Rivers the former is 6 miles long and falls 2,109 feet, and is one continuous rice-field, from which the Indians in the vicinity procure their staple food.

From half a mile above the mouth of Eau Claire River to the Big Dam the river has but very little current, falling 6.657 feet in 9 miles.

Between the Big Dam and the mouth of Moose River, a distance of 18 miles, the river falls 18.019 feet. The river is very tortuous throughout its whole length. Below the Big Dam the river-bed is rock, whereas above, it is pure sand or sand and mud. The valley banks are composed of gravel and drift clays covered with sand. On the ridges black-jack, pine, and black scrub-oak grow in abundance, with a Norway pine here and there. In the lower lands tamarack, cedar, birch, poplar, spruce, and balsam, with scattering small soft maples, grow thickly. Willows and alders grow in vast profusion. The whole Saint Croix River region explored from section 3, township 43 north, range 13 west, on both sides of the stream to the head of Upper Lake Saint Croix, in township 45 north, ranges 11 and 12 west, is, except in the valley of the river, deeply covered with sand, in many places loose. Through this valley and the valley of the Bois Brulé River, it is evident that there was once a very large and powerful stream flowing, presumably from Lake Superior, when the elevation of that lake was higher by 400 feet than it is at present. This stream has cleaned out the sand from the valleys down to the drift clays and large gravel of the glacial period, which generally stretch in a northeasterly direction. In places these glacial deposits have been swept away, leaving bare the substratum of sandstone rock. The sand forming the general surface of the country does not arrange itself into dunes from the action of the winds, but must have been greatly disturbed since its deposit. The disturbing elements I should judge were of volcanic origin, namely, earthquakes and eruptions of a minor nature, since the sand formed itself into long irregular ridges running north 45° east to north 65° east, and into deep circular or nearly circular hollows. Nearly all of these depressions are partially filled with water, forming lakes or wet marshes, without any outlet, and in many cases without inlet. Nearly all of these lakes contain fish. As evidenced by the paucity of the streams except where the sands have been washed away, for the sand is too loose generally speaking to allow of surface drainage, the drainage is subterranean, the rainfall finding its way to the river along the surface of the underlying clay or rock. The rock is Potsdam sandstone, and is copper-bearing, since that metal has been mined near the crossing of the proposed dam. The line of upheaval of this rock is north 30° east, with a dip to the southeast of 17° from the horizon. It is of a very firm nature, and I should judge would prove an excellent building stone. When I found any of this stone exposed to the action of the air or water, I examined it closely, and found the action of the elements upon it was very slight indeed; in fact it was hardly perceptible.

DAM SITES AND RESERVOIRS SURVEYED.

There were three in number: one 1 mile below what is known as the Big Dam on the Upper Saint Croix River; one on the Totogatic River; and one on the Yellow River below the outlet of Yellow Lake. Maps and tracings of all of these have been made, showing contours of country, flowage lines, cross-sections at dam sites, and area of watershed and capacity. A reference to these and to Assistant Treherne's report will render any further description unnecessary here. As in the case of the Mississippi River, there is annexed a tabular statement of the area of basin, capacity and supply of each reservoir, and the method of computing the same.

CAPACITY AND SUPPLY OF RESERVOIRS.

Upper Saint Croix Lake reservoir.

This has a surface area of 16½ square miles, or 459,792,500 square feet. The height of the dam will be 25 feet, and the surface of Upper Lake Saint Croix will be raised 12 feet. The total capacity of the reservoir is 4,698,269,800 cubic feet.

The supply is derived from an area of 290 square miles, or 8,084,736,000 square feet. The rainfall for this river is the same as in Minnesota—25 inches.

	Cubic feet.
One-third of which gives	5,659,315,200
Capacity before given as	4,698,269,800
Surplus	961,045,400

which can undoubtedly be retained by dams on the Eau Claire River. The capacity above given will furnish, for a period of 90 days, a supply of 604 cubic feet per second, and if the surplus were retained, 124 cubic feet per second could be added.

Totogatic reservoir.

This has a watershed of 330 square miles extent, or, in square feet, 9,199,872,000.

	Cubic feet.
This, by one-third rainfall, gives	6,439,910,400
The capacity of the reservoir is only	2,881,095,000
Leaving a surplus of	3,558,815,400

which I have no doubt further examination will enable us to retain.

The capacity furnishes us for 90 days, per second	370
The surplus would furnish for 90 days, per second	457

Yellow Lake reservoir.

The watershed is 321½ square miles, or 8,962,905,600 square feet.

	Cubic feet.
Its supply (one-third rainfall) is	6,274,033,920
Its capacity is	3,402,712,000
Leaving a surplus of	2,871,321,920

The capacity furnishes per second for 90 days	438
The surplus would furnish per second for 90 days	369

RECAPITULATION.

Total supply from the reservoirs examined on the Saint Croix.

	Supply.	Surplus.
	Cubic feet.	*Cubic feet.*
From Yellow Lake reservoir we can draw for a period of 90 days, per second	438	
But there is a surplus which, if it could be held back, would give in addition, for 90 days, per second		369
From Totogatic reservoir for same period, per second	370	
Surplus, per second		457
Upper Saint Croix Lake reservoir for same period, per second	604	
Surplus which, could it be retained for same period, per second		124
Total	1,412	950

That is, from the few reservoirs already examined, we could deliver to the lower river, for a period of 90 days, 1,412 cubic feet per second, and could the surplus waters be retained for a like period, we could, from these three sources alone, furnish a total of 2,362 cubic feet per second.

There still remains to be examined the remainder of the three above-named rivers, the whole of the Namekagon River, itself more extensive than the Saint Croix above their junction, the Kettle and Snake Rivers. Energetic work by one party for the entire season will not more than complete this examination. We have not yet gone far enough in our surveys to hazard an opinion as to what, if any, aid could be afforded to navigation on the Mississippi River below the mouth of the Saint Croix. It would be well worth the while to make a survey of the mouth of the Saint Croix River at Prescott, to ascertain the practicability of constructing a lock and dam at that point. Were this practicable, and did it not conflict too strongly with existing interests, it would solve the whole problem. All the surplus waters of the Saint Croix could be retained at that point, and the whole system of dams on the headwaters done away with. The logging interests would not be interfered with, as they could use their own dams as they pleased, and the water, after having been used by them, would be retained below. One thing, however, is certain, that should the plan of reservoirs at the sources prove feasible, the lumbering interests will have to be made subservient to those of navigation; otherwise any system of reservoirs would prove useless. Assistants H. S. Treherne and George R. Stuntz discharged the duties assigned them with fidelity and obtained a large amount of valuable information. No estimate of the cost of dams is submitted, both on account of the incipient stage of the work and the lack of time to make the necessary plans.

GAUGING OF THE STREAMS.

The party under Mr. Treherne gauged the rivers at the dam sites. Another party, under Mr. W. H. Fuller, assistant engineer, gauged the Saint Croix River at various places, from the mouth of the Namekagon to Taylor's Falls. Gauge-readings were also recorded at Stillwater, Taylor's Falls, and points above. These last are plotted, and the plats appended. A tabular statement of the discharges at the points gauged, the areas of cross-sections, height above low-water, &c., is hereto annexed, and marked D.

DAMAGE TO PROPERTY.

The damage caused by overflow is very slight, consisting only of the drowning out of wild-rice fields on the Upper Saint Croix and the submergence of a few meadows and fields near the entrance of the Eau Claire River at Amick (Antoine Gorden's). It is hardly worth mentioning.

HEADWATERS OF THE CHIPPEWA RIVER.

The Chippewa River takes its rise from numerous small streams and lakes that lie along the south side of the ridge that separates it from the waters flowing into Lake Superior. Two branches uniting at "Flambeau Farm" form the main stream. The east and principal fork is known as the Flambeau River, and the west fork as the Chippewa River, a title more properly belonging to the Flambeau, as the discharge of the latter considerably exceeds that of the former. The total watershed above the junction of these two branches is, on the the Flambeau, 1,960 square miles, and on the Chippewa 1,801 square miles, making together the sum of 3,761 square miles. Not all of this area, however, will avail toward supplying reservoirs. Below the mouth of Turtle River, on the North Fork of the Flambeau River, and Little Chief Lake, on the Chippewa River (see map showing watershed in Wisconsin), the streams flow through narrow valleys, and are full of rapids and falls. Below the points named none but the most temporary reservoirs for the storage of water can be secured. Dams have been erected for logging purposes, but when the gates are opened they empty themselves in a day or two. There is no holding ground that could give a supply for any length of time. We are, then, limited to the watershed above the points named as the area from which we must derive our supply of water for the river below.

	Square miles.
The total area on the Flambeau River	1,960
The total area on the West Fork	1,801
Total watershed above Flambeau Farm	3,761

But of this we only have an area to draw from—

	Square miles.
On Flambeau River	712
On West Fork	700
Total area to draw from	1,412

which will give us, in case we can utilize all the water available from it (a very improbable supposition), 3,900 cubic feet per second for a period of ninety days. No instrumental examination was made of the West Fork this year, the amount of funds allotted not allowing another party to be put in the field; but sufficient information was gained to warrant the assumption that a fair portion of the waters due to its 700 square miles area can be made available. The surveys were therefore confined to the Flambeau River, the north fork of this stream being the theater of operations. Mr. John H. Dager, assistant engineer, was in charge of these surveys, assisted by Messrs. Parker, Foss, and Redfield. All of these discharged their duty with industry and ability. These duties were precisely similar to those of the Saint Croix party.

DESCRIPTION OF THE COUNTRY.

The North Fork of the Flambeau River above the crossing of the Wisconsin Central Railroad to a point half a mile above the mouth of the Turtle River (see progress map, No. 2) is a succession of still reaches and sharp "pitches" or rapids, there being in that distance (21 miles) a fall of 85 feet. The rapids are 29 in number, some of which are quite precipitous and dangerous to pass. The only mode of transportation is by log canoes, which are poled by skillful boatmen. On the Turtle River, above the rapids, the character of the stream changes, up to what is known as "30-foot Falls," where a dam-site was selected and a survey made. Assistant Dager says, in his report,

on file: "The valley is of considerable width, being from one-fourth to one-half mile wide. The stream is quite crooked, working its way across the valley from ridge to ridge. On one or the other side are found hay-meadows, while on the higher lands small areas of pine are seen." On the Flambeau, below Turtle River, the timber is of various kinds; birch, ash, soft maple, and poplar on the lower lands and on some of the ridges. On most of the latter, however, white or Norway pine is found. Of the river above the rapids, just above Turtle River, and the Manadonish above its junction to Rest Lake (see map), where another excellent dam-site was found and a survey made, Assistant Dager says: "The river has few rapids, but is one of the crookedest imaginable; the bottom and banks are fine sand and loam, though below the junction of the Manadonish a cluster of bowlders occurs about every mile. Considerable pine, mostly second growth, is found on the high lands, with more poplar and soft wood than is generally seen, up to the junction; above this there is no timber of value; the country is mostly covered with brush. The land is valueless, full of swamps and sink-holes. The valley of the river is from ½ to 1 mile wide, with large grass-meadows on either side; these I learn are considered quite valuable, and have all been taken up by lumbermen. No indication of rock in place is seen within the limits of this survey."

The fall of the river from the dam-site at Rest Lake to the junction of the Manadonish and Flambeau Rivers is 18.7 feet. Thence to the crossing of the Wisconsin Central Railroad below Muskelonge Falls the fall is 107 feet, making a total fall in a distance of about 75 miles by river of 125.7 feet, 85 feet of which is below the head of the rapids just above Turtle River. A survey was also made of a dam-site and reservoir on Butternut Creek, which enters into the Flambeau below the railroad crossing.

DESCRIPTION OF THE WORK DONE.

The work was, as before said, similar to that on the Saint Croix. Flowage-lines were run out and accurate cross-sections made. The stream was carefully gauged at each dam-site, although in one, Butternut Lake, the stream was so very low that the results were not satisfactory. Observations to show evaporation and temperature were made daily, and tables of discharge of the streams are hereto appended, being among the general discharge and velocity tables which form part of this report. A general map of this district, showing the different watersheds and the supply to and the capacity of the reservoirs, has been made. It is marked Progress Map No. 2. Detailed maps of the dam-sites and reservoirs have also been made, and tracings of all these accompany this report. A table showing the manner in which the results hereafter given were obtained is also appended. A line of levels was run from the most elevated lake in the system at the head of the Manadonish River to the foot of Muskelonge Falls at the crossing of the Wisconsin Central Railroad and there connected with their system, thus enabling us to reduce the elevations to the sea-level. The elevations, so reduced, of the different lakes and the water-surface at the different points on the river are marked on progress map No. 2 in blue figures. The elevations in red figures are from an assumed local datum.

DAM-SITES AND RESERVOIRS.

The first of these is at Butternut Lake and is not of great value. The area of the basin tributary to this reservoir is 55 square miles, or 1,533,312,000 square feet. The average rainfall is 30 inches, one-third of which (10 inches, or 0.83 feet) is taken as available. This will give a supply of 1,272,648,960 cubic feet. The height to which the water can be raised above the surface of Butternut Lake (see detail map) is 10 feet.

The capacity of the reservoir is 585,446,400 feet, which, taken from the supply, leaves a surplus of 687,202,560 cubic feet, while, could we retain it, the surplus would add, per second, 89 cubic feet.

PARK LAKE.

The second reservoir is just above the "30-foot Falls" on Turtle River (see detail map). Its supply is as follows:

Area of watershed, 174 square miles, or	4,850,841,600	square feet.
This will give a supply of	4,026,198,428	cubic feet.
The capacity is, with 15 feet rise at dam	620,782,720	cubic feet.
Which leaves a surplus of	3,405,415,708	cubic feet.

The capacity will give for a period of 90 days 82 cubic feet per second. It is possible that further examination may enable us to retain this surplus. In that case we could add, per second, 518 cubic feet.

REST LAKE RESERVOIR.

This is the most important of the three surveyed. The water can be raised 25 feet and the dam-site is an excellent one. The detail map will show its characteristics. Its capacity will exceed its supply, the former being 5,645,376,000 cubic feet, while the latter is 4,897,100,264 cubic feet. We can draw from this reservoir for a period of 90 days, per second, 730 cubic feet. The following is a recapitulation of the water that can be furnished from the three reservoirs surveyed:

SUMMARY.

Total supply furnished by the reservoirs examined this season on the headwaters of the Flambeau River, or, more properly, the East Fork of the Chippewa River.

	Manadonish River.	
	Supply.	Surplus.
RESERVOIR AT REST LAKE.	*Cub. feet.*	*Cub. feet.*
From this we can draw for a period of 90 days, per second	730	.....
From reservoir at Turtle River we can draw for a period of 90 days, per second	82	.....
While, could the surplus be elsewhere retained, we could add to the above, per second	.....	436
From reservoir at Butternut Lake, for a like period, we can furnish	75	.....
While, could we retain the surplus, we could add, per second	.....	89
Total	887	525

RESULTS.

That is, as far as we have gone, which is only a very little way. We can supply to the Chippewa River from the North Fork of the Flambeau River alone 887 cubic feet per second, and could we retain the surplus, we could furnish 1,412 cubic feet per second. I have not included the South Fork of the Flambeau River, nor that portion of the North Fork which lies between Rest Lake and the junction of the Manadonish and the Flambeau Rivers. These, I have no doubt, would increase the supply considerably. I have said before that we were limited to the watersheds mentioned. The Eau Claire River and Red Cedar or Menominee River, it is possible, might furnish from reservoirs a useful addition to our supply. These two streams, however, are controlled by private parties, who have numerous dams upon them, for the purpose of furnishing water and logs to their mills. On the Menonimee alone there are upwards of 25 dams, and on the Eau Claire River there are 4. These dams occupy all available points on the river, and there is nothing left for the United States to do, unless they were to take the control of the dams away from the owners and manage them. They are not, therefore, considered. I have not touched upon the Lower Chippewa. Mr. Charles Wanzer, assistant engineer, made an examination of the river from "Flambeau Farm" to the mouth, and has made a full report thereon. He gauged the river and its tributaries at various points very accurately, and has contributed greatly to a knowledge of the Chippewa River.

The tabulated discharges, areas of cross-sections, velocities, &c., are contained in the table of discharges annexed to this report, marked D. The dams on the Menominee and Eau Claire, as managed, do no damage to navigation. Very different is the effect of the Little Falls dam, used for driving logs. Mr. Wanzer fully describes this in his report, and the gauge curves on the sheets hereto annexed strikingly illustrate the sudden fluctuations caused by the opening and closing of the gates.

HEADWATERS OF THE WISCONSIN RIVER.

It was expected that the party on the Chippewa River, after finishing the surveys before described, would cross over from the Flambeau, and, coming down the Tomahawk River, examine the dam-sites which were reported to exist on that stream. This, however, they were unable to do, and Assistant Wanzer, with a small party, was sent to make the desired survey. He left Saint Paul on November 19, and returned, having completed his examinations on the Tomahawk River, on December 13. Great credit is due to him for the intelligence and activity with which he performed his work. Two dam-sites and reservoirs were surveyed, and much valuable information obtained. The examination of that region, however, is only begun, and an entire season's work will be necessary to complete it.

DESCRIPTION OF THE COUNTRY.

The headwaters of the Wisconsin River are in close proximity to those of the Flambeau, the dividing ridge being in some places less than a mile in width. The character of the country is the same. The Wisconsin River rises in Lac Vieux Deserts, which lies on the boundary line between Wisconsin and Michigan. A full description of the river from its source will be found in the report of Maj. D. C. Houston, dated January 21, 1878. Of the Tomahawk, Assistant Wanzer says:

"The river from its mouth to the junction of the Summo River is about 300 feet in width, after which it narrows down to an average of 130 feet, and so continues to a distance of 10 miles. The current is generally swift, and for the first 2 miles the bottom is rocky, the succeeding 8 miles being mud and sand. At this point Prairie Rapids are reached, which have a fall of 7.5 feet in a distance of 450 feet, the stream here being full of large bowlders. These rapids are the second on the river, and will be "flowed out" by the proposed dam, which is located 6½ miles above the mouth. The first rapids are situated below the proposed dam, beginning 1,500 feet from the mouth of the river, and having a fall of 19 feet in the space of a mile. The Little and Big Rice Rivers, which join the Tomahawk River 7 miles above the mouth, are very sluggish and tortuous streams. The banks are entirely of sand, covered with Norway pine, and the bottom lands are hay-marshes. These two streams furnish the best holding ground for a reservoir that is to be found on the river in that vicinity. At the proposed upper dam the river is only 40 feet wide, and has a swift current, the fall from Tomahawk Lake to the dam-site being 38.3 feet. From this point the banks are high and contracted, affording little holding ground. The bottom of the river is rocky and slight rapids are frequent. Squirrel Creek joins the main river (see progress map No. 1) immediately above the located dam-site, and is a comparatively sluggish stream, the banks and marshes being similar to those of the Little and Big Rice Rivers, and the lake itself affording a fair but insufficient holding capacity, which I believe a more detailed survey will considerably increase. There is no doubt that supplementary sites may be selected above the present proposed dam, which would probably give one or more of the lakes near the head of the Tomahawk as a reservoir for flooding purposes.

"The country adjoining the river from the mouth of Tomahawk Lake, which is its source, is sandy and covered with a small growth of Norway pine, and is dotted with small lakes. Very little pine fit for logging purposes remains on this stream, the ravages of fire having destroyed nearly all that has not been cut."

DAM-SITES AND RESERVOIRS.

Below the mouth of the Tomahawk River there would seem to be no suitable places for reservoirs, judging from the information obtained from the most reliable sources. Above these are two good dam-sites commanding the whole watershed above the mouth of Pelican River, an area of 830 square miles. The supply from this basin, if it could all be utilized, which is not probable, would give 2,470 cubic feet per second, for a period of 90 days. Two dams have already been erected, one just above the mouth of Pelican River and another 30 miles above, below the mouth of Eagle River, at a point which is known as Otter Rapids. The first has a watershed of 444 square miles, the last one of 386. The data that I have been able to obtain as to the operations of these dams are as follows: The Upper or Otter dam has raised the water above it to a height of 4 feet above ordinary level. I am informed that it can easily be raised 12 feet.

The lower or Pelican dam allows of a rise of 9 feet, and can be also raised so as to admit of 12 feet. This last dam, when the water is raised 9 feet, backs up the water 22 miles, or within 8 miles of the Otter dam. The upper reservoir, with 4-foot head when the gates are opened, requires from a week to ten days to empty itself. When it has discharged its contents into the Pelican dam below, the latter reservoir is raised to a height of 8 feet 10 inches, and when the gates of this are opened a rise of 4 feet at Jenny, 65 miles below, and a rise of 3 feet at Warsaw, another 65 miles farther down, ensues. These are the facts given to me by the lumbermen. No examination has as yet been made. On the Tomahawk River, the main affluent of the Upper Wisconsin, the dams surveyed by Assistant Wanzer will enable us to supply water to the river below as follows:

Upper dam (see sheet No. 1, detail map):	
Area of watershed 200 square miles	5,575,680,000 square feet.
	Cubic feet.
Which by one-third of rainfall of 30 inches gives	4,627,714,400
Capacity of reservoir	2,000,000,000
Surplus	2,627,714,400

The reservoir would furnish, for a period of 90 days, 257 cubic feet per second. Could the surplus be retained there could be added, per second, 338 cubic feet.

Lower dam (see detail map, sheet No. 2):
Area of watershed 380 square miles ..... 10,593,792,000 square feet.

	Cubic feet.
Which by one-third rainfall gives	8,792,847,360
Capacity of reservoir at 14 feet rise	1,043,516,880
Surplus	7,749,330,480

Which probably cannot be retained. The reservoir will furnish, for a period of 90 days, per second, 134 cubic feet. To summarize the above results, we have—

	Cubic feet.
From upper dam for 90 days, per second	257
From lower dam for 90 days, per second	134
Total ascertained supply from Tomahawk	391

So little has yet been done on the Wisconsin River headwaters that it would be idle to express an opinion, but the limited area of the available watershed would seem to render it doubtful if much efficient aid could be given to the Mississippi River below the mouth of the Wisconsin. One thing, however, is certain, and that is that, from what experience we have had on the three above-named rivers, and with the information we have obtained, we are in a position to make the surveys, to be made the coming season, much more complete and thorough, and at a less proportionate cost. We have parties of men trained to the work that can be got together at short notice. A knowledge of the country has been acquired, and the mistakes, that are inevitable with a new party and untried assistants, to whom the country is new, can be avoided.

METEOROLOGICAL OBSERVATIONS.

Meteorological stations have been established at the three Indian agencies which are situated near the sources of the Mississippi River, one at Red Lake on the north of the watershed, one at White Earth on the west, and one at Leech Lake on the south. The observers at all of these stations keep a record of rainfall and snow and evaporation. At Leech Lake, a record of temperature and readings of the water-gauge are also kept, while at White Earth, besides that of the temperature there is added a record of readings of the anemometer. These records, if kept for a sufficient length of time, will give us, what we most need, an accurate idea of the rainfall of that most important region, as well as the daily and monthly evaporation, temperature, &c.

With the opening of the rivers gauges should be established at suitable points on the Mississippi River from Pokegama Falls to Saint Paul, on the Chippewa River from its sources to its mouth, on the Saint Croix River from Upper Saint Croix Lake to Prescott, and on the Wisconsin from the Tomahawk to Portage. It is presumed that gauge-readings will be taken below Portage by those in charge of the Fox and Wisconsin River improvement.

Respectfully submitting the above,
I am, your obedient servant,

JAMES D. SKINNER,
Assistant Engineer.

Maj. CHAS. J. ALLEN,
Corps of Engineers, U. S. A.

TABLE A.—*Annual and monthly means of rainfall in Minnesota, from data furnished by the War Department, up to* 1878.

Month.	Fort Snelling.	Fort Ripley.	Fort Ridgely.	Saint Paul.	Grand mean.
January	0.97	0.85	1.51	0.88	1.07
February	0.76	0.92	1.36	0.97	1.00
March	1.31	1.55	1.61	1.78	1.56
April	2.13	1.62	1.60	2.20	1.89
May	3.40	3.08	2.88	3.75	3.28
June	3.80	4.33	2.59	5.82	4.13
July	3.01	4.14	2.67	2.68	3.07
August	3.24	3.11	4.02	3.96	3.58
September	3.42	3.28	3.22	3.09	3.25
October	1.39	1.60	1.65	2.08	1.68
November	1.49	1.73	1.18	1.17	1.39
December	0.94	0.91	1.12	0.72	0.92
From				1859 to 1866	
To	1836 to 1878	1849 to 1877	1855 to 1867	1871 to 1878	
Period	31 years.	19 years.	13 years.	7 years. 8 years.	
Mean	25.89	27.31	25.31	25.09 29.05	26.41

Annual and monthly means of rainfall in Dakota Territory, from data of War Department, to 1878.

Month.	Fort Abercrombie.	Fort Pembina.	Totals.	Grand mean.
January	0.52	0.18	0.70	0.35
February	0.55	0.34	0.89	0.44
March	1.01	0.70	1.71	0.85
April	1.54	1.17	2.71	1.35
May	2.16	2.65	4.81	2.40
June	3.20	3.91	7.15	3.51
July	2.23	2.81	5.04	2.52
August	2.63	2.64	5.27	2.63
September	1.66	1.24	2.90	1.45
October	0.96	1.24	2.20	1.10
November	0.64	0.52	1.01	0.50
December	0.70	0.77	1.51	0.75
From To	1860–1877	1871–1878		
Period	17 years.	8 years.		
Mean	18.44	16.91	35.25	17.67

It being evident that the rainfall decreases as the Red River Valley is approached, it would not be safe to count on more than 25 inches as the rainfall around the sources of the Mississippi River, which has been adopted.—J. D. S.

Rainfall, Dakota, up to 1868.

Location.	Extent.	Spring.	Summer.	Autumn.	Winter.	Total.
Fort Randall	1857–'67 8 9/12	4.76	6.64	3.90	1.21	16.51
Fort Pierce	1855–'57 1 9/12	4.28	3.32	3.76	2.15	13.51
Fort Abercrombie	1860–'67 6 11/12	4.67	7.49	3.36	1.82	17.34

Rainfall, Wisconsin, up to 1867.

Location.	Extent.	Spring.	Summer.	Autumn.	Winter.	Total.
Fort Winnebago	1836–'45 9	5.58	11.46	7.63	2.82	27.49
Fort Crawford	1830–'45 9 3/12	7.63	11.87	7.90	4.00	31.40
Milwaukee	1841–'66 23 4/12	7.98	9.64	7.96	4.82	30.40
Superior	1856–'66 7 9/12	6.14	8.68	7.64	3.18	25.64
Appleton	1856–'61 4 7/12	7.46	10.24	7.43	5.93	31.06
Ashland	1856–'62 4 2/12	13.50	13.95	13.93	5.07	46.45
Green Bay	1864–'68 1 9/12	6.03	9.81	11.52	4.46	31.82

Rainfall, Minnesota, up to 1868.

Location.	Extent.	Spring.	Summer.	Autumn.	Winter.	Total.
	1836–'67					
Fort Snelling	22 4/12	6.68	10.50	6.38	2.26	25.82
	1850–'67					
Fort Ripley	16 12/12	5.86	10.90	6.31	2.04	25.11
Fort Ridgely	13	6.61	9.11	5.86	4.11	25.69
	1854–'62					
Lac qui Parle	5 4/12	7.78	11.84	6.47	2.98	29.07
	1859–'66					
Saint Paul	5	5.63	11.11	5.46	2.89	25.09
	1865–'66					
Minneapolis	1	3.73	14.60	6.48	2.57	27.38
	1858–'66					
Beaver Bay	6 7/12	7.89	8.56	6.27	4.48	27.20

TABLE B.—*Table of daily evaporation at the sources of the Mississippi River, autumn,* 1878.

Date.	Pan exposed.	Pan in shade.	Pan sunk in marsh.	Remarks.
August 26	0.08	0.00		
August 27				Rain.
August 28	0.12	0.07		
August 29	0.28	0.08		
August 30	0.30	0.15		
August 31	0.18	0.05		
September 1	0.17	0.06		Rain.
September 2	0.12	0.02		
September 3	0.21	0.03		
September 4	0.20	0.08		
September 5	0.02	0.01		Rain.
September 6	0.05	0.01	0.03	
September 7	0.17	0.08	0.08	
September 8	0.02	0.01	0.01	Rain.
September 9	0.00	0.00		Rain.
September 10	0.15	0.05	0.07	Rain.
September 11	0.08	0.06	0.07	
September 12	0.17	0.03	0.08	
September 13	0.15	0.04	0.08	
September 14	0.18	0.08	0.13	
September 15	0.14	0.05	0.11	
September 16		0.05	0.06	
September 17	0.17	0.13	0.09	
September 18	0.02	0.02	0.02	
September 19				
September 20	0.07	0.04	0.06	
September 21	0.13	0.08		
September 22	0.17	0.13	0.08	
September 23	0.13	0.10	0.04	
September 24	0.02	0.02	0.00	
September 27	0.12	0.07	0.10	
September 28	0.03	0.03	0.02	
September 29				Rain.
September 30	0.03	0.02	0.02	Rain.
October 1	0.07	0.03	0.03	Rain.
October 2	0.03	0.02	0.02	Rain.
October 3				Rain.
October 4	0.15	0.12	0.05	Rain.
October 5	0.10	0.09	0.06	
October 6	0.09	0.09	0.04	
October 7	0.07	0.07	0.04	
October 8	0.01	0.01	0.00	Rain.
October 9				
October 10	0.05	0.05	0.05	Rain
October 11	0.15	0.12	0.05	
October 12	0.10	0.06	0.10	
October 13	0.10	0.10	0.08	
October 14	0.08	0.05	0.03	
October 15	0.02	0.01	0.04	
October 16				Rain.
October 17				Rain.
October 18				
October 19				
October 20	0.12	0.10	0.03	
October 21	0.03	0.03	0.02	

TABLE B.—*Table of daily evaporation at the sources of the Mississippi River, &c.*—Cont'd.

Date.	Pan exposed.	Pan in shade.	Pan sunk in marsh.	Remarks.
October 22				
October 23	0.08	0.08	0.02	
October 24	0.04	0.04	0.00	

	No. of days observed.	Evaporation.	Daily mean.
		Inches.	
Pan exposed	49½	4.97	0.1040
Pan in shade	50½	2.72	0.0538
Pan in marsh	39	1.81	0.0460
Days of no evaporation			Rain, 6.
Days of partial evaporation			Rain, 9.

TABLE C.

CAPACITY OF LEECH LAKE RESERVOIR WHEN RAISED 4 FEET ABOVE HIGH-WATER OF 1874.

	Cubic feet.
175.5 square miles, 4 feet rise	=19,570,636,800
43.0 square miles, 2½ feet rise	= 2,996,928,000
	22,567,564,800

Annual supply.

From rainfalls of 25 inches, taking 0.7 foot as the available supply:

Area of watershed, 1,001 square miles	=27,906,278,400 square feet
Which multiplied by 0.7 foot	=19,534,394,880 cubic feet.

	Square feet.
In computing, 175.5 square miles	=4,892,659,200
In computing, 43. square miles	=1,198,771,200

Supply to Leach Lake.

Calculated from flow of water as gauged:

	Cubic feet
Mean low-water flow, 1878, per day	25,056,000
Mean low-water flow, 1878, per second	290

	Cubic feet.
For December, January, February, and March, 120 days' flow	=3,006,720,000
Three-fourths melted snow and rain for same period	=7,534,695,168
One-half rainfall April, May, and June	9,488,134,656
Total when dam is shut from December 1 to July 1	20,029,549,824
Evaporation subtracted for 90 days, at 0.1 inch per day,=9 inches on 218.5 square miles	4,568,572,803
Total in reservoir July 1	15,460,977,021

MUD-LAKE.

Capacity with 6 feet rise above high water of 1874:

Surface overflowed 17.25 square miles	= 480,902,400 square feet.
Which multiplied by depth, 6 feet	=2,885,414,400 cubic feet.

Supply from rainfall, assuming 0.7 inch as available:

Area of watershed	4,460,544,000 square feet.

	Cubic feet.
Which multiplied by 0.7 inch	3,122,380,800
Capacity	2,885,414,400
Surplus	236,966,400