soon gained the good will and confidence of his superior officers to such a degree that he was intrusted with the charge of the Freight Receiving Department of the Milwaukee and Mississippi Branch, which position he held until April 1870, when he was elected to the responsible and arduous position of City Comptroller of the city of Milwaukee, which he holds at the present time.

CHAPTER VII.

The next subject which shall engage my attention, is a description of the formation of the Upper Mississippi, commencing at Prairie du Chien, which is built on a plain north of the Wisconsin River. Viewing the valley of the Mississippi up towards the north, a range of geological terraces may be seen converging in long lines of perspective, which continue to rise as you ascend the valley, and especially in going north towards the Kickapoo. Though the strata actually rises in these directions, yet the face of the country retains nearly the same elevations; from which it follows, that, one after another, the superior beds thin out and disappear, and the lower blue limestone, sandstone, and magnesian limestone gradually emerge from beneath the water courses and are ultimately found capping the adjacent hills, as may be seen near the mouth of Plumb Creek. Travelling still farther north, or northeast, very thin beds of magnesian limestone are seen capping the crest of the hills; and going a little further, the stratum runs out, and is succeeded by the next inferior stratum. Though the surface stratum runs out, yet, at some distance, it is found again to thicken. The lower magnesian limestone, at the bend of the Mississippi River, nearly runs out, and it again thickens farther north, near Bad Axe River. Between this and Prairie La Crosse the northerly rise again sets in, so that sandstone constitutes the great body of Mountain Island.

A few miles below this, the principal axis of the Upper Mississippi commences, where the strata again descend towards the falls of St. Anthony. Between the entrance to Lake Pepin, the lower sandstone and lower magnesian limestone stand at the height of forty feet, and at the great bend of that lake, the top of the eminence stands at the same height. This order of superposition continues till we go three miles below Vermillion River, where the sandstone disappears, the magnesian limestone occupying the whole way from the river to the top of the cliff. The sandstone again emerges from beneath the water, three or four miles above the mouth of the St. Croix. The lower magnesian limestone extends up the rivers Carron and Vermillion.
The scene depicted by nature on the main branch of the Chippewa, about fifty miles from its mouth, is by no means devoid of beauty. Being based on a soft sandstone, the surface is covered with disintegrated sand in every direction. The Chippewa River has laid bare, on its north side, a bank of light yellow sand to the depth of forty feet. This sandy soil gives no great promise to repay the farmer for his labor, containing only a small percentage of organic matter, while it contains a very large percentage of insoluble matter, composed chiefly of fine white sand, and only a very small quantity of soluble salts, chiefly oxide of iron and alumina, with but a mere trace of lime. In some places however, it is far more productive than its appearance would indicate, on account of a larger admixture of calcereous drift, derived from the magnesian limestone. "A similar belt of land extends from the Chippewa to the Black River and Prairie La Crosse River." This tract lies nearly parallel with the Mississippi, distant from it about twenty miles, and averages in width from forty to fifty miles. It diverges from Prairie La Crosse to the east, and crosses the Wisconsin River between Point Bas and the Dalles. From the Menomonee, this sandy belt runs north and northeasterly, towards Apple River, but receives a large quantity of calcereous matter, which improves its character. This sandstone district being interstratified with magnesian limestone, the action of water undermines the harder rocks, leaving overhanging ledges and caverns, which are the favorite resorts of reptiles, which are seen in multitudes here, as well as at the Mississippi, below Lake Pepin, basking in the sun, at certain seasons of the year. In such places the traveller should be cautious.

A striking analogy exists between the physical features of the country occupied by the lower magnesian limestone and that of the district before described, and occupied by the upper magnesian limestone. This resemblance, no doubt, is owing to the similar chemical composition of both rocks. The soil derived from the decomposition of both these formations is of excellent quality, being rich, not only in organic matter, but also in those mineral salts which confer durability and give rapidity to the growth of plants. The immediate vicinity of the streams is in many places rough, but the rest presents a sufficiently level surface for agricultural purposes. But from Lake Pepin south to upper Iowa, the surface is considerably broken; not too much so, however, for grazing purposes. This region is adapted to the breeding of sheep.

The streams in this district are amply supplied with trout, and the rivers with bass, carp, sunfish, pickerel, pike, and catfish. On the prairies
are deer, grouse, pheasants and partridges; and the streams are visited, at the proper season, by immense flocks of wild geese and ducks. The soil is of good quality between Turkey and Yellow rivers, in the eastern part of the Winnebago reserve, but is deficient in timber. The physical and agricultural features of the upper Iowa are somewhat similar to those of the district just described, as regards the land, a few miles below the Big Spring. The upland prairie between the upper Iowa and Turkey River is of second rate quality, and the surface undulates; the want of timber is a great drawback.

Between Turkey River and the head water of the Wapsipinicon, and beyond that stream to near the Red Cedar, the country is rather marshy, but level, and deficient in timber. In the interior of the Chippewa land district, the features of the country vary with the change in the geological formation. A little before reaching the igneous ranges, the stream runs between solid walls cut into the sandstone, known in that locality by the name of Delles. In this region may be seen granite, sienite, greenstone, hornblende, gneiss and mica slate. Chloritic and talcose rocks are also to be occasionally found in the region.

The most southerly point on which granite rocks occur on the tributaries of the Mississippi, is on the Black River, the primitive rocks extend nearly to the top of the highest hills, pebbly sandstone occurring here and there. The soil and timber at this place are considerably improved. After crossing Cunningham's Creek, the granite is replaced by gneiss, which extends five or six miles. "After the fourth principal meridian crosses Black River, no rocks, but boulders appear on the surface for sixty miles."

It is not easy to define the boundaries of the sandstone region of Wisconsin. It occupies a large tract, resembling a crescent, commencing at the St. Croix district, and extending to the Menomonee, the broadest part being on the Wisconsin River. This sandstone is supposed to be identical with the Pottsdam sandstone of New York, from the discovery of fossils, characteristic of both, not far from Lyons, in Sauk County. This rock is supposed to be the oldest containing fossil remains. The northern part of the state rests upon primary and other rocks of igneous origin, such as granite, trap. &c. This region is principally covered with pine.

In a work like mine, I find it impossible to give a connected geological statement of facts; as in connection with such facts I was often obliged to branch off into some other subject relating to the industrial resources of the district under discussion. The economic geology of the State, therefore, could not be continuous without losing more time in the arrangement of the work than I could spare.

The igneous ranges show themselves first in the beds of the east branch
of the Chippewa. In all this region of country, rapids are numerous, and water-power extensive, with occasional groves of good timber. In the Lake Superior region is found good maple timber, indicative of good land; the surface is much broken, but not so much so as to render it unfit for agricultural purposes. There are numerous ponds and morasses in many of the hollows, and sometimes, on very elevated situations throughout this region, of trap formations. Similar ones occur in Michigan. From their circular form, and having no visible outlet, these are supposed to be cracks for the exit of lava. About a quarter of a mile north of the trap rock range, sandstone conglomerate makes its appearance. The maple land in the vicinity of the east fork is of good quality.

The bays on Lake Superior are sandy; the crests of the hills rocky, composed of sandstone and marly beds. A variety of opinions have been advanced regarding the age of the conglomerates, marls and red sandstone of Lake Superior. Some believe them to be contemporaneous with the new red sandstone of Great Britain, and others refer them to the oldest sandstone of the New York system. As no organic remains are found here, it is difficult to decide this question. Dr. Owen, however, is of the opinion, that from lithological and mineralogical character, these rocks may be referred to the new and red sandstone of England. Twenty miles south of St. Louis river, fine pine timber may be seen, and also, on the heights, good sugar maple.

Lake Superior is the largest body of fresh water in the world, containing, according to official report, 22,000 square miles. Its surface is elevated 596 feet above the ocean level, while portions of its bed are several hundred feet below it, thus making it one of the deepest depressions on the face of the earth, excluding those portions covered by the ocean waters. Its greatest length is 400 miles, and its greatest breadth 160 miles. It contains but few islands, some of these being of igneous origin. At a period not very remote, a strong current swept one of these islands in a northwesterly direction, grinding down the softer beds, and polishing the hardest materials; the grooves being perfectly distinct and well defined over a large extent. I have seen specimens whose surfaces were so definitely marked, that one would suppose they had recently left the hands of the engraver, their angles having suffered so little from the ordinary action of the elements. Six miles from Milwaukee, up the Menomonee River, is found a limestone well polished and beautifully fluted, all the grooves running perfectly parallel to one another, no two of them, however, being of the same breadth or depth. This stone is the best I have seen in the vicinity of Milwaukee, for building purposes, being rather compact, and presenting a pretty smooth surface.
The basement story of a house in the town land of Lisbon shows the result of glacier movement in great perfection. The floor is perfectly polished, and the grooving in it very deeply marked, but far asunder. I have seen the surface of a limestone quarry in the town of Menomonee, adjoining the town land of Granville, well polished, with numerous parallel grooves, but slightly marked. Near the lighthouse, one mile north of the village of Sheboygan, the upper face of the limestone rock, which is near a hundred feet under the surface, is polished and ground, the direction of the grooves being W. N. W. and E. S. E. A short distance from the lighthouse, the limestone presents the same polished surface, and is streaked similar to the rock at that place, the direction of the streak being the same as above.

The water of Lake Superior occupies a depression not by any means "excavated out of the soft and yielding sandstone," but caused by a depression of the earth, resulting from volcanic action. No mechanical action of water could excavate such an immense area to such a vast depth below the surface of the ocean, as the bottom of this wonderful expanse of water is known to be. To excavate it even a quarter of an inch below the surface of the ocean, would be a physical impossibility. Large quantities of gaseous matter having escaped from the regions now occupied by our great lakes, a depression or falling down would necessarily take place, when the temperature became cooled. If this depression took place when those portions of the northern hemisphere, now occupied by the great lakes, were covered by the ocean, the lakes must have originally been salt water. A paper recently read before the Archeological Society of Ireland, points out the historical date of the formation of Lough Neagh and other lakes in Ireland, by volcanic action. If the moon had seas and rivers, many of those deep volcanic caverns which have been rendered visible by Lord Rosse's telescope, would be lakes, whose bottoms would be far below the surrounding seas, as is the case with many of the American lakes. Numbers of these lunar caverns are known to be of great depth, the surrounding surface presenting no cone, but rather a flat plain, such as surrounds Lake Michigan and some of the other great lakes. These lunar caverns could no more be the result of the mechanical action of water, (allowing that this fluid did exist in the moon,) than that water could ascend from a lower point to a higher, unassisted by any force. I must, therefore, refer the excavation of such of our lakes, at least, as are below the ocean, not to the mechanical action of water, but rather to volcanic action. If Lakes Michigan and Huron were elevated by igneous action, the abrading action of water may have carried away large quantities of the surface, but none under the ocean; so that, in either case, a falling down of the bottom
must have taken place to account for their present position.

Lake Superior is guarded on the east and north by an irregular belt of granite, which will arrest any further encroachments of the waters at these points. There are some limited patches of sandstone which have escaped the degrading action of the lake waters.

Lake Michigan, next in magnitude to Lake Superior, bounds Wisconsin on the east, and covers an area of 20,400 square miles; its greatest length being 320 miles, and greatest breadth 100 miles. The depth of Lake Superior is 900 feet, and its surface is 596 feet above the ocean, leaving its bottom 304 feet below the ocean. The depth of Lake Michigan is 1000 feet, and its surface is 578 feet above the sea; therefore the bottom of Lake Michigan is 422 feet below the surface of the ocean. Lake Huron is 1000 feet deep, and its surface 578 feet above the ocean; therefore its bottom is 422 feet below the surface of the ocean. This lake occupies an area of 20,400 square miles.

From what is here exhibited, it appears that Lakes Michigan and Huron are on the same level. Lake Erie is comparatively shallow, its mean depth being only 84 ft., and area 9,600 square miles, and its surface 565 feet above the sea. Ontario has a mean depth of 500 feet, and covers 6,800 square miles. Its surface is 232 feet above the sea. Lake St. Clair covers an area of 364 square miles, and is only 20 feet deep, its surface being 520 feet over the sea.

The area drained by these lakes is estimated at 335,515 square miles, all of which being a part of that immense plain bounded by the Appalachian chain of mountains on the east, and by the Rocky Mountains on the west, and extending north and south from the Arctic Sea to the Gulf of Mexico. The mean elevation of this immense region is less than 1000 feet, and its highest points nowhere exceed 2500 feet. These culminating points can scarcely be designated mountains, being only the more elevated portions of a gently rising and widely extended plateau. The two great outlets to carry off all the water of this district are the St. Lawrence and the Mississippi. The Mississippi is by far the larger, but the St. Lawrence discharges the greater quantity of water into the ocean. The St. Lawrence has stupendous cataracts—the other difficult rapids; the "Father of Waters" is turbid—the water of the other preserves crystal purity. The St. Lawrence swells into inland seas—the other is destitute of such expansions, except Lake Pepin. Both, however, are similar in one particular, being the great highways of commerce, by which the vast regions through which they pass are enriched and supplied with the luxuries of other climes.

It has been argued by many that these lakes have tides similar to
those in the open seas; but now it is an admitted fact, that there is not
regular flow or ebb of the waters similar to what is observed on the sea-
shore. No doubt, the waters constantly lash the shore with a degree of
force proportionate to existing causes; but the changes in the elevation
are too variable to be traced to any natural cause constantly acting. I
have taken some trouble myself to ascertain if the surface of Lake Michi-
gan obeyed the attracting influence of the sun and moon, but on account
of the limited area over which the attracting force of these bodies acts, I
could observe no regular rise or fall of the surface, such as would result
from the laws of gravity. The constant motion of the waters of these lakes
may be traced to other causes of a local character. The variation in the
surface of the lake may be due to unequal barometric pressures on its sur-
face, at different points, at the same time, by which motion may be com-
unicated, such as is generally seen on the margin of the lake. There are,
however, times when the water is perfectly motionless, but not often for
any length of time together. A local increased or diminished atmospheric
pressure would lower or raise the water level, especially where the expanse
of water is considerable. The water being thus locally raised, would, from
its gravity, fall back, by which an oscillating motion would be communicat-
ed, which would continue for some time after the producing cause had
ceased. In such a wide expanse of water as Lake Michigan, or Lake
Superior, the surface must be constantly subject to unequal barometric
pressure, by which the surface must continually be disturbed. The action
of the wind will likewise set the water in motion, as is well known to every
one occupying a low situation on the border of any of the lakes. A strong
easterly wind will cause the waves to rise some feet at all the piers along
the western shore of Lake Michigan, inundating all such places as lie be-
low a certain level. A westerly wind will produce similar effects on the
eastern shore of the lake. De Le Bach very properly observes, that a
sudden impulse given to particles of water, either by suddenly increased or
diminished pressure of the atmosphere, would cause a rise or fall, in the
manner of a wave, beyond the height or depth strictly due to mere weight
itself. This would manifestly give rise to a series of aqueous waves, which
would propagate themselves from the centre of disturbance, like the circles
which are observed when a stone is thrown into the water. Hence it is,
that undulations are observed in the water before the gale sets in.

It is known that there is an annual variation in the surface of these
lakes, arising from the melting of the ice and snow, which accumulate in
their catchment basins during the inclement seasons of the year. When
the water and snow freeze, the supply to the lake diminishes, and there-
fore the surface falls; but when these congealed masses begin to melt un-
der the influence of returning heat, the surface of the lakes begins to rise. To this may be added the spring rains, which tend to elevate the lake surface in proportion to the quantity fallen.

Besides the annual rise of the lakes, which is but small, (being no more than from 12 to 18 inches,) a considerable one is known to occur at unequal intervals, varying from five to seven years, and, according to the report of persons who had opportunities of observing the phenomenon, to fourteen and nineteen years. During the last year, the surface of Lake Michigan attained a height of about four feet above its usual level, by which the lower parts of the city of Milwaukee were covered with water. A knowledge of this fact shows the necessity of filling up such places, so as to raise them above the destructive influence of such recurring variations. Lake Superior has been known to rise six feet above its usual level. The cause of these variations in the surface of the lakes, at unequal intervals, is not so easily accounted for as the annual variation.—One might be apt to refer the cause to the melting of immense glaciers, which might have taken years to accumulate in the bosom of some elevated regions in a high latitude; but the geography of the country shows that no such regions exist, and no evidence is on record of the existence of such accumulations. Therefore we cannot refer these extraordinary accumulations of water in the lakes to extraordinary accumulations of snow. To what, then, are these periodical elevations of the surface of the lakes to be referred? Are we to refer the cause to increased rains falling in the catchment basins of the lakes at unequal intervals? No rain gauges having been kept in the Lake Superior region, the condition of all its tributaries previous to, and during the gradual elevation of the surface, can only be resorted to in the solution of the problem. Gentlemen connected with the copper mines of Lake Superior, informed me that during the years 1851 and 1852, the surface of the lake continued to rise day by day, while all the tributaries to it were lower than they had been seen for many years before. This information was corroborated by Mr. Sterling, of the State of Pennsylvania, a gentleman of great and correct observation, who travelled round the lake in 1852, when its surface was from four to six feet higher than usual, which proves that the increased elevation of the surface could, by no means, be due to an unequal quantity of rain falling in its catchment basin, previous to, and during the year in which the surface was seen continually to rise; from which it appears that we must look to some other cause than that of rain for the solution of the problem.

In connection with this subject, I might mention that the Fox River, the principal tributary to Lake Michigan, contributed a less quantity of water than usual to that lake, in 1852, while the surface of the lake rose.
during that year, from three to four feet higher than usual. Persons liv-
ing on the bank of the Mississippi River assured me that that river was
three feet lower during that year than usual.

From these facts the conclusion is irresistible—that igneous
action communicated an upward motion to the bottom of the lakes, which,
of course, caused the water to rise while the upward movement contin-
ued. If we conceive this upward motion to cease, the surface of the lakes
would soon begin to descend by discharging the elevated surface through
the usual natural channel. When the upward force began again to act, so as to communicate motion, the same phenomenon must necessarily have
taken place. And as there is no reason why this internal force should
communicate motion at equal intervals of time, we cannot expect a recur-
rance of the above phenomenon at the end of equal periods. Our rivers
show ample evidence of this up-heaving force; as they are all of consider-
able depth for some distance from the lakes; a condition that could not
exist under any other circumstance than that of subterranean force, which
would drive back the elevated waters, just as we see them at the different
points where the rivers discharge themselves into the lake. These deep
channels, now occupied by still water, must have been excavated by the
mechanical action of water flowing from a higher to a lower point. Hence
it appears that the water must have been forced back into these deep chan-
nels by an upward motion communicated to the bottom of our lake; and
as this phenomenon occurred once, without any doubt, there is no reason
why it should not occur again and again, as often as similar circumstances
may occur.

Tables in my possession showing the quantity of rain and snow fallen
at Milwaukee in the years 1849, 1850, 1851 and 1862 make it appear,
that more rain fell during ten months of the year 1849, than during the
whole year of 1850; yet the lake was higher in 1850 than in 1849; and
comparing the quantity fallen during the year 1849 with that which fell
in 1852, the former exceeded the latter, though the surface of Lake Mich-
igan was higher in '52 than in '49 by three or four feet.

I was told that Lake Huron was higher in '52 than usual, but got
no reliable information in reference to the state of its tributaries in that
year.

The following article, taken from the American Athenæum of May
9th, 1865, will account for the high stages of water sometimes observed in
our great lakes.
THE TIDES OF THE GREAT LAKES.

At irregular intervals, the surface of the great interior lakes of this continent are found to be higher by four, five, six, or even eight feet, than at other times. To account for this, various theories have been started. Mr. John Gregory, a gentleman of careful research, believes the tides to be the effect of igneous action, and states his belief as follows:

A residence of about twenty years in Milwaukee enables me to say, with positive certainty, that the periodical rise of Lake Superior, as well of Lake Michigan, are not due to the attraction of the sun and moon. — Though the attraction of the celestial bodies extend their influences to the waters of our lakes, the forces do not act for a sufficient length of time to set them in motion, by reasons of the limited areas of the fluid surfaces exposed to such influences.

For thousands of years may be observed a recurrence of the flow and ebb of the tide in the open seas and oceans at regular intervals of time. When we compare these regular occurrences of tidal phenomena with the aspects of the moon, or the relative positions of the sun, moon and earth, during an entire cycle, we observe an unbroken relation, as regards time, which enables us at once to trace the cause of the flowing and ebbing of the tides to the attracting influence of the sun and moon (see Gregory's Astronomy). If this relation of equality, in point of time, were found not to exist between the recurring periods of the flowing and ebbing of the tides, as compared with the aspects of the moon, on the relative positions of the sun, moon and earth, during an entire cycle, we could not, by any mode of reasoning founded on the established rules of logic, refer the cause of the tides to the attracting influence of the sun and moon. Let us apply this undeniable principle, to prove the fallacy of an opinion some times put forward on this subject by persons of respectable pretensions; namely, that a subterranean communication exists between the lakes and the sea or ocean, and that the high stages of water periodically observed in the former are produced by the spring tides in the latter. From all the facts I could collect from written documents and from intelligent persons who had long resided on the borders of these great lakes, these high stage return at intervals of periods varying from five to seven years, and some times to fourteen and nineteen years. These periods have no relation what ever, in point of time, to the recurring periods of high tides in the ocean or sea. They are too variable to be traced to any natural cause constantly and uniformly acting.
Therefore the idea of subterranean channels communicating with the ocean should not be entertained. If Alpine regions, occupying a high position and shedding their waters into the lakes were found to exist, one might be apt to refer the cause to the meeting of immense glaciers, which might have taken more or less years to accumulate in the bosom of such regions; but geography proves that no such regions exist, nor is there any extraordinary accumulation of ice or snow on written record, or handed down to us by tradition. Therefore we cannot refer these extraordinary elevations in the surface of the lakes at irregular intervals to accumulations of snow. To what, then, are we to refer them?

Are we to refer the cause to increased rains falling in the catchment basins of the lakes at unequal intervals? No rain gauges having been kept in the Lake Superior regions that I am aware of, the condition of all its tributaries previous to, and during the gradual elevations of the surface, can only be resorted to in the solution of the problem.

Gentlemen connected with the copper mines of Lake Superior informed me that during the years 1851 and 1852, the surface of the lake continued to rise day by day, while all the tributaries to it were lower than they had been for many years before. This information was corroborated by Mr. Sterling, of Pennsylvania, a gentleman of great and correct observation, who travelled around the lake in 1852, when the surface was from five to six feet higher than usual, which proves that the increased elevation of the surface could, by no means, be due to an unequal quantity of rain falling in its catchment basin previous to, or during the year in which the surface was seen continually to rise; from which it appears that we must look to some other cause than that of rain for the solution of the problem under discussion. In connection with this subject I may mention that the Fox River, the principal tributary to Lake Michigan, contributed a less quantity of water than usual to that lake in 1852, while the surface rose during that year from three to four feet higher than usual. Persons living on the bank of the Mississippi River, assured me that that river was three feet lower during that year than usual.

From all the facts above stated, in connection with others, the conclusion is irresistible, namely, that igneous action, at different times, communicated an upward motion to the bottom of the lakes, which, of course, caused the water to rise while the upward motion continued. If this upward motion ceased, the surface of the lakes would soon begin to descend, by discharging the elevated surface through the usual natural channels. When the upward force begins again to act, so as to communicate motion, the same phenomenon would necessarily take place. And as there is no reason why this internal igneous force should occur at
equal intervals of time, we cannot expect a recurrence of the above phenomenon at the end of equal periods. Our rivers show ample evidence of this up-heaving force, as they are all of considerable depth for some distance from the lakes, a condition of things that could not exist under any other circumstance than that of an up-heaving force, which would necessarily drive back the elevated surface waters into the rivers, just as we see them at different points where the rivers discharge themselves into the lake.

These deep channels, now occupied by still water, must have been excavated by the mechanical action of water flowing from a higher to a lower point. Hence it appears that the water must have been forced back into these deep channels by an upward motion communicated to the bottom of the lake; and as it is a settled and conceded fact that this phenomenon occurred once, there is no reason why it should not occur again and again, under similar circumstances.—

A year or two ago, Lake Michigan rose to some small height near Racine, by which the water of the lake was forced up the Racine River to some distance. This rise of the surface of the lake and river was caused by a small igneous force acting beneath. The earthquake that caused the surface to rise lasted but a short time, and the up-heaving force was not considerable.

Earthquakes have frequently occurred in many parts of the world of late years. Last year (1869) one of considerable force disturbed the equilbrium of the Pacific along the western American coast for many miles, and a small shock was felt last year in the third ward of the city of Milwaukee, which lasted about one minute and a half, doing little or no injury.

Green Bay, a name derived from the fancied color of the water, may be considered as a part of Lake Michigan, being the outlet of Fox or Neenah River. At this point there are several islands, the largest being Potawatomie Island. The bay contains, besides this, Rock Island, Detroit and Plum Islands, Chamber Islands and Gras Island.

The largest lake in the State is Lake Winnebago, being about thirty miles long and ten broad, and containing an area of about two hundred and twenty square miles. The Fox, or Neenah River, enters it at Oshkosh, and issues from it by two channels; the south channel leading to the town of Neenah, and the north to Menasha, enclosing Doty Island between both branches. These two rival towns have grown with magic speed within a few years, and are destined, at least one of them, to rise to some importance; occupying, as they do, the high way between the great lakes and the Mississippi. These channels, connecting Lake Winnebago.
with the little Butte des Mortes lake, are known as the Winnebago Rapids, which are now navigable by steam-boats. When I first went to lay out the canal at the Neenah side, only one boat was employed on the lake, and now there are no less than five, being an increase of three steam-boats in about three years; and if the improvements down from these points to Green Bay, and west to the Mississippi, were completed, which it is expected they will be within a year or two, I have no doubt but scores of steam-boats will be seen daily on this fine sheet of water. In calm weather, the water of this lake is quite clear; but during a heavy gale it becomes turbid, the lake being shallow, but sufficiently deep for purposes of navigation. This lake must have been deeper than at present. For about the distance of eight miles, the north shore of Lake Winnebago is composed of low sandy beach, and for an extent of fifteen miles, the east side of the shore presents a wall composed of rocks, so closely laid together as to lead one to suppose that the work was constructed by man. A similar wall, but of less continuity, skirts portions of the western shore. These walls rise about five feet above the water, and extend under it some hundreds of feet. These walls have been forced by the expansive force of ice in winter, by which the rocks near the shore are annually driven towards it, until they are finally thrown up into a ridge, or wall; a phenomenon observable at Pewaukee, and other lakes in Milwaukee County. The surface of this lake, according to Mr. Cram, is 160 feet above the level of Lake Michigan.

All these vast lakes discharge themselves through the river St. Lawrence; but time has left upon record ample evidence that Lake Michigan once sent its waters down the valley of the Illinois, into the Father of Waters. Lakes Huron and Erie were the tributaries to Lake Michigan. I have traced the old track through Illinois, and, if space and time permitted, I should feel much pleasure in describing the evidences left behind by the deserted river. It is supposed that a barrier once existed across the straits of Mackinaw, through which the waters of Lake Michigan now flow into Lake Huron. This change of direction in the course of these immense bodies of water may be accounted for on the principle of elevation and depression. The bottom of Lake Michigan must have once occupied, relatively to its western shores, a lower position than it does at present, as before stated. All the streams I have seen discharging themselves into this lake, are, for some distance inland, very deep, affording basins for the accommodation of shipping at Chicago, Southport, Racine, Milwaukee, Port Washington, Sheboygan, Manitowoc, &c.

* The improvement of the Fox River will probably be soon commenced. Gov. Fairchild and other influential gentlemen of the State, took up the subject last year (1869) in real earnest, and it is not likely that they will slacken their exertions till so desirable an improvement shall have been accomplished.
Ancient lake beeches are traced round lake Erie, elevated one hundred and eight feet above the present surface of the water, which is sufficient evidence that a depression must have taken place at that point. Now, a depression of the country about the Niagara River, and an elevation on the northern part of Illinois, would evidently change the course of the lake waters from the Mississippi to the St. Lawrence, as we find them at present. Every geologist is aware that great changes in the relative elevations of several districts have taken place, and that the causes which produced such changes are still in operation in many parts of the world. The earth is rising in Scandinavia at the rate of two feet in a century, and I have no doubt but that Lake Michigan is rising, not, perhaps, by an equible motion, from a similar cause.

The absence of islands in Lake Michigan, except a few near its northern extremity, is unfavorable to navigation, as there is scarcely anything deserving the name of a deep bay on the entire coast, except at Green Bay, before noticed. There are circumstances, however, which in some degree compensate for the absence of deep bays or islands along the western shore of Lake Michigan. Not a single shoal or rock is to be found, the entire shore being lined with a bank of clay, and the margin sufficiently deep for vessels drawing any depth of water, with these deep and safe inlets at the mouths of the streams, before mentioned. It is very remarkable that all these great lakes are characterized by the absence of islands.

Hitherto these Western States have been hemmed in for about five months in the year by the ice and snow. The navigation of Lake Michigan usually opens in the month of March, but we seldom have arrivals from below the straits of Mackinaw till some time in April, in consequence of these straits remaining closed with masses of solid ice until about this time. In future, I see no reason why we should continue separated from the Eastern States even for one month. The Rail Roads proposed to be built along the shore, from Green Bay to Chicago, and from Grand Haven, opposite Milwaukee, to Detroit, and by port Huron, to Halifax, will enable the Wisconsin merchant, and others, to go to New York or Boston, or any other place, where their business may require them to go. The navigation across the lake, from Milwaukee to Grand Haven, may not be interrupted for three days together during a whole year; but should it become interrupted, the difficulty will be obviated by going through Chicago. The use of an ice-breaker would enable a first class steam-boat to cross the lake during the entire winter, during high gales excepted. A break-water outside, and a good dock at or near the confluence of the Milwaukee and Menomonee Rivers, with a straight cut to the lake, would advance the interests of the city of Milwaukee very considerably. These are improvements which
the necessities of the State imperatively demand speedily to be carried into effect.*

Some years ago, the foolish and inhuman practice of some steam-boat commanders of running races with rival steamboats, often resulted in the loss of many human lives and much valuable property, on our lakes and rivers. This practice, however, is no longer known, and the travelling public have more security, which is a step in the right direction. With the view to guard against the danger of storms, scientific men began, some years ago, to keep regular records of the direction, force, duration, and velocity of the winds in different places, expecting to find out such facts, as would enable the mariner to foretell the approach of a storm, and prepare against its dangerous effects.

The late Admiral Fitzroy, of the British Navy, was the first person that put into practical operation storm signals, at different places, in 1861. His precautioning plans were soon adopted in several of the nations in Europe, and, in 1869, the Hon. H. E. Paine, of Milwaukee, favorably known as an able general, an honest representative of the people, and a good citizen, brought the matter formally before Congress at Washington, and it is expected we shall soon have a system of storm-signals regularly established throughout the length and breadth of this great continent. To carry out the plan here proposed, our fellow-citizen, Prof. J. A Lapham, L. L. D., is stationed at Chicago. Dr. Lapham is well qualified to discharge the duties of the post he occupies.

Though America does not claim the credit of being the first that put in operation a practical system of weather forecasts and storm signals, yet the writer feels it his duty, to state, that the world is indebted to an American citizen for the best work on the theory of storms ever published. This work is the production of Prof. Espy, who has done more to establish the physical laws that govern atmospheric disturbance, than all the philosophers of Europe put together. Many years ago Prof. Espy visited Ireland, when the writer happened to have the honor of being a member of the council of the Geological Society of Dublin, and from a hasty glance at the work, having been forcibly impressed by the novelty and truth of the Professor's theory of storms, he recommended that he be forthwith engaged to deliver lectures on the subject, exclusively for the benefit of that society. Candor demands this testimony to be borne to the character of Prof. Espy, as a philosopher, by one who has

* This note was made some years ago, as surveyed and located by me. At the same time I forwarded a report and map of the rivers to Washington, on which were laid down all the improvements I then recommended.
devoted a portion of a long life to scientific subjects, but claims no right to be considered a high authority.

The quantity of fish caught in these lakes is really astonishing—the white fish being by far the best. Sturgeon of large size are caught in Lake Michigan; and, among other fish found in many of our lakes and rivers, are salmon, perch, bass, suckers, herrings, pickerel, trout, catfish, sheep's head, lawyers, and many others. Large quantities of the fish are used in all the populous towns in the State, and in some places in the northern part of the State, where agriculture has not made much progress; and where game is scarce, the Indians have lived almost exclusively on it. The salmon, or trout, is not as good a quality as those caught in Great Britain or Ireland. The exact quantity of fish taken in our lakes is not easily ascertained, as no one takes the trouble to collect the statistics of this important branch of our resources.

Besides Lakes Superior, Michigan, and Winnebago, our State is profusely dotted with many others of less note, in point of magnitude; several of them exhibiting the grandest scenery that can be imagined. Skirting many of these deep and crystal reservoirs, are sloping hills, covered with groves and clumps of stately trees, precipitous bluffs covered with cedar, hemlock, spruce and other evergreens; projecting rocks, (whose base have been worn away by the corroding hand of time,) on which the American eagle stands, with all the pride of majesty, inspired by the consciousness of his power and superiority over the rest of the feathered tribes of the forest, eagerly watching the ingress and egress of such animals as may have taken refuge in the gloomy cavern beneath, and ready to pounce upon them with relentless rapacity. The thousands of small wooded islands confer on the Lake of the Woods and Rainy Lake a degree of picturesque character peculiarly interesting.

Particular description of scenery forms no part of my design, otherwise many of the smaller lakes of Wisconsin would deserve special notice. Among them are Cass Lake, Lake Pepin, St. Croix, (Upper an Lower), the Four Lakes, the Mille Lac, Ottowa, Geneva, Green, Little Green, Pewaukee, Pewaugan, Koshkonong, Sand Lake, Leech Lake, Nagoweka Lake, Nemahbin Lake, Crooked Lake, Cranberry Lake, Silver Lake, La Belle Lake, Oconomowoc Lake, Lake Traverse, Itasca Lake, Front Lake, Lac Brule, Lake Kataketlekon, Little or Lac Vieux Desert, Sturgeon, Lac de Flambeau, or Torch Lake, Otter, Puckawa, Buffalo, Lake Shawano, English Lake, Cedar Lake, Big Elkhardt Lake, Little Elkhardt Lake, Sheboygan Lake, Musquowoc Lake, Random Lake, Gold Lake, Kauchee Lake, Beaver Lake, Mequonago Lake, Mouse Lake, Monish Lake, Muskego Lake, Nagowick Lake, Nashota (Twin) Lakes, North
Lake, Pine Lake, Round Lake, Powoock Lake, Tuck-kip-ping Lake, Del-
avan Lake, Como Lake, Deer Lake, Rock Lake. Ripley Lake, Red Cedar
Lake, Fox Lake, Lake Emily, Lakie, Long Lake, Rush Lake, Great But-
te des Mortes, Little Butte des Mortes, Swan Lake, Mud Lake, Lake
Sarah, Lacs Courtesielle, Lacs Chétac, Tamaraack Lake, Rice Lake, Yellow
Lake, Lake Pokegoma, Portage Lake, White Elk Lake, Puckwee Lake,
or Flag Lake, Island Lake, Pekegomag Lake, Big Turdle Lake, Little
Turdle Lake, Kewaykovede, Little Lake, Swamp Lake, Lake Wepelanock,
Lower Rock Lake, Upper Rock Lake, Muscle Lake, Qui Traine Lake,
Lilly Lake, Sheshebagomag Lake, Mishun Lake, La Roche Lake, Win-
ibigoshish Lake, Lacs Grit, Hornangle Lake, Pejekig Lake. Besides these,
Wisconsin contains numerous lakes which have not yet received names.—
The lakes are here mentioned without any regard to order and locality.

The lakes in the north and west part of the State of Wisconsin may
be divided into two classes, or, rather, varieties. From these lakes many
of the streams take their rise. One class, or variety, forms a chain, con-
ected by streams, sometimes so shallow as scarcely to admit the passage
of a light canoe, while in other instances they are formed by the expan-
sion of the waters of larger streams in basins of one or two miles in diam-
eter. To this variety belong the lakes which have no communication ex-
cept in the spring of the year, during the melting of the snow, or in rainy
seasons, "when they are joined by streams which flow along vallies, once
evidently the beds of large water courses, but now elevated above the gen-
eral level of the lakes, and converted into meadows, cranberry marshes, or
swamps." Mr. Norwood further observes, that between a great portion
of the now isolated lakes west of Bois Brule and St. Croix River, from
St. Louis River to the Falls of St. Anthony, old communications of this
kind may be traced, and most of the rich vallies of that portion of the dis-
trict owe their soils to lacustrine deposits, made during the long period
of elevation, during which the beds of large rivers were first converted in-
to chains of lakes, and subsequently drained, as the process of elevation
continued."

Many of the vallies west of the Bois Brule, and south of the great bend
of the St. Louis River, present indications of having been drained at a
comparatively recent period, while some of them are evidently in process
of drainage at the present time; so that we may safely calculate on a con-
siderable addition to the tillage land of the State in the course of time.
This process of drainage might be accelerated by art, at a very incon-
siderable expense. In connection with this process of drainage, I take
leave to state that Dr. Owen says that the Little Makoquito, (a stream
barely large enough to turn a mill,) has, by abrading its channel for
countless ages, worn its bed to the depth of four hundred feet in solid
limestone, and that the mighty Mississippi has rolled its tide long
enough to have worn the chasm through which it passes.

Before I conclude the subject connected with these two classes of
lakes, I might mention, as being rather curious, that several of them
are situated at the summit of the water-shed, and are tributary both to
Lake Superior, and the Mississippi.

The second variety of lakes are such as have no visible outlet,
or any visible source of supply except what collects from the surrounding
hills. These are perhaps more numerous than the chain variety, before
described. These lakes, which seldom exceed one mile in diameter, are
generally found in districts based upon sandstone, or where heavy depos-
its of drifts are found resting upon metamorphic rocks. These lakes are
generally circular or oval, while the chain lakes present every variety of
form.

These circular or oval lakes are generally from 60 to 100 feet under
the surrounding surface, "the ground sloping down to the water's edge
with great regularity, like the descend of an amphitheatre, and covered
with grass." Many of these lakes are dotted with islands, based on bould-
ers, and covered with wood. These are seldom of any considerable depth,
and are supplied, as well as the chain lakes, with delicious food. These
lakes show unmistakable evidence of being extinct volcanoes. The bord-
ers of some of the chain lakes are covered with marsh, in which the wild
rice grows in great plenty, which invites myriads of wild fowl to flock to-
gether in this region of country. The beds of almost all are pebly, and the
water clear.

With so many lakes and rivers, what country is better supplied with
fish and fowl? With such a vast extent of navigable waters, what country
can equal it in facilities of transport? The Mississippi alone, with its trib-
utaries, affords continuous navigation for 14,500 miles. On this river
were 600 steamers, making a tonnage of 150,000, worth $16,000,000, and
carrying $250,000,000 yearly, in 1855. When all the railroads chartered,
at present amounting to 53, shall have been completed, all the tributaries
to this river made navigable, what calculation will represent the sum total
of the business done on it? Time alone can tell. The Mississippi, with all
its outlets, measures 51,000 miles, and some writers are of the opinion
that 20,000 miles are navigable, which exceeds the above estimate.