lac trail to Pokegoma, 18 miles south of St. Louis river	475
Fond du Lac trail to Pokegoma, 2 miles south of St. Louis river	269
Bank of St. Louis river, at trading-house	21

Section No. 3. From the outlet of Lake St. Croix to the mouth of Bois Brulé river.

		feet.
Outlet of Lake St. Croix, (feet below)		7
Table land at the mouth of Lake St. Croix, (feet above)		105
Still water, one mile north, on table land	do	250
Trap dyke, nine miles above St. Croix falls	do	466
Summit, three miles above Sunrise river	do	334
Nine miles above the mouth of Kettle river	do	304
Thirty miles above the mouth of Kettle river	do	443
Rapids below the mouth of Nemakagon river	do	
Hill, one mile north of Pijikig lake	do	596
St. Croix and Brulé portage	do	656
Head of Bois Brulé river	do	544
Fifteen miles below the portage	do	415
Third portage on Bois Brulé river	do	373

It will be seen by this table and reference to the sections, that the line of greatest altitude decreases from the eastern boundary of the territory, as the range of highlands is followed westward. This will be still more manifest by referring to No. 1 of the geological section accompanying the report of the reconnoissance from the mouth of the Montreal river to the dalles of the Wisconsin. On this section of the elevations are given as far as measurements were made; and it will be perceived that the elevation of the watershed, on that route, is more than 400 feet greater than it is between the sources of the Chippewa and the west fork of Bad river, and 640 feet higher than the highlands between St. Louis river and the falls of St. Anthony—the top of the rapids above the falls of St. Anthony being fifty-one feet above the level of Lake superior.

This outline of the general features of the territory will afford some ground upon which to base an opinion with regard to its climate. It will be seen from the sections of elevation, that an almost free passage is afforded to the northwest winds, which sweep over the middle and Mississippi regions with a force unbroken, save by the forests which stretch in a westerly direction from the head waters of the St. Croix as far as explorations were made.

In the elevated country, in addition to the influence of the forests, shelter from the prevailing winds is afforded by the great number of short spurs, with irregular bearings, which are thrown off from the principal ranges, at intervals of a few miles, until the sandy region is reached. The ranges which bear N. E. and S. W. give facility for the passage of winds from those points. The N. E. and E. winds, however, are greatly tempered by their passage over the large lakes; while the S. W. wind, which passes up the valley of the Mississippi, and is deflected east by the western chains of highlands and mountains, is both temperate and healthful. The north winds, which sweep across Lake Superior, and descend upon the region south of the water shed, are, even in midwinter, rendered comparatively mild, until they reach the sand plains, where, in consequence of the greater radiating power of their surface, which renders them colder than the forest lands, the temperature of the wind is lowered many degrees before it reaches the country still further south, and gives rise to a more excessive climate. In the middle and southern parts of the territory, the northern winds, in summer, contribute very materially towards tempering the heat of the season, while the southern winds, which frequently bring rain, exercise a like influence.

The influence of the lakes and rivers in modifying climate is determined, in a great measure, by the prevailing winds, and, consequently, a knowledge of their course and force is indispensable to enable us to form an estimate of the modification which is really produced in the climate of the district by the bodies of water which surround it, and are contained within it. On this point, I am in possession of but little information at present. The necessary measures have been taken, however, to collect all such observations, and the result will be laid before you, at the termination of the survey, in such a form as to enable every one to judge of the climate of the country from more accurate and sufficient data than we now possess.

In the absence of positive observation, however, it mav be stated, as the result of investigations in every country possessing similar topographical features, that the almost innumerable small lakes which dot the surface of a great portion of the district, exercise great influence in rendering the summers mild. They do not, however, soften the rigors of winter in the same proportion, because of their being frozen during a great part of that season. The same remark may be made with respect to the extensive marshes which are found in some sections.

The evaporation and condensation of water may be called the great modifiers of climate; and in a country constituted like Wisconsin, the influence of these processes is felt to an extreme degree. The temperature of the nights is so equalized by the heavy dews of the northern portions of the district, that the cold mornings so common in the middle and western States, during the summer months, are not experienced in the lake country; the condensation of the vapor exhaled during the earlier part of the night causing the evolution of a sufficient amount of caloric to render the mornings mild and pleasant.

A further modification of climate is found in clouds and mists, which obstruct the caloric radiated from the surface during the night, and reflect it back to the earth. Clouds, it is well known, are much more common in the neighborhood of large bodies of water than in other localities. The temperature of the lake region is modified in winter by the cloudy state of the atmosphere; while in summer the clouds and mists contribute to coolness, by obstructing the passage of the direct rays of the sun to the earth. The important influence exercised by this state of the atmosphere will be more fully recognized, when it is recollected that the force of radiation from the earth into space increases as we proceed northward; and so, also, does it increase as a district is elevated above the level of the sea.

It will be seen, by consulting the sections of elevation, that a range of highlands extends along the line dividing the sandy and limestone regions, following the general course of the Mississippi, and crossing the tributaries of that stream from twenty to forty miles above their mouths. Along this line of elevation, the country is generally much lower than along the water shed; although, at some points, as at the dalles of the Chippewa, for example, the tops of the highest ridges equal in height the great northern range directly north of them.

This elevation of the sandy region contributes very much towards modifying the climate of the agricultural district bordering on the Mississippi. The rays of the sun act more energetically in elevated than in low regions, and as the direct influence of the sun is necessary to the germination and perfection of vegetation, and especially of wheat and other grains, the vicinity of the high sand region, and the character of the soil in the limestone district, combine to render that portion of the district peculiarly favorable to the growth of such grains, while the generally clear and dry state of the atmosphere in midsummer will secure them from blight and mildew.

The summer temperature of this portion of the district is much higher than in the northern parts. Sandy regions are always much warmer in summer than those which have a soil of clay, or other compact materials. This is owing, in part, to the reflecting power of the sands, by which a great portion of the heat derived from the rays of the sun is immediately thrown back into the atmosphere, and partly to their radiating properties. The temperature of surrounding regions will, of course, be modified, as currents of wind may prevail at the time, and carry the warm air of the sands over them. From an attentive consideration of the topography of the limestone district, it will be seen that prevailing winds, unaccompanied by rain, from every point except the northwest, must contribute to an increase of summer temperature; and this is fully proved by meteorological observations made at Forts Snelling and Crawford.

As already stated, the temperature of different sections of Wisconsin varies accordingly as they are forest lands, sand plains, verdant prairies, elevated ridges, or naked rocks; are dotted with lakes, or contain but little water. The character of the lake region, so far as temperature is concerned, resembles, very much, that of the coast of New England, and, consequently, the seasons succeed each other in the same, or a similar manner, and their duration is about the same. The difference between winter and spring is precisely the same at the east end of Lake Superior that it is at Fort Preble, Maine—18° 42′; while the mean difference between winter and summer on the lake is 42° 11′, and at Fort Preble 40° 58′. South of Lake Superior, in Wisconsin, from a few observations made last year, I am inclined to think that the difference in the mean temperature and duration of spring and summer will be found highly favorable to Wisconsin, in comparison with Maine.

The daily alterations of temperature in Wisconsin are about equal to those of New York; while, in the lake region, they are less than at any point in the middle or western States remote from the seaboard. The difference between winter and spring is greater in Wisconsin than it is in the middle States; but the difference between spring and summer, and summer and autumn, is not so great, especially in the lake region. The springs are colder than further south, in consequence of the amount of caloric rendered latent by the melting of the ice and snows; and, as might be expected, vegetation is retarded; the usual garden vegetables which come to maturity in the valley of the Ohio in May, and the early part of June, not coming forward in the north until July. When spring opens, however, the winter is ended, and the danger to which early vegetation and fruits are frequently exposed in the middle and western States, in consequence of great and sudden alternations of temperature, is unknown in the north.

In consequence of the greater energy with which the sun acts in the middle and southern parts of Wisconsin, and the higher temperature of the spring, vegetation is more forward; but it does not come to perfection much earlier than in the more northern districts where the spring and summer temperature is lower, with a much greater amount of moisture. Ice forms along the shores of Lake Superior for several miles out, but the lake, it is said, never freezes over even in the coldest winters, so that the cold of spring is but little augmented by its melting; the low spring temperature being due, principally, to the melting of the snows, and the constant low temperature of the waters of the lake, which does not vary much throughout the year.

Throughout the whole territory the winters are said to be usually dry, and the ground generally covered with snow. When, however, the thermometer is very low, but little snow falls; and hence, in the coldest northwest winters, the ground is often clear of snow even in midwinter, and the atmosphere is dry and salubrious. When the country is covered with snow, the temperature of the atmosphere is, of necessity, reduced by the evaporation which is constantly going on, but it is a question whether this reduction is not, in some degree, compensated by the influence of the sun. It is difficult to estimate the elevating force of the sun's rays in modifying the temperature of northern regions, when the ground is covered with snow, but, it is agreed by every one, it must be very great. The observations of Humboldt, Parry, Scoresby, Sabine, and Saussure, all go to show this. No observations have been made on this subject in the northwest. It is intended, however, to institute a series of observations, at proper points, during the coming winter, and until that is done no deductions can be made from the facts collected by Humboldt and others, as their observations relate more particularly to elevated mountains, or high northern latitudes, where the influence of the sun is much less in winter than in Wisconsin, while it is much greater in summer in regions of perpetual snow, and on high mountains.

The proportion of clear weather in the middle and southern portions of Wisconsin greatly exceeds that of the States further south, while there is more cloudy weather in the northern section of the district than in the southern. It also rains more frequently in the north, which is accounted for by the greater amount of evaporation constantly going on from the large bodies of water in that section, and from the forests. Large forests exercise great influence in increasing the humidity of the atmosphere, by the evaporation from their foliage. At the same time they intercept the rays of the sun and prevent too rapid evaporation from the earth. The temperature is, therefore, more constant and equable in the wooded districts than in the open country. The highlands, whether sand plains or prairies, have a dry atmosphere, but the difference of temperature between day and night, and between winter and summer, is much greater than in the timbered lands, especially if they are dense forests.

The great difference in the temperature of the waters tributary to Lake Superior, and those flowing into the Mississippi, has been alluded to in another place. Although the sources of all the large rivers are in the same range of highlands, and in many cases the northern and southern streams interlock or flow out of the same lake or swamp, the difference in the temperature of their waters, even at no great distance from their source, is astonishing. This difference serves to illustrate the influence exercised by northern and southern exposures, conjoined with the nature of the country through which the waters flow. In the one case the country is protected by the great range of highlands from southern influences, is densely wooded, and tempered by the vicinity of the lake; in the other the waters creep sluggishly, for long distances, through meadows, and between drift banks sparsely timbered, or wind about in the naked sand plains, exposed to the direct rays of the sun and the heating influence of the sands.

As it will not be practicable to prepare the meteorological materials of last season in time for this report, the following abstiact of observations made at Prairie du Chien, and at Madeline island, are given, chiefly for the purpose of showing the relative temperature of the southern part of the territory with that of the lake region. The observations were made during the months of August, September, and October, 1847.

Prairie du Chien.—Latitude 43° 3′ 6″.

August.

Mean of the thermometer for the month, 66.12.
Range " " " " 37°
Lowest temperature at sunrise, 51°—occurred three times; on the 1st, 20th, and 27th.
Highest temperature at sunrise, 68°—on the 12th.
Lowest temperature at 2 o'clock, p. m., 62°—on the 30th.
Highest " " " 88°—on the 4th.
Lowest temperature at sunset, 60°—on the 1st and 30th.
Highest " " 80°—on the 24th.
Lowest temperature at 9 o'clock, p. m., 52°—on the 20th.
Amount of rain during the month 2.40.
During the month there were 29 cloudy days, 12 rainy days, 2 clear days, and 5 days partly clear.
In the *forenoon*, the wind blew from the S. W. 8 days, N. 6 days, N. W. 7 days, S. E. 2 days, S. 7 days, W. 1 day.
In the *afternoon*, from the S. 5 days, N. 7 days, W. 2 days, E. S. E. 1 day, S. S. W. 1 day, S. E. 4 days, N. E. 1 day, N. W. 6 days, S. W. 4 days. It was variable 20 days, and constant 11 days.
The wind blew from the S. W. 4 rainy days.
S. 5 " with thunder and lightning.
S. E. 1 "
N. W. 1 "
N. 1 "

September.

Mean of the thermometer for the month, 60.15.
Range " " " " 45°
Lowest temperature at sunrise, 39°—on the 30th.
Highest " " 64°—on the 7th.
Lowest temperature at 2 o'clock, p. m., 58°—on the 13th.
Highest " " " 84°—on the 2d.
Lowest temperature at sunset, 50°—on the 4th and 13th.
Highest " " 76°—on the 25th.

Lowest temperature at 9 o'clock, p. m., 42°—on the 13th.
Highest " " " 68°—on the 1st and 2d.
Lowest daily mean, 47° 30'—on the 13th.
Highest " " 69°—on the 2d and 21st.
Mean daily range, 22°.
Amount of rain during the month, 1.90.
During the month there were 26 cloudy days, 3 rainy days, 4 clear days, and 6 days partly clear.
In the *forenoon*, the wind blew from the S. W. 4 days, N. 6 days, W. 5 days, S. 6 days, N. W. 7 days, S. E. 2 days.
In the *afternoon*, from the S. W. 6 days, N. 5 days, N. E. 1 day, N. W. 6 days, S. E. 3 days, W. 4 days, E. 2 days, S. 3 days, W. 4 days, E. 2 days, S. 3 days.
It was variable 11 days, and constant 19 days.
The wind blew from the N. W. 1 rainy day.
W. 1 "
S. W. 1 "

October (21 *days*).

Mean of the thermometer for the month, 50.49.
Range " " " " 56°
Lowest temperature at sunrise, 23°—on the 14th.
Highest " " 68°—on the 4th.
Lowest temperature at 2 o'clock, p. m., 41°—on the 21st.
Highest " " " 79°—on the 9th.
Lowest temperature at sunset, 32°—on the 14th.
Highest " " 72°—on the 9th.
Lowest temperature at 9 o'clock, p. m., 26°—on the 14th.
Highest " " " 60°—on the 3d and 8th.
Amount of rain during the month .55.
In the *forenoon*, the wind blew from the S. E. 1 day, S. W. 3 days, S. 2 days, N. W. 9 days, N. 3 days, W. 3 days.
In the *afternoon*, from the N. E. 1 day, S. 3 days, N. 4 days, N. W. 7 days, S. W. 2 days, W. 4 days. It was variable 6 days, and constant 15 days.
The wind blew from the S. 1 rainy day.
N. W. 1 "
N. 1 "
During the month there were 12 cloudy days, 4 rainy days, 6 clear days, and 6 days partly clear.

MADELINE ISLAND.—LATITUDE.

August.

Mean of the thermometer for the month, 64° 08'.
Range " " 30°.
Lowest temperature at 7 o'clock, a. m., 47°—on the 29th.
Highest " " 68°—on the 15th.
Lowest " at 1 o'clock, p. m., 47°—on the 29th.
Highest " " 77°—on the 13th.

Lowest temperature at 6 o'clock, p. m., 45°—on the 29th.
Highest " " 74°—on the 20th.

In the *forenoon* the wind blew from the S. 11 days, N. 3 days, W. 1 day, N. E. 7 days, N. W. 3 days.

In the *afternoon*, from the S. 7 days, N. 4 days, S. W. 2 days, N. E. 12 days, N. W. 2 days. It was variable 7 days, and constant 24 days.

The wind blew from the N. E. 6 rainy days.
N. 2 "
S. 1 "

There were 3 thunder storms during the month, the wind coming from the south each time.

During the month there were 16 clear days, 4 cloudy days, 11 days partly clear, and 9 rainy days.

September.

Mean of the thermometer for the month, 57° 59′.
Range " " 33°.
Lowest temperature at 7 o'clock, a. m., 45°—on the 30th.
Highest " " 72°—on the 22d.
Lowest " at 1 o'clock, p. m., 48°—on the 12th.
Highest " " 78°—on the 22d.
Lowest " at 6 o'clock, p. m., 52°—on the 3d, 4th, 8th and 23d.
Highest " " 67°—on the 20th.

In the *forenoon* the wind blew from the S. 2 days, N. 3 days, W. 3 days, E. 1 day, S. W. 4 days, S. E. 2 days, N. W. 2 days, N. E. 6 days.

In the *afternoon*, from the S. 2 days, N. 5 days, W. 5 days, E. 3 days, S. W. 2 days, S. E. 2 days, N. W. 2 days, N. E. 7 days.

The wind blew from the S. 1 rainy day.
N. 2 "
E. 2 "
S. W. 1 "
S. E. 1 "
N. W. 1 "
N. E. 3 "
Calm 1 "

During the month there were 10 clear days, 18 cloudy days, 12 rainy days, and 5 days partly clear.

October.

Mean of the thermometer for the month, 50° 18.
Range " " 38°.
Lowest temperature at 7 o'clock, a. m., 32°—on the 13th and 14th.
Highest " " 60°—on the 3d and 9th.
Lowest " at 1 o'clock, p. m., 34°—on the 13th.
Highest " " 70°—on the 3d.

Lowest temperature at 6 o'clock, p. m., 34°—on the 13th.
Highest " " 67°—on the 3d.

In the *forenoon* the wind blew from the S. 4 days, W. 6 days, E. 1 day, S. W. 4 days, N. W. 8 days, N. E. 2 days.

In the *afternoon*, from the S. 4 days, W. 7 days, E. 2 days, S. W. 4 days, N. W. 9 days, N. E. 2 days. The W. and N. W. winds were the coldest.

The wind blew from the N. W. 1 rainy day.
S. 1 "
N. W. 2 days of hail.
W. 1 day of snow.

During the month there were 18 clear days, 11 cloudy days, 9 days partly clear, 2 rainy days, 2 days of hail, and 1 day of snow.

Future investigation will no doubt bring to light many new facts with regard to the meteorology of the northwest, and some modification of the opinions here expressed respecting its climate may be found necessary. It is believed, however, so far as deductions from general principles are to be relied on, when applied to individualities, that the views with respect to the climate of Wisconsin will be found to be in the main correct.

It only remains now, in connexion with the topography of the country, to say something respecting the map which has been constructed to illustrate the reconnoissance of last year. It is not a correct map of the country, but it is more nearly correct than any map of it heretofore constructed and published; I mean with regard to points already laid down on other maps. It is based upon the map accompanying the report of Mr. Nicollet. The first step in its preparation was to lay down all points the latitude and longitude of which had been approximately determined. These were taken from the table accompanying Nicollet's report, and were determined, most of them, by that gentleman, and the remainder by Captain Cram. The water courses and lakes were then laid down in the surveyed lands from the returns of the surveyors, and those in the unsurveyed portions of the territory from the observations of the geological corps, and from the information of intelligent traders and Indians, who are perfectly familiar with the country.

No instruments were furnished last year, by which geographical positions could be determined; and, under the circumstances, it is to be expected that numerous and important corrections will have to be made as the surveys are extended, and the position of different points ascertained with precision. The principal method employed for ascertaining position, was to note the courses from points of departure, keep an accurate account of the number of hours consumed in travel, and estimate the rate at which we travelled. This rude method was the only one which could be followed last season. Owing to this, the great amount of new matter introduced into the map may, much of it, prove to be, by proper observations, some miles out of its true geographical position. With all its imperfections, however, it will afford a very correct representation of the principal geological formations of the country, so far as ascertained; and for the purposes of the traveller, will be found a sufficient guide to lead him along all the routes between the Mississippi river and Lake Superior.

I must be allowed, in conclusion, to acknowledge the many favors received from yourself, and from the members of the corps generally, as well as from various gentlemen resident in the northwest, and to say, that in a final report I shall consider it a duty, as it will be a pleasure, to give them a more special acknowledgment.

All which is respectfully submitted:

J. G. NORWOOD,
Assistant Geologist.

the principal geological formations of the country, so far as ascertained; and for the purposes of the traveller, will be found a sufficient guide to lead him along all the routes between the Mississippi river and Lake Superior.

I must be allowed, in conclusion, to acknowledge the many favors received from yourself, and from the members of the corps generally, as well as from various gentlemen resident in the northwest, and to say, that in a final report I shall consider it a duty, as it will be a pleasure, to give them a more special acknowledgment.

All which is respectfully submitted.

J. G. NORWOOD,
Assistant Geologist.

APPENDIX.

List of fossil genera found in the lower sandstones of Wisconsin, F. 1.—Species undetermined.

No. 1. *Trilobites.*—Three or more species.
2. *Orthis.*—One species or more.
3. *Delthyris.*—One species.
4. *Lingula.*—Three or more species.
5. *Orbicula.*—One or more species.
6. *Fucoides.*—One or more species.

List of fossil genera found in the lower magnesian limestone, F. 2. Species undetermined.

No. 1. *Terebratula.*—One species.
2. *Ophileta.*—Two species.
3 *Trilobites.*—Two species, one found at White Rock, St. Peters; one at Stillwater Lake St. Croix.
4. *Lingula.*—One small species found both at Stillwater and White Rock.

List of fossil genera and species found in the lower fossiliferous limestone at St. Peter's and Fort Snelling, which are identical with those occurring in the blue limestone of the Ohio valley.

No. 1. *Terebratula capax,* (Conrad.)—A species very common, both in the blue limestone of Ohio, Indiana, and Kentucky.
2. *Atrypa communis.*—A species of frequent occurrence at Cincinnati, Ohio; Madison, Indiana; Frankfort, Kentucky; and Davidson county, Tennessee.
3. *Orthis formosa.*—A characteristic species at the same localities.
4. *Orthis testudenaria.*
5. *Orthis callactis?*—This species resembles closely the species considered callactis found at Cincinnati.
6. *Leptæna Madisonii.*—A species abundant at Madison, Indiana.
7. *Leptæna Sericea.*—The same species which is found at Cincinnati, Ohio; Madison, Indiana; Mount Washington, Kentucky; and Davidson county, Tennessee.
8. *Spirifer Lynx.*—Exceedingly abundant in the blue limestone of Ohio, Kentucky, Indiana, and Tennessee.
9. *Pleurotomaria,* (Carl,) sp?.—Identical with one found at Cincinnati.
10. *Bellerophon vilobatus.*
11. *Isotelus gigas.*—A species found at Covington and Frankfort, Kentucky; at Cincinnati, Ohio; Madison, Indiana; and in Tennessee.
12. *Calymena senaria.*—One of the most abundant trilobites at many localities in Ohio, Indiana, Kentucky, and Tennessee.

No. 13. *Chaetetes lycoperdon.*—A very abundant species at Frankfort, Kentucky, as well as Cincinnati; Madison, Indiana, and Davidson county, Tennessee.

14. *Graptolites.*—Identical with a species found at Cincinnati, Ohio.

15. *Cyathophyllum ceratites?.*—A species common both in Ohio, Kentucky, Indiana, and Tennessee.

In addition to the above, there have been obtained from these at least twenty-four species of undetermined fossils belonging to the genera *calymene* (two species,) *asaphus brontes, ilænus, spirifer* (two species,) *terebratula* (two species) *orthis* (three or four species,) *leptæna orthoceratites* (three species,) *cyrtoceras, cypredardia pleurotomaria, turbo, farosites* (two species,) *cyathocrinus?.*

In the upper fossiliferous limestone of Fort Snelling and the Falls of St. Anthony, the species of fossils appear to be all different from those found in blue limestone of the Ohio valley. A few forms have been found identical with the following species: *illænus crassicauda, pleurotomaria umbillicata, certoceras macrostoma, pleurotomaria subconica;* along with others of the following genera: *leptæna, orthis, terebratula, pentamerus, euomphalus,* and *cyathophyllum.*

List of organic remains found near the "Big spring," on the Upper Iowa river.

No. 1. *Leptæna sericea.*
2. " *rugosa.*
3. " *Madisoniensis.*
4. " *deltoidea.*
5. *Plurotomaria* lenticularis.
6. Cyathophyllum ceratites.
7. *Cosinopora sulcata.*
8. *Bellerophon bilobatus.*
9. *Isotelus majestos.*
10. *Actinoceras.* Sp?.
11. *Pleurotomaria.* Sp?.
12. *Orthis testudinaria?.*
13. " *formosa.*
14. *Leptæna alternata.*
15. *Illænus crassicauda.*
16. *Murchisonia bellicincta.*
17. *Pleurotomaria.* Sp?.
18. *Murchisonia subfusifornus.*
19. *Atrypa capax.*
20. *Asaphas.* Sp?.
21. *Orthis* subæquata.
22. *Pleurotomaria.* Sp?.
23. *Atrypa hemiplicata ?.*
24. *Orbitulites? reticulatus?.*

List of organic remains found in the limestones (F. 3) of Turkey river, near the agency and the vicinity.

No. 1. Bumastis barriensis ?.

2. *Atrypa capax* and *A. Wilsoni?*.

3. *Macrocheilus (Buccinum) bellicenta*, twenty miles below agency.

4. *Euomphalus*, twenty miles below agency.

5. *Orbitulites? reticulatus*, seven miles bolow Winnebago line.

6. *Leptæna Madisoniensis*, forty miles below agency.

7. " *sericea*, forty miles below agency.

8. " *alternata*, forty miles below agency.

9. *Pleurotomaria lenticularis*, fifteen miles below agency.

10. *Leptæna*. Sp? seven miles below agency.

11. *Orthoceratites*.—Four or more undetermined species.

12. *Atrypa* resembling *exiqua*.

13. *Orthis formosa ?*.

14. *Spirifer lynx*.

15. Leptæna like rugosa of Phillips.

16. *Trochus bilex*.

17. *Orthoceras la queatum ?*.

18. Lingula (last of.)

19. Cestoceras.

Besides the above, a fine structured concentric coralline allied to ***stroneatopora***. Several trilobites, probably of undescribed species allied to ***phecops***, one near to P. ***calicephalus***, but with compound eyes.

Mineral localities in the Chippewa land district, in Wisconsin

THREE MILES SQUARE.

Lease No.	19	At the mouth of Montreal river—two-thirds in Wisconsin territory.	
Do	22	On the Montreal river—one-fourth in Wisconsin.	
Do	23	do	one-fifth.
Do	25	do	seven-eighths.
Do	26	do	one-half.
Do	34	do	seven-eighths.
Do	137	do	the whole in Wisconsin.

ONE MILE SQUARE.

Location No.	57	On the waters of Montreal river.			
Do	164	do	do		
Do	165	do	do	half in Wisconsin territory.	
Do	166	do	do	do	do
Do	219	do	do		
Do	220	do	do		
Do	221	do	do		
Do	223	do	do		
Do	259	do	do		
Do	304	do	do		

Location No.	305	On the waters of Montreal river.	
Do	471	do	do
Do	472	do	do
Do	473	do	do
Do	170	do	Bad river.
Do	222	do	do
Do	263	do	do
Do	467	do	do
Do	468	do	do
Do	469	do	do
Do	332	On the main land, opposite La Pointe.	
Do	333	do	do
Do	334	do	do
Do	394	Near the Detour.	
Do	395	do	
Do	396	do	

Besides the above, there are some half dozen locations on the head waters of Bad and Montreal rivers, and several on Bad river, the numbers of which are not known. There are, also, two or three on the Nemaji or Left Hand river, south of Fond du Lac, and several at the falls of the St. Croix.

Mr. R. Chapman has a settler's claim to a location about twenty miles north of Fond du Lac.

D.D. Owen Delt

C.B. Graham Lith

A NATURAL SECTION OF THE BLUFFS ON THE MISSISSIPPI.

North of the Wisconsin River

D.D. Owen Delt.

C.B. Graham Lith.

A HILL CROWNED WITH LOWER MAGNESIAN LIMESTONE (F.2.)

On the Kickapoo

D.D. Owen Delt

C.B. Graham Lith

EXPOSURE OF LEDGES OF SANDSTONE. (F.1.)

In a valley near the mouth of the Kickapoo.

D.D. Owen Delt. C.B. Graham Lith.

OUTLINE OF A HILL OF SANDSTONE CAPPED WITH A SILICEO-CALCARIOUS ROCK (F.1.f.)

Surmounted by an Indian Grave.

D.D. Owen Delt. G.B. Graham Lith.

CAPE DE SIOUX OR MAIDENS ROCK

Presenting a perpendicular escarpment of nearly 200 feet of Magnesian Limestone, (F 2.)

Plate 6

LA GRANGE MOUNTAIN.

At the head of Lake Pepire, capped with Magnesian limestone. F. 2


2


1.


5.


4.


3.

D.D. Owen Delt.

C.B. Graham Lith.

AMPHITHEATRE OF SAND IN THE REGION OF F. 1.

On the Chippewa River.

D.D. Owen Delt. C.B. Graham Lith.

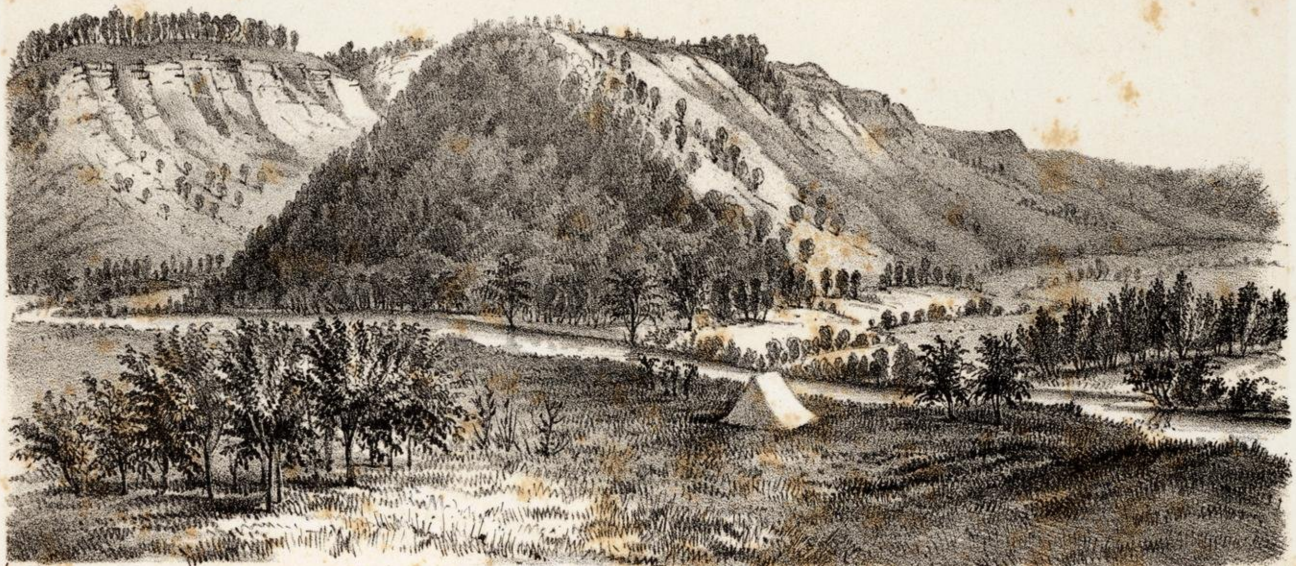
CASTELLATED APPEARANCE OF THE LOWER MAGNESIAN LIMESTONE (F. 2.)

On the Upper Iowa River

D. D. Owen Delt. C. B. Graham Lith.

CASTELLATED APPEARANCE OF THE LOWER MAGNESIAN LIMESTONE (F. 2.)

On the Upper Iowa River.



D.D. Owen Delt. C.B. Graham Lith.

NORTHERN AND SOUTHERN SLOPE OF HILLS ON THE UPPER IOWA.

C. B. Graham Lith

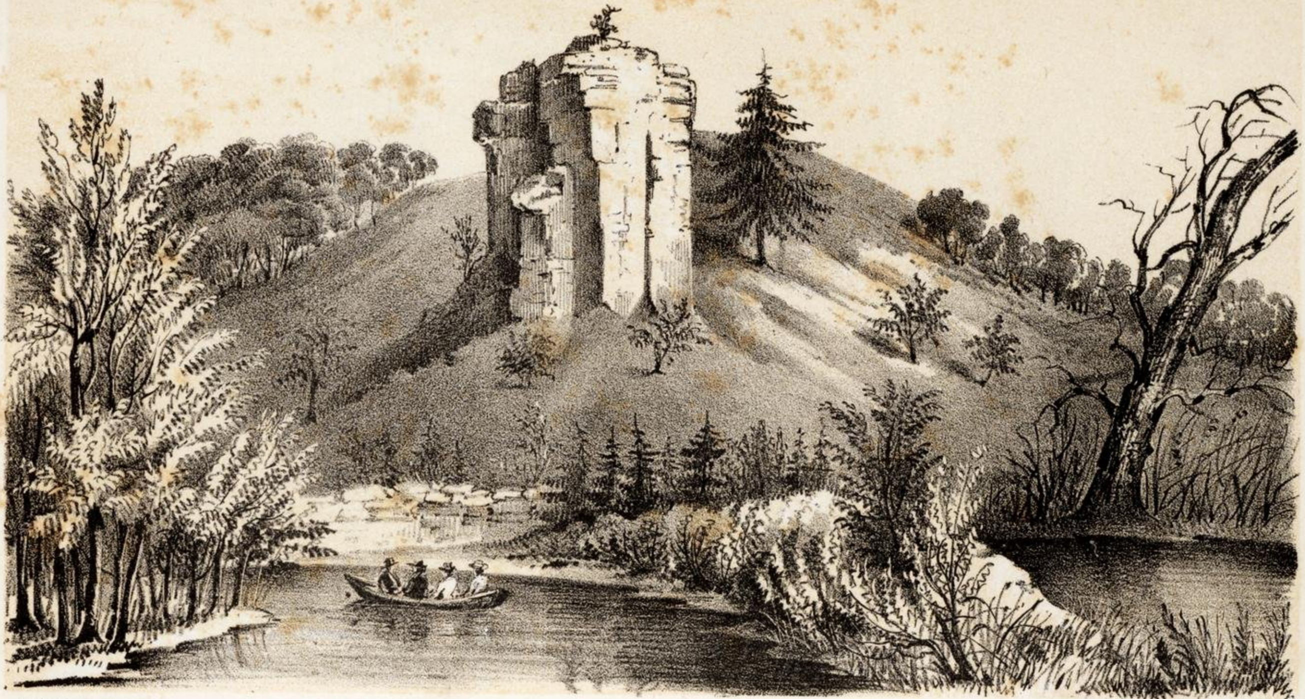
NATURAL WALL OF SANDSTONE, (F.2?c)

Near the Kinikinick River _ From a Sketch by Mr Lewis.

D D Owen Delt C.B.Graham Lith

OUTLINE OF HILLS ON TURKEY RIVER.

In the Winnebago Reserve



D.D. Owen Delr

EXPOSURE OF UPPER MAGNESIAN LIMESTONE.

Based on F 3 on Turkey River

D.D. Owen Delt   C.B. Graham Lith.

A BLUFF NEAR THE MOUTH OF THE UPPER IOWA.

Composed of Sandstones and Siliceo-Calcarious Rock (F1f)

D.D. Owen Delt.

C.B. Graham Lith

SCENE ON THE UPPER IOWA.

Hills capped with Castellated Cliffs

C. B. Graham Lith.

FALLS OF THE CHIPPEWA.

During the Freshet of June 1847.

G. B. Graham Lith

EXPOSURE OF HORNBLENDIC & GRANITIC ROCKS.

Near Brunets Portage. T 31 R 6 W

J.B. Graham lith

LONG LAKE T 44 N., R 7 W

The waters of which flow North to Lake Superior, and South into the Mississippi.

C. B. Graham Lith.

NATURAL SECTION OF TILTED STRATA OF RED SANDSTONE

On South shore of Lake Superior, near the Mouth of Montreal River, east of the point where the 4.th P.M strikes the Lake

C. B. Graham Lith

"TRIUMPHAL ARCH" AND WEATHER WORN CLIFFS OF RED SANDSTONE

West of Point Deston on Lake Superior

C. B. Graham lith

TRAP, THE DALLES OF THE S^{T} CROIX

Plate 23

C.B. Graham, Lith.

BOULDERS OF PORPHYRITIC GRANITE.

In the prairie of the Winnebago Reserve, between the Wapsipinicon and the Red Cedar Rivers

Maps removed and filed in Map area.

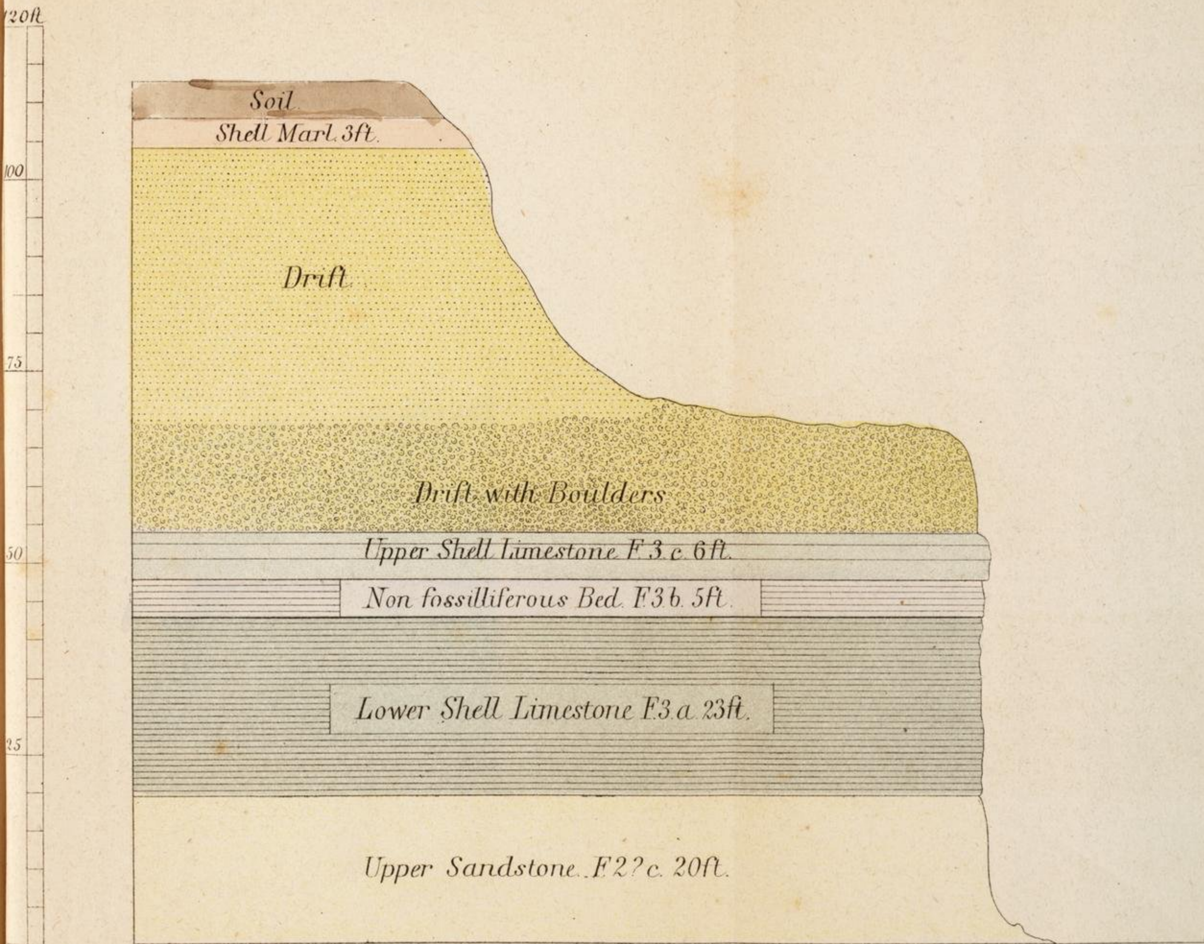
Section 1 - The Chippeway Land District of Wisconsin.

Section 2 - Section along the course of the Mississippi from the mouth of the Wisconsin River to .... the Falls of St. Anthony.

Section 3 - Sections of the St. Croix of the succession, thickness, relative elevation of F1 and F2 with their subordinate members.

Map 8- Section on the Iowa side of the Mississippi 30 miles below Lake Pepin at a Great Slide.

Section - Section by A. Randall along the line of 4th P.M. to the Mississippi.



Geological Section at the Falls of St. Anthony.

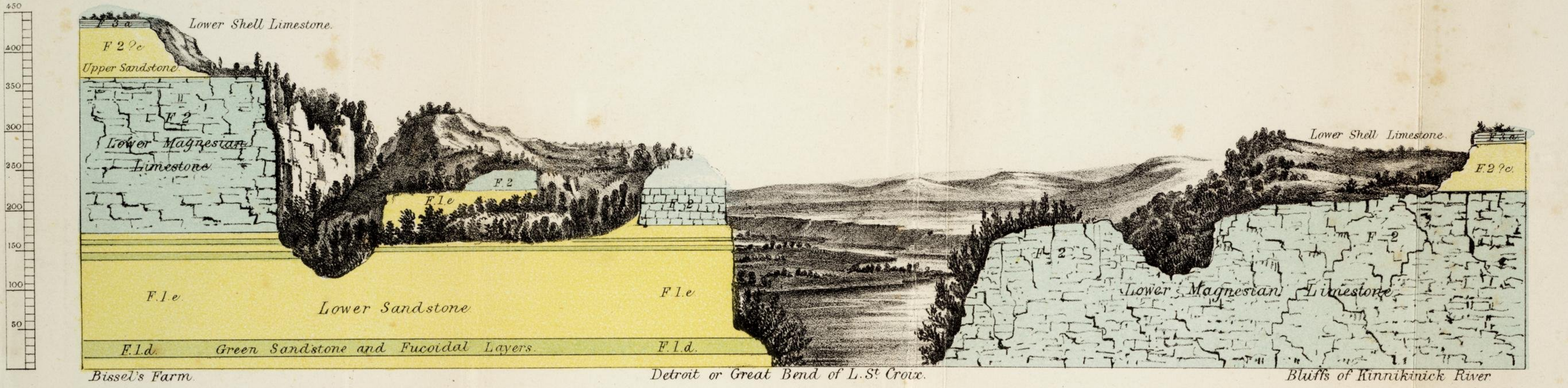
By B. F. Shumard.

h

Sec. No. 1.

Geological Section of the Strata from Bissel's Farm to 3 miles above the mouth of Kinnikinick River.

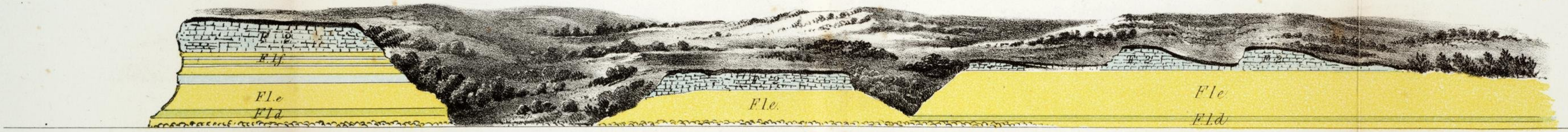
by B. F. Shumard.



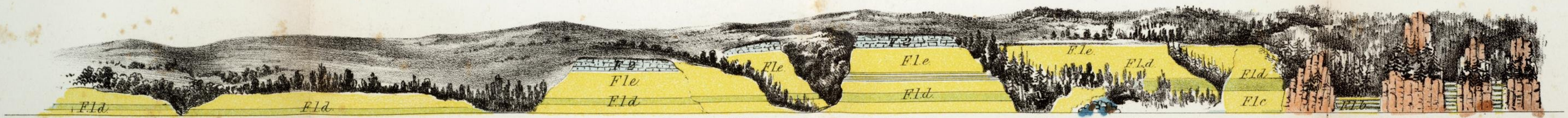
C. B. Graham Lith.

Section showing the relative thickness, and dip, of the Lower Magnesian Limestone (F. N°2) and underlying Sandstone.
with its subordinate beds (F. N°1. b. c. d. and f) from the Mississippi River, to the trap exposure at the Falls of St. Croix.
by D. D. Owen.

Section from the mouth of Lake St. Croix to near the Great Bend, or Detroit of Lake St. Croix.



Section from the great Bend of Lake St. Croix to the Correction Line.



Section from Marine Mills to the Dalles & Falls of St. Croix.

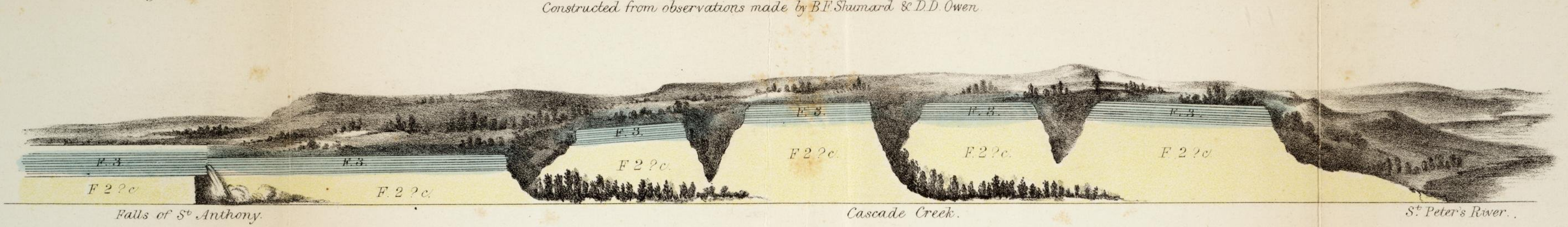
4

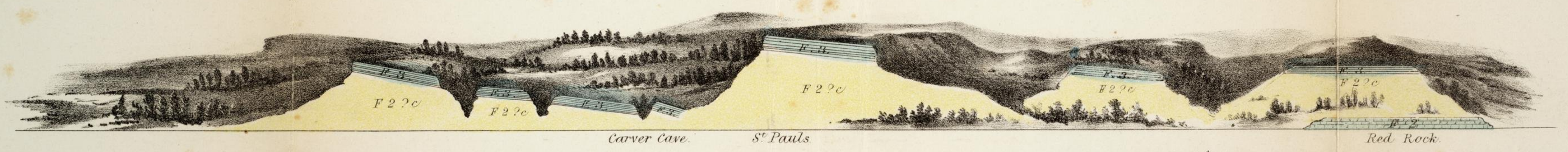
Sec No. 5.

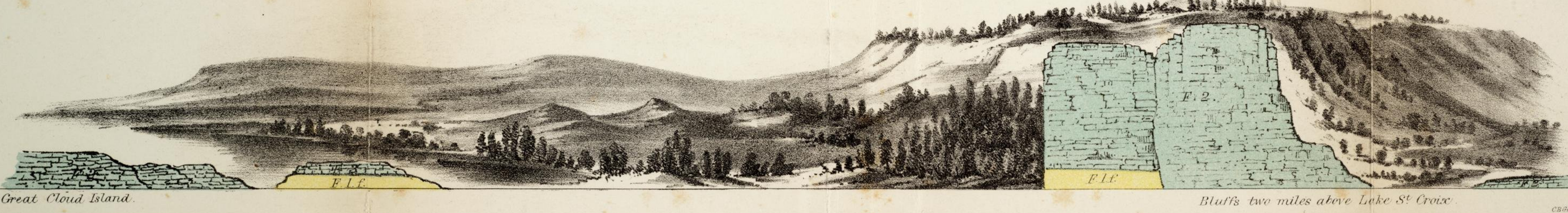
Geological Section on the Mississippi River, from the mouth of Lake St. Croix 1mile above the falls of St. Anthony

Showing the relative thickness, and dip of the Shell Limestones (F. No. 3) White Sandstone, (F. No. 2 ? c) Lower Magnesian Limestone (F. No. 2.) and Lower Sandstone F. No. 1. f.

Constructed from observations made by B. F. Shumard & D. D. Owen.







C. B. Graham Lith.

B

Section on Black River from the granite at the Falls to sandstone F1 a.

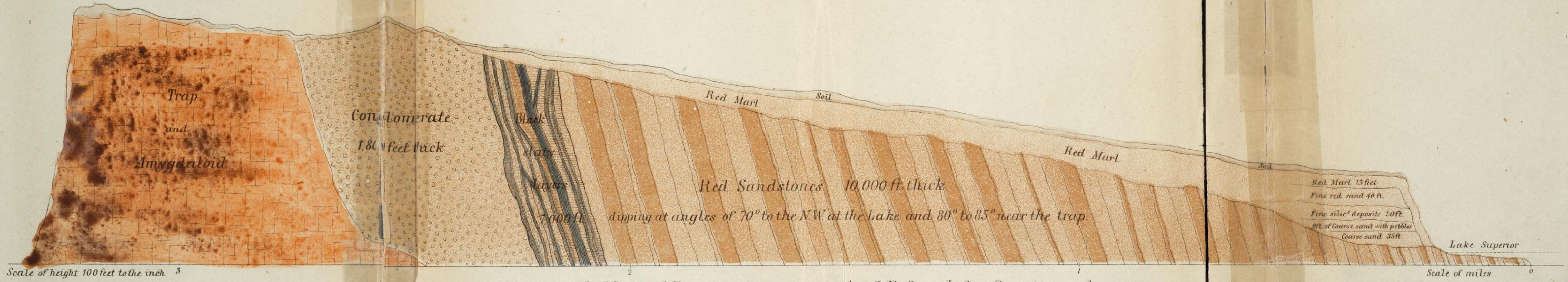
By A. Randall

S.

N

See p. 39.

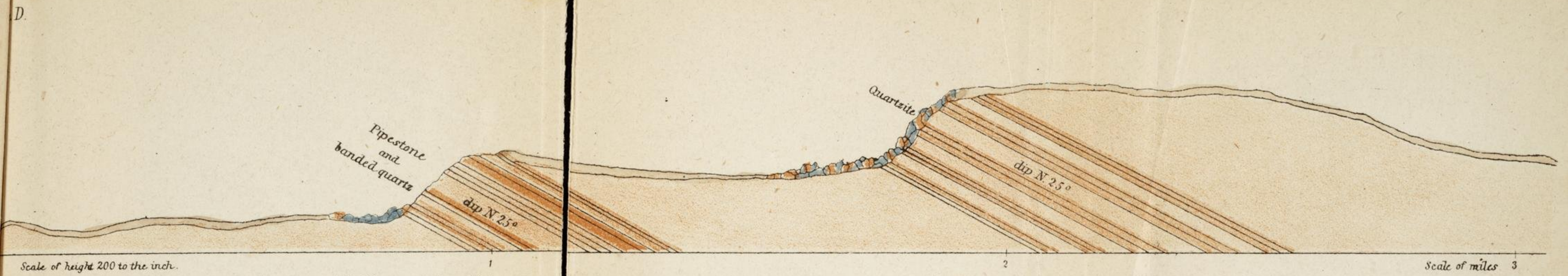
Sec. C.



Approximate Section on the Montreal River in a course nearly S.E. from Lake Superior to the trap.

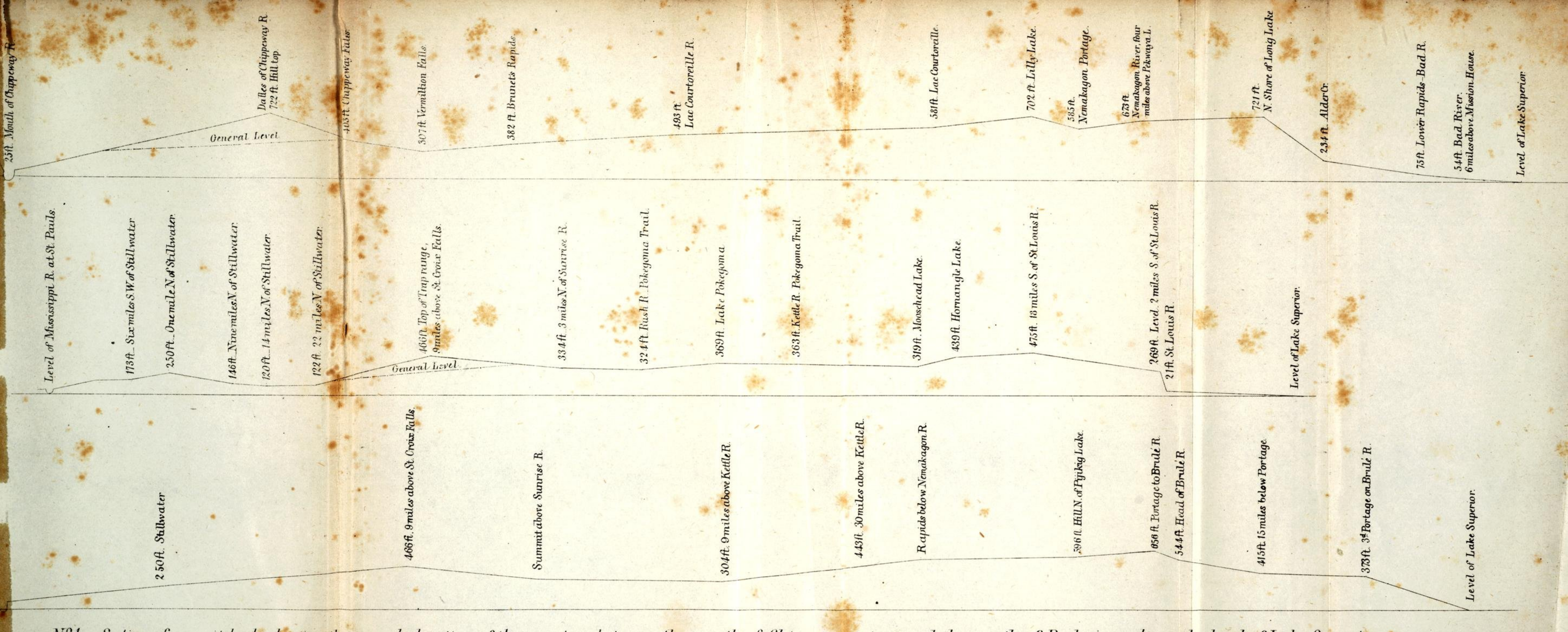
By A. Randall.

11



Section of hills at the Chippeway red pipestone locality between the Chippeway and Red Cedar rivers.
20 miles from Lake Courtoreille and 15 miles N. of Rice Lake.
By A. Randall.

Pipe stone found on
Pipestone Creek SW¼ Sec 27 27?
~~27~~ T. 35 R 10 W.



N°1. Section of summit levels, showing the general elevation of the country between the mouth of Chippeway river and the mouth of Bad river, above the level of Lake Superior.

N°2. Section " " " " " " " " " " " " Mississippi river, at St. Paul's, and St. Louis river, 18 miles above Fond du Lac, above Lake Superior.

N°3. Section " " " " " " " " " " " " " , at the outlet of Lake St. Croix, and the mouth of Bois Brulé river; " " "

From Barometrical Measurements

Made during a Geological Reconnoisance of the Chippeway Land District, under the direction of David Dale Owen, M.D., Principal Geologist,

By J. G. Norwood, M.D. Assistant Geologist.

MAP Removed and filed in Map Area

Title: Provisional Geological Map of part of the Chippewy Sand District...

Date Loaned

30Mr 62			
18Ap 62			
1My62			
1No '63			
9Mr'67			
DEC 10 '71			
MAY 8 '72			
SEP 25 1972			
FEB 27 1973			
AUG 28 1973			
APR 11 1975			
SEP 24 1975			
MAR 2 1976			
NOV 30 1977			
JAN 10 1984			

Demco 292-5

— Non-circulating! —