O P T I O N

KNOW ALL MEN BY THESE PRESENTS: That WHEREAS, the undersigned "Optionors", KAY TODD and SINCLAIR H. TODD, his wife, and EDWARD P. SCALLON and FRANCES SCALLON, his wife, all of the City of St. Paul, Ramsey County, Minnesota, are named as Lessees in and are the owners of a Mining Lease dated January 1, 1950, wherein Andyck Corporation, a New York corporation, of Yonkers, New York, leased to these Optionors for a period of fifty (50) years from date

> All of Section Twenty-three (23), Township Forty-eight (48), Range Twenty-seven (27), Aitkin County, Minnesota,

for general mining purposes as therein enumerated, and subject to the conditions in said Lease set forth; and

WHEREAS, Tintic Standard Mining Co., of Salt Lake City, Utah; Nellie R. Mining Co., of Picher, Oklahoma; Hubert T. Howard, of Chicago, Illinois; Harold F. Hallatz, of La Jolla, California, and William L. Hayden, of New York City, New York, hereinafter designated as the Optionees, have now concluded negotiations with the undersigned Optionors, for the purpose of procuring an Option, with privileges of exploration and research development, to purchase a Contract of Assignment of the aforementioned Lease and establishing the respective rights and obligations of all of the aforesaid parties in connection therewith; said Contract of Assignment to be in the form of Exhibit "A" attached hereto and made a part hereof;

N O W , T H E R E F O R E,

(a) In consideration of the sum of Twenty-five Thousand dollars ($25,000.00) in hand paid, the receipt whereof is hereby acknowledged by the Optionors, the above named Optionors do hereby grant to the said Optionees the sole and exclusive right and

privilege: (1) to demand and take said Contract of Assignment from the Optionors at any time up to and including the first day of April, 1951, upon the payment on or before said date of purchase price of Two Hundred Twenty Five Thousand dollars ($225,000.00); and (2), as an alternative, at their election, to renew this Option for a period from the first day of April, 1951, to and including the first day of September, 1951, upon the payment to the Optionors of the sum of Twelve Thousand Five Hundred dollars ($12,500.00) on or before the first day of April, 1951; and, in case that is done, to demand and take from the Optionors the aforementioned Contract of Assignment on or before September 1, 1951, upon the payment of a purchase price of Two Hundred Twelve Thousand Five Hundred dollars ($212,500.00), together with interest on said sum at the rate of four per cent per annum from April 1, 1951; and (3), as a further alternative, at their election, to renew this Option for an additional period from the first day of September, 1951, to and including the first day of April, 1952, upon the payment to the Optionors on or before said first day of September, 1951, of the sum of Twelve Thousand Five Hundred dollars ($12,500.00), together with interest on the sum of Two Hundred Twelve Thousand Five Hundred dollars ($212,500.00) at the rate of four per cent per annum from April 1, 1951; and in such event, to demand and take from the Optionors the aforementioned Contract of Assignment on or before April 1, 1952, upon the payment of a purchase price of Two Hundred Thousand dollars ($200,000.00), together with interest on said sum at the rate of four per cent per annum from September 1, 1951; upon which date of April 1, 1952, this Option shall have been exercised in the manner aforesaid or it shall cease and terminate and be of no further force and effect.

(b) The Optionors do hereby further give and grant to the Optionees during the life of this Option and any renewal thereof, the sole and exclusive right and privilege to enter upon all of any

part of the optioned premises for the purpose of examining and exploring the same for iron ores and other ores in a manner conforming to good engineering and mining practice, and to take away samples of ore materials found thereon or therein by testing, drilling or other process, o undertake metallurgical research and experiments thereon and to erect such structures and install such equipment as may be necessary therefor, and in any other manner which may not be in conflict with the terms of the aforementioned Mining Lease to carry on activities involving studies preliminary to the development of a mining operation.

(c) The Optionees shall have the right to contract with others to exercise in their behalf the privileges hereinabove granted; all of the operations herein referred to, whether conducted by the Optionees or others, to be done without damage or loss for which the Optionors would be liable under the terms of said Lease.

(d) The Optionors reserve the right during the period of this Option or any renewal thereof to enter upon the premises for the purpose of examination and inspection of the work being donducted by the Optionees or others in their behalf, and to demand and be furnished samples of ore or ore-bearing materials being removed therefrom and copies of charts, prints, analyses, drilling reports, research reports and all other data with respect to such operations at the time when the same becomes available to the Optionees.

(e) This Option may be abandoned and surrendered at any time by giving the Optionors ten days' notice inwriting of the election of the Optionees so to do. Upon any such surrender or termination of this Option, the Optionees shall have a period of thirty (30) days thereafter within which to remove from the optioned premises all tools, supplies, equipment, structures and other chattels of any nature placed thereon by the Optionees during the life of this Option.

(f) Time of performance is of the essence of this Option, and the privileges herein granted shall be considered exercised only by the payment of the sums of money hereinbefore specified at the designated times into the hand of or to the credit of the Optionors at St. Paul, Minnesota.

(g) Any notice required or desired to be given hereunder shall be in writing and forwarded by registered mail to the respective parties at the following addresses or at such other address as any of such parties may from time to time designate.

Ray Todd, [illegible] First National Bank Building
St. Paul 1, Minnesota.

Edward P. Scallon, 117 E. 8th Street
St. Paul 1, Minnesota.

Tintic Standard Mining Co.
Salt Lake City, Utah.

Wellie W. Mining Co.
Picher, Oklahoma.

Lubert E. Howard
Chicago, Illinois.

Harold E. Saddata,
La Jolla, California.

William [illegible] Tyson, 4[illegible] Madison Avenue
New York, N.Y.

(h) The conditions of this Option shall run with the land and inure to the benefit of and be binding upon the respective representatives, heirs, successors and assigns of the parties hereinbefore named.

IN WITNESS WHEREOF, This instrument is executed at St. Paul, Minnesota, by the undersigned Optionors as of December 16, 1950.

IN PRESENCE OF:

[illegible] — Ray Todd

[illegible] — Sinclair H. Todd

As to Ray Todd and Sinclair H. Todd.

[illegible] — [illegible]

[illegible] — Frances Scallon

As to Edward P. Scallon and Frances Scallon

STATE OF MINNESOTA)
SS
COUNTY OF RAMSEY)

On this 7th day of December, 1950, before me, a Notary Public within and for said County, personally appeared KAY TODD and SINCLAIR H. TODD, his wife, to me known to be the persons described in and who executed the foregoing instrument, and each acknowledged the same as his free act and deed.

Philip J. Mackey

STATE OF MINNESOTA)
SS
COUNTY OF RAMSEY)

On this 7th day of December, 1950, before me, a Notary Public within and for said County, personally appeared EDWARD F. SCALLON and FRANCES SCALLON, his wife, to me known to be the persons described in and who executed the foregoing instrument, and each acknowledged that he executed the same as his free act and deed.

Philip J. Mackey

EXHIBIT "A"

CONTRACT OF ASSIGNMENT

THIS INDENTURE, made and entered into this _____ day of _____, 19____, by and between KAY TODD and SINCLAIR H. TODD, his wife, EDWARD A. SCALLON and FRANCES SCALLON, his wife, all of the City of St. Paul, Ramsey County, Minnesota, parties of the first part, hereinafter referred to as the "Assignors", and TINTIC STANDARD MINING CO., of Salt Lake City, Utah; NELLIE B. MINING COMPANY, of Pocher, Oklahoma; HUBERT G. KNOLD, of Chicago, Illinois; HAROLD E. RADDATZ, of LaJolla, California, and WILLIAM A. HAYDEN, of New York City, New York, parties of the second part, hereinafter referred to as the "Assignees";

WITNESSETH THAT:

For and in consideration of the sum of _____ _____Dollars in hand paid to the Assignors, the receipt and sufficiency whereof is hereby acknowledged, and in further consideration of the covenants and conditions of this Contract to be performed and observed by the parties hereto, the above named Assignors do hereby sell, assign, transfer, convey and set over unto the Assignees all of their right, title and interest in and to that certain Lease dated January 1, 1950, by and between Andyck Corporation and the Assignees, a copy of which is attached hereto and marked Exhibit 1, by which the said Andyck Corporation has leased to the Assignors, for mining purposes, the following described land:

All of Section Twenty-three (23), Township Forty-eight (48), Range Twenty-seven (27), Aitkin County, Minnesota.

TO HAVE AND TO HOLD the same unto the said Assignees, their successors and assigns, for a period until July 1, 1999, which is six months prior to the expiration date of said Lease, and all of the Assignors'

right, title, estate and interest in and to said Lease and the lands thereby demised, together with all the hereditaments and appurtenances, rights and privileges thereunto belonging; upon the condition that said Assignees shall observe and perform all of the covenants and conditions which have been hereby undertaken by them.

The Assignors covenant and agree, for themselves, their executors and administrators, that they are the true and lawful owners of said Lease, and that said leasehold interest is free and clear from all claims and incumbrances, and that they have good right and full power to sell, assign, transfer and convey the same in the manner hereby pursued.

It is understood and agreed between the parties as follows:

1. ASSUMPTION OF LEASE

The Assignees hereby assume all the obligations of the Assignors under the terms and provisions of said Lease; that they will not permit a default to occur in the observance of said obligations; and that at the conclusion of the term of this Assignment or at the time of any earlier cancellation or termination of either said Lease or this Assignment pursuant to the provisions providing therefor, they will execute and deliver to the Assignors a recordable instrument of reassignment of the leasehold interest. The privilege of surrendering said Lease from Andyck Corporation as set forth therein is expressly reserved to the Assignors and is not to be exercised by the Assignees.

2. Royalty

The Assignees hereby covenant and agree that they will on the 20th day of April, July, October and January in each year during the period this Assignment of Lease shall continue in force pay to the Assignors for all iron ore, manganese ore and manganiferous ore or concentrates thereof mined and removed from the leased premises and shipped to market during the three months preceding the first day of the month in which payment is to be made as aforesaid an over-riding royalty, consisting of the difference be-

tween the royalty paid by them to the lessor under the terms of said lease and one to be computed at the following base rates per gross ton of 2240 pounds of ore so removed and shipped:

Ore with natural manganese content of less than 13%			$ .60
Ore with natural manganese content of 13% up to but not including		14%	.80
" " " " "	14%	15%	.90
" " " " "	15%	16%	.95
" " " " "	16%	17%	1.00
" " " " "	17%	18%	1.05
" " " " "	18%	19%	1.10
" " " " "	19%	20%	1.15
" " " " "	20%	21%	1.20
" " " " "	21%	25%	.08*
" " " " "	25	30%	.10*
" " " " "	30% and above		

to be negotiated or arbitrated if its application becomes necessary.

(*additional per percentage point unit; additional cents per percentage point unit, i.e., 21% ore would carry a rate of $1.28; 22% ore would carry a rate of $1.36, etc.)

Provided, however, that when the f.o.b. mine price of a ton of non-bessemer ore averaging 51.5% iron natural is in excess of $5.105 per ton, the royalties herein stipulated shall be increased by thirty (30) percent of such excess over $5.105. As used herein, the "published lake erie price" is that price generally recognized by the iron ore trade, or if no such price is published and recognized, means the average market price per ton for ore of the kind and grade corresponding to the present lessor's non-bessemer grade sold for delivery at lake erie ports during the season of navigation current at the time it is to be used for the then current season's sale and delivery by the principal producers in such ore. To fix the f.o.b. mine price, there shall be deducted from such "published lake erie price" all charges from the lake erie ports which are included in such "published lake erie price" under the then current season's ore sale contracts, the

deduction for the year 1950 being:

Upper Lake rail freight plus dock	$ 1.05
3% transportation tax	.0315
Lake freight plus unloading charge (hold to rail of vessel)	1.45
3% transportation tax	.0435
Miscellaneous	.02
Total ----------	$ 2.595

(The published Lake Erie price at the date hereof is $7.70 from which should be subtracted $2.595 covering the above charges which results in a current mine price of $5.105.)

Provided, however, anything herein to the contrary notwithstanding, the royalty payable under this Assignment of Lease shall never be less than the base rates established in the foregoing schedule.

3. Minimum Royalty

The Assignees further agree with the Assignors that beginning as of April 1, 1953, they will pay to the Assignors in quarterly installments on the 20th day of April, July, October and January in each year, a minimum annual royalty in the amount of the difference between the sum of $25,000.00 and the minimum annual royalty required to be paid to Andyck Corporation; provided, however, that if in any one year or more royalties for the shipment of ore actually mined and removed from said premises shall be paid in an amount in excess of said established annual minimum royalty, then and in such case the amount of such excess may be applied in any subsequent year as a prepayment on such royalty as may accrue for that year over and above the stipulated annual minimum royalty for said year.

4. Credit for Royalty Paid

The Assignees agree that, when they shall become entitled to credit against royalties to be paid to the Andyck Corporation to the extent of minimum royalties heretofore paid by the Assignors to Andyck Corporation, they will upon taking such credit pay to the Assignors the amounts so credited by way of

reimbursement due as further consideration for this Contract of Assignment. At the date of this Assignment the Assignors are entitled to credits for advance royalty paid to Andyck Corporation in the amount of _____ _____Dollars, for which reimbursement is thus provided.

5. Payment of Royalty Taxes

The Assignees hereby agree to pay to the proper public authorities whatever royalty tax or other assessment may be levied upon royalty payments made to the Assignors under this Assignment; and they agree to furnish the Assignors with duplicate tax receipts showing the payment of all such taxes and assessments made by them hereunder. Provided, however, that the Assignees shall be at liberty to contest in the Courts or otherwise the validity of any such tax before they shall be required to pay and discharge the same, upon the condition, however, that they shall not permit or suffer the said premises or any ore mined thereon to be sold at any time for any of such taxes.

6. Furnishing of Reports

The Assignees agree to furnish to the Assignors at the times specified in said Lease duplicate reports of exploration, mining operations, shipments and ore treatments required to be furnished to Andyck Corporation under Paragraphs Ten (10), Eleven (11), Twelve (12) and Thirteen (13) of said Lease.

7. Right of Inspection

The Assignors or their agents shall at all times have the right to enter upon said Lands or upon any other lands upon which ore from the leased premises shall be stockpiled or treated for the purpose of observing the manner of handling said ore and treating same, and to check its quantity and quality, but not in any manner to interfere with the operations of the Assignees; and the Assignees agree to furnish the Assignors with such additional information from time to time as may be reasonably requested covering any matters pertaining to the mining, treatment, shipment, and removal of the ore.

8. Assignment and Subletting

The Assignors agree that the Assignees shall have the right to assign this contract and to sublet said lands for all the purposes of said mining lease, or to contract with others to operate any mine or mines on said lands, but no assignment of their rights by the Assignees shall relieve them of their obligation hereunder unless and until such assignment shall have been approved in writing by these Assignors.

9. Surrender

The Assignors agree that the Assignees not being in default hereunder may terminate this Contract of Assignment and the estate hereby granted on the last day of any quarterly period in any year by giving to the Assignors written notice of their election so to do not less than sixty (60) days prior to the effective date of such surrender, and by paying to the Assignors prior to the date of such termination all sums that shall then have accrued to them thereunder, whether payable then or thereafter, and by performing all the covenants and agreements and observing all the conditions hereof on the part of the Assignees to be performed and observed up to the date of such termination; and thereupon all obligations hereunder of the parties hereto shall cease and terminate except the obligation of the Assignees to pay all taxes payable by them hereunder which shall not be payable on the date of such termination.

10. Termination on Default

In case of default by the Assignees this Contract of Assignment may be terminated by the Assignors upon sixty (60) days' notice; provided that if the default involves matters which are subject to arbitration under this compact, and the Assignees deny the default, the termination shall not be effective until sixty (60) days after final determination that a default exists. Should the claimed default involve the payment of money by the Assignees, then the Assignees shall pay the amount in dispute and should it subsequently be determined that the amount so paid was not due, then the Assignors shall reimburse the Assignees for the amount so paid with interest

at the rate of 4% per annum from the date of such payment. In any event, the termination shall not become effective if the default is cured within said sixty (60) days after giving notice as above provided or, to the extent that it cannot be cured by performance, if the Assignees shall pay the damages for default as determined by arbitrators within sixty (60) days after such determination. In the event of the insolvency, bankruptcy, or receivership of all or any of the Assignees, or should an execution against either or any of them remain unsatisfied, no ore shall thereafter be removed unless paid for in advance or satisfactory security be furnished to the Assignors.

11. Assignors Right to Remedy Default

If, upon default or claim of default in the performance of the terms of the lease from Andyck Corporation, committed or permitted to exist by the Assignees hereunder, and said Andyck Corporation shall give notice to the Assignors of the termination of said lease under the provisions thereof, the said Assignors hereby expressly reserve to themselves the right to make good such default so as to maintain said lease in good standing and upon doing so shall have the right to charge against the account of the Assignees all sums of money paid out together with expenses, attorneys' fees, and any other costs which they shall have borne in connection therewith, which amounts shall be immediately due and payable and shall bear interest at the rate of 6% per annum from the time that the same were paid by the Assignors until the date of repayment. Until repayment is made, such sums shall be secured by the Assignors by lien as hereinafter provided.

12. Rights of Parties on Surrender or Termination

Upon the termination of this Contract of Assignment in any manner and for any cause whatsoever, the Assignees shall peaceably surrender said lands to the Assignors, and not being in default hereunder shall have sixty (60) days after such termination in which to remove all engines, tools, machinery, railroad tracks, frames, structures and other chattels erected or placed by the Assignees on said premises but shall not have the right to remove or impair any supports placed in any mine or any timber or frame work necessary to the use and maintenance of the shafts or approaches to such mine, nor any tramways therein,

ner to impair the stability of any such mine or shafts on any such lands.

13. Retention of Lien

The Assignees agree that the Assignors shall at all times have, possess and hold a lien upon all ore mined from said lands and the concentrated product thereof until the same shall have been actually shipped away from said lands or from the place of treatment if treated off said lands, and on all movable machinery, implements and personal chattels of the Assignees which shall be on said lands as security for the payment of all royalty, taxes, or other claims arising hereunder and that become payable hereunder, which lien may be enforced against such property in like manner as chattel mortgage liens may be enforced under the laws of the State of Minnesota in such case made and provided.

14. Arbitration

Any disagreement or controversy between the parties hereto shall be determined by arbitration in the manner and with the effect provided for in Paragraph 20 of the Lease between Andyck Corporation and these Assignors. In the application of the provisions of said paragraph, the Assignors and Assignees shall occupy the positions of the respective Lessors and Lessees referred to in the Andyck Corporation Lease, and otherwise the provisions of said paragraph are incorporated herein by reference the same as though fully set forth at this point.

15. Interests of Assignors

As for the interests of the Assignors in this Contract of Assignment, they do hereby declare that they are each the owners of an undivided one-half interest in the lands herein assigned and that unless written notice is given to the contrary, payment of royalty is to be made to them in that proportion.

16. Interests of Assignees

As for the interests of the Assignees in this Contract of Assignment, they do hereby declare that they take the following undivided interests

therein:

Tintic Standard Mining Company, a one-third interest;

Nellie B. Mining Company, a one-third interest;

Hubert E. Howard, a one-ninth interest;

Harold E. Raddatz, a one-ninth interest; and

William M. Hayden, a one-ninth interest

17. Notices

Any notices to be given hereunder shall be in writing and sent by registered mail addressed respectively as follows:

Ray Todd, W-2631 First National Bank Building,
St. Paul 1, Minnesota

Edward P. Scallon, 137 East Eighth Street,
St. Paul 1, Minnesota

Tintic Standard Mining Company,
Salt Lake City, Utah

Nellie B. Mining Company,
Picher, Oklahoma

Hubert E. Howard, _____
Chicago, Illinois

Harold E. Raddatz,
LaJolla, California

William M. Hayden, 488 Madison Avenue,
New York 22, New York.

Any parties desiring to record a change of address shall notify the others in writing to that effect.

18. Obligations to run with the land

The covenants, conditions and agreements herein contained shall inure to the benefit of, and be obligatory upon the heirs, personal representatives, successors and assigns of the parties hereto, and the same shall run with the land.

IN TESTIMONY WHEREOF, the parties hereto have executed this agreement as of the day and year first above written.

((To be executed and acknowledged by the contracting parties))

EXHIBIT I

MINING LEASE

THIS AGREEMENT, made and entered into as of the 1st day of January, 1950, by and between ANDYCK CORPORATION, a New York corporation, of Yonkers, New York, as party of the first part, hereinafter called the "Lessor", and KAY TODD, of St. Paul, Minnesota, and EDWARD F. SCALLON, of St. Paul, Minnesota, parties of the second part, hereinafter called the "Lessees",

W I T N E S S E T H:

1. Ownership of Land.

The Lessor hereby represents that it is informed and believes that at the date hereof it is well seized of the following described lands, hereinafter called "the leased premises", situated in Aitkin County, Minnesota, viz:

> All of Section Twenty-three (23), Township Forty-eight (48), Range Twenty-seven (27),

but it is distinctly understood that the Lessor makes no warranties whatever with respect to the title to said premises, except that it has not made, done or executed any act whatsoever whereby said premises may be encumbered or imperilled.

2. Granting Clause.

In consideration of the sum of One Dollar ($1.00) to it in hand paid by Lessees, the receipt and sufficiency of which is hereby acknowledged and in further consideration by Lessees of the covenants and conditions herein contained to be kept and performed by them, and in further consideration of the payment of One Thousand One Hundred Thirty-six Dollars and Ninety-three Cents ($1,136.93) by Lessees to Lessor, Lessor does hereby lease to the Lessees the leased premises for the term of fifty (50) years from and after the date hereof, unless this agreement is earlier terminated in accordance with the provisions hereof, with all surface rights, and also all rights to explore for, develop, mine, by open pit or underground methods or both, treat and remove all iron ore, manganiferous iron ore, siliceous ore and other ores,

metals and materials found therein and thereon.

3. Habendum Clause.

TO HAVE AND TO HOLD said lands to the Lessees for and during said term upon condition that the Lessees shall well and truly perform, keep and observe each and every of the covenants, agreements and conditions hereinafter contained and on the part of the Lessees to be performed, kept or observed.

4. Treatment of Ores.

It may prove to be economically feasible to dry ore from said lands or to concentrate it, or to treat it in some other manner; therefore Lessor hereby agrees that Lessees shall have the right at this option to dry, wash, screen or otherwise treat any of such ore, and that the royalty herein provided for shall, as to any ore thus treated, accrue on the product of such treatment and not on the crude ore before such treatment. Such treatment of ore may be conducted by Lessees either on said lands or on other lands in the vicinity available for the installation of a plant adapted to such purpose, provided that the Lessees shall first obtain the fee title to such other lands or such a lease thereon that the lien and rights of Lessor in any ore removed thereto shall be fully preserved and protected to the same extent as though such ore had remained on said lands. Any ore removed from the leased premises to any other lands for the purpose of treating the same shall not be deemed to be mined and removed from said lands so as to cause the royalty thereon to accrue, and such royalty shall not accrue until the product or concentrate resulting from such treatment shall be actually shipped from the place of treatment to market. In the event Lessees shall erect on the leased premises a plant for the treatment of ore mined therefrom, they shall have the right to treat in such plant ore mined and removed from other lands. Ore mined from the leased premises and the product of any treatment thereof shall be kept separate and apart from all other ores and ore concentrates, until the ore from the leases premises shall have been weighed or royalty has been paid thereon, and all said opera-

tions shall be conducted and completed within a reasonable length of time. In case such treatment shall be conducted on the leased premises, Lessees agree that any refuse or waste arising from such treatment shall be so deposited as not to interfere with the future operation of any mine or mines on the leased premises. Lessees agree to conduct the washing, screening or other treatment of any such ore in a good and workmanlike manner and according to good engineering practice and sound business judgment and so as not to cause any greater waste of such ore than is necessary to render the ore product or concentrate thereof merchantable and of proper composition and character for successful and economical furnace use, and that they will use in any such treatment proper machinery and appliances to that end.

5. Royalty.

The Lessees hereby covenant and agree that they will on the 20th day of April, July, October and January in each year during the period this Lease shall continue in force, pay to the Lessor for all iron ore, manganese ore and manganiferous ore or concentrates thereof mined and removed from leased premises and shipped to market during the three months preceding the first day of the month in which payment is to be made as aforesaid, a base royalty at the rate of twenty-two and one-half cents (22½¢) per gross ton of 2,240 pounds of ore so removed and shipped.

Provided, however, that when the f.o.b. mine price of Mesabi Non-Bessemer ore averaging 51.50% iron natural is in excess of $3.75 per ton, the royalties herein stipulated shall be increased by ten per cent (10%) of the excess over $3.73. As used herein, the "published Lake Erie price" is that price generally recognized by the iron ore trade, or if no such price is published and recognized, means the average market price per ton for ores of the kind and grade corresponding to the present Mesabi Non-Bessemer grade sold for delivery at Lake Erie ports during the season of navigation current at the time of shipment for the then current season's sale and delivery by the

principal dealers in such ore. To fix the f.o.b. mine price there shall be deducted from such "published Lake Erie price" all charges from mine to Lake Erie ports which are included in such "published Lake Erie price" under the then current season's ore sale contracts, the deduction for the year 1948 being

Upper Lake Rail Freight	1.05
3% Transportation Tax	.0276
Lake Freight	1.15
3% Transportation Tax	.0345
Unloading Charge (Hold to Rail of Vessel	.18
3% Transportation Tax	.0054
Arbitrary	.02
	2.4675

Provided, however, anything herein to the contrary notwithstanding, the royalty payable under this lease shall never be less than the said rate of twenty-two and one-half cents (22½¢) per gross ton of 2240 pounds of ore.

6. Minimums

The Lessees further agree with the Lessor that during the period in which this lease agreement continues in force, they will mine or cause to be mined from said land and shipped as defined herein the following minimum amounts of direct shipping ore and/or ore concentrates, namely, at the rate of 2,500 tons per year for each of the first three (3) years of the term of said lease, and at the rate of 5,000 tons per year for the fourth (4th) year of said term and each year thereafter. In case the Lessees shall not so ship the full quantity of the agreed minimum output hereby stipulated to be mined and shipped in any such year, the Lessees shall nevertheless pay to the Lessor a royalty of twenty-two and one-half cents (22½¢) per ton on the tonnages stipulated to be mined and shipped for that year until this Lease shall expire or be terminated in manner herein expressed; provided, however, that if in any one year more iron or manganese ores or concentrates thereof are thus paid for in excess of what is actually mined and shipped in such year or years, then and in such case such ores and concentrates not removed may be removed in any subsequent

year during the continuance of this Lease without payment therefor, but such iron ore or concentrates so permitted to be moved in such subsequent year, in consideration of such prepayment therefor, must be in excess of the stipulated minimum amount of tons agreed to be taken from the leased premises for that year under this contract. The Lessees agree that they will pay all of such royalties on the 20th days of April, July, October and January in each year during the period this lease shall continue in force.

7. Manner of Operation

Lessees shall conduct all operations hereunder in a good, skillful and workmanlike manner and in accordance with good engineering practice, and will not do, or cause or suffer to be done anything which will hinder, prevent or detract from the profitable development and use of said lands as an iron ore or manganiferous ore mine or which will unnecessarily increase the cost of developing or operating the same or result in waste of the minerals therein except such as is usual and necessary in skillfully conducted mining operations, or except by the removal of ores and minerals as herein permitted, lessen the present and future value of said lands as such ore-producing property, and Lessees shall deposit any waste material resulting from the mining or treatment of iron ore, manganese ore and manganiferous ore from said lands in such manner as not to interfere with the future operations of any mine on said lands.

8. Cross-Mining Rights.

Lessees shall have the right to use said lands for ingress to and egress from other adjoining lands, and to construct, maintain and operate over and upon said lands railroad tracks, truck roads, pole and pipe lines and other facilities in connection with mining operations on such other lands. Lessees shall also have the right to carry on the mining of ore from said lands and from adjoining lands as one operation, removing from either property through the other; provided, however, that ore mined and removed from said lands shall not be stockpiled on other lands until such ore has been weighed or royalty thereon shall have been paid to Lessor, and that surface overburden or other

waste material removed from other lands shall not be placed on said lands without the written consent of Lessor.

9. Taxes to be Paid by Lessees.

The Lessees further agree to pay all taxes and assessment, general or specific, which may be levied or assessed against or upon said premises, or any part thereof, or on any ores, or the product thereof, or upon any property that may be placed thereon by the Lessees, from and after the date hereof, before the same shall become delinquent, during the period that this lease is in force and effect; provided, however, that in the year of termination hereof, the Lessees shall be liable for only that proportion of the total of said taxes for such year that the number of days in such year that the Lessees have possession of the premises bears to three hundred sixty-five (365) days. The Lessees shall also pay all lawful personal property taxes that may be assessed or imposed upon the iron and other ores mined from the demised premises or from other lands and stockpiled upon the demised premises, and upon the iron and other ores mined from the demised premises and stockpiled on other lands or shipped therefrom. The Lessees agree to pay the Minnesota royalty tax upon royalty payments made by them hereunder but shall not be liable for any other tax or assessment levied upon or measured by income to the Lessor hereunder. Provided, however, that the Lessees shall be at liberty to contest in the courts, or otherwise, the validity of any tax for which they are liable hereunder before the Lessees shall be required to pay and discharge the same, or any part thereof, provided, further, that the Lessees shall not permit or suffer said premises, or any part thereof, or any ore mined thereon, or any improvements or personal property thereon, to be sold at any time for any of such taxes. The Lessees agree to furnish Lessor with duplicate tax receipts showing the payment of all taxes and assessments made by them hereunder.

10. Reports of Exploration.

Lessees agree that on or before the twentieth day of January, April, July and October in each year, they will furnish to the Lessor a report of all

explorations carried on by them on said lands during the preceding three calendar months, each such report to be accompanied by blueprints showing the location of all work of exploration and the results thereof and also showing the character of any ore encountered, and by reports of all analyses of such ore.

11. Reports of Mining Operations.

Lessees shall furnish to the Lessor on or before the twentieth day of January in each calendar year during the continuance of this lease blueprints or maps showing the true condition of the workings of any mine or mines on said lands on the first day of such month, together with the location of all ore bodies and any information which Lessees may have showing the character of such ore bodies and also showing the places from which ore shall have been extracted and generally showing the underground and open pit workings of such mine or mines.

12. Reports of Shipments.

Lessees shall cause all ore removed from said lands to be weighed by the person or corporation transporting the same therefrom to market, and shall on or before the twentieth day of each calendar month furnish to the Lessor a detailed report of such shipments for the preceding calendar month, showing the dates thereof and the quantity of each such shipment as set forth by the manifest thereof, which report shall be verified by some one having knowledge of the facts or otherwise, sufficiently authenticated.

The Lessees further agree to furnish Lessor a duplicate copy of each of the railway company's weight tissues, showing date and weight of all ore shipped from the demised premises, and also to furnish Lessor with duplicate copies of all analyses of crude ores, concentrates of ores taken by the Lessees from their exploration on said premises or shipments of ore therefrom.

All such reports of any such transportation company and all copies of transcripts from the books of any such transportation company relative to the transportation or weight of such ores shall, as against Lessees, be

prima facie evidence of the facts so stated or appearing in any suit at law or equity or in any controversy between the parties hereto in and before any court, reference or arbitration. Lessees shall also furnish to the Lessor on each of the quarter days hereinabove fixed for the payment of royalties, written reports of all ore removed from said lands during the three months preceding each quarter day.

13. Reports of Treatments.

The Lessees shall cause all ore treated by them in any way whatsoever to be weighed, and shall cause the product of such treatment to be weighed, and shall on or before the twentieth day of each calendar month during the continuance of this lease furnish to the Lessor a detailed report of the number of tons of ore in its natural condition so treated and the number of tons of the product of such treatment, together with copies of any analyses which the Lessees may have made showing the mineral content of such ore before treatment and after treatment.

14. Lessor's Right to Additional Information.

Upon request made by the Lessor, from time to time, the Lessees shall furnish to the Lessor such additional information as the Lessor may reasonably request and as may not be obtained by the Lessees from their records, tending to show the quantity and quality of all iron ore and manganese bearing material mined and removed from said demised lands, the quantity, quality and mining availability of the iron ore and manganiferous bearing material then remaining therein, including copies of maps, cross sections, analyses and other engineering data obtained by the Lessees for their own use.

15. Lessor's Right to Inspect said Lands.

Lessor, through its agents and employees, shall at all times have the right to enter upon said lands or any part thereof, or upon any other lands upon which ore from said lands shall be treated, and view the same and the method of said treatment, and take all reasonable means to ascertain the condition of said land and the quantity of ore removed therefrom, but not so as to hinder or interfere with the operations of Lessees thereon, and Lessor shall furnish the results of all such inspections to Lessees.

16. Peaceable Surrender of said Lands on Termination of Lease.

At the termination of this lease, Lessees shall peaceably surrender said lands to Lessor or to its successors in interest, with all stopes, supports, pits, shafts and other improvements and erections that may be thereon or therein (buildings, head-frames, machinery, tools, implements and all movable personal chattels excepted) in good order and condition save for reasonable wear and tear; provided, however, that the Lessees shall not be entitled to remove any of said excepted personal property if the Lessees are then in default under the terms of this lease.

17. Satisfaction of Lease on Termination.

Lessees agree that when this lease shall terminate for any cause they will enter or cause to be entered a certificate of that fact upon the proper books of record in Aitkin County, Minnesota, provided this lease shall have been recorded there.

18. Assignment and Subletting by Lessees.

Lessor agrees that Lessees shall have the right to assign this lease and to contract with others to work any mine or mines on said lands, and to sublet said lands for all the purposes of this lease and with the same rights and privileges as are herein granted to Lessees, but no assignment of their rights by the Lessees shall relieve them of their obligations hereunder unless and until such assignment shall have been approved in writing by the Lessor.

19. Termination for Default.

In case of default by Lessees, this lease may be terminated by Lessor upon sixty (60) days notice; provided that if the default involves matters which are subject to arbitration under the provisions of Section 20 hereof, and Lessees deny the default, the termination shall not be effective until sixty (60) days after final determination that a default exists pursuant to such arbitration provisions. Should the claimed default involve the payment of money by Lessees, then Lessees shall pay the amount in dispute, and should it subsequently be determined that the amount so paid was not due, then Lessor shall reimburse Lessees for the

amount so paid, with interest at the rate of four per cent (4%) per annum from the date of such payment. In any event, the termination shall not become effective if the default is cured within said sixty (60) days after giving notice as provided in Section 19 hereof, or, to the extent that it cannot be cured by performance, if Lessees pay the damages for default as determined by such arbitrators within sixty (60) days of such determination. In the event of insolvency, bankruptcy or receivership of Lessees, or should an execution against them remain unsatisfied, no ore shall thereafter be removed unless paid for in advance, or satisfactory security be furnished to the Lessor, and in any event this lease shall not be assigned within the written consent of the Lessor.

20. Arbitration.

In case any disagreement or controversy shall arise between the parties hereto relative to the observance or fulfillment of the terms and obligations hereof by either party, then such controversy or disagreement shall be determined by arbitration. Either party may within thirty (30) days after such disagreement arises, demand arbitration thereof, and the party or parties making such demand shall in writing specify the matter to be submitted to arbitration and at the same time choose and nominate some disinterested competent person to act as an arbitfator; thereupon, within ten (10) days after receipt of such written notice, the other party to this lease shall in writing choose and nominate a disinterested and competent arbitrator and the two arbitrators so chosen shall forthwith select a third arbitrator, giving written notice to both parties of the choice so made and fixing a place and time for meeting not later than thirty (30) days thereafter, at which both parties may appear and be heard touching such controversy. The decision of said arbitrators should be made in writing within thirty (30) days after the completion of hearings thereon, and when signed by a majority of them shall be final and conclusive upon both parties and the award so made shall be forthwith complied with. In case the notified party shall neglect or refuse to choose and nominate an arbitrator as above provided and within the time hereinabove specified, or in case the two

chosen by either method herein provided shall fail to agree upon a third arbitrator, then such arbitrator shall in each case, upon application of either party, be named by the person (or any one of the person) who may then be holding the office of Senior Judge of the United States District Court in and for the district in which the mine is located, or the person holding an office which corresponds to such office as now extant if it shall then have been abolished. The expenses of any such arbitration, including reasonable compensation for the arbitrators, shall be paid by the party against which the award therein shall be made or as otherwise directed by the arbitrators.

21. Surrender of Lease by Lessees.

Lessor agrees that Lessees, not being in default hereunder, may terminate this lease and the estate hereby granted on the last day of any quarterly period in any year by giving to Lessor written notice of their election so to do not less than sixty (60) days prior to the effective date of such surrender, and by paying to Lessor prior to the date of such termination all sums that shall then have accrued to it thereunder, whether payable then or thereafter, and by performing all the covenants and agreements and observing all the conditions hereof on the part of Lessees to be performed and observed up to the date of such termination; and thereupon all obligations hereunder of the parties hereto shall cease and terminate except the obligation of Lessees to pay all taxes payable by them hereunder which shall not be payable on the date of such termination.

22. Right of Lessee to Remove Personal Property After Termination of Lease.

Lessor agrees that upon the termination of this lease for any cause the Lessees, not being in default hereunder, shall have sixty (60) days after such termination in which to remove all engines, tools, machinery, railroad tracks, head frames and structures erected or placed by Lessees on said lands, but shall not have the right to remove or impair any supports placed in any mine or any timber or framework necessary to the use and maintenance of the shafts or approaches to such mine, nor any tramways therein, nor to impair the stability

of any such mine or shafts on said lands. Any such property not removed from said lands by Lessees within such sixty-day period shall become the property of the Lessor.

23. Lessor's Lien on Ore and Personal Property Belonging to Lessees.

Lessees agree that Lessor shall at all times have, possess and hold a lien upon all ore mined from said lands and the concentrated product thereof until the same shall have been actually shipped away from said lands or from the place of treatment if treated off said lands, and on all movable machinery, implements and personal chattels of Lessees which shall be on said lands, as security for the payment of all royalty, taxes, or other claims arising hereunder, that may become payable hereunder, which lien may be enforced against such property in like manner as chattel mortgage liens may then be enforced under the laws of the State of Minnesota.

24. Manner of Giving Notices.

All notices hereunder shall be written and sent by registered mail, addressed respectively as follows:

Andyck Corporation, c/o United States Trust Company
45 Wall Street
New York 5, New York

c/o Harold G. Cant, Attorney at Law,
1010 Midland Bank Building
Minneapolis 1, Minnesota

Kay Todd, Attorney at Law, W-2681 First National Bank Building
St. Paul 1, Minnesota

Edward J. Scallon, Mining Engineer, c/o Butler Bros.
136 East 8th Street
St. Paul 1, Minnesota

or at such different addresses as may be in writing hereafter specified by the respective parties to the other party. All notices served hereunder shall be effective as of the day when deposited in the United States mail properly addressed, stamped and registered.

Royalty payments shall be made to Lessor at the first above given address unless otherwise directed by it in writing.

25. Obligations Hereof to Run with the Land.

The covenants, conditions and agreements herein contained shall inure to the benefit of, and be obligatory upon, as the case may be, the heirs, personal representatives, successors and assigns of the parties hereto, and the same shall run with the land.

The Lessees hereby acknowledge receipt of a copy of this instrument.

IN TESTIMONY WHEREOF, the parties hereto have executed this agreement in triplicate as of the day and year first above written.

Signed and sealed and delivered in presence of;

(Signed) Eleanore B. Benedict

(Signed) John J. Judge
As to Andyck Corporation

Lillian M. Gardelin (Signed)

Philip J. Mackey (Signed)
As to Kay Todd

Lillian M. Gardelin (Signed)

Philip J. Mackey (Signed
As to Edward F. Scallon

ANDYCK CORPORATION

By (Signed) Helen A. Benedict
Its President

and (Signed) Frederick M. L. Fuelle
Its Secretary-Treasurer

Kay Todd (Signed)
Kay Todd

Edward F. Scallon (Signed)
Edward F. Scallon

STATE OF NEW YORK

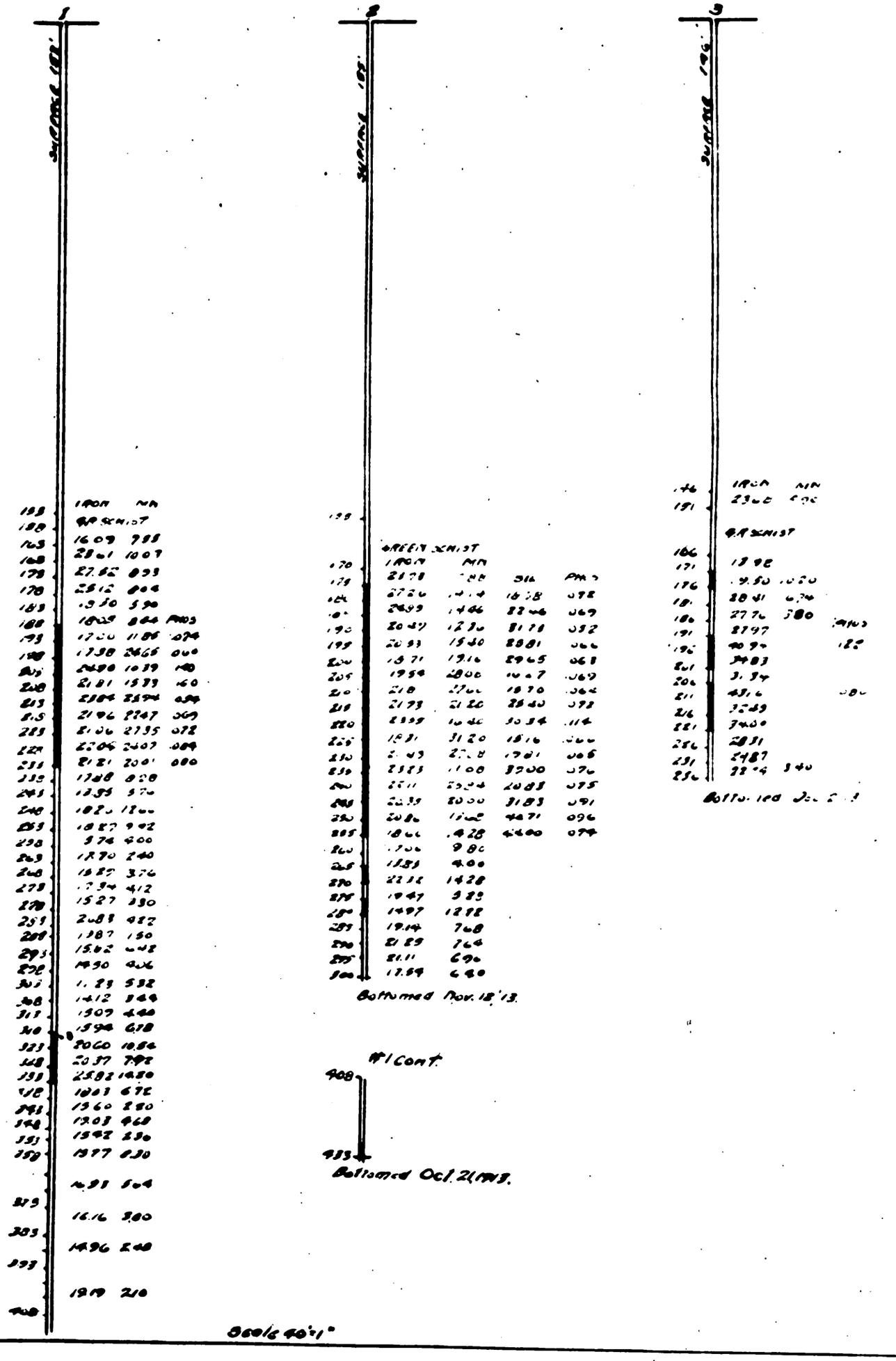
COUNTY OF NEW YORK

On this 17th day of January, 1950, before me, a Notary Public within and for said county, personally appeared Helen A. Benedict and Frederick M. L. Fuelle to me personally known, who, being by me duly sworn, did say that they are respectively the President and Secretary-Treasurer of ANDYCK CORPORATION, the corporation named in the foregoing instrument, that the seal affixed to said instrument is the corporate seal of said corporation, and that said instrument was signed and sealed in behalf of said corporation by authority of its Board of Directors, and said President and Secretary-Treasurer knowledged said instrument to be the free act and deed of said corporation.

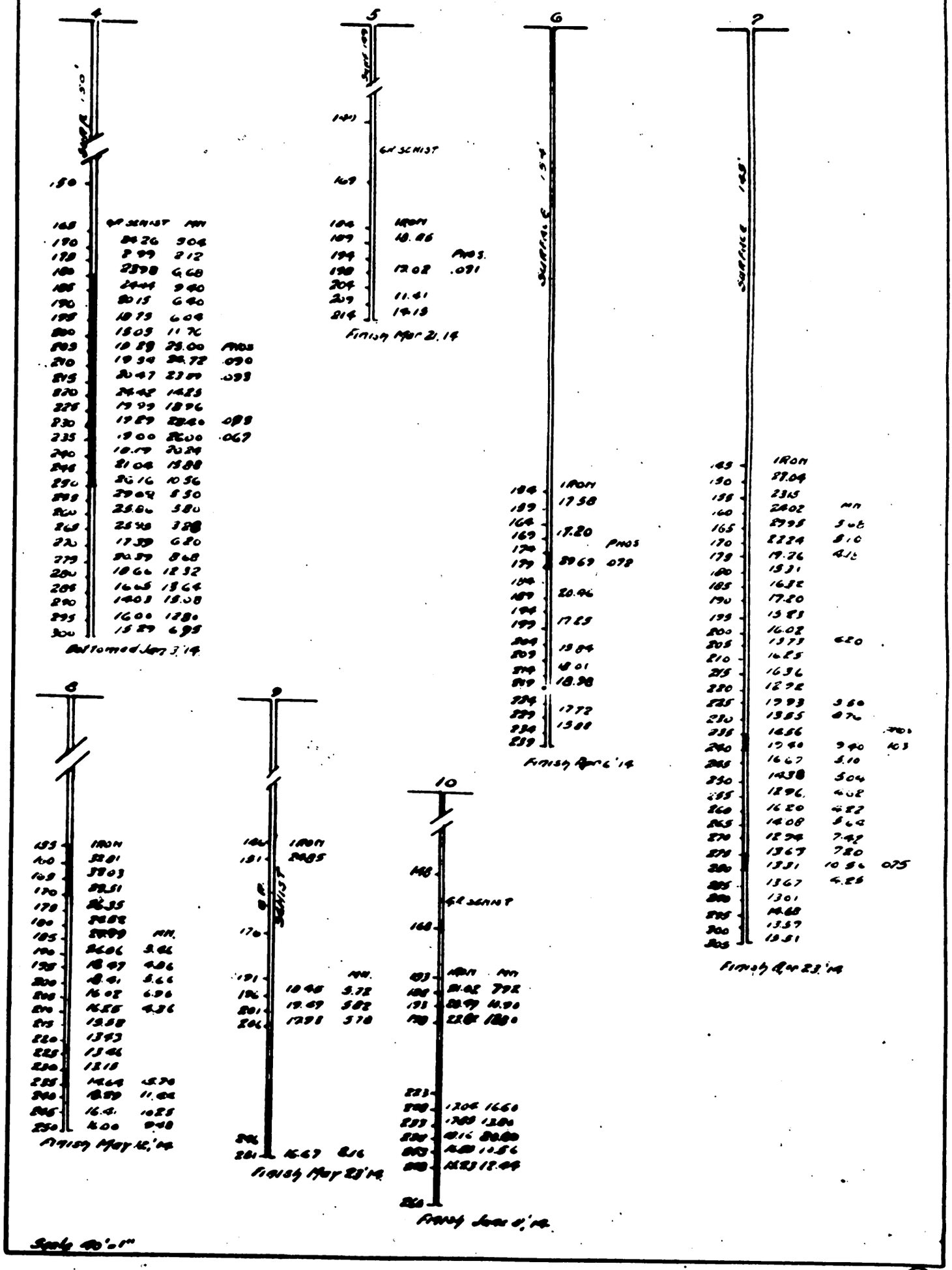
(Signed) Stephen H. Faherty
Notary Public, New York County, N.Y.
My commission expires Mar. 30, 1950.

(Rubber Stamp)

Stephen H. Faherty
Notary Public, State of New York
Residing in Queens County. Queens Co. Clk's No. 3788, Reg. No. 693-F-0
N.Y.Co. Clk's No. 860, Reg. No. 328-F-0
Commission Expires March 30, 1950.


1
SURFACE 182'
IRON MN
G.R. SCHIST
2
SURFACE 182'
GREEN SCHIST
IRON MN SIO PMO
Bottomed Nov. 18, '13.
#1 Cont.
Bottomed Oct. 21, 1913.
3
SURFACE 196'
IRON MN
G.R. SCHIST
Bottom 100 Dec. 2, '1
Scale 40'=1"

Sheet 1


4
Bottomed Jan 3 '14
5
Finish Mar 21 '14
6
Finish Apr 6 '14
7
Finish Apr 23 '14
8
Finish May 12 '14
9
Finish May 23 '14
10
Finish June 6 '14
Scale 40' = 1"

Sheet A-1

1001

	Mat.	Color	Texture	Hardness				
7	Sand & Clay	Yellow	Fine	Soft				
20	Clay	Blue	"	"				
29	Hardpan	Gray		Medium				
40	Sand	Dark	Coarse					
61	"	"	Medium					
70	"	"	Coarse					
84	Sand & Gravel	"	"					
93	"	"	Fine					
99	Gravel & Boulders	"		Hard				
102	Gravel	Gray	Medium	Medium				
14	Sand & Gravel	"	"	Hard				
117	Clay, Sand & Boulders	"		Medium				
135	Hardpan Boulders	"	Coarse	Hard				
	Sand	Lt Yellow	Fine	Soft				
132	Sand, Gravel &							
135	Schist	Red	Medium	"				
160	20.00 Fe		5.45 Mn		SiO_2			
165	21.00		4.81					
170	30.30		3.85					
175	22.20		7.10					
180	25.20	.090	10.18	31.15				
185	23.70	.129	10.18	32.20				
190	22.10	.156	11.96	25.75				
195	16.80	.100	15.12	31.90				
200	19.33		5.93					
205	21.17		7.98					
210	16.48		7.70					
215	17.33		8.25					
220	22.48		8.75					
225	15.45	.102	10.45	46.15				
230	14.60		8.25					
235	19.50		6.32					
240	17.40		3.99					
245	16.80		3.49					
250	15.60		6.79					
255	15.40	.102	25.10	32.65				
260	30.80		7.98					
265	15.40		1.65					
270	16.30		2.20					
275	14.80		1.18					
280	17.20		9.26					
285	19.40	.108	10.06	46.05				
290	19.00		8.03					
295	16.80		5.50					
300	11.05		1.88					
305	16.76		7.00					
310	16.08		3.00					
315	15.12		9.50					
320	17.41	.092	18.00					
325	11.70	.069	9.06					
330	12.51	.078	9.30					
335	16.22	.041	14.00					
340	12.16	.079	8.52					
345	18.18		4.92					
350	13.43		2.16					
355	12.94		3.16					
360	10.35		17.00					
365	8.67		10.49					
370	15.90		6.32					
375	18.67		4.64					
380	28.01		.80					
385	18.33		1.88					
390	22.18		.64					
395	24.96		.58					
400	28.49		.56					

Cont

1002

	Mat.	Color	Texture	Hardness				
7	Muskeg	Black		Soft				
24	Sand & Clay	Gray		"				
37	Sand, Gravel Boulders	"		Hard				
43	Sand, Gravel	"	Coarse	Medium				
68	Hardpan	"		"				
73	Sand, Gravel & Boulders	"	"	Hard				
100	Hardpan & Gravel	Brown	Medium	"				
123	Gravel & Boulders	Gray	Coarse	"				
133	Hardpan Sand & Gravel	"	Medium	"				
142	Sand	"	Fine	Soft				
145	Sand & Gravel	Yellow	Medium					
150	22.70 Fe		3.58 Mn		SiO_2			
155	24.10		3.00					
160	23.00		12.23					
165	24.70		4.18					
170	21.00	.069	10.83	24.40				
175	23.80	.078	10.58	25.00				
180	26.00		5.53					
185	19.80		7.18					
190	24.70		4.81					
195	19.40		8.08					
200	19.50		6.10					
205	24.70		3.61					
210	15.32	.060	7.60	42.84				
215	1[illegible].47	.058	16.00	31.41				
220	18.71	.052	12.40	42.51				
225	18.46	.056	9.60	46.18				
230	19.63	.063	7.20	45.76				
235	18.54	.089	22.10	38.66				
240	13.44	.104	14.00					
245	12.87	.175	7.10					
250	13.35	.086	16.00					
255	12.24	.077	13.94					
260	20.16	.091	2.84					
265	16.05	.080	14.06					
270	14.43	.079	15.60					
275	14.45	.110	19.46					
280	16.89	.154	12.80					
285	17.71	.117	16.80					
290	15.91	.123	10.40					
295	17.53	.116	7.20					
300	20.61	.119	16.14					
305	19.27	.096	1.52					
310	18.41		2.36					
315	17.36		1.96					
320	18.51		.742					
325	16.36		.841					
330	13.87		1.76					
335	16.79		1.96					
340	20.08		3.19					
345	19.63		14.68					
350	17.02		10.80					
355	16.42		11.00					
360	16.81		6.39					
365	20.9		3.80					
370	22.10		1.98					
375	19.89		1.74					
380	14.48		1.38					
385	17.13		1.40					
390	15.19		1.84					
395	15.09		2.60					
400	15.17		2.78					
405	16.30		2.12					
410	14.70		6.48					

Cont.

Sheet 2

1001 cont

	Iron	Mn
400		
405	4.66	.42
410	2.315	.34
415	13.33	.26
420	17.64	.26
425	7.37	.30
430	12.43	.32
435	11.01	.34
440	8.04	.28
445	8.04	
450	6.02	
455	8.08	
460	6.46	
465	7.45	
470	7.25	
475	7.05	
476	Slate	

Finished May 17, 1916.

(1) Slate

1002 cont

	Iron	Mn
410		
415	16.32	5.08
420	13.43	1.20
425	13.17	2.32
430	9.14	2.88
435	Slate	

Finished May 17 1916

(1) Slate

1003

	Material	Color	Text	Hardness
3	Quicksand	Gray	Fine	Soft
10	Sand	Brown	Med.	"
	Clay	Gray		Medium
93				
40	Sand	"	Med.	Soft
	"	"	Fine	"
75				
81	"	"	Coarse	"
	"	"	Fine	"
94				
101	Gravel		"	Med.
	"		Med	"
110	Gravel &		Coarse	Hard
116	Boulders			
	Hardpan & Boulders	Gray	"	"
139	Hardpan	"	"	
145	Sand	Yellow	Fine	Soft

	Fe.	Mn
150		7.46
155		9.32
160		1.30
165		10.04
170		10.44
175		6.36
180		9.18
185		6.80
190		8.96
195		5.94
200		6.90
205		3.92
210		12.49
215		14.54
220		5.84
225	14.95	12.88
230		15.60
235		5.40
240		9.00
245		10.96
250		8.28
255		1.80
260		7.20
265		5.68
270		6.48
275	19.25	5.40
280	22.46	5.92
285	22.22	5.92
290	27.18	11.88
295	24.58	19.20
300	14.08	6.92

Cont.

1004

	Mat.	Color	Texture	Hardness
1	Rusty Sand	Black Gray	Fine	Soft Soft
6	Boulders			
	Hardpan	"	"	Hard
26				
30	Hardpan	"		"
	Sand & Gravel	"		Soft
76				
82	Sand	Red		"
91	Clay	"		"
	Hardpan & Boulders	Gray		Hard
137				
142	Hardpan	"		"
144	Sand		Medium	Soft

	Fe.	Mn.	SiO_2	Graph.
150		.44		
155		.44		
160		.44		
165		.28		
170		.08		
175		.10		
180		.14		
185		.14		
190		.16		
195		.14		
200		.28		
205		.14		
210		.18		
215		.4		
220	6.18	.32		1.27
225	7.40			21.32
230	7.50			7.95
235	15.37	.20		
240		.10		
245		.14		
250		.20		
255		.18		
260		.16		
265		.10		
270		.14		
275		.14		
280			55.00	
285			62.10	
290			52.60	
295			62.64	
300			60.50	
305	7.60		70.75	
310			70.32	
315			74.64	
320			69.24	
325		.24	62.50	
330		.24	68.80	
335		.38		14.35
340		.28		21.85
345		.68		10.35
350		.44		34.25
355		.20		26.15
360		.34		10.40
365		.32		30.95
370		.66		33.65
375		.60		29.38
380		.20		30.80
385		.52		30.60
390		.44		24.72
395		.56		29.83

Cont.

1003 cont

	Iron	Mn.
300	[illegible]	[illegible]
305	21.07	15.84
310	16.46	2.52
315	13.87	1.28
320	19.36	6.44
325	12.48	3.68
330	16.71	8.24
335	20.21	14.18
340	25.14	11.14
345	21.32	12.92
350	20.53	7.06
355	16.46	8.08
360	14.08	4.00
365	18.13	5.02
370	17.46	1.94
375	11.94	5.0
380	16.67	2.90
385	9.84	.54

Bottomed in Slate
Finished June 14 '16

1004 cont

	Mn.	Graph.
395	60	28.45
400	42	26.15
405	32	29.00
410	46	30.80
415	44	27.85
420	34	25.80
425	34	25.00
430	34	24.85
435	40	25.60
440	36	23.30
445		25.97
448		20.46
450		20.35
455		

Finished June 14 '16
Bottomed in Graphitic Slate & Quartz

1005

	Material	Color	Texture	Hardness
2	Muck	Black	Fine	Soft
10	Sand & Clay	Yellow	Medium	Medium
	Clay	Grey	"	Hard
33	Gravel & Sand	"	Coarse	Med.
42	Clay & "	Red	Fine	Soft
47				
62	Clay	Grey	Coarse	Hard
74	Sand	"	"	"
94	Clay	"	Medium	"
105	Clay & Rock	"	Coarse	"
113	Sand & Grit	"	Med	Soft
122	Gravel	"	Coarse	Med
135	Hardpan	Brown	"	Hard
142	Clay Boulders	Grey	Med	"
149	" & Sand	"	"	Med

	Fe	Phos	Mn	SiO_2	Graph
155			10.20		
160			11.50		
165			12.32		
170			6.96		
175			5.96		
180			3.80		
185			4.64		
190			7.78		
195			6.68		
200			7.44		
205			5.12		
210			5.94		
215			2.18		
220			6.94		
225			7.44		
230	1022	.104	14.42		
235	1845	.091	11.60		
240		.103	12.20		
245		.120	13.76		
250		.117	10.08		
255		.175	7.20		
260		.174	14.54		
265		.095	12.24		
270		.111	8.96		
275		.087	8.60		
280		.066	10.76		
285		.063	13.76		
290		.050	21.30		
295		.179	6.52		
300		.097	12.46		
305		.081	14.90		
310		.088	1.36		
315		.130	17.66		
320		.090	12.60		
325		.102	16.64		
330		.095	11.98		
335			3.84		
340			1.70		

Bottomed in Slate July 12 1916

Sheet 4

1006

Depth	Material	Color	Texture	Hardness
	Muskeg	Black		
7.	Sand	Gray	Fine	Soft
18.	Clay	"	"	Medium
30.	"	"	"	Soft
40.	Sand & Gravel	"	Coarse	"
65.	Sand	"	Fine	"
85.	Clay	"	"	"
100.	Clay & Sand	"	"	"
115.	Hardpan	"	Med	Hard
	"	"	"	"

Depth	Fe	Mn
145.		
150.		92
155.		88
160.		108
165.		112
170.		96
175.		156
180.		54
185.		68
190.		64

Graphitic Slate & Quartz

215.

260.

Quartz & Schist

285.

Graphitic Slate & Quartz.

Depth	Fe	Mn
320.		
325.	1379	24
330.	2327	28
335.	2770	32
340.	1965	36
345.		
350.	Graphitic Slate	
355.		

Bottomed in Graphitic Slate July 1 1916

1007

Depth	Material	Color	Texture	Hardness
9	Sand	Yellow	Fine	Soft
30	Clay	Gray	"	Medium
40	Hardpan	"	Coarse	Hard
55	Sand	Yellow	Fine	Soft
64	Sand & Boulders	Brown	"	"
68	Hardpan	Gray	Coarse	Med
80	Sand	Brown	Med	Soft
88	Clay	Gray	Fine	"
93	Sand	"	Med	"
110	Hardpan	"	Coarse	Hard
120	Clay & Boulders	"	"	"
146	Hardpan & Boulders	"	"	"
152	Hardpan	"	"	"
161	Sand	"	Med	Soft
165	Gray Shist		Fine	"
170	Sandstone		"	Hard
	Schist	Red & Gray		

Depth	Mn
195	
200	450
205	516

Red Schist

230

Bottomed in Chert July 26 1916

1008

	Material	Color	Texture	Hardness
8.	Muskeg	Black	Fine	Soft
	Clay	Gray	"	"
29.				
	Clay & Boulders	"	Medium	Medium
45.				
55.	Hardpan	-	-	-
	Gravel & Sand.	Red	-	Soft
195.				
	Sand	Gray	Fine	Soft
150.				
153.	Clay	"	Med	Med
160.	Sand	-	Fine	Soft
165.		Mn 56		
	Gray Schist			
215.				
	Red Schist			
235.		44		
240.				
265.				
	Red Schist & Quartz			
300.	Iron			
305.	1922	.92		
	Red Schist & Quartz & Ore			
330.	Iron	Mn		
335.	9961	24		
	Schist & Ore			
360.				
370.	Graphitic Slate & Schist			

Finished Aug. 4. 1916
Bottomed in Graphitic Slate.

1009

	Material	Color	Texture	Hardness
0	Sand	Yellow	Medium	Soft
15.	Clay	Coarse	"	Med
20.	"	"	"	Hard.
27.	Sand	Yellow	"	Soft
35	Hardpan	Gray	Coarse	Hard
40	Sand & Boulders	-	-	Med.
	Gravel & Boulders	-	-	"
50				
70	Gravel & Boulders	"	"	Hard
75.	Hardpan	-	-	"
	Gravel	-	"	"
92.				
	Hardpan & Boulders	"	"	"
120.				
	Hardpan	-	"	"
134.				
	Clay	Blue	Med	-
157.	Sand	White	Fine	Soft.
162.		Mn 44		
165.				
	Graphitic Slate & Quartz	Black	"	"
205.				
210.	Graphitic Slate	-	-	"

Finished Aug 5 1916
Bottomed in Graphitic Slate.

Sheet 8

1010

	Material	Color	Texture	Hardness
7	Muskeg	Black	Medium	Soft
10	Sand	Yellow	Fine	"
	Clay	Gray	Med.	Med.
30				
36	Gravel & Boulders	"	"	"
	Sand & Boulders	"	"	"
65				
	Sand, Gravel Clay & Boulders	"	"	"
85				
	Gravel, Sand & Boulders	"	"	"
100				
	Sand	"	Fine	Soft
135				
	Gravel, Sand & Boulders	"	Med	Med
150				
	Boulders & Gravel	"	Coarse	Hard
165				
	Quartz & Schist	"		
	Iron	Mn		
190				
195	1966	68		
200	1899	70		
	Schist & Paintrock seams	"		
244				
	Red & Gray Schist, Mixed			
260				

Finished Aug 24 1916
Bottomed in Schist

1011

	Material	Color	Texture	Hardness
0	Sand & Clay	Yellow	Med	Med
18	Hardpan	Gray	Coarse	Hard
	Hardpan & Boulders	"	"	"
36				
	Clay & Gravel	"	"	"
48				
	Gravel & Boulders	"	"	"
60				
	" " "	"	"	Med
90				
	Clay, Gravel & Boulders	"	"	Hard
135				
	Clay & Sand	"	Med	Med.
160				
163	Dark Gray Schist	Iron 784		Mn .22
	Gray & Brown Schist			
175				

Finished Aug. 24 1916
Bottomed in Schist.

1012

	Material	Color	Texture	Hardness
5	Sand	Yellow	Fine	Soft
	Hardpan	Gray	Coarse	Hard
35				
	Sand & Boulders	Brown	Med.	Med.
90				
95	Gravel & Boulders	Gray	Coarse	"
	Hardpan & Boulders	"	"	"
115				
120	Clay & Boulders	"	"	"
	Hardpan & Boulders	"	"	"
175				
180	Sand & Gravel	"	"	"
	Hardpan & Boulders	"	"	"
215				
	Gravel Sand & Boulders	"	"	"
235	Schist & Quartz	"	"	"
245				
250		Green	"	Hard

Bottomed in Schist & Quartz.
Finished Sept 21. 16

1014

	Material	Color	Texture	Hardness
7	Muskeg	Black	Med	Soft
15	Sand	Yellow	"	Med.
	Hardpan	Gray	Coarse	Hard
35				
40	Sand	"	Med	Med.
	Hardpan & Boulders	"	Coarse	Hard
70				
80	Gravel	"	Med	Med.
	Hardpan	"	Coarse	Hard
120				
	Hardpan & Boulders	Gray	Med	Hard
150				
	Sand	"	Fine	Soft
165				
170	Sand & Gravel	"	Med	"
175	Black Clay	Black	"	"
180	Schist	Gray	"	Med.
	Quartz	White	Coarse	"
200				
210	Schist	Geen	"	"

Bottomed in Green Schist.
Finished Oct. 9. 1916

1013 Δ Hole 60° NW

	Material	Color	Texture	Hardness
	Muskeg	Black		Soft
20	Clay	Gray	Med	Med
25	Quicksand	"	"	"
35	Clay-Sand	"	Med	Med
45	Clay-Gravel	"	"	"
52	Bowlder-Gravel	"	"	"
62	Gravel-Clay	"	"	"
	Boulders			
15	Gravel		Coarse	
87	Gravel-Sand	"	"	"
98	Sand	"	"	"
102	Sand	Red	"	"
115	Sand-Gravel	Gray	Med	"
122	Clay-Grave	Blue	"	"
139	Gravel-Sand	Gray	Coarse	Soft
153	Hardpan	"	"	Mud
	Boulders			
170	Hardpan	"	Med	"
	Solid Seams			
180	Clay-Sand	Green	"	"
185	Sub-Lignite	Black	Fine	Hard
			Med	"
	Schist	Gray-Brown	"	Med
				Soft
245				
	Green & Brown Schist			Med
260				
265				
270				
275				
280				
285				
290				
295				
300				

Iron	Mn
1008	316
2045	360
1503	380
1138	340
1642	340
1432	276
1743	312
1108	280
1469	346

Bottomed in Schist & Point Rock
Finished Oct 7. 1916.

1015 Commenced Oct 9. 1916

	Material	Color	Texture	Hardness
20.	Muskeg	Black	Fine	Soft
	Clay & Sand	Gray	"	Med
22.				
	Boulder & Sand	Yellow	Med.	Soft
70.				
75.	Sand	"	Fine	Med
	Gravel & Sand	Green	Coarse	"
91.				
96.	Gravel	Gray	"	"
100.	Boulders & Clay	"	Med.	"
112.	Hardpan	"	"	Hard
115.	Gravel & Boulders	"	Coarse	Med
	Hardpan	"	Med.	Hard
130.				
	Sand & Gravel with Clay Seams	Yellow	"	Med

	Iron	Mn	Mn
143.			
145.			
150.	2819	.071	360
155.	2106	.085	1950
160.	1924	.121	1194
165.	1667	.020	874
170.	1444	.045	1210
175.	1916	.034	678
180.	1665	.030	848
185.	2035	.038	926
190.	1986	.045	842
195.	2282	.054	840
200.	1805	.004	480
205.	1632	.064	230
210.	1746	.071	[illegible]
215.	1165	.089	[illegible]
220.	1088	.089	754
225.	1906	.118	796
230.	1201	.069	826
235.	1590	.132	1390
240.	1363	.128	1092
245.	1278	.049	1072
250.	1329	.069	1880
255.	1387	.101	1200
260.	1432	.069	1848
265.	1424	.078	2070
270.	1588	.120	792
275.		.118	674
280.		.081	658
285.		.091	850
290.		.100	252
295.		.169	190
300.		.150	580
305.		.135	556
310.		.110	254
315.		.146	.370
320.		.101	.566
325.		.094	.58
330.		.109	.44
335.		.096	.38
340.		.127	.36
345.		.079	.26
350.		.078	1.66
355.			1.60
360.			1.26
365.			1.92
370.			3.28
375.			1.40
380.			4.00
385.			5.80
390.			2.64
395.			2.52
400.			.82

Bottomed in Slate
Finished Nov. 2 1916

1016 Commenced Oct. 10. 1916

	Material	Color	Texture	Hardness
3.	Sand	Yellow	Fine	Soft
	Clay	Gray	Med.	"
50.				
	Gravel & Boulders	"	"	"
90.				
	Hardpan	"	Med.	Med.
102.				
	Hardpan & Boulders	"	Coarse	"
140.				
145.	Hardpan	"	Med.	"
150.				
165.	Sand	"	Fine	Soft
170.	Clay & Sublignite	Black	Med.	Med
	Schist	Gray	Fine	Soft
185.				
	Quartz	"	Coarse	"
225.				

Bottomed in gray Quartz.
Finished Oct. 19. 1916

1017 Commenced Oct 20. 1916

	Material	Color	Texture	Hardness			
5	Muskeg	Black	Fine	Soft			
	Clay	Gray	"	"			
20							
30	Sand	Yellow	Coarse	"			
40	Clay	Red	Med	Med			
50	Hardpan + Boulders	Gray	"				
60	Sand	"	Coarse	Soft			
70	Gravel	"	"	"			
80	Sand	"	"	"			
	Sand + Clay Seams	"	Med	"			
130							
140	Gravel + Boulders	"	Coarse	Med			
146	Clay	"	Med	"			
150	Boulders	"	Coarse	Hard			
160	Sand	Gray	Fine	Soft			
170	Sub-lignite	Black	Med	"			
	Talc	Gray	Fine	"			
190							
	Quartz	"	"	Hard			
210	Quartz + paint-rock	Red	Med	Med.			
215			Mn.				
220			1.24				
225			.92				
230			1.12				
235	15.05	.075	1.24				
240	19.71	.099	1.56				
245	Paintrock + Schist	Red	76	Med	Hard		
252	Slate + Schist	Black	Fine	"			
260	Slate	"	Med	"			

Bottomed in Slate
Finished Nov 16. 1916.

1018

	Material	Color	Texture	Hardness			
15	Clay-Sand	Gray	Med.	Med			
32	Hardpan	"	"	Hard			
38	Sand	Red	Fine	Soft			
69	Sand, Gravel + Boulders.	Gray	Coarse	Med.			
	Sand	"	Fine	Med			
85	Gravel + Boulders	"	Coarse	"			
	Hardpan	"	Med.	Hard			
132	Gravel	"		Med.			
137	Sand	"	Fine	Soft			
143	25.84						
145			9.24				
150			2.14				
155			.84				
160			.58				
165			6.34				
170			3.66				
175			2.24				
180			1.32				
185			4.90				
190			.942				
195	16.16		6.36				
200			3.40				
205			3.34				
210			1.52				
215			2.08				
220			1.00				
225			.62				
230			.24				
235	16.00		.22				
	Ore + Schist						
260							
268	Chert + Slate						

Bottomed in Chert + Slate
Finished Nov. 28. 1916

1019

	Material	Color	Texture	Hardness
	Muskeg	Black	Med	Soft
5	Sand	Gray	Fine	"
	Clay	"	Med	"
30				
	Sand	"	Fine	"
30				
40	Boulders	"	Coarse	Hard
48	Clay	Red	Med	Med
	Gravel & Boulders	Gray	Coarse	Hard
80				
87	Sand	"	Fine	Soft
95	Hardpan	"	Med	Med
	Hardpan Boulders	"	Med	Hard
120				
	Hardpan & Sand	"	"	"
152	Sand &			
160	Boulders	"	"	"
165	Clay	"	"	Med
	Schist	"	"	"
185				
	Schist & Quartz	"	"	"
200				

Bottomed in Schist & Quartz
Finished Nov. 28, 1916

1020

	Material	Color	Texture	Hardness
8	Muskeg	Black	Med.	Soft.
	Clay	Red & Gray	"	"
57				
60	Hardpan	Gray	"	Hard
	Gravel-Boulders	"	Coarse	"
70	Clay & Sand	"	Med	Med.
80			—	
	Sand. Clay & Boulders	Gray	Med.	Soft.
105	Sand	"	"	"
120				
130	Gravel & Boulders	"	Coarse	Med.
	Gravel & Sand	"	Med	"
145	Boulders			
150	Gravel & Sand	"	Coarse	"
	Gravel & Sand	"	Med	"
168				
175	Gray Schist	"	"	Hard
185	Sub. lignite	Black	Fine	Soft.
190	Schist	Gray	Med	Hard
195	2.39	Mn. .34		
200	Schist	"	"	"

Bottomed in Schist
Finished Dec. 5, 1916

1021

	Material	Color	Texture	Hardness
	Muck & Clay	Gray	Fine	Soft
48				
56	Hardpan	"	Med	Med
68	Gravel, Sand & Boulders	"	"	"
	Sand & Gravel	Green	Coarse	Soft
90				
94	Clay & Gravel Seams	Gray	Med	Med
98	Quicksand	"	Fine	Soft
102	Gravel & Boulders	-	Coarse	Hard
107	Boulders & Gravel	-	Med	-
	Hardpan & Gravel Seams	-	"	Med
132				
135	Sand	Yellow	Fine	Soft

	Iron	Phos.	Mn
145	4742	165	498
150	3969	102	674
155	2546	131	476
160	2549	102	830
165	2416	061	594
170	1551	081	248
175	2542	065	164
180	2527	053	362
185	1604	147	294
190	1701	053	242
195	1954	077	330
200	2375	127	144
205	2782	139	100
210	2497	123	128
215	1477	056	540
220	1750	054	1012
225	2185	147	984
230	2396	190	1240
235	2446	178	266
240	1750	127	1224
245	2185	185	836
250	1474	139	936
255	2230	486	516
260	1750	076	276
265	1847	121	116
270	1331	075	1274
275			1266
280			
285			512
290			1164
295			162

Bottomed in Schist
Finished 12-20-16

1022

	Material	Color	Texture	Hardness
	Muskeg	Gray	Fine	Soft
6	Sand	Yellow	"	Med
	Clay	Gray	"	-
26				
	Sand Boulders	-	"	"
60				
	Hardpan	-	Med	Hard
70				
78	Sand & Gravel	"	-	Med
	Boulders & Sand	"	-	Hard
90				
	Boulders & Hardpan	-	-	"
160				
	Clay	-	Fine	Soft
172				
180	Schist	"	Coarse	-
	Quartz	-	Med	Med
210				

Bottomed in Quartz
Finished 1/13/17

1023

	Material	Color	Texture	Hardness
	Sand Clay	Gray	Fine	Soft
30				
	Clay	"	"	"
35				
	Clay & Sandseams	"	"	Med
51				
	Boulders & Hardpan	"	Coarse	"
62				
64				
72	Sand	"	Med	Soft
	Sand & Gravel	Green	Med	Med
95				
101	Gravel & Boulders	"	Coarse	"
	Hardpan & Boulders	Gray	Med	Hard
118				
	Hardpan	"	"	Med
134				
141	Sand & Gravel	Yellow	"	Soft

	Iron	Phos.	Mn
145	27.07		1.80
150	31.10		.60
155	22.51		.58
160	35.90		.82
165	25.75		2.10
170			4.54
175			4.21
180			4.76
185			2.61
190			1.14
195			1.33
200			2.43
205			2.24
210			2.84
215		.127	17.38
220		.120	12.50
225		.144	12.45
230		.252	9.88
235	29.82	.164	8.13
240		.171	15.70
245		.107	8.92
250		.090	8.97
255		.068	3.60
260		.119	8.22
265			5.09
270			4.43
275			3.14
280			3.78
285		.088	10.55
290			1.38
295			.92
300			2.68
305		.094	11.64
310			8.60
315		.068	11.55
320		.100	11.97
325			4.44
330			2.89
335			2.22
340			2.44
345			3.44
350			3.26
355			5.83
360	13.91	.121	20.82

Bottomed in Chert
Finished 2/24/17

1024

	Material	Color	Texture	Hardness
5	Muskeg	Gray	Fine	Soft
	Clay	"	Med	"
61				
	Sand	"	"	Med
86				
	Gravel & Boulders	"	"	Hard
100				
	Boulders & Hardpan	"	"	"
140				
145	Sand & Gravel	"	"	Med
150				
154	Sand	"	"	"

	Iron	Phos	Mn
160	21.52	.112	7.54
165	19.45	.075	3.00
170	21.55	.101	9.08
175			3.30
180			1.74
185			2.70
190			1.88
195			1.37
200			1.88
205			2.28
210			.82
215			.50
220			.68
225			4.94
230			6.77
235			4.85
240			2.70
245			6.65
250			4.72
255		.080	14.05
260			8.22
265			7.03
270			8.77
275			3.70
280			1.34
285			1.85
290			2.26
295			2.53
300			5.06
305			3.98
310			2.84
315			2.19
320			2.76
325			3.89
330			2.68
335			3.82
340			3.25
345			2.11
350			1.95
355	18.60		1.23
360			2.44
365			3.01

Bottomed in Slate
Finished 2/23/17

1025

	Material	Color	Texture	Hardness			
4		Gray	Fine	Soft			
13	Sand	"	"	"			
	Clay	"	"	"			
62	Sand, Gravel & Boulders	"	Med	Hard			
91							
105	Gravel & Boulders	"	Coarse	"			
110	Hardpan		Med	Med			
	Hardpan & Boulders	"	-	"			
125							
130	Clay & Sand	"	Fine	Soft			
138	Sand		Med	"			
142	Clay & Sand		Mn	Med			
145					Phos.		6.37
150						.049	9.45
155					22.83	.072	5.42
160							3.98
165						.041	6.42
170							4.08
175							2.98
180							4.12
185							4.13
190							1.94
195							1.62
200							1.45
205							7.28
210							1.94
215						.074	2.35
220						.102	18.02
225						.072	4.60
230						.056	14.80
235						.080	17.61
240					22.46	.108	19.64
245						.083	11.09
250					18.98	.051	16.64
255						.052	23.09
260						.046	5.70
265						.065	6.52
270						.068	18.02
275						.196	1.70
280						.187	1.09
285					33.34	.154	9.20
290						.134	4.68
295						.101	13.15
300						.081	7.37
305						.092	9.13
310						.113	11.31
315						.100	14.60
320							7.72
325							4.91
330							6.87
335					19.13		2.79
340					18.53		1.05
345							5.92
350							2.02
355							3.08
360					16.22	.105	2.38
362					12.52	.107	2.93

Bottomed in Quartz
April 14 1917.

1026

	Material	Color	Texture	Hardness			
	Muskeg	Blue	Fine	Soft			
8	Sand & Clay	"	"	"			
20	" " "		"	"			
30	Clay	Gray	"	"			
50	Sand & Clay	"	"	"			
63	Sand, Gravel & Clay	"	"	"			
80	Sand		Med	"			
88							
94	Gravel & Boulders	"	"	Med			
102	Hardpan	"	"	Hard			
	Sand-Gravel Hardpan & Boulders	"	"	"			
117							
125	Hardpan	"	"	"			
	Gravel & Hardpan	"	"	Med			
134							
137	Gravel	"	Mn	"			
140							1.54
145							1.90
150							1.18
156							3.48
160							2.31
165							2.84
170							2.54
175							1.45
180							.46
185							.54
190							2.49
195							2.36
200							1.58
205							1.49
210					Iron	Phos	1.40
215							68
220					19.43	.081	13.92
225						.061	9.08
230							4.05
235							6.08
240							3.58
245							5.88
250							6.25
255							2.26
260							1.38
265							2.09
270							.82
275							2.21
280							.73
285							18
290							4.69
295							3.60
300							2.66
305							1.24
310							1.28
315					21.55		.92
320							1.74
325							1.55
330							1.74
335							1.00
340					24.19		.82
344							1.82
345							.88
350							.78
355							.96
360							.82
365							2.02
370							1.56
375					29.41	.200	1.93
376					24.88	.141	1.37

Bottomed in Schist
April 17 1917.

Sheet 16

1027

	Material	Color	Texture	Hardness
5	Muskeg	Black	Fine	Soft
	Clay	Gray	"	"
44				
59	Clay & Hardpan	"	Med.	Med.
73	Hardpan & Gravel	"	"	"
	Gravel & Boulders		"	"
100				
	Hardpan & Boulders			"
130				
142	Hardpan & Sand		"	"

	Iron	Phos	Mn.
145	21.95	102	.78
150	19.83	068	1.55
155	22.62	082	1.56
160	20.21	072	3.88
165	17.27	054	2.38
170	20.21	066	4.70
175	19.00	075	3.02
180	14.80	065	2.10
185	13.89	055	3.20
190	17.64	119	3.24
195	.8.25	.068	3.83
200	15.85	090	2.28
205			.39
210			6.59
215			2.28
220			4.75
225			4.43
230			1.77
235			6.35
240			1.18
245			.89
250	11.29		.92
255	11.30		.38
260			1.18
266			9.55
270			16.04
275			12.38
280			6.49
285			3.83

Finished May 3, 1917

1028

	Material	Color	Texture	Hardness
	Muskeg & Clay	Black	Fine	Soft
20				
	Clay & Sand	Gray	Med.	"
38				
	Boulders & Hardpan	"	"	Med
80				
89	Gravel & Sand	"	Coarse	"
	Boulders Hardpan	"	"	"
129				
137	Boulders Gravel & Hardpan	"	Med	"

	Iron	Phos	Mn
140	24.59		1.64
145	19.73		2.19
150	21.99		2.28
155			2.37
160			1.77
165			4.06
170			3.05
175			2.47
180			2.46
185			.45
190			.36
195			.40
200			.27
205			.81
210			4.39
215			9.05
220			10.03
225			7.68
230			6.31
235			6.12
240			1.96
245			6.75
250			1.09
255	18.02	.126	1.97
260	17.65	053	11.12
262	17.65	056	9.12

Finished May 10, 1917

1029

	Material	Color	Texture	Hardness
5	Muskeg	Black	Fine	Soft
	Clay	Gray	Fine	Soft
47				
	Clay + Gravel	"	Coarse	Medium
63				
	Sand	"	Medium	Soft
78				
	Gravel + Boulders	"	Coarse	Hard
87				
	Gravel, Sand, + Boulders	"	Medium	
96				
	Hardpan + Boulders	"	Medium	Hard
134				
	Clay, Gravel, + Boulders	"	Medium	Soft
143				
149			.45 Mn	
150	Fe	P	.40	
155			.36	
160			.90	
165			1.74	
170			1.91	
175			.90	
180	17.05	.064	2.47	
185	22.08	.109	1.74	
190	15.85	.085	3.07	
195	16.90	.082	9.98	
200	14.72	.066	1.88	
205	14.64	.075	2.01	
210	14.42	.079	.78	
215	12.69	.061	1.10	
220	12.77	.037	3.66	
225	9.61	.052	3.93	
230	9.96	.041	2.33	
235	16.82	.059	8.83	
240	12.24	.050	3.66	

Finished May 9, 1917

1030

	Material	Color	Texture	Hardness
5	Muskeg	Black		
10	Sand	Yellow		
	Clay	Gray		
45				
	Hardpan	"		
60				
	Gravel, Sand, + Boulders	"		
90				
96	Clay	Red		
	Hardpan + Boulders	Gray		
143	Fe	P	Mn	
150	29.14	.040	8.10	
155	29.97	.050	5.08	
160	20.13	.043	3.07	Fine Soft
165	20.81	.126	3.80	
170	25.83	.084	5.58	

Finished May 14, 1917

Sheet P

1031

	Material	Color	Texture	Hardness
	Sand + Clay	Gray	Fine	Soft
M 22	Gravel + boulders	"	"	Medium
	Hardpan, gravel, + boulders	"	Medium	"
40				
	Gravel + Sand	Mixed Gray	"	"
80				
	Gravel, Sand, + Hardpan		"	"
101				
	Hardpan, Gravel, + Boulders	Gray	"	"
121				
	Clay	Blue	Fine	"
160				
160	Sand + Gravel	Gray	Coarse + Fine	Medium + Soft
	Fe Mn			
165	27.49 .54			
170	24.27 .63		Fine	Soft
180				
	Schist + Quartz	Black + white	Coarse + Fine	Soft
200				
225				
230	22.11 .05			
	Schist	Variety	Coarse + Fine	Hard to soft
280				
285	20.45 .13			
290	31.16 .18			

Finished May 7 1911

1032

	Material	Color	Texture	Hardness
5	Muskeg			
	Clay	Gray	Fine	Soft
35				
	Clay	Red	Medium	Medium
57				
	Clay + Gravel	Gray	Coarse + Medium	"
84				
	Sand + Gravel	"	Coarse	Soft
120				
	Sand	"	Medium	Soft
136				
144	Gravel	"	Course	
	Hardpan	"	Medium	Hard
176				
180	Sand	"	Fine	
	Schist + Sub lignite	Variety	Coarse to Fine	Soft
195				
203	Quartz	Gray	Fine	Hard

Finished May 23, 1917.

Sheet P

1033

	Material	Color	Texture	Hardness
2	Muskeg			
12	Sand	Yellow		
31	Clay	Gray		
101	Sand, Gravel + Boulders	Brown + Gray		
121	Hardpan + Boulders	Gray		
139	Hardpan	"		
141	Hardpan, Gravel + Boulders	"	Coarse + Medium	Hard + Medium
146	Hardpan, Gravel + Sand	"	Medium + Fine	Medium
150	12.93 Fe .13 Mn			
155	29.27 1.99	Variety	" + "	Soft
160	27.71 1.87			
165	13.38 .95			
170	29.51 2.93	Red, Gray, Green	" + "	Medium + Soft
175	18.72 1.08	Gray + Brown	" + "	Soft
180	13.93 .45			
185	16.98 .18	" + Red	" + "	Medium + Soft
190	18.23 .09			
	Schist + Graphite	Variety	" + "	" + "
220				
225				
229				
232	17.63 .85	"	" + "	Hard + Medium

Finished May 31, 1917.

1034

	Material	Color	Texture	Hardness
	Clay + Sand	Gray	Fine	Soft
18	Clay	"	"	Medium + Soft
38	Water, Sand + Gravel	"	Medium + Fine	Soft
90	Gravel + Boulders	Mixed	Coarse + Medium	Hard
97	Hardpan	Gray	Medium	Medium
139	Hardpan, Sand + Gravel	"	Coarse To Fine	"
152	Fe Mn			
165	10.91 .09			
170				
	Schist	Variety	Medium + Fine	Medium + Soft
210				
215	7.91 .14			
225				
230				
235	5.38 .14			
240				
245	5.38 .14	"	" + "	Soft
250				
255	5.98 .14			
260				
265				
	Schist + Point R.	"	" + "	"
285				
290				
295	5.83 .85	"	" + "	"
300				

Finished June 18, 1917.

Sheet P

Aitkin County
Sec Ref 1072

Serial No. 43
Hole No. 2 (Cont'd.)
Collar Elevation: 1213.5'
Depth of Hole: 467'
Location: N.E.- S.W.

Date completed: 10/9/50
Drilled by: U.S.Bureau of Mines
Logged by: W. A. Green
Type of Drilling: Diamond drill-Core

Depth			Analyses								
			Core			Sludge			Adjusted Average		
From	To	Material	Iron	Mang.	SiO_2	Iron	Mang.	SiO_2	Iron	Mang.	SiO_2
313	318	Band of hard mn. ± 2' or more; dk. sl. at 318'	12.69	14.58	44.96	15.30	16.29	39.84	14.81	15.97	40.81
318	323	Red sl. and hard bands of mn. to 320'; softer red sl. 320 to 323'; rumpled bedding at 322'	9.40	1.73	65.64				9.40	1.73	65.64
323	327.5	Soft red sl.	11.03	5.00	59.74				11.03	5.00	59.74
327.5	333	Soft red sl. with ± 1' of hard mn.	22.54	10.64	40.33	14.98	5.91	57.17	18.74	7.01	53.25
Average									13.14	7.48	54.70
333	338	Soft red sl. and clay	8.60	.23	69.22				8.60	.23	69.22
338	343	Soft red sl.; bedding 30°; cleavage 55°; angle of cleavage & bedding ± 90°	6.81	.27	70.27				6.81	.27	70.27
343	347	Light red sl.; cleavage and bedding vertical	10.70	.86	65.60				10.70	.86	65.60
347	351.5	Red clay and sl.; bedding 27°; some wad	9.73	.19	68.21				9.73	.19	68.21
351.5	356.5	Red sl.; dk. gray sl. only slightly altered at 354'; bedding 35°; cleavage 20°	11.35	.15	67.60				11.35	.15	67.60
Average									9.38	.31	68.29
356.5	360.5	Soft dark gray slate	9.57	.55	69.07	11.07	2.21	65.21	10.33	1.40	67.10
360.5	366	Hard banded slate, dk. gray to light red; bedding 37°; cleavage 70°	7.30	.82	69.97				7.30	.82	69.97

(Continued)

Aitkin County
Sec Ref 1072

Serial No. 43
Hole No. 2 (Cont'd.)
Collar Elevation: 1213.5'
Depth of Hole: 467'
Location: N.E.- S.W.

Date completed: 10/9/50
Drilled by: U. S. Bureau of Mines
Logged by: W. A. Grosh
Type of Drilling: Diamond drill-Core

Depth From	Depth To	Material	Core Iron	Core Mang.	Core SiO_2	Sludge Iron	Sludge Mang.	Sludge SiO_2	Adjusted Average Iron	Adjusted Average Mang.	Adjusted Average SiO_2
366	371	Hard, dk.gray sl. with streaks of iron stain; cleavage 27°	8.11	1.68	64.31				8.11	1.68	64.31
Average									8.42	1.28	67.23
371	373	Hard, dk.gray slate;rumpled bedding	5.35	4.98	53.95				5.35	4.98	53.95
373	378	Hard,reddish iron stained slate	7.19	2.29	47.57				7.19	2.29	47.57
378	383	Hard,dk.gray slate;some iron stain;cleavage 30°	8.92	.04	69.45				8.92	.04	69.45
383	388	Bedding 15°; tends to cleave on bedding planes;dk.gray slate;2' light gray slate with thin iron seams	9.40	.63	68.53				9.40	.63	68.53
388	392	Dk.gray to moderately light gray sl.; some iron stain	7.95	1.97	64.55				7.95	1.97	64.55
392	397	Light gray slate	9.40	1.61	65.16	11.23	1.95	63.70	10.24	1.77	64.49
397	402	Light gray slate	12.16	2.13	63.04				12.16	2.13	63.04
402	407	Gray slate; some iron stain	9.57	2.49	65.03				9.57	2.49	65.03
407	412	Dk.gray slate; some iron stain; uneven fracture; rumpled bedding	8.11	1.53	67.17				8.11	1.53	67.17
412	417	Moderate gray slate;some iron stained bands	7.60	2.76	65.73				7.60	2.76	65.73
417	422	Gray slate; some iron stain; bedding 35°	7.27	1.06	69.08				7.27	1.06	69.08
422	427	Gray slate; some iron stain; bedding 35°	6.63	1.81	69.98				6.63	1.81	69.98
Average									8.53	1.49	64.58

(Continued)

Aitkin County
Sec Ref 1072

Serial No. 43
Hole No. 2 (Cont'd.)
Collar Elevation: 1213.5'
Depth of Hole: 467'
Location: N.E. - S.W.

Date completed: 10/9/50
Drilled by: U.S.Bureau of Mines
Logged by: W. A. Grosh
Type of Drilling: Diamond drill-Core

Depth From	Depth To	Material	Core Iron	Core Mang.	Core SiO_2	Sludge Iron	Sludge Mang.	Sludge SiO_2	Adjusted Average Iron	Adjusted Average Mang.	Adjusted Average SiO_2
427	432	Gray slate; ± 1' badly fractured iron stained slate	8.57	.20	69.64				8.57	.20	69.64
432	437	Gray slate & red iron-stained slate	7.92	.12	71.43				7.92	.12	71.43
437	442	Dk.gray slate; bedding 40°	7.03	.12	72.82				7.03	.12	72.82
442	447	Dk. to light gray slates; some iron stain	8.08	.12	68.76				8.08	.12	68.76
447	452	Medium gray slate; several iron stained bands	8.65	.12	68.97				8.65	.12	68.97
Average									8.05	.14	70.32
452	457	Light gray slate; iron stained bands	6.95	1.18	66.44				6.95	1.18	66.44
457	462	Light gray slate; iron stained bands	8.08	2.72	62.07				8.08	2.72	62.07
462	467	Light gray slate; iron stained bands	6.47	1.57	65.27				6.47	1.57	65.27
Average									7.17	1.82	64.59
144	467	Average for hole							10.88	1.82	64.03

Aitkin County
Sec Ref 1072

Serial No. 43
Hole No. 2 (Cont'd.)
Collar Elevation: 1213.5'
Depth of Hole: 467'
Location: N.E.- S.W.

Date completed: 10/9/50
Drilled by: U.S.Bureau of Mines
Logged by: W. A. Grosh
Type of Drilling: Diamond drill-Core

Depth From	Depth To	Material	Analyses Core Iron	Core Mang.	Core SiO_2	Sludge Iron	Sludge Mang.	Sludge SiO_2	Adjusted Average Iron	Adjusted Average Mang.	Adjusted Average SiO_2
269	274	Red to dk. red clay with highly fractured sl.; a few bands of harder slate	13.90	.66	60.17				13.90	.66	60.17
274	279	Black sl. 274' to 275'; red sl. 275' to 279'	7.60	.51	69.87				7.60	.51	69.87
279	284	Red sl.(soft) to 282'; soft gray sl. 282' to 284'	6.79	.28	71.30				6.79	.28	71.30
284	289	Soft red and light gray sl.	10.99	.78	64.73	11.72	.59	67.04	11.42	.67	66.09
289	294	Soft red sl.; mn. filling in fractures and/or bedding planes	9.94	.98	65.91	11.88	1.89	65.20	10.70	1.34	65.63
294	299	Soft red sl.	8.73	.36	66.56				8.73	.36	66.56
299	303.5	Soft light gray sl.; cleavage 25° at 299' to 300'; soft red sl. at 300' to 302'; hard black sl. at 302 to 303.5' (manganiferous?)	10.51	2.44	63.30				10.51	2.44	63.30
303.5	308	Soft red clay & sl. to 306'; Light red sl. to 306 to 308', soft bedding 35°; hard black sl. at 308'	8.81	.32	67.91				8.81	.32	67.91
308	313	Red sl.; cleavage 35°; mn.band at 309'; fractured pieces of mn. 312' to 313'	7.68	1.65	67.18				7.68	1.65	67.18
Average									9.57	.90	66.46

(Continued)

Aitkin County
Sec Ref 1072

Serial No. 42
Hole No. 1
Collar Elevation:
Depth of Hole: 332'
Location: Sec. 23, T43N - R27W

Date completed: 5/13/
Drilled by: U. S. Bure
Logged by: W. A. Grosh
Type of Drilling: Diamon

Depth From	Depth To	Material	Material and Analyses Iron	Mang.	Core
0	150	Sand gravel, boulders			
150	162	Green sand	Surface		
162	167	Soft iron formation			
167	172	Red mud			8.2
172	177	No core			
177	182	Red mud and lump of red slate	18.92	1.88	36.8
182	187				31.6
187	192		18.76	7.81	58.5
192	197		17.16	4.64	48.4
197	202		13.79	6.71	40.0
202	207	Mud and red slate and black slate			26.6
207	210		16.36	20.17	
210	213				
213	218				33.3
218	222				21.6
222	227		13.79	6.87	50.0
227	232		15.79	6.05	53.4
232	237				
237	242				50.0
242	247		12.67	2.27	20.0
247	250.5	No core			3.4
250.5	253	Red slatey			
253	257				21.3
257	260	Clayey light decomb. slate. Lump of black slate & manganese at 260', 263'4", 269', 296'7", 300', 300½' to 302'.	7.86	0.75	18.8
260	263				83.5
263	266		10.42	2.74	83.5
266	269.5				94.4
269.5	273		11.39	5.97	62.0
273	277				90.4
277	281		9.30	0.32	85.6
281	283.5		11.47	1.49	100.0
283.5	287				100.0
287	291.5		7.94	0.95	95.4
291.5	295				50.0
295	298		8.58	3.06	105.1
298	300.5				116.5
300.5	302		11.45	7.69	90.0
302	304				44.6
304	307	Similar but red.	8.90	7.50	100.0
307	309				86.0
309	312.5	Similar to above but red. Few small black mang. nodules. Large at 319'.	11.79	3.02	87.5
312.5	314				90.8
314	316		15.31	2.82	66.7
316	320				66.5
320	324.7		7.70	4.33	54.0
324.7	327.7		10.42	1.38	94.0
327	332		8.18	1.42	100.0
116	332		14.51	0.13	93.0
			11.79	3.60	

No unaltered formation.
Bands show dips 45°±

Aitkin County
Sec [illegible] 1072

Serial No. 43
Hole No. 2 (Cont'd.)
Collar Elevation: 1213.5'
Depth of Hole: 467'
Location: N.E.- S.W.

Date completed: 10/9/[illegible]
Drilled by: U.S. Bureau [illegible]
Logged by: W. A. Groth
Type of Drilling: Diamond Drill Core

Depth From	Depth To	Material	Core Analyses Iron	Core Mang.	Core SiO_2	Sludge Iron	Sludge Mang.	Sludge SiO_2	Adjusted Iron	Adjusted Mang.	Adjusted SiO_2
220	225	Soft red sl. & clay; bedding 45°; cleavage 31° about right angles to bedding	7.60	1.22	75.79				7.60	1.22	75.79
Average									9.93	1.07	72.08
225	230	Soft red sl.	7.11	4.73	78.90				7.11	4.73	78.90
230	235	Soft red sl.; a few bands of black slate	8.08	3.23	74.01				8.08	3.23	74.01
235	238.5	Black sl. with some pale red slate	13.42	7.60	59.43	10.74	4.71	65.71	11.72	5.76	63.41
Average									9.36	4.44	73.07
238.5	243.5	Soft pale red slate	8.08	1.45	68.32				8.08	1.45	68.32
243.5	248.5	Soft pale red sl. with bands of harder red slate	7.92	.39	68.19	6.51	.89	76.76	7.25	.63	72.28
248.5	254	Pale red sl.; cleavage 52° at 249.5'; vertical fracture plane at 249'	7.27	1.49	69.22	11.56	3.88	65.03	9.92	2.97	66.63
254	259	Soft red & light gray sl.; vertical banding at 255'; cleavage 15°	6.47	.47	71.71				6.47	.47	71.71
259	264	Soft red sl. to 261'; harder red sl. 261 to 264'; cleavage 28° to 33°; mn. filling along cleavage planes	5.17	.66	75.34				5.17	.66	75.34
264	269	Red sl. band of chert & mn.(?) at 269'; bedding 53°	13.42	.59	54.27	13.38	1.44	62.93	15.44	1.17	63.36
Average									8.74	1.25	69.55

(Continued)

Aitkin County
Sec Ref 1[illegible]

Serial No. 43
Hole No. 2
Collar Elevation: 1218.5'
Depth of Hole: 467'
Location: N.E. - S.E.

Date completed: 10/9/50
Drilled by: [illegible] of Mines
Logged by: [illegible] Brosn
Type of drilling: Diamond drill-Core
Assays by: [illegible]

Depth From	Depth To	Material	Core Iron	Core Mn.	Core SiO_2	Slabs Iron	Slabs Mn.	Slabs SiO_2	Adjusted Average Iron	Adjusted Average Mn.	Adjusted Average SiO_2
0	144	Surface									
144	150	material							[illegible]	.93	44.99
150	155	Dk.red clay	20.56	1.41	54.[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.97	40.44
155	160	No core				[illegible]	[illegible]	[illegible]	21.65	.85	43.92
160	164	Dk.red clay; a few soft pieces of mn. oxide	23.77	2.29	42.1[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.41	45.40
164	169	Dk.red clay; a few streaks of wad ore	19.73	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible].59	1.17	50.95
Average									[illegible].21	[illegible]	[illegible].52
169	174	Dk.red clay & broken soft slate	19.5[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	21.23	1.08	46.96
174	179	No core				[illegible]	[illegible]	[illegible]	[illegible]	2.96	42.10
179	184	Soft red sl. & clay; a few black mn.-bearing bands in sl.; bedding 45°	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	5.36	39.06
184	187	No core				[illegible]	[illegible]	[illegible]	15.83	3.41	50.27
187	191	Red clay & soft sl.; a few [illegible] of sl. with [illegible] bands	14.55	2.09	[illegible]				14.55	2.09	32.45
Average									[illegible]	2.96	47.55
191	196	Soft red [illegible] clay [illegible]							[illegible]	1.[illegible]1	[illegible]
196	201	Soft red sl. [illegible] or narrow band hard black sl.	[illegible]	[illegible]	[illegible]				[illegible]	[illegible]	70.33
201	206	Soft red sl.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]
206	211	Soft red sl.; bedding [illegible]	[illegible]	[illegible]	[illegible]					[illegible]	[illegible]
211	216	Soft red sl.	[illegible]	[illegible]	[illegible]					[illegible]	[illegible]
216	220	Soft red clay [illegible] rather hard band of black slate	[illegible]	[illegible]	[illegible]				[illegible]	[illegible]	[illegible]

Aitkin County
Sec Ref 1072

Serial No. 44
Hole No. 3
Collar Elevation: 1213.1'
Depth of Hole: 340'
Location: N.E.- S.W.

Date completed: 10/6/50
Drilled by: U.S.Bureau of Mines
Logged by: W. A. Grosh
Type of Drilling: Diamond drill-core

Depth From	Depth To	Material	Analyses: Core Iron	Core Mang.	Core SiO_2	Sludge Iron	Sludge Mang.	Sludge SiO_2	Adjusted Average Iron	Adjusted Average Mang.	Adjusted Average SiO_2
0	175	Surface									
175	181					13.05	2.25	62.54	13.05	2.25	62.54
181	185	Light grey clay & soft slate	12.13	3.90	57.80				12.13	3.90	57.80
185	188	Red, light red soft slate; bedding vertical	10.91	1.08	63.54				10.91	1.08	63.54
188	191	Soft red sl.; bedding vertical	10.99	2.32	63.84				10.99	2.32	63.84
191	194	Soft red sl.; bedding at 45°; rock breaks along bedding easily at 198'	12.21	2.60	56.90				12.21	2.60	56.90
Average									12.06	2.48	61.01
194	197	Light grey, closely folded slate; cleavage 15° (axis of folds) at 194 to 195'. Red sl.; bedding vertical; cleavage 70° at 196'	10.02	1.85	64.30				10.02	1.85	64.30
197	200	Red slate; bedding 43°	8.89	.59	65.78				8.89	.59	65.78
200	205	Soft red sl. & clay; bedding 15°	10.99	.95	62.22				10.99	.95	62.22
205	210	Light red sl.; bedding 50°; cleavage vertical (?)	11.24	1.28	62.77	14.34	1.77	61.95	13.67	1.66	62.13
Average									11.25	1.27	63.25
210	215	Light red, soft slate; some mang.	11.32	6.23	58.07	14.18	1.57	61.23	13.82	2.16	60.83
215	218.5	Dk. red clay; pale red slate; some mang.	12.94	3.31	61.50	14.50	1.68	59.92	13.85	2.36	60.58
218.5	221	Pale red slate; ± 3' mang.									
221	224	Red & pale red slate; cleavage 20°	11.16	1.69	63.04	11.28	1.93	66.25	11.25	1.97	65.41

(Continued)

Aitkin County
Sec Ref 1072

Serial No. 44
Hole No. 3 (Cont'd.)
Collar Elevation: 1213.1'
Depth of Hole: 340'
Location: N.E.- S.W.

Date completed: 10/6/50
Drilled by: U.S. Bureau of Mines
Logged by: A. A. Grosh
Type of Drilling: Diamond drilling

Depth From	Depth To	Material	Analyses: Core Iron	Core Mang.	Core SiO_2	Sludge Iron	Sludge Mang.	Sludge SiO_2	Adjusted Average Iron	Adjusted Average Mang.	Adjusted Average SiO_2
224	230	Some good mang. at 224'; pale red sl.; bedding 45°	14.15	3.27	55.70	14.34 11.03	4.18 1.18	62.01 64.03	13.20	[illegible]	[illegible]
230	233	Some mang. at 230'; red sl.; bedding 22°; cleavage 50°	14.96	3.84	58.16	10.87	1.33	65.34	12.34	2.23	62.76
Average									12.86	2.33	62.17
233	235	Soft, pale red slate									
235	237	No core	19.40	4.49	51.74	14.42	4.43	58.84	14.74	4.43	58.39
237	240	Pale red sl.; cleavage 52°	10.19	2.96	63.84				10.19	2.96	63.84
240	242.7	Pale, red sl.; little core; mostly mang.									
242.7	244	Clay, most of core good mang.; bedding 30°	16.49	9.00	46.80	12.24	3.43	64.01	13.59	5.20	58.55
244	247	Soft clay	15.20	5.14	55.87				15.20	5.14	55.87
247	250	Pale red sl.; some mang.									
250	253	Red slate; cleavage 47°; bedding ± horizontal; some mang.(?)	11.24	3.43	61.53	11.84	3.11	63.31	11.65	3.21	62.76
253	256	Little core; all mang.	11.48	20.23	42.10	9.70	2.64	74.42	9.87	4.29	71.38
Average									12.57	4.13	61.63
256	258	Soft red sl. or clay									
258	262	Dk. red clay; some mang.	13.10	3.51	62.35	12.08	1.77	65.60	12.34	2.21	64.78
262	265	Soft red sl.; bedding 10°; cleavage 10° in opposite directions									
265	268	No core	9.65	2.34	66.15	12.81	2.17	64.15	12.14	2.21	64.58
268	271	Red clay	13.42	1.71	63.15				13.42	1.71	63.15
Average									12.48	2.11	64.37

(Continued)

Serial No. 44
Hole No. 3 (Cont'd.)
Collar Elevation: 1213.1'
Depth of Hole: 340'
Location: N.E. - S.W.

Aitkin County
Sec Ref 1072

Date completed: 10/6/50
Drilled by: U.S. Bureau of Mines
Logged by: W. A. Brosh
Type of Drilling: Diamond Drill-Core

Depth From	Depth To	Material	Core Iron	Core Mang.	Core SiO_2	Sludge Iron	Sludge Mang.	Sludge SiO_2	Adjusted Average Iron	Adjusted Average Mang.	Adjusted Average SiO_2
271	274	Soft, pale red to red slate	12.29	.95	67.69	9.99	.63	67.56	10.87	.87	66.58
274	277	Red clay	10.51	.95	65.54						
277	280	Soft, pale red slate	9.54	.89	65.06	10.51	1.10	67.02	9.84	1.34	65.51
280	283	Red slate	9.54	1.77	62.98						
283	286	Soft, pale red slate	9.86	.79	67.33	12.13	1.32	67.00	12.10	.82	65.18
286	289	Red slate, rather hard; bedding 30°; cleavage 30°	12.61	.24	62.44						
Average									10.94	1.01	65.76
289	295	Red slate; 2 good bands of mang.	10.51	4.83	63.10	10.91	2.82	69.11	10.80	3.36	67.49
295	298	Red slate; 1 good band of mang.									
298	301	Red slate; some mang.	10.19	1.40	68.67	11.96	2.44	69.36	11.49	2.16	69.17
301	304	Red slate; bedding 70°									
304	307	Pale red sl.	10.35	.77	64.63	11.88	1.64	65.55	11.25	1.28	65.17
307	310	Red slate; 2 bands mang.; cleavage vertical (?)									
310	313	Pale red sl.; some mang.	12.29	7.46	54.32	13.42	2.44	62.91	12.99	4.35	59.65
313	316	Pale red sl.; some mang.									
316	319	Red slate; some mang.	13.10	5.48	58.23	64.88	3.55	61.20	14.39	4.09	60.37
319	322	Pale red sl.; some ochre; bedding 70°; cleavage 15°									
322	325	Red slate	10.02	1.30	65.33	11.16	3.51	60.02	10.35	2.53	65.71
325	328	Darker red sl.									
328	331	Some mang.; red slate; bedding 30°; cleavage vertical (?)	12.29	1.41	62.33	13.98	2.25	64.25	13.52	2.02	63.72

(Continued)

Serial No. 44
Hole No. 3 (Cont'd.)
Collar Elevation: 1213.1'
Depth of Hole: 340'
Location: N.E.- S.W.

Aitkin County
Sec Ref 1072

Date completed: 10/6/50
Drilled by: U.S.Bureau of Mines
Logged by: W. A. Grosh
Type of Drilling: Diamond drill-Core

Depth From	Depth To	Material	Analyses: Core Iron	Core Mang.	Core SiO_2	Sludge Iron	Sludge Mang.	Sludge SiO_2	Adjusted Average Iron	Adjusted Average Mang.	Adjusted Average SiO_2
331	333	Dk.red slate									
333	337	Lk.red slate; bedding 35°	6.30	4.45	62.97	14.71	3.80	60.00	12.39	3.98	60.82
337	340	Gray slate; some good mang.	11.48	1.50	62.24	14.63	3.64	60.30	13.81	3.08	60.80
340		Bottom of hole									
Average									12.28	2.98	63.82
175	340	Average for hole							12.15	2.53	63.17

Aitkin County
Sec Ref 1072

Serial No. 45
Hole No. 4
Collar Elevation: 1213.3'
Depth of Hole: 370'
Location: N.E.- S.W.

Date completed: 10/26/50
Drilled by: U. S. Bureau of Mines
Logged by: W. A. Grosh
Type of Drilling: Diamond drill-Core

Depth From	Depth To	Material	Analyses: Core Iron	Core Mang.	Core SiO_2	Sludge Iron	Sludge Mang.	Sludge SiO_2	Adjusted Average Iron	Adjusted Average Mang.	Adjusted Average SiO_2
0	143	Surface material									
143	148	Iron form.; drilled with chopping bit				8.94	.39	48.30	8.94	.39	48.30
148	151	Reddish brown clay & slate									
151	154	Reddish brown clay & slate; bedding 35°	13.23	.20	52.56	16.21	.32	52.20	14.46	.25	52.41
154	157	Soft red sl.	12.58	.24	53.66				12.58	.24	53.66
Average									12.09	.30	51.21
157	160	Soft red-gray slate	15.40	1.45	47.72				15.40	1.45	47.72
160	163	Red & dk.gray to black sl. (some mang.?) bedding 45°	22.90	2.21	36.24				22.90	2.21	36.24
163	166	Dk.red slate; bedding 40°	22.26	3.62	36.48				22.26	3.62	36.48
166	169	Soft red sl.									
169	172	Dk.red slate	15.65	3.11	43.90				15.65	3.11	43.90
172	175	Dk.red slate	17.34	2.09	46.18	16.05	2.29	50.82	16.98	2.15	47.27
Average									18.14	2.61	42.62
175	178	Red slate; bedding 50°; some mang,	15.16	1.89	45.92				15.16	1.89	45.92
178	182	Red slate; bedding 45° at 180; 35° at 181									
182	187	Red slate with dark streaks; mang.?; rolling bedding at 183; 180 at 184	14.03	1.77	45.40				14.03	1.77	45.40
187	192	Red slate; bedding vertical at 330	10.32	1.02	54.82				10.32	1.02	54.82
192	197	Red slate; bedding vertical at 199; wavey at 201,	15.81	1.65	45.76				15.81	1.65	45.76
197	202	approx. 70°	16.61	2.29	42.04				16.61	2.29	42.04
202	207	Red slate	8.22	.59	56.26				8.22	.59	56.26

(Continued)

Aitkin County
Sec Ref 1072

Serial No. 45
Hole No. 4 (Cont'd.)
Collar Elevation: 1213.3'
Depth of Hole: 370'
Location: N.E.- S.W.

Date completed: 10/26/50
Drilled by: U.S.Bureau of Mines
Logged by: W. A. Grosh
Type of Drilling: Diamond drill-Core

Depth From	Depth To	Material	Analyses: Core Iron	Core Mang.	Core SiO_2	Sludge Iron	Sludge Mang.	Sludge SiO_2	Adjusted Average Iron	Adjusted Average Mang.	Adjusted Average SiO_2
Average									13.33	1.54	48.15
207	212	Red slate	14.03	4.96	47.56	12.84	2.52	51.08	13.42	3.72	49.36
212	217	Red slate; some mang.; rolling bedding	12.34	2.76	49.84				12.34	2.76	49.84
217	222	Red slate; bedding 15°; some mang.	11.94	1.49	54.10				11.94	1.49	54.10
222	227	Red slate	12.42	2.44	50.40				12.42	2.44	50.40
227	232	Red slate; quartz & mang.	9.68	2.29	68.60	9.63	2.29	66.46	9.64	2.29	66.93
Average									11.95	2.54	54.13
232	235	Red slate; some mang.	22.26	7.96	31.48	14.12	2.84	55.70	18.51	5.60	42.65
235	238	Broken red slate with thin bands of mang. (?)	21.57	6.38	34.80	20.70	6.07	36.34	21.23	6.26	35.39
238	241	Dk.red slate; some mang.									
241	244	Red slate; some mang.	29.14	6.70	28.48				29.14	6.70	28.48
244	247	Light red sl. 4" good mang.									
247	250	Light red sl. some good mang.	22.14	6.78	37.68	24.88	6.15	35.42	23.61	6.44	36.47
Average									24.21	6.36	34.66
250	253	Pink to light gray slate	9.12	2.44	56.24				9.12	2.44	56.24
253	257	Pink to light gray slate; some mang.	9.93	2.30	55.00				9.93	2.80	55.00
257	261	Same, changing to red at 260	12.37	1.30	53.98	12.20	1.53	55.80	12.30	1.40	54.72
261	265	Light red sl. vertical bedding	7.33	1.06	59.34				7.33	1.06	59.34
265	270	Light red & gray slates; folded bedding; axis of folds 10°	12.05	.55	58.88				12.05	.55	58.88
Average									10.29	1.56	56.97

(Continued)

Aitkin County
Sec Ref 1072

Serial No. 45
Hole No. 4 (Cont'd.)
Collar Elevation: 1213.3'
Depth of Hole: 370'
Location: N.E.- S.W.

Date completed: 10/26/50
Drilled by: U. S. Bureau of Mines
Logged by: W. A. Grosh
Type of Drilling: Diamond drill-Core

Depth From	Depth To	Material	Analyses: Core Iron	Core Mang.	Core SiO_2	Sludge Iron	Sludge Mang.	Sludge SiO_2	Adjusted Average Iron	Adjusted Average Mang.	Adjusted Average SiO_2
270	275	Light red sl. some mang.	14.65	8.98	46.74				14.65	8.98	46.74
275	280	Red slate	11.56	2.13	52.48				11.56	2.13	52.48
280	285	Red slate	9.12	.90	54.40				9.12	.90	54.40
285	290	Red slate; some mang. in fissures	12.37	2.17	55.32				12.37	2.17	55.32
290	295	Red slate; some mang.				14.44	3.15	55.90	14.44	3.15	55.90
295	300	Gray slate; some good mang.	14.81	4.47	52.44	14.19	5.59	51.42	14.45	5.13	51.84
300	303	Gray slate; some good mang.									
303	306	Red slate; folded bedding; mang. between bedding planes	12.99	5.32	52.96	14.12	2.01	60.10	13.74	3.14	57.67
306	309	Red slate	9.91	.39	54.48				9.91	.39	54.48
Average									12.70	3.39	53.66
309	312	Red slate; some good mang.	15.51	10.44	39.90	11.55	4.89	55.92	13.98	8.30	46.08
312	315	Mostly broken-up mang.	13.80	21.12	33.50	15.25	9.65	50.10	14.95	12.00	46.70
315	318	Mostly broken-up mang.									
318	321	Red slate; bedding 30°	12.10	2.32	54.28	14.76	9.73	48.22	13.86	7.21	50.28
321	325	Light red slate	12.34	11.78	47.34				12.34	11.78	47.34
325	328	Red slate; cleavage vertical (?)	9.91	.12	52.50	10.11	1.26	63.14	9.91	.12	52.50
328	332	Red slate; 6" solid mang. & grey sl.	12.34	10.24	47.40	12.04	6.90	53.70	12.17	8.31	51.04
Average									12.94	8.04	49.18
332	335	Red slate									
335	338	Light red sl.; some good mang.	9.09	2.32	63.88				9.09	2.32	63.88
338	342	Red slate; good mang.	13.23	1.73	53.94				13.23	1.73	53.94

(Continued)

Aitkin County
Sec Ref 1072

Serial No. 45
Hole No. 4 (Cont'd.)
Collar Elevation: 1213 3'
Depth of Hole: 370'
Location: N.E.- S.W.

Date completed: 10/26/50
Drilled by: U. S. Bureau of Mines
Logged by: W. A. Grosh
Type of Drilling: Diamond drill-Core

Depth			Analyses								
			Core			Sludge			Adjusted Average		
From	To	Material	Iron	Mang.	SiO_2	Iron	Mang.	SiO_2	Iron	Mang.	SiO_2
342	345	Mostly broken mang.	11.21	11.17	49.12	9.23	4.11	60.50	9.67	5.98	57.97
345	348	Red slate; some mang.	10.39	9.81	45.44				10.39	9.81	45.44
348	352	Red slate; some mang; irregular bedding	9.42	5.20	51.40				9.42	5.20	51.40
352	356	Gray & red slate; some mang.	9.58	2.64	55.38				9.58	2.64	55.38
Average									10.15	4.15	55.68
356	360	Gray & black banded slate; vertical bedding at 35°	16.08	1.22	51.82				16.08	1.22	51.82
360	365	Gray slate banded with red slate; bedding 10°	17.21	.82	48.60				17.21	.82	48.60
365	370	Gray slate, wavy bedding at 65°	6.09	.24	62.00				6.09	.24	62.00
Average									12.92	.73	54.31
143	370	Average for hole							13.57	3.24	50.49

Aitkin County
Sec Ref 1072

Serial No. 46
Hole No. 5
Collar Elevation: 1214.0'
Depth of Hole: 349'
Location: N.E.- S.W.

Date completed: 11/4/50
Drilled by: U. S. Bureau of Mines
Logged by: W. A. Grosh
Type of Drilling: Diamond drill-Core

Depth From	Depth To	Material	Analyses: Core Iron	Core Mang.	Core SiO_2	Sludge Iron	Sludge Mang.	Sludge SiO_2	Adjusted Average Iron	Adjusted Average Mang.	Adjusted Average SiO_2
0	146										
146	150	Surface				13.92	4.73	49.28	13.92	4.73	49.28
150	155										
155	157	Carb.slate	15.14	5.83	29.34				15.14	5.83	29.34
157	160	Carb.slate	14.98	4.89	31.10	14.65	4.02	31.60	14.70	4.15	31.52
160	170	Carb.slate	18.56	7.21	24.50	12.54	1.33	36.28	13.26	2.04	34.87
170	175	Altered red slate & some carb. slate									
175	178	Red slate & light gray clay	11.74	6.30	30.54	10.58	3.66	33.80	10.88	4.33	32.97
178	181	Red to dk. red slate; bedding 35°	18.07	5.04	28.58				18.07	5.04	28.58
181	182	Gray slate									
182	185	Gray slate to 183, red slate 183 to 185	20.19	2.60	31.84	22.06	3.47	42.22	21.23	3.08	37.61
Average									14.44	3.55	33.40
185	189	Dk.red slate; bedding 18°; cleavage 70 to 90°(?)	16.20	.70	44.22	18.88	2.84	46.80	17.06	1.38	45.05
189	193	Dk.red slate; bedding 15°; cleavage vertical (?)	17.58	1.45	46.50				17.58	1.45	46.50
193	198	Dk.red slate; bedding 55°; cleavage vertical	18.72	1.81	44.04				18.72	1.81	44.04
198	203	Dk.red slate & clay	16.44	3.94	42.54	17.26	3.62	45.00	16.90	3.76	43.91
Average									17.59	2.18	44.77
203	206	Red slate; bedding 50°									
206	209	Red & light red slates; bedding 35°; cleavage vertical	13.70	.63	48.10				13.70	.63	48.10

(Continued)

Aitkin County
Sec Ref 1072

Serial No. 46
Hole No. 5 (Cont'd.)
Collar Elevation: 1214.0'
Depth of Hole: 348'
Location: N.E.- S.W.

Date completed: 11/4/50
Drilled by: U.S.Bureau of Mines
Logged by: W. A. Grosh
Type of Drilling: Diamond drill-Core

Depth From	Depth To	Material	Analyses: Core Iron	Core Mang.	Core SiO_2	Sludge Iron	Sludge Mang.	Sludge SiO_2	Adjusted Average Iron	Adjusted Average Mang.	Adjusted Average SiO_2
209	213	Red slate & clay; a little mang.	15.49	3.70	42.60				15.49	3.70	42.60
213	218	Red slate; bedding 30°; bedding vertical	14.19	3.35	44.62				14.19	3.35	44.62
218	221	Red slate; bedding 20°	9.87	4.49	49.30				9.87	4.49	49.30
221	226	Light red slate	13.86	2.36	44.88	19.37	3.31	48.40	15.54	2.65	45.95
Average									14.02	2.70	46.09
226	231	Red slate; bedding 25°	12.39	1.53	52.02				12.39	1.53	52.02
231	236	Red slate	8.72	.90	57.48				8.72	.90	57.48
236	241	Red to light red slate; bedding 25°	9.95	1.10	54.92				9.95	1.10	54.92
Average									10.35	1.18	54.81
241	246	Light red sl.; bedding 33°	5.71	.59	59.90	15.71	5.08	47.62	9.47	2.28	55.28
246	250	Light red sl.	9.13	3.15	54.44				9.13	3.15	54.44
250	253	Light red sl.; some chert	15.49	6.34	45.20	15.47	6.07	49.40	15.47	6.13	48.42
253	256	Red slate; cleavage 35°									
256	259	Red slate; some mang.	8.81	.55	58.66	15.95	1.65	53.00	12.34	1.09	55.86
259	262	Red & light red bands of slate; some mang.	10.44	5.36	56.16				10.44	5.36	56.16
262	265	Red slate; some mang.; rumpled bedding	11.50	2.68	53.32	15.55	3.47	37.80	13.37	3.04	46.15
265	268	Light red to red slates; little mang.	12.07	2.29	54.64				12.07	2.29	54.64

(Continued)

Aitkin County
Sec Ref 1072

Serial No. 46
Hole No. 5 (Cont'd.)
Collar Elevation: 1214.0'
Depth of Hole: 348'
Location: N.E.- S.W.

Date completed: 11/4/50
Drilled by: U. S. Bureau of Mines
Logged by: W. A. Grosh
Type of Drilling: Diamond drill-Core

Depth			Analyses								
			Core			Sludge			Adjusted Average		
From	To	Material	Iron	Mang.	SiO_2	Iron	Mang.	SiO_2	Iron	Mang.	SiO_2
268	273	Red slates; bedding 40°	7.34	.12	60.46	15.38	4.06	52.70	13.68	3.23	54.34
273	279	Red slates; some mang.; bedding 38°	8.97	3.74	54.42	15.63	5.83	51.56	13.14	5.05	52.63
279	282	Red & light red slates; some mang.									
282	285	Red slate	6.85	4.73	52.10	11.31	5.67	55.52	8.81	5.14	53.60
285	289	Red slate; some mang.	11.42	4.45	50.26	10.58	4.69	56.44	11.34	4.47	50.86
289	293	Red slate	10.44	2.29	57.00				18.92	2.29	57.00
293	298	Red slate	18.92	8.27	41.50	11.88	3.55	54.86	12.70	4.10	53.31
298	304	Red slate	15.49	6.38	42.06	12.78	2.56	56.46	14.85	5.47	45.49
304	308	Red to light red slate; bedding; cleavage at 90° to bedding(?)	10.19	4.02	51.06				10.19	4.02	51.06
Average									12.34	3.80	52.68
308	313	Red slates	10.52	1.18	51.70				10.52	1.18	51.70
313	317	Banded red & gray slates; bedding 30°	10.44	.98	53.70				10.44	.98	53.70
317	322	Red slate	6.36	.78	61.66	10.91	1.26	56.48	10.00	1.16	57.52
322	325	Banded red & gray slates; bedding 35°	8.81	1.10	53.90				8.81	1.10	53.90
325	330	Banded red & gray slates; bedding 35°	11.58	1.18	50.40				11.58	1.18	50.40
330	335	Light red slate	9.79	6.38	47.24	17.58	8.39	40.92	15.98	7.98	42.22
335	338	Gray slate with red & black bands	13.86	1.45	48.70				13.86	1.45	48.70
Average									11.67	2.30	51.06

(Continued)

Aitkin County
Sec Ref 1072

Serial No. 46
Hole No. 5 (Cont'd.)
Collar Elevation: 1214.0'
Depth of Hole: 348'
Location: N.E.- S.W.

Date completed: 11/4/50
Drilled by: U. S. Bureau of Mines
Logged by: W. A. Grosh
Type of Drilling: Diamond drill-Core

Depth			Analyses								
			Core			Sludge			Adjusted Average		
From	To	Material	Iron	Mang.	SiO_2	Iron	Mang.	SiO_2	Iron	Mang.	SiO_2
338	343	Gray slate with red & black bands; bedding 30°	9.62	.66	53.62				9.62	.66	53.62
343	348	Same, bedding 30°; cleavage 55°	10.44	.66	53.26				10.44	.66	53.26
Average									10.03	.66	53.44
155	348	Average for hole							12.98	2.88	47.96

Aitkin County
Sec Ref 1072

Serial No. 47
Hole No. 6
Collar Elevation: 1213.8'
Depth of Hole: 334'
Location; N.E. - S.W.

Date completed: 11/16/50
Drilled by: U. S. Bureau of Mines
Logged by: W. A. Grosh
Type of Drilling: Diamond drill-Core

Depth From	Depth To	Material	Analyses: Core Iron	Core Mang.	Core SiO_2	Sludge Iron	Sludge Mang.	Sludge SiO_2	Adjusted Average Iron	Adjusted Average Mang.	Adjusted Average SiO_2
0	138	Surface									
138	143	Iron form. (chopped sample)				15.93	2.92	53.48	15.93	2.92	53.48
143	148	Dk.red clay & soft slate; a few mang. nodules in clay	12.55	2.36	52.52	11.02	3.03	58.78	11.23	2.94	57.92
148	155	Soft dk.red clay & slate	14.80	2.13	48.84				14.80	2.13	48.84
155	160	Red slate; bedding 52 to 55°;cleavage 25° (?)	13.52	2.92	47.66				13.52	2.92	47.66
160	165	Dk.red slate	14.72	1.77	49.20				14.72	1.77	49.20
165	170	Dk.red slate	11.26	1.57	52.30				11.26	1.57	52.30
170	175	Dk.red slate	17.70	2.52	48.62				17.70	2.52	48.62
175	180	Dk.red slate & clay; bedding 60°	18.18	1.81	44.80	14.48	2.09	55.78	16.21	1.96	50.64
180	185	Dk.red slate; bands of chert 184 to 185	13.60	2.52	52.20				13.60	2.52	52.20
185	190	Dk.red slate; chert band at 185.5;chert slate contact 75°;bedding 65°;cleavage (?)50°,approx. right angles to bedding; bedding 60° at 188	16.89	2.68	50.22				16.89	2.68	50.22
Average									14.59	2.38	51.02
190	195	Dk.red slate chert (± 1') 194 to 195	18.18	17.81	30.00	12.55	8.98	55.20	14.07	11.36	48.40
195	200	Some red sl; considerable chert; some mang.	15.77	28.37	19.40	15.77	12.61	46.06	15.77	14.86	42.25
200	203	Some red sl.; considerable chert	12.71	7.88	60.90	7.56	3.55	67.64	8.44	4.29	66.47

(Continued)

Aitkin County
Sec Ref 1072

Serial No. 47
Hole No. 6 (Cont'd.)
Collar Elevation: 1213.8'
Depth of Hole: 334'
Location: N.E. - S.W.

Date completed: 11/16/50
Drilled by: U. S. Bureau of Mines
Logged by: W. A. Grosh
Type of Drilling: Diamond drill-Core

Depth From	Depth To	Material	Analyses: Core Iron	Core Mang.	Core SiO_2	Sludge Iron	Sludge Mang.	Sludge SiO_2	Adjusted Average Iron	Adjusted Average Mang.	Adjusted Average SiO_2
203	206	Red slate; some mang.; cleavage 20° (?)									
206	210	Red slate; some mang.	14.28	7.92	47.20				14.28	7.92	47.20
210	215	Red slate; some mang.	14.20	7.80	43.00	13.84	5.08	54.20	13.97	6.03	50.30
215	218	Red slate; bedding 25°	10.43	2.36	54.60				10.43	2.36	54.60
218	222	Red slate; some mang. & chert	18.46	13.67	34.80				18.46	13.67	34.80
222	227	Red slate; some mang. & chert	24.71	8.71	39.22	16.89	1.73	54.08	17.69	2.44	52.56
Average									14.54	8.20	48.66
227	230	Red clay.									
230	234	Red to dark red slate; bedding 36°	19.58	.96	47.06				19.58	.96	47.06
234	239	Red slate & clay; cleavage 25°(?)	17.81	2.48	53.60	20.11	1.93	51.80	19.16	2.16	52.55
239	242	Red slate; considerable chert; some mang.(?)	12.76	6.86	63.46	17.22	6.70	55.40	16.13	6.74	57.37
242	249	Red slate; some chert	11.31	3.03	58.00				11.31	3.03	58.00
Average									16.38	2.68	53.19
249	254	Red slate; irregular bedding	11.23	.76	53.34				11.23	.76	53.34
254	259	Red slate	18.37	.53	55.92	11.58	.39	58.88	13.41	.43	60.75
259	263	Red slate	11.39	.21	64.24				11.39	.21	64.24
263	268	Red slate; cleavage 43° (?)	12.32	.15	64.24				12.32	.15	64.24
Average									12.12	.40	60.45
268	273	Red slate & clay; a little gray slate	14.32	3.70	53.18				14.32	3.70	53.18

(Continued)

Aitkin County
Sec Ref 1072

Serial No. 47
Hole No. 6 (Cont'd.)
Collar Elevation: 1213.8'
Depth of Hole: 334'
Location: N.E. - S.W.

Date completed: 11/16/50
Drilled by: U.S.Bureau of Mines
Logged by: W. A. Grosh
Type of Drilling: Diamond drill-Core

Depth From	Depth To	Material	Analyses: Core Iron	Core Mang.	Core SiO_2	Sludge Iron	Sludge Mang.	Sludge SiO_2	Adjusted Average Iron	Adjusted Average Mang.	Adjusted Average SiO_2
273	278	Red & gray slates; bedding 50°; cleavage 30° approx.right angles to bedding	8.00	.96	58.84	11.26	1.77	58.40	9.95	1.45	58.58
278	281	Red & gray slates; irregular bedding;some red clay									
281	285	Red & gray slates;folded bedding;axis of folds 38°	9.36	2.17	60.64				9.36	2.17	60.64
285	290	Red & gray slates	6.88	5.99	53.36	8.53	5.16	55.92	8.30	5.28	55.56
290	294	Gray slate with iron bands;bedding 28° at 290	8.24	2.13	53.36				8.24	2.13	53.36
294	299	Dk.gray slate; bedding 65°; cleavage 22°; some soft mang. (?)	6.64	4.14	61.50				6.64	4.14	61.50
Average									9.50	3.11	57.48
299	304	Banded red & gray slates; bedding 35°	6.40	.24	61.84				6.40	.24	61.84
304	309	Dk.gray slate; cleavage(?)45°; few iron stains	7.36	.37	59.50				7.36	.37	59.50
309	314	Gray slate, some red slate; gray slate highly fractured at 309'; quartz filling in fractures; bedding 35° at 311;cleavage (?) 46°	7.37	.56	61.22				7.37	.56	61.22

(Continued)

Aitkin County
Sec Ref 1072

Serial No. 47
Hole No. 6 (Cont'd.)
Collar Elevation: 1213.8'
Depth of Hole: 334'
Location: N.E. - S.W.

Date completed: 11/16/50
Drilled by: U.S.Bureau of Mines
Logged by: W. A. Grosh
Type of Drilling: Diamond drill-Core

Depth From	Depth To	Material	Analyses: Core Iron	Core Mang.	Core SiO_2	Sludge Iron	Sludge Mang.	Sludge SiO_2	Adjusted Average Iron	Adjusted Average Mang.	Adjusted Average SiO_2
314	319	Gray slate; bedding 50°	8.00	.15	59.56				8.00	.15	59.56
319	324	Gray slate; some iron bands; bedding 45°; vertical band of iron 1/2 inch wise 320 to 322	10.08	.12	57.64				10.08	.12	57.64
324	329	Gray slate; some iron bands; bedding 15°	6.40	.09	62.10				6.40	.09	62.10
329	334	Gray slate; few iron bands; cleavage (?) 30°	7.36	.18	61.32				7.36	.18	61.32
334		Bottom of hole									
Average									7.57	.24	60.45
138	334	Average for hole							12.48	3.05	54.44

Aitkin County
Sec Ref 1072

Serial No. 48
Hole No. 7
Collar Elevation: 1214.3'
Depth of Hole: 392'
Location: N.E. - N.E.

Date completed: 12/2/50
Drilled by: U.S.Bureau of Mines
Logged by: W. A. Grosh
Type of Drilling: Diamond drill-Core

Depth			Analyses								
			Core			Sludge			Adjusted Average		
From	To	Material	Iron	Mang.	SiO_2	Iron	Mang.	SiO_2	Iron	Mang.	SiO_2
0	140	Surface									
140	145					12.36	1.41	55.02	12.36	1.41	55.02
145	151		11.84	.33		10.83	1.14	60.00	11.02	.98	
151	154	Red Slate	12.48	.45		13.80	1.53	54.40	13.30	1.12	
154	157	Red-Light Red Slate	13.92	.76					13.92	.76	
Average									12.33	1.09	
157	160	Red-Light Red Slate.Bedding 50°	25.28	2.36					25.28	2.36	
160	163	Red Slate. Bedding 55° Cleavage 35° Same direction	14.24	1.12		18.13	2.25	50.20	14.63	1.03	
163	166	Red Slate. Cleavage(?) 40°									
166	169	Lt.Red Slate Folded Bedding. Axis of folds 35°	10.80	1.52					10.80	1.52	
169	173	Lt.Red Slate	14.72	.15		17.92	.49	51.00	17.14	.41	
173	176	Pink Slate	4.72	.06		14.88	.51	56.28	12.91	.42	
176	179	Pink-Lt.Red Slate.Bedding 40°	11.76	.68		11.20	1.22	60.60	11.55	.88	
179	182	Lt.Red Slate Bedding 52°	13.36	1.04		13.44	2.13	58.70	13.40	1.53	
182	185	Lt.Red Slate Bedding 25° at 153. Bedding 70° at 154.Cleavage along bedding.	16.61	3.15					16.61	3.15	
185	190	Red Slate. Bedding 45° at 186. Bedding 25° at 188.Cleavage (?) 60°	9.60	.37					9.60	.37	
190	195	Red Slate	20.56	1.77					20.56	1.77	
195	200	Red Slate. Bedding 30°	8.56	.68		15.60	1.10	58.40	13.66	.98	
200	205	Red Slate.	13.76	.80		13.44	.76	62.20	13.51	.77	

(Continued)

Serial No. 48
Hole No. 7 (Cont'd.)
Collar Elevation:
Depth of Hole: 392'
Location: N.E. - N.E.

Aitkin County
Sec Ref 1072

Date completed: 12/2/50
Drilled by: U.S.Bureau of Mines
Logged by: W. A. Grosh
Type of Drilling: Diamond drill-Core

Depth From	Depth To	Material	Core Iron	Core Mang.	Core SiO_2	Sludge Iron	Sludge Mang.	Sludge SiO_2	Adjusted Average Iron	Adjusted Average Mang.	Adjusted Average SiO_2
205	208	Red slate. Bedding 20°. Cleavage 50°.	14.72	.84					14.72	.84	
Average									14.63	1.19	
208	213	Lt.red slate. Bedding 60°.	17.84	.30		13.60	5.79	55.90	14.60	4.50	
213	216	Red slate. Bedding 50°.	9.12	4.57					9.12	4.57	
216	221	Lt.red slate.	9.92	4.61		14.32	6.03	51.90	13.38	5.72	
221	224	Red slate.Some good mang.	9.52	5.16		14.24	4.89	53.30	13.01	4.96	
224	227	Red slate.	10.08	6.19		8.48	4.41	61.30	8.91	4.89	
227	230	Red slate. Bedding 48°.									
230	235	Red slate. Bedding 50°.	10.40	.53					10.40	.53	
235	240	Red slate. One small piece of mang. oxide.Bedding 45°.	10.48	.37		11.68	3.07	61.20	11.11	1.78	
240	245	Red slate.A little chert. Some mang. oxide,Bedding 35°.	14.64	3.31		20.96	4.53	51.28	19.18	4.19	
Average									16.64	3.47	
245	250	Red slate. Bedding 50°.	9.92	.06					9.92	.06	
250	255	Red slate. 6" of solid chert or qtz.	10.24	.80		16.96	.90	63.80	15.88	.88	
255	258	Red slate. Bedding 48°.	13.36	6.62					13.36	6.62	
258	263	Red slate. Bedding 48°.	21.28	1.30		17.12	1.41	59.26	18.38	1.38	
263	268	Red slate. Bedding 48°.	16.96	.18					16.96	.18	
268	273	Red slate. Bedding 53°. Cleavage 27°.	8.72	.12					8.72	.12	
Average									13.91	1.18	

(Continued)

Aitkin County
Sec Ref 1072

Serial No. 48
Hole No. 7 (Cont'd.)
Collar Elevation:
Depth of Hole: 392'
Location: N.E. - N.E.

Date completed: 12/2/50
Drilled by: U.S.Bureau of Mines
Logged by: W.A.Grosh
Type of Drilling:Diamond drill-Core

Depth From	Depth To	Material	Core Analyses Iron	Core Mang.	Core SiO_2	Sludge Iron	Sludge Mang.	Sludge SiO_2	Adjusted Average Iron	Adjusted Average Mang.	Adjusted Average SiO_2
273	278	Red slate. Some chert & mang. oxide. Bedding 50°. Cleavage(?) 25°.	12.00	2.92					12.00	2.92	
278	283	Red & gray slate.	15.76	.68		21.28	3.03	53.26	20.15	2.55	
283	285	Chert.	6.72	4.26					6.72	4.26	
285	290	Red slate. Some chert, little mang. oxide. Chert slate contact 10°. (almost vertical)	22.24	10.32		21.60	3.07	54.04	21.76	4.93	
290	295	Red slate.	23.52	12.61		22.40	3.66	48.22	22.48	4.30	
295	298	Red slate.	20.40	2.72		21.12	2.52	51.08	20.73	2.63	
298	301	Red slate. Bedding 48°.	15.68	2.13		18.72	2.29	58.64	17.08	2.20	
Average									18.17	3.45	
301	304	Red slate. Irregular bedding.	24.40	1.49					24.40	1.49	
304	307	Red slate. Bedding 50°. Cleavage 30°.	16.24	2.01					16.24	2.01	
307	312	Red slate. 6" chert at 312.	14.40	1.65		20.08	1.89	55.60	18.04	1.80	
312	317	Red & gray slates.	10.40	2.36		16.96	1.53	59.72	15.86	1.67	
317	320	Red slate. Some chert. Bedding 40°.	24.16	1.06					24.16	1.06	
320	325	Gray slate. Bedding 45°.	10.40	2.13		15.04	1.14	67.28	14.40	1.28	
Average									18.16	1.56	
325	330	Red slate. Bedding 65°.	22.40	.68					22.40	.68	
330	335	Red slate. Bedding 45°.	19.84	1.33		15.84	.70	64.28	17.80	1.01	
335	340	Red slate. Bedding 45°.	23.28	1.41					23.28	1.41	
340	345	Red slate. Bedding 20°.	19.92	.45		26.24	.45	47.46	24.78	.45	

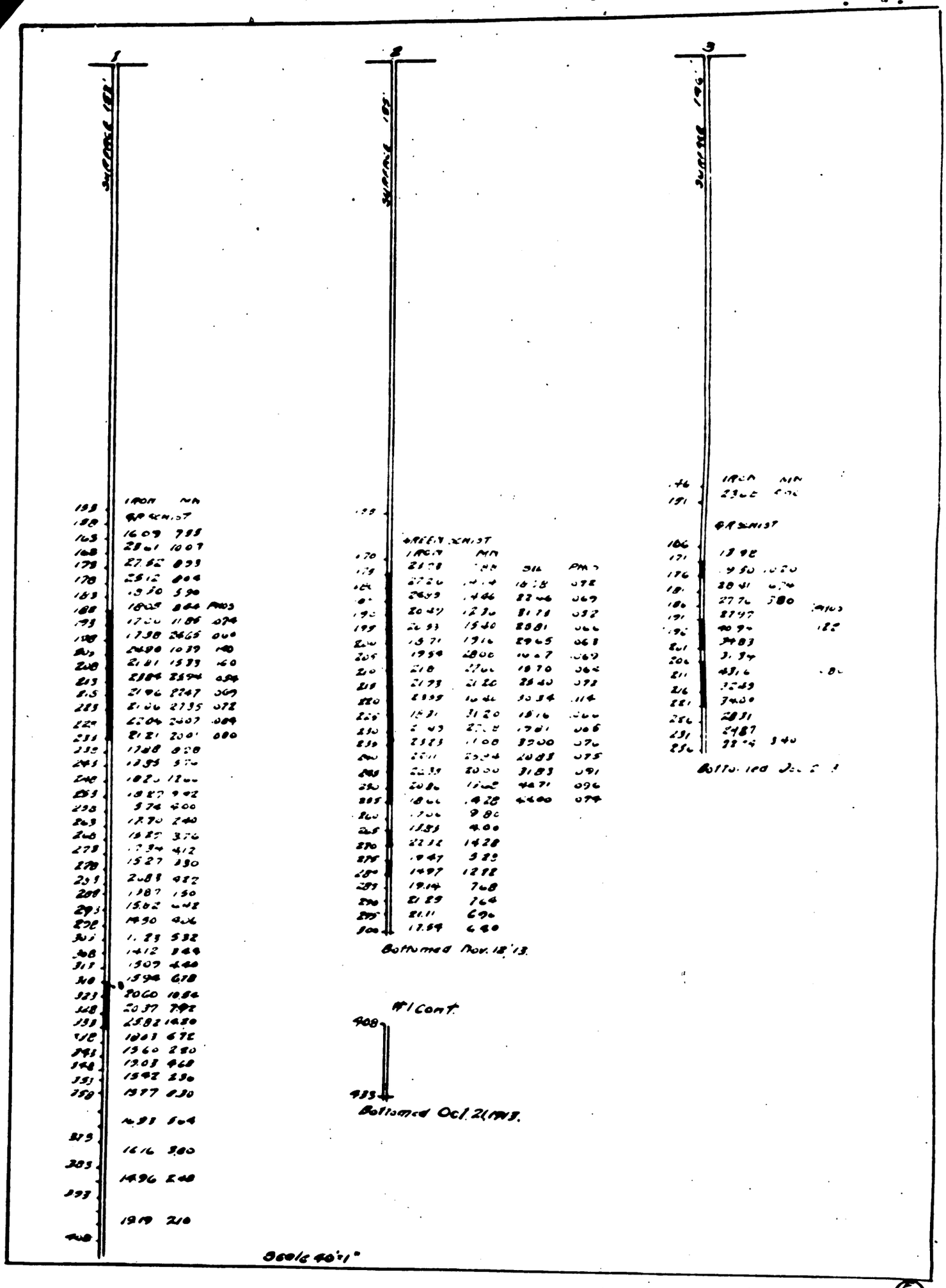
(Continued)

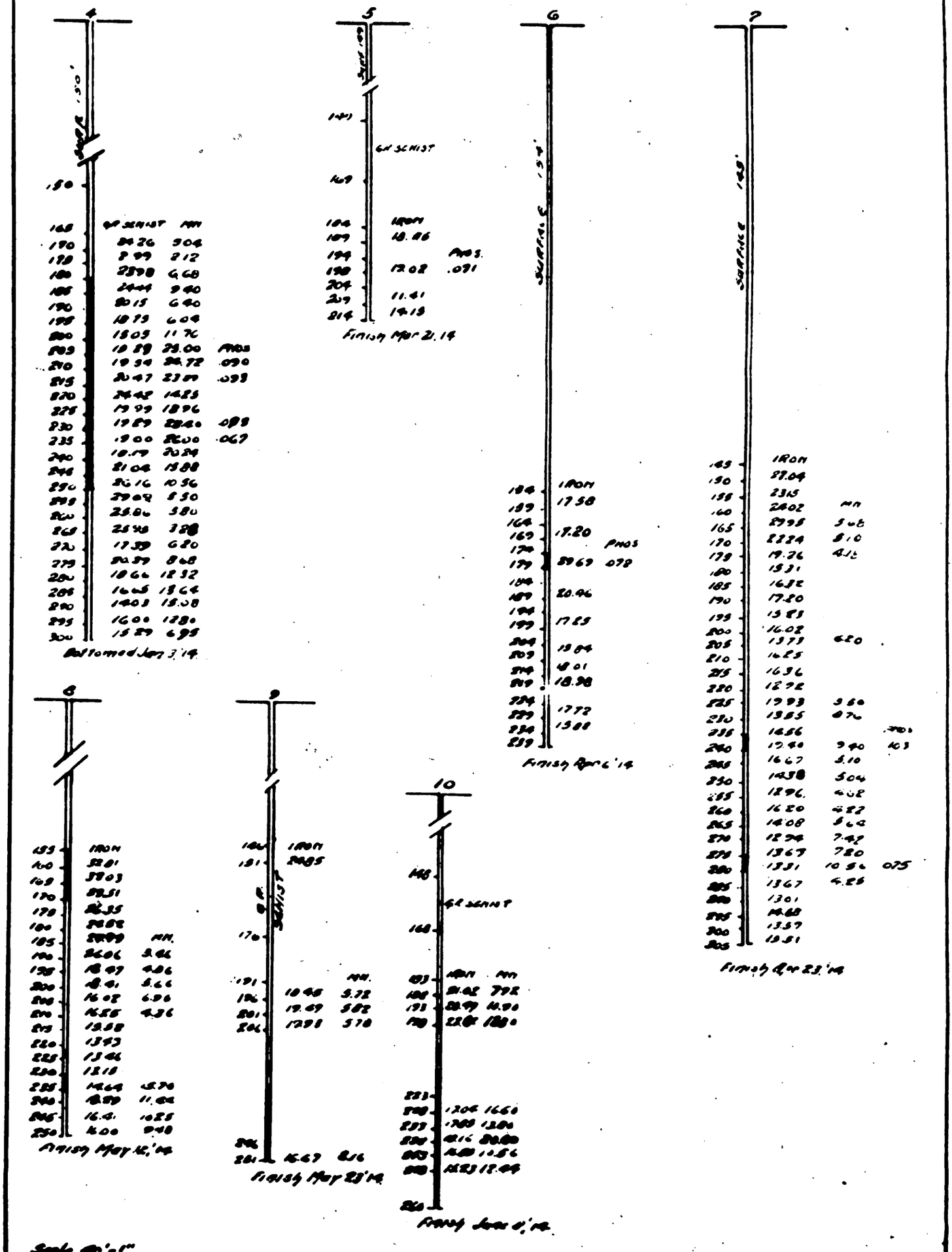
Aitkin County
Sec Ref 1072

Serial No. 48
Hole No. 7 (Cont'd.)
Collar Elevation:
Depth of Hole: 392'
Location: N.E. - N.E.

Date completed: 12/2/50
Drilled by: U.S.Bureau of Mines
Logged by: W. A. Grosh
Type of Drilling: Diamond drill-Core

Depth From	Depth To	Material	Analyses: Core Iron	Core Mang.	Core SiO_2	Sludge Iron	Sludge Mang.	Sludge SiO_2	Adjusted Average Iron	Adjusted Average Mang.	Adjusted Average SiO_2
345	350	Red slate. Some chert at 350. Bedding 45°.	19.20	1.06					19.20	1.06	
350	355	Red slate. Bedding 35°.	16.64	1.02		16.32	.30	60.86	16.46	.61	
355	358	Red slate. Bedding 35°.									
358	360	Gray slate. Some red slate chert. Bedding 35°.	14.72	1.18					14.72	1.18	
360	362	Red slate. Bedding 40°.	20.32	.45		16.00	.53	60.42	17.11	.51	
362	366	Red slate. Some gray slate at 365. Bedding red slate 35°. Gray slate 25°.	14.48	.60					14.48	.60	
Average											
366	367	Dk.red slate & chert.							19.15	.86	
367	372	Red slate. Bedding 45°.	14.64	1.37					14.64	1.37	
372	377	Red slate. Some chert.	22.24	.76		17.92	1.06	60.80	19.06	.98	
377	382	Red slate. Folded bedding. Axis of folds 5°.	25.92	2.13		18.72	1.61	57.02	21.14	1.78	
382	387	Red slate. Some chert. Gray slate at 385'. Bedding 50°.	18.56	1.45					18.56	1.45	
387	392	Red & gray slates. Some chert. Bedding 45°. Cleavage 20°.	16.48	1.30					16.48	1.30	
Average									17.85	1.38	
140	392	Average for hole							16.55	1.77	


1
SURFACE 182'
IRON MN
GRANISTOR
2
SURFACE 185'
GREEN SCHIST
IRON MN
SIL PMO
Bottomed Nov. 18 '13.
#1 Cont.
Bottomed Oct. 21, 1913.
3
SURFACE 196'
IRON MN
GRANISTOR
PMO
Bottomed Dec. 2 '


4
SURFACE 1.50'
GR SCHIST
MN
PHOS
Bottomed Jan 3 '14
5
SURFACE 1.50'
GR SCHIST
IRON
PHOS.
Finish Mar 21, 14
6
SURFACE 1.50'
IRON
PHOS
Finish Apr 6 '14
7
SURFACE 1.45'
IRON
MN
PHOS
Finish Apr 23 '14
8
IRON
MN.
Finish May 12, '14
9
SURFACE 1.50'
IRON
PHOS
GR SCHIST
MN.
Finish May 28 '14
10
GR SCHIST
IRON
MN
Finish June 4 '14
Scale 40' = 1"

Spect A-1

1001

	Mat	Color	Texture	Hardness			
7	Sand & Clay	Yellow	Fine	Soft			
20	Clay	Blue		"			
29	Hardpan	Gray		Medium			
40	Sand	Dark	Coarse				
61	"	"	Medium				
70	"	"	Coarse				
84	Sand & Gravel	"	"				
93	"	"	Fine				
99	Gravel & Boulders	"		Hard			
102	Gravel	Gray	Medium	Medium			
14	Sand & Gravel	"	"	Hard			
11	Clay, Sand & Boulders	"		Medium			
135	Hardpan Boulders	"	Coarse	Hard			
	Sand	Lt Yellow	Fine	Soft			
136	Sand, Gravel &						
135	Schist	Red	Medium	"			
160	20.00 Fe		5.45 Mn		SiO_2		
165	21.00		4.81				
170	30.30		3.85				
115	22.20		7.10				
180	25.20	.090	10.18	31.15			
185	23.70	.129	10.18	32.20			
190	22.10	.156	11.96	23.75			
195	16.80	.100	15.12	31.90			
200	19.33		5.93				
205	21.17		7.98				
210	16.48		7.70				
215	17.33		8.25				
220	22.48		8.75				
225	15.45	.102	10.45	46.15			
230	14.60		8.25				
235	19.50		6.32				
240	17.40		3.99				
245	16.80		3.49				
250	15.60		6.79				
255	13.40	.102	25.10	32.65			
260	30.80		7.98				
265	15.40		1.65				
270	16.30		2.20				
275	14.80		1.18				
280	17.20		9.20				
285	19.40	.108	10.06	46.05			
290	19.00		8.03				
295	16.80		5.50				
300	11.05		1.88				
305	16.76		7.00				
310	16.03		5.00				
315	18.12		9.50				
320	17.41	.092	18.00				
325	11.70	.069	4.06				
330	12.51	.078	9.30				
335	16.22	.041	14.00				
340	12.16	.079	8.52				
345	18.18		4.92				
350	13.43		3.16				
355	12.94		3.16				
360	10.35		17.00				
365	8.67		10.49				
370	15.90		6.32				
375	18.47		4.64				
380	28.01		.80				
385	18.33		1.48				
390	22.18		.64				
395	24.96		.58				
400	28.49		.86				

Cont

1002

	Mat	Color	Texture	Hardness			
7	Muskeg	Black		Soft			
24	Sand & Clay	Gray		"			
37	Sand, Gravel Boulders	"		Hard			
43	Sand, Gravel	"	Coarse	Medium			
68	Hardpan Sand, Gravel	"		"			
73	& Boulders	"	"	Hard			
100	Hardpan & Gravel	Brown	Medium	"			
123	Gravel Boulders	Gray	Coarse	"			
133	Hardpan Sand & Gravel	"	Medium	"			
142	Sand		Fine	Soft			
142	Sand & Gravel	Yellow	Medium				
190	27.70 Fe		3.68 Mn		SiO_2		
155	24.10		3.00				
160	22.00		1.23				
165	24.70		4.18				
170	21.40	.064	10.83	24.40			
175	23.80	.079	10.58	29.00			
180	26.30		5.53				
185	19.80		7.18				
190	24.10		4.81				
195	19.40		8.08				
200	19.90		6.10				
205	24.20		9.61				
210	15.20	.060	7.60	42.84			
215	16.71	.058	16.00	51.41			
220	18.71	.092	12.40	41.51			
225	18.46	.056	9.60	46.16			
230	19.63	.063	7.20	45.76			
235	18.54	.089	22.10	38.66			
240	19.54	.104	14.00				
245	17.87	.178	7.10				
250	18.35	.086	16.00				
255	18.24	.077	13.94				
260	20.16	.091	2.84				
265	16.05	.080	14.06				
270	14.43	.079	15.60				
275	19.45	.110	18.96				
280	16.87	.164	12.80				
285	17.71	.117	16.80				
290	15.91	.123	10.40				
295	17.53	.116	7.20				
300	20.61	.119	16.14				
305	19.27	.096	1.52				
310	18.41		2.56				
315	17.86		1.96				
320	18.81		9.48				
325	16.96		8.41				
330	13.87		1.76				
335	16.79		1.96				
340	20.08		5.19				
345	19.63		14.08				
350	17.42		10.50				
355	16.42		11.00				
360	16.81		6.04				
365	[illegible]		3.80				
370	18.10		1.98				
375	19.84		1.74				
380	14.48		1.38				
385	17.13		1.40				
390	15.19		1.84				
395	15.09		2.60				
400	15.17		2.78				
405	16.30		2.12				
410	14.70		6.48				

Cont.

Sheet 2

1001 cont

	Iron	Mn
400		
405	2.66	.42
410	2.315	.34
415	1.35	.26
420	1.64	.26
425	7.37	.30
430	12.43	.32
435	11.61	.34
440	8.06	.28
445	8.04	
450	6.02	
455	8.08	
460	6.46	
465	7.45	
470	7.25	
475	7.05	
476	Slate	

Finished May 17 1916.
111 Slate

1002 cont

	Iron	Mn
410		
415	16.32	5.08
420	13.43	1.20
425	13.17	2.32
430	9.14	2.88
435	Slate	

Finished May 17 1916
111 Slate

1003 Material Color Text Hardness

3	Quicksand	Gray	Fine	Soft
10	Sand	Brown	Med.	"
	Clay	Gray		Medium
32				
40	Sand	"	Med.	Soft
	"	"	Fine	"
72				
81	"	"	Coarse	"
	"	"	Fine	"
94				
101	Gravel		"	Med.
	"		Med	"
110	Gravel &		Coarse	Hard
116	Boulders			
	Hardpan	Gray	"	"
	Boulders			
134				
139	Hardpan	"	"	
145	Sand	Yellow	Fine	Soft

	Fe.	Mn
150		7.46
155		9.32
160		1.30
165		10.04
170		10.44
175		6.36
180		9.16
185		6.80
190		8.76
195		5.94
200		6.80
205		3.92
210		12.48
215		14.54
220		5.84
225	14.95	12.88
230		15.60
235		5.40
240		9.00
245		10.96
250		6.28
255		1.80
260		7.20
265		5.68
270		6.48
275	19.75	5.40
280	22.46	5.02
285	22.22	5.32
290	27.18	11.28
295	24.58	18.20
300	14.08	6.02

Cont.

1004 Mat Color Texture Hardness

0	Muddy Sand	Black Gray	Fine	Soft Soft
6	Boulders			
	Hardpan	"		Hard
26				
30	Hardpan	"		"
	Sand & Gravel	"		Soft
76	Sand	Red		"
82	Clay	"		"
91				
	Hardpan	Gray		Hard
	Boulders			
137				
142	Hardpan	"		"
144	Sand		Medium	Soft

	Fe.	Mn.	SiO_2	Graph.
150		.44		
155		.44		
160		.44		
165		.28		
170		.08		
175		.10		
180		.14		
185		.14		
190		.16		
195		.14		
200		.28		
205		.14		
210		.18		
215		.4		
220	6.18	.32		1.27
225	7.40			21.32
230	7.50			7.95
235	15.37	.20		
240		.16		
245		.14		
250		.20		
255		.18		
260		.16		
265		.10		
270		.14		
275		.14		
280			55.00	
285			62.10	
290			52.60	
295			62.64	
300			60.50	
305	7.60		70.75	
310			70.32	
315			74.64	
320			69.24	
325		.24	62.50	
330		.24	68.80	
335		.38		14.35
340		.28		21.85
345		.68		10.35
350		.40		34.25
355		.20		26.15
360		.34		10.40
365		.32		30.95
370		.64		33.65
375		.60		29.38
380		.20		30.80
385		.52		30.60
390		.44		24.7?
395		.56		29.83

Cont.

1003 cont

	Iron	Mn.
300	21.02	15.84
305	16.46	2.52
310	13.87	1.28
315	19.56	6.44
320	12.48	3.68
325	16.71	8.24
330	20.21	14.18
335	25.14	11.14
340	21.32	12.52
345	20.53	7.06
350	16.46	8.08
355	14.08	4.00
360	18.13	5.02
365	17.46	1.94
370	11.94	5.0
375	16.67	2.90
380	9.84	5.4
385		

Bottomed in Slate
Finished June 14 '16

1004 cont

	Mn.	Graph.
395	60	28.45
400	42	26.15
405	32	29.00
410	46	30.80
415	44	27.85
420	34	25.80
425	34	25.00
430	34	24.85
435	40	25.50
440	36	23.30
445		25.97
448		20.45
450		20.35
455		

Finished June 14 '16
Bottomed in Graphitic Slate & Quartz

1005

	Material	Color	Texture	Hardness
2	Muck	Black	Fine	Soft
10	Sand & Clay	Yellow	Medium	Medium
35	Clay	Gray	"	Hard
42	Gravel & Sand	"	Coarse	Med.
47	Clay & "	Red	Fine	Soft
62	Clay	Gray	Coarse	Hard
74	Sand	"	"	"
90	Clay	"	Medium	"
94	Clay & Rock	"	Coarse	"
105	Sand & Grit	"	Med	Soft
115	Gravel	"	Coarse	Med
122	Hardpan	Brown	"	Hard
135	Clay Boulders	Gray	Med	"
142	" & Sand	"	"	Med.
149				

	Fe	Phos	Mn	SiO_2	Graph
155			10.20		
160			11.50		
165			12.32		
170			6.96		
175			5.96		
180			3.80		
185			4.64		
190			7.78		
195			6.68		
200			7.44		
205			5.12		
210			5.94		
215			2.18		
220			6.94		
225			7.44		
230	19.26	.104	14.42		
235	18.45	.097	11.60		
240		.103	12.20		
245		.180	13.76		
250		.119	10.06		
255		.125	7.20		
260		.124	14.54		
265		.099	12.24		
270		.111	8.96		
275		.087	8.60		
280		.066	10.76		
285		.063	13.76		
290		.090	21.36		
295		.179	6.52		
300		.097	12.46		
305		.081	14.90		
310		.088	1.36		
315		.130	17.60		
320		.090	12.60		
325		.108	16.64		
330		.095	11.98		
335			3.84		
340			1.70		

Bottomed in Slate July 12. 1916

1006

	Material	Color	Texture	Hardness
7.	Muskeg	Black		
	Sand	Gray	Fine	Soft
18.	Clay	"	"	Medium
	"	"	"	Soft
30.				
40.	Sand & Gravel	"	Coarse	"
	Sand	"	Fine	"
65.				
	Clay	"	"	"
85.				
	Clay & Sand	"	"	"
100.				
	Hardpan	"	Med	Hard
115.				
	"	"	"	"
145.	Fe	Mn		
150.		92		
155.		88		
160.		108		
165.		112		
170.		96		
175.		156		
180.		54		
185.		68		
190.		64		
	Graphitic Slate & Quartz			
215.				
260.				
	Quartz & Schist			
285.				
	Graphitic Slate & Quartz.			
320.				
325.	1973	24		
330.	2327	28		
335.	2770	32		
340.	19.65	36		
345.				
350.	Graphitic Slate			
355.				

Bottomed in Graphitic Slate July 1 1916

1007

	Material	Color	Texture	Hardness
9.	Sand	Yellow	Fine	Soft
	Clay	Gray	"	Medium
30.				
40.	Hardpan	"	Coarse	Hard
	Sand	Yellow	Fine	Soft
55.				
64.	Sand & Boulders	Brown	"	"
68.	Hardpan	Gray	Coarse	Med
80.	Sand	Brown	Med	Soft
88.	Clay	Gray	Fine	"
93.	Sand	"	Med	"
110.	Hardpan	"	Coarse	Hard
120.	Clay & Boulders	"	"	"
	Hardpan & Boulders	"	"	"
146.				
152.	Hardpan	"	"	"
161.	Sand	"	Med	Soft
165.	Gray Schist		Fine	"
170.	Sandstone		"	Hard
	Schist	Med & Gray		
195.		Mn.		
200.		450		
205.		516		
	Red Schist			
230.				

Bottomed in Chert July 26 1916

1008

	Material	Color	Texture	Hardness
8.	Muskeg	Black	Fine	Soft
	Clay	Gray	"	"
23.				
	Clay • Boulders	"	Medium	Medium
45.				
55.	Hardpan	-	-	-
	Gravel • Sand.	Red	-	Soft
195.				
	Sand	Gray	Fine	Soft
150.				
153.	Clay	"	Med	Med
160.	Sand	-	Fine	Soft
165.		Mn 56		
	Gray Schist			
215.				
	Red Schist			
235.		44		
240.				
265.				
	Red Schist + Quartz			
300.	Iron			
305.	14.22	.92		
	Red Schist + Quartz & Ore			
330.	Iron	Mn		
335.	39.61	24		
	Schist & Ore			
360.				
370.	Graphitic Slate & Schist			

Finished Aug. 4. 1916
Bottomed in Graphitic Slate.

1009

	Material	Color	Texture	Hardness
0	Sand	Yellow	Medium	Soft.
15.	Clay	Coarse	"	Med
20.	"	"	"	Hard.
27.	Sand.	Yellow	"	Soft
35.	Hardpan	Gray	Coarse	Hard
40.	Sand • Boulders	-	-	Med.
	Gravel • Boulders	-	-	"
50.				
70.	Gravel • Boulders	"	"	Hard
75.	Hardpan	-	-	"
	Gravel	•	"	"
92.				
	Hardpan • Boulders	"	"	"
120.				
	Hardpan	-	"	"
139.				
	Clay	Blue	Med	"
157.				
162.	Sand	White	Fine	Soft.
165.		Mn 44		
	Graphitic Slate & Quartz	Black	"	"
205.				
210.	Graphitic Slate	•	•	"

Finished Aug 5 1916
Bottomed in Graphitic Slate.

1010

	Material	Color	Texture	Hardness
0	Muskeg	Black	Medium	Soft
10	Sand	Yellow	Fine	"
	Clay	Gray	Med.	Med.
30	Gravel & Boulders	"	"	"
	Sand & Boulders	"	"	"
65				
	Sand, Gravel Clay & Boulders	"	"	"
85				
	Gravel, Sand & Boulders	"	"	"
100				
	Sand	"	Fine	Soft
136				
	Gravel, Sand & Boulders	"	Med	Med
150				
	Boulders & Gravel	"	Coarse	Hard
165				
	Quartz & Schist	"		
	Iron	Mn		
190	1966	68		
195	1899	70		
200				
	Schist & Paintrock seams	"		
240				
	Red & Gray Schist, Mixed			
260				

Finished Aug 24 1916
Bottomed in Schist

1011

	Material	Color	Texture	Hardness
0	Sand & Clay	Yellow	Med	Med
18	Hardpan	Gray	Coarse	Hard
	Hardpan & Boulders	"	"	"
36	Clay & Gravel	"	"	"
48	Gravel & Boulders	"	"	"
60				
	" " "		"	Med
90				
	Clay, Gravel & Boulders	"	"	Hard
135				
	Clay & Sand	"	Med	Med
160		Iron		Mn
163	Dark Gray Schist	784		.22
	Gray & Brown Schist			
175				

Finished Aug. 24 1916
Bottomed in Schist.

1012

	Material	Color	Texture	Hardness
5	Sand	Yellow	Fine	Soft
	Hardpan	Gray	Coarse	Hard
35				
	Sand & Boulders	Brown	Med.	Med.
90				
95	Gravel & Boulders	Gray	Coarse	"
	Hardpan & Boulders	"	"	"
115				
120	Clay & Boulders	"	"	"
	Hardpan & Boulders	"	"	"
175				
180	Sand & Gravel	"	"	"
	Hardpan & Boulders	"	"	"
215				
	Gravel Sand & Boulders	"	"	"
235	Schist & Quartz	"	"	"
245				
250		Green	"	Hard

Bottomed in Schist & Quartz
Finished Sept 21 16

1014

	Material	Color	Texture	Hardness
1	Muskeg	Black	Med	Soft
	Sand	Yellow	"	Med.
15				
	Hardpan	Gray	Coarse	Hard
35				
40	Sand	"	Med	Med.
	Hardpan & Boulders	"	Coarse	Hard
70				
80	Gravel	"	Med	Med.
	Hardpan	"	Coarse	Hard.
120				
	Hardpan & Boulders	Gray	Med	Hard.
150				
	Sand	"	Fine	Soft.
165				
170	Sand & Gravel	"	Med	"
175	Block Clay	Block	"	"
180	Schist	Gray	"	Med.
	Quartz	White	Coarse	"
200				
210	Schist	Geen	"	"

Bottomed in Green Schist.
Finished Oct 9 1916

1013 Δ Hole 60° NW

	Material	Color	Texture	Hardness
	Muskeg	Black		
20	Clay	Gray	Med	Soft
25	Quicksand	"	Med	Med
35	Clay-Sand	"	"	"
45	Clay-Gravel	"	"	"
52	Boulder-Gravel	"	"	"
12	Gravel-Clay	"	Coarse	"
	Boulders			
15	Boulders?			
97	Gravel-Sand	"	"	"
98	Sand	"	"	"
103	Sand	Red	"	"
115	Sand-Gravel	Gray	Med	"
128	Clay-Gravel	Blue	Coarse	Soft
199	Gravel-Sand	Gray	"	Med
153	Hardpan	"	Med	"
	Boulders			
170	Hardpan	"	"	"
	Solid Seams			
180	Clay-Sand	Green	Fine	Hard
	Seams			
185	Sub-Lignite	Black	Med.	"
	Schist	Gray-Brown	"	Med
245				Soft
	Green & Brown Schist			Med

260	Iron	Mn
265	1008	326
270	2045	360
275	1503	340
280	1138	340
285	1642	346
290	1452	376
295	1700	412
300	1100	340
	1400	346

Bottomed in Schist & Point Rock
Finished Oct 7. 1916.

Sheet 10 (P 150)

1015 Commenced Oct. 9. 1916

	Material	Color	Texture	Hardness
2.	Muskeg	Black	Fine	Soft
	Clay-Sand	Gray	"	Med
22.				
	Boulder-Sand	Yellow	Med.	Soft
70.				
75.	Sand	"	Fine	Med
	Gravel-Sand	Green	Coarse	"
91.				
96.	Gravel	Gray	"	"
100.	Boulders-Clay	"	Med.	"
	Hardpan	"	"	Hard
112.				
115.	Gravel-Boulders	"	Coarse	Med
	Hardpan	"	Med.	Hard
130.				
	Sand-Gravel with Clay Seams	Yellow	"	Med

	Iron	Po4	Mn
143.			
145.			
150.	2819	.071	360
155.	2104	.085	1350
160.	1924	.121	1.94
165.	1667	.020	874
170.	1444	.045	1210
175.	1916	.034	678
180.	1665	.30	848
185.	2035	.038	926
190.	1986	.045	842
195.	2282	.054	840
200.	1905	.084	480
205.	1632	.064	230
210.	1746	.071	[illegible]
215.	1165	.083	[illegible]
220.	1088	.089	754
225.	1906	.118	796
230.	1201	.069	826
235.	1590	.132	1390
240.	1363	.128	1092
245.	1278	.049	1072
250.	1329	.069	1880
255.	1387	.101	12.00
260.	1432	.069	1318
265.	1424	.078	2070
270.	1588	.120	792
275.		.118	674
280.		.081	658
285.		.091	850
290.		.100	252
295.		.169	1.90
300.		.150	580
305.		.135	556
310.		.110	254
315.		.146	.370
320.		.101	566
325.		.094	.58
330.		109	.44
335.		096	.38
340.		.127	.36
345.		.079	.26
350.		.078	1.66
355.			1.60
360.			1.26
365.			1.92
370.			3.28
375.			1.40
380.			4.00
385.			5.80
390.			2.64
395.			2.52
401.			.82

Bottomed in Slate
Finished Nov. 2 1916

1016 Commenced Oct. 10. 1916

	Material	Color	Texture	Hardness
3.	Sand	Yellow	Fine	Soft
	Clay	Gray	Med.	"
50.				
	Gravel-Boulders	"	"	"
90.				
	Hardpan	"	Med.	Med.
102.				
	Hardpan-Boulders	"	Coarse	"
144.				
145.	Hardpan	"	Med.	"
155.				
	Sand	"	Fine	Soft
165.				
170.	Clay-Sublignite	Black	Med.	Med
	Schist	Gray	Fine	Soft
185.				
	Quartz	"	Coarse	"
225.				

Bottomed in gray Quartz.
Finished Oct. 19 1916

1017 Commenced Oct 20. 1916

	Material	Color	Texture	Hardness
5	Muskeg	Black	Fine	Soft
	Clay	Gray	"	"
20				
30	Sand	Yellow	Coarse	"
40	Clay	Red	Med	Med
50	Hardpan + Boulders	Gray	-	
60	Sand	"	Coarse	Soft
70	Gravel	-	"	"
80	Sand	"	"	"
	Sand + Clay Seams	"	Med	"
130				
140	Gravel + Boulders	-	Coarse	Med
146	Clay	"	Med	"
150	Boulders	"	Coarse	Hard
160	Sand	Gray	Fine	Soft
170	Sub-lignite	Black	Med	"
	Talc	Gray	Fine	"
190				
	Quartz	"	-	Hard
210	Quartz + Bunt-rock	Red	Med	Med.
215		Mn.	1.24	
220			.92	
225			1.12	
230			1.24	
235	15.05	.075	1.56	
240	13.71	.099	.76	
245	Bunt-rock + Schist	Red	Med	Hard
252	Slate + Schist	Black	Fine	"
260	Slate	"	Med	"

Bottomed in Slate
Finished Nov 16. 1916.

1018

	Material	Color	Texture	Hardness
15	Clay-Sand	Gray	Med.	Med
	Hardpan	"	-	Hard
32				
38	Sand	Red	Fine	Soft
	Sand Gravel + Boulders	Gray	Coarse	Med.
69				
	Sand	-	Fine	Med
85	Gravel + Boulders	-	Coarse	"
93				
	Hardpan	"	Med.	Hard
132	Gravel	"	"	Med.
137	Sand	"	Fine	Soft
143	25.84			
145			3.24	
150			2.14	
155			.84	
160			.58	
165			6.34	
170			3.66	
175			2.24	
180			1.32	
185			4.30	
190			3.42	
195	16.16		6.36	
200			3.40	
205			3.34	
210			1.52	
215			2.08	
220			1.00	
225			.62	
230			.24	
235	16.00		.22	
	Ore + Schist			
260				
268	Chert + Slate			

Bottomed in Chert + Slate
Finished Nov. 28. 1916

1019

	Material	Color	Texture	Hardness
1	Muskeg	Black	Med	Soft.
5	Sand	Gray	Fine	"
	Clay	"	Med	"
30	Sand	"	Fine	"
39	Boulders	"	Coarse	Hard.
48	Clay	Red	Med.	Med.
	Gravel & Boulders	Gray	Coarse	Hard
80				
87	Sand	"	Fine	Soft.
95	Hardpan	"	Med	Med.
	Hardpan Boulders	"	Med.	Hard
120				
	Hardpan & Sand	"	"	"
152	Sand &			
160	Boulders	"	"	"
165	Clay	"	"	Med
	Schist	"	"	"
185				
	Schist & Quartz	"	"	"
200				

Bottomed in Schist & Quartz
Finished Nov. 28, 1916

1020

	Material	Color	Texture	Hardness
8	Muskeg	Black	Med.	Soft.
	Clay	Red & Gray	"	"
57				
60	Hardpan	Gray	"	Hard
	Gravel-Boulders	"	Coarse	"
70	Clay & Sand	"	Med	Med.
80			—	
	Sand. Clay & Boulders	Gray	Med.	Soft.
105	Sand	"	"	"
120				
130	Gravel & Boulders	"	Coarse	Med.
	Gravel & Sand	"	Med	"
145	Boulders			
156	Gravel & Sand	"	Coarse	"
	Gravel & Sand	"	Med	"
168				
175	Gray Schist	"	"	Hard
185	Sub-lignite	Black	Fine	Soft.
190	Schist	Gray	Med	Hard
195	2.39 Mn. 34			
200	Schist	"	"	"

Bottomed in Schist
Finished Dec. 5, 1916

1021

	Material	Color	Texture	Hardness
	Muck & Clay	Gray	Fine	Soft
48				
56	Hardpan	"	Med	Med
68	Gravel, Sand & Boulders	"	"	"
	Sand & Gravel	Green	Coarse	Soft
90				
94	Clay & Gravel Seams	Gray	Med	Med
98	Quicksand	"	Fine	Soft
102	Gravel & Boulders	"	Coarse	Hard
107	Boulders & Gravel	"	Med	"
	Hardpan & Gravel Seams	"	"	Med
132				
136	Sand	Yellow	Fine	Soft

	Iron	Phos	Mn
145	4742	165	498
150	3969	102	674
155	2548	131	476
160	2349	102	830
166	2416	061	594
170	1551	081	248
175	2542	065	164
180	2527	053	362
185	1604	147	254
190	1701	058	242
195	1954	077	530
200	2375	127	144
205	2782	199	100
210	2497	183	128
215	1477	056	540
220	1750	054	1012
225	2185	147	984
230	2396	190	1240
235	2446	178	266
240	1750	127	1224
245	2185	185	836
250	1474	159	956
255	2230	486	516
260	1750	076	276
265	1847	121	116
270	1931	075	1274
275			1266
280			
285			512
290			1164
295			162

Bottomed in Schist
Finished 12-20-16

1022

	Material	Color	Texture	Hardness
	Muck & Sand	Gray & Yellow	Fine	Soft & Med
8				
	Clay	Gray	"	"
26				
	Sand Boulders	"	"	"
60				
	Hardpan	"	Med	Hard
70				
78	Sand & Gravel	"	"	Med
	Boulders & Sand	"	"	Hard
90				
	Boulders & Hardpan	"	"	"
160				
	Clay	"	Fine	Soft
172				
184	Schist	"	Coarse	"
	Quartz	"	Med	Med
210				

Bottomed in Quartz
Finished 1/13/17

1023

	Material	Color	Texture	Hardness
	Sand Clay	Gray	Fine	Soft
20				
	Clay	"	"	"
35				
	Clay & Sandseams	"	"	Med
51				
	Boulders & Hardpan	"	Coarse	"
62				
64				
72	Sand	"	Med	Soft
	Sand & Gravel	Green	Med	Med
95				
101	Gravel & Boulders	"	Coarse	"
	Hardpan & Boulders	Gray	Med	Hard
118				
	Hardpan	"	"	Med
134				
141	Sand & Gravel	Yellow	"	Soft

	Iron	Phos.	Mn
145	27.07		1.80
150	31.20		.60
155	22.51		.58
160	35.30		.82
165	25.75		2.10
170			4.54
175			4.21
180			4.76
185			2.61
190			1.14
195			1.33
200			2.43
205			2.24
210			2.84
215		.127	17.38
220		.120	12.50
225		.144	12.45
230		.252	9.88
235	29.82	.164	8.13
240		.171	15.70
245		.107	8.92
250		.090	8.97
255		.068	3.60
260		.119	8.22
265			5.09
270			4.43
275			3.14
280			3.78
285		.088	10.55
290			1.38
295			.92
300			2.68
305		.094	11.64
310			8.60
315		.068	11.55
320		.100	11.97
325			4.44
330			2.89
335			2.22
340			2.44
345			3.44
350			3.26
355			5.83
358	13.91	.121	20.82

Bottomed in Chert
Finished 2/24/17

1024

	Material	Color	Texture	Hardness
5	Muskeg	Gray	Fine	Soft
	Clay	"	Med	"
61				
	Sand	"	"	Med
86				
	Gravel & Boulders	"	"	Hard
100				
	Boulders & Hardpan	"	"	"
140				
145	Sand & Gravel	"	"	Med
150				
154	Sand			"

	Iron	Phos	Mn
160	21.52	.112	7.54
165	19.45	.075	3.00
170	21.55	.101	9.08
175			3.30
180			1.74
185			2.70
190			1.88
195			1.37
200			1.88
205			2.28
210			.82
215			.50
220			.68
225			4.94
230			6.77
235			4.85
240			2.70
245			6.65
250			4.72
255		.080	14.05
260			8.22
265			7.03
270			8.77
275			3.70
280			1.34
285			1.85
290			2.26
295			2.53
300			5.06
305			3.98
310			2.84
315			2.19
320			2.76
325			3.89
330			2.68
335			3.82
340			3.75
345			2.11
350			1.95
355	18.60		1.23
360			2.44
365			3.01

Bottomed in Slate
Finished 2/23/17

1025

	Material	Color	Texture	Hardness			
4		Gray	Fine	Soft			
13	Sand	"	"	"			
	Clay	"	"	"			
62							
	Sand, Gravel & Boulders	"	Med	Hard			
91							
105	Gravel & Boulders	"	Coarse	"			
110	Hardpan		Med	Med			
	Hardpan & Boulders	"	"	"			
125							
130	Clay & Sand	"	Fine	Soft			
138	Sand		Med	"			
142	Clay & Sand Mos.	"	Mn.	"	Med		
145		0.85	6.37				
150		.049	9.45				
155	22.83	.072	5.42				
160			3.98				
165		.041	6.42				
170			4.08				
175			2.98				
180			4.12				
185			4.13				
190			1.94				
195			1.62				
200			1.45				
205			7.28				
210			1.94				
215		.074	2.35				
220		.102	18.02				
225		.072	4.60				
230		.056	14.80				
235		.080	17.61				
240	22.46	.108	19.64				
245		.083	11.09				
250	18.98	.051	16.64				
255		.052	23.09				
260		.046	5.70				
265		.065	6.52				
270		.068	18.02				
275		.196	1.70				
280		.187	1.09				
285	33.34	.154	9.20				
290		.134	4.68				
295		.101	13.15				
300		.081	7.37				
305		.092	9.13				
310		.113	11.31				
315		.100	14.60				
320			7.72				
325			4.91				
330			6.87				
335	19.13		2.79				
340	18.53		1.05				
345			5.32				
350			2.02				
355			3.08				
360	16.22	.105	2.38				
362	12.52	.107	2.93				

Bottomed in Quartz
April 14 1917.

1026

	Material	Color	Texture	Hardness			
8	Muskeg	Blue	Fine	Soft			
20	Sand & Clay	"	"	"			
30	" " "		"	"			
	Clay	Gray	"	"			
50							
	Sand & Clay	"	"	"			
63							
	Sand, Gravel & Clay	"	"	"			
80							
88	Sand		Med	"			
94	Gravel & Boulders	"	"	Med			
102	Hardpan	"	"	Hard			
	Sand-Gravel Hardpan & Boulders	"	"	"			
117							
	Hardpan	"	"	"			
125							
	Gravel & Hardpan	"	"	Med			
134							
137	Gravel	"	Mn	"			
140			1.54				
145			1.90				
150			1.18				
155			3.48				
160			2.31				
165			2.84				
170			2.54				
175			1.45				
180			.46				
185			.54				
190			2.49				
195			2.36				
200			1.58				
205			1.49				
210	Iron	Phos	1.40				
215			.68				
220	19.43	.081	13.92				
225		.061	9.08				
230			4.05				
235			6.08				
240			3.58				
245			5.88				
250			6.25				
255			2.26				
260			1.38				
265			2.09				
270			.82				
275			2.21				
280			.73				
285			.18				
290			4.69				
295			3.60				
300			2.66				
305			1.24				
310			1.28				
315	21.55		.92				
320			1.74				
325			1.55				
330			1.74				
335			1.00				
340	24.19		.82				
344			1.82				
345			.88				
350			.78				
355			.96				
360			.82				
365			2.02				
370			1.56				
375	28.41	.200	1.39				
376	24.88	.141	1.37				

Bottomed in Schist
April 17. 1917.

Sheet 16

1027

	Material	Color	Texture	Hardness
5	Muskeg	Black	Fine	Soft
	Clay	Gray	"	"
44				
	Clay & Hardpan	"	Med.	Med.
59				
73	Hardpan & Gravel	"	"	"
	Gravel & Boulders		"	"
100				
	Hardpan & Boulders			"
130				
142	Hardpan & Sand		"	"

	Iron	Phos	Mn.
145	21.95	.102	.78
150	19.83	.068	1.55
155	22.62	.082	1.56
160	20.21	.072	3.88
165	17.27	.054	2.38
170	20.21	.066	4.76
175	19.00	.075	3.02
180	14.80	.065	2.10
185	13.89	.055	3.20
190	17.64	.119	3.24
195	18.25	.068	3.83
200	15.85	.090	2.28
205			.39
210			6.59
215			2.28
220			4.75
225			4.43
230			1.77
235			6.35
240			1.18
245			.89
250	11.29		.32
255	11.30		.38
260			1.18
265			9.55
270			16.04
275			12.38
280			6.49
285			3.83

Finished May 3, 1917

29 1049

3

148' 3.90

1028

	Material	Color	Texture	Hardness
20	Muskeg & Clay	Black	Fine	Soft
38	Clay & Sand	Gray	Med.	"
	Boulders & Hardpan		"	Med
80				
89	Gravel & Sand		Coarse	"
	Boulders & Hardpan		"	"
129				
137	Boulders, Gravel & Hardpan		Med	"

	Iron	Phos	Mn
140	24.39		1.64
145	19.73		2.19
150	21.99		2.28
155			2.37
160			1.77
165			4.06
170			3.05
175			2.47
180			2.46
185			.45
190			.36
195			.40
200			.27
205			.81
210			4.39
215			9.05
220			10.03
225			7.68
230			6.51
235			6.12
240			1.96
245			6.75
250			1.09
255	18.02	.126	1.97
260	17.65	.053	1.12
262	17.65	.050	9.12

Finished May 10, 1917

26 1005

3.86

3

1029

	Material	Color	Texture	Hardness
5	Muskeg	Black	Fine	Soft
	Clay	Gray	Fine	Soft
47				
	Clay + Gravel	"	Coarse	Medium
63				
	Sand	"	Medium	Soft
78				
	Gravel + Boulders	"	Coarse	Hard
87				
	Gravel, Sand, + Boulders	"	Medium	
96				
	Hardpan + Boulders	"	Medium	Hard
134				
	Clay, Gravel, + Boulders	"	Medium	Soft
143				
145			.45 Mn	
150	Fe	P	.40	
155			.36	
160			.90	
165			1.74	
170			1.91	
175			.90	
180	17.05	.064	2.47	
185	22.08	.109	1.74	
190	15.85	.085	3.07	
195	16.90	.082	9.98	
200	14.72	.066	1.88	
205	14.64	.075	2.01	
210	19.92	.079	.78	
215	12.69	.061	1.10	
220	12.77	.037	3.66	
225	9.61	.052	3.93	
230	9.96	.041	2.33	
235	16.82	.059	8.83	
240	12.24	.050	3.66	

Finished May 9, 1917

35 [illegible]

2,23

1030

	Material	Color	Texture	Hardness
5	Muskeg	Black		
10	Sand	Yellow		
	Clay	Gray		
45				
	Hardpan	"		
60				
	Gravel, Sand, + Boulders	"		
90				
96	Clay	Red		
	Hardpan + Boulders	Gray		
143	Fe	P	Mn	
150	29.14	.040	8.10	
155	29.97	.050	5.08	
160	20.13	.043	3.07	Fine Soft
165	20.81	.126	3.80	
170	25.83	.084	5.58	

Finished May 14, 1917

[illegible]

[illegible]

Sheet P

1031

	Material	Color	Texture	Hardness
	Sand + Clay	Gray	Fine	Soft
19				
22	Gravel + boulders	"	"	Medium
	Hardpan, gravel, + boulders	"	Medium	"
40				
	Gravel + Sand	Mixed Gray	"	"
80				
	Gravel, Sand, + Hardpan		"	"
101				
	Hardpan, Gravel, + Boulders	Gray	"	"
121				
	Clay	Blue	Fine	"
160				
159	Sand + Gravel	Gray	Coarse + Fine	Medium + Soft
	Fe Mn			
165	27.49 .54			
170	24.27 .63		Fine	Soft
180				
	Schist + Quartz	Black + white	Coarse + Fine	Soft
200				
225				
230	22.11 .05			
	Schist	Variety	Coarse + Fine	Hard to soft
280				
285	20.45 .13			
290	31.16 .18			

Finished May 27, 1917

1032

	Material	Color	Texture	Hardness
5	Muskeg			
	Clay	Gray	Fine	Soft
35				
	Clay	Red	Medium	Medium
57				
	Clay + Gravel	Gray	Coarse + Medium	"
84				
	Sand + Gravel	"	Coarse	Soft
120				
	Sand	"	Medium	Soft
136				
144	Gravel	"	Course	
	Hardpan	"	Medium	Hard
176				
180	Sand	"	Fine	
	Schist + Sub lignite	Variety	Coarse to Fine	Soft
195				
203	Quartz	Gray	Fine	Hard

Finished May 23, 1917

Sheet P

1033

	Material	Color	Texture	Hardness
2	Muskeg			
12	Sand	Yellow		
	Clay	Gray		
31				
	Sand, Gravel + Boulders	Brown + Gray		
101				
	Hardpan + Boulders	Gray		
121				
	Hardpan	"		
139	Hardpan, Gravel + Boulders	"	Coarse + Medium	Hard + Medium
141	Hardpan, Gravel + Sand	"	Medium + Fine	Medium
146	12.93 Fe .13 Mn			
150	29.27 1.99	Variety	" + "	Soft
155	27.71 1.89			
160	13.38 .95			
165	29.51 2.93	Red, Gray, Green	" + "	Medium + Soft
170	18.72 1.08			
175	13.93 .45	Gray + Brown	" + "	Soft
180	16.98 .18	" + Red	" + "	Medium + Soft
185	18.73 .09			
190				
	Schist + Graphite	Variety	" + "	" + "
220				
225				
230	17.63 .05	"	" + "	Hard + Medium
232				

Finished May 31, 1917.

1034

	Material	Color	Texture	Hardness
	Clay + Sand	Gray	Fine	Soft
18				
	Clay	"	"	Medium + Soft
38				
	Water, Sand + Gravel	"	Medium + Fine	Soft
90				
97	Gravel + Boulders	Mixed	Coarse + Medium	Hard
	Hardpan	Gray	Medium	Medium
139				
	Hardpan, Sand + Gravel	"	Coarse To Fine	"
152				
	Fe Mn			
165				
170	10.91 .09			
	Schist	Variety	Medium + Fine	Medium + Soft
210				
215	7.91 .14			
225				
230				
235	5.38 .44			
240				
245	5.38 .14	"	" + "	Soft
250				
260	5.98 .14			
265				
	Schist + Point R.	"	" + "	"
285				
290				
295	5.83 .05	"	" + "	"
300				

Finished June 18, 1917.

Sheet P

Aitkin County
Sec Ref 1072

Serial No. 42
Hole No. 1
Collar Elevation:
Depth of Hole: 332'
Location: Sec. 23, T43N - R27W

Date completed: 5/13/50
Drilled by: U. S. Bureau of Mines
Logged by: W. A. Grosh
Type of Drilling: Diamond Drill-Core

Depth From	Depth To	Material	Material and Analyses Iron	Mang.	Core
0	150	Sand gravel, boulders	Surface		
150	162	Green sand			
162	167	Soft iron formation			
167	172	Red mud			8.2
172	177	No core			
177	182		18.92	1.88	36.8
182	187				31.6
187	192	Red mud and lump	18.76	7.81	58.5
192	197	of red slate	17.16	4.64	48.4
197	202		13.79	6.71	40.0
202	207				26.6
207	210		16.36	20.17	
210	213				33.3
213	218	Mud and red slate			21.6
218	222	and black slate	13.79	6.87	50.0
222	227		15.79	6.05	53.4
227	232				
232	237				50.0
237	242		12.67	2.27	20.0
242	247				3.4
247	250.5	No core			
250.5	253				21.3
253	257	Red slatey	7.86	0.75	18.8
257	260				83.5
260	263		10.42	2.74	83.5
263	266				94.4
266	269.5	Clayey light decomb.	11.39	5.97	62.0
269.5	273	slate. Lump of black			90.4
273	277	slate & manganese at	9.30	0.32	85.6
277	281	260', 263'4", 269',	11.47	1.49	100.0
281	283.5	296'7", 300', 300½'			100.0
283.5	287	to 302'.	7.94	0.95	95.4
287	291.5				50.0
291.5	295		8.58	3.06	105.1
295	298				116.5
298	300.5		11.45	7.69	90.0
300.5	302				44.6
302	304		8.90	7.50	100.0
304	307	Similar but			86.0
307	309	red.	11.79	3.02	87.5
309	312.5				90.8
312.5	314		15.31	2.82	66.7
314	318	Similar to above but			66.5
318	320	red. Few small black	7.70	4.33	54.0
320	324.7	mang. nodules. Large	10.42	1.38	94.0
324.7	327.7	at 319'.	8.18	1.42	100.0
327	332		14.51	0.13	93.0
116	332		11.79	3.60	

No unaltered formation.
Bands show dips 45°±

Serial No. 43
Hole No. 2
Collar Elevation: 1818.5'
Depth of Hole: 4[illegible]
Location: N.E. - [illegible]

[illegible]: 10/6/50
[illegible] of mines
[illegible]
[illegible] Drill.-Core

Depth From	Depth To	Material	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Average [illegible]	Average [illegible]	Average SiO_2
0	144	Surface material												
144	150												.[illegible]	44.99
150	155	Dk.red clay	[illegible]	1.41	[illegible]								[illegible]	40.44
155	160	No core											.[illegible]	47.92
160	164	Dk.red clay; a few soft pieces of mn. oxide	[illegible].77	2.29	[illegible]								1.11	45.40
164	169	Dk.red clay; a few streaks of wrd ore	[illegible]	[illegible]	[illegible]							[illegible].39	[illegible]	[illegible]
Average												[illegible].01	[illegible]	[illegible].52
169	174	Dk.red clay & broken soft slate	[illegible]	[illegible]	[illegible]							[illegible].23	[illegible]	[illegible]
174	179	No core										[illegible]	[illegible]	[illegible].10
179	184	Soft red sl. & clay; a few black mn.-bearing bands in sl.; bedding 45°	[illegible]	[illegible]	[illegible]							[illegible]	[illegible]	39.06
184	187	No core										15.65	3.41	50.27
187	191	Red clay [illegible] soft [illegible] few [illegible] of sl. [illegible] bands	14.85	[illegible]	[illegible]							14.88	2.09	[illegible].45
Average												[illegible]	[illegible]	[illegible]
191	[illegible]	Soft red [illegible] [illegible]	[illegible]	[illegible]	[illegible]							[illegible]	1.[illegible]	[illegible]
196	[illegible]	Soft red sl. [illegible] or [illegible] bed hard black sl.	[illegible]	[illegible]	[illegible]							[illegible]	[illegible]	7[illegible].13
201	206	Soft red sl.	[illegible]	[illegible]	[illegible]								[illegible]	[illegible]
206	211	Soft red sl.; bedding [illegible]	[illegible]	[illegible]	[illegible]								[illegible]	[illegible]
211	216	Soft red sl.	[illegible]	[illegible]	[illegible]							[illegible]	[illegible]	[illegible]
216	[illegible]	Soft red sl.; [illegible] hard band of black slate	[illegible]	[illegible]	[illegible]							[illegible]	[illegible]	[illegible]

[illegible]

Aitkin County
Sec [illegible] 107[illegible]

Serial No. 43
Hole No. 2 (Cont'd.)
Collar Elevation: 1213.5'
Depth of Hole: 467'
Location: N.E.- S.W.

Date completed: 10/[illegible]
Drilled by: U.S. Bur[illegible]
Logged by: W. A. Gro[illegible]
Type of Drilling: Diam[illegible]

Depth From	Depth To	Material	Analyses: Core Iron	Core Mang.	Core SiO_2	Sludge Iron	Sludge Mang.	Sludge SiO_2	Adjusted Iron	Adjusted Mang.	Adjusted SiO_2
220	225	Soft red sl. & clay; bedding 45°; cleavage 31° about right angles to bedding	7.60	1.22	75.79				7.60	1.[illegible]	[illegible]
Average									9.93	1.07	70.[illegible]
225	230	Soft red sl.	7.11	4.73	78.90				7.11	4.73	78.90
230	235	Soft red sl.; a few bands of black slate	8.08	3.23	74.01				8.08	3.23	74.01
235	238.5	Black sl. with some pale red slate	13.42	7.60	59.43	10.74	4.71	65.71	11.72	5.76	62.41
Average									9.36	4.44	73.07
238.5	243.5	Soft pale red slate	8.08	1.45	68.32				8.08	1.45	68.32
243.5	248.5	Soft pale red sl. with bands of harder red slate	7.92	.39	68.19	6.51	.89	76.76	7.25	.63	72.28
248.5	254	Pale red sl.; cleavage 52° at 248.5'; vertical fracture plane at 249'	7.27	1.49	69.22	11.56	3.88	65.03	9.92	2.97	66.[illegible]
254	259	Soft red & light gray sl.; vertical banding at 255'; cleavage 15°	8.47	.47	71.71				8.47	.47	71.71
259	264	Soft red sl. to 261'; harder red sl. 261 to 264'; cleavage 28° to 33°; mn. filling along cleavage planes	5.17	.66	75.34				5.17	.66	75.34
264	269	Red sl. band of chert & mn.(?) at 269'; bedding 53°	13.42	.59	54.27	13.28	1.44	62.93	15.44	1.17	63.36
Average									8.74	1.25	69.55

(Continued)

Aitkin County
Sec Ref 1072

Serial No. 43
Hole No. 2 (Cont'd.)
Collar Elevation: 1213.5'
Depth of Hole: 467'
Location: N.E.- S.W.

Date completed: 10/9/50
Drilled by: U.S.Bureau of Mines
Logged by: W. A. Grosh
Type of Drilling: Diamond drill-Core

Depth From	Depth To	Material	Analyses: Core Iron	Core Mang.	Core SiO_2	Sludge Iron	Sludge Mang.	Sludge SiO_2	Adjusted Average Iron	Adjusted Average Mang.	Adjusted Average SiO_2
269	274	Red to dk. red clay with highly fractured sl.; a few bands of harder slate	13.90	.66	60.17				13.90	.66	60.17
274	279	Black sl. 274' to 275'; red sl. 275' to 279'	7.60	.51	69.87				7.60	.51	69.87
279	284	Red sl.(soft) to 282'; soft gray sl. 282' to 284'	6.79	.28	71.30				6.79	.28	71.30
284	289	Soft red and light gray sl.	10.99	.78	64.73	11.72	.59	67.04	11.42	.67	66.09
289	294	Soft red sl.; mn. filling in fractures and/or bedding planes	9.94	.98	65.91	11.88	1.89	65.20	10.70	1.34	65.63
294	299	Soft red sl.	8.73	.36	66.56				8.73	.36	66.56
299	303.5	Soft light gray sl.;cleavage 25° at 299' to 300'; soft red sl. at 300' to 302'; hard black sl. at 302 to 303.5' (manganiferous?)	10.51	2.44	63.30				10.51	2.44	63.30
303.5	308	Soft red clay & sl. to 306'; Light red sl. to 306 to 308', soft bedding 35°; hard black sl. at 308'	8.81	.32	67.91				8.81	.32	67.91
308	313	Red sl.; cleavage 35°; mn.band at 309';fractured pieces of mn. 312' to 313'	7.68	1.65	67.18				7.68	1.65	67.18
Average									9.57	.90	66.46

(Continued)

Aitkin County
Sec Ref 1072

Serial No. 43
Hole No. 2 (Cont'd.)
Collar Elevation: 1213.5'
Depth of Hole: 467'
Location: N.E.- S.W.

Date completed: 10/9/50
Drilled by: U.S.Bureau of Mines
Logged by: W. A. Green
Type of Drilling: Diamond drill-Core

Depth From	Depth To	Material	Analyses: Core Iron	Core Mang.	Core SiO_2	Sludge Iron	Sludge Mang.	Sludge SiO_2	Adjusted Average Iron	Adjusted Average Mang.	Adjusted Average SiO_2
313	318	Band of hard mn. ± 2' or more; dk. sl. at 318'	12.69	14.58	44.96	15.30	16.29	39.84	14.81	15.97	40.81
318	323	Red sl. and hard bands of mn. to 320'; softer red sl. 320 to 323'; rumpled bedding at 322'	9.40	1.73	65.64				9.40	1.73	65.64
323	327.5	Soft red sl.	11.03	5.00	59.74				11.03	5.00	59.74
327.5	333	Soft red sl. with ± 1' of hard mn.	22.54	10.64	40.33	14.98	5.91	57.17	16.74	7.01	53.25
Average									13.14	7.48	54.70
333	338	Soft red sl. and clay	8.60	.23	69.22				8.60	.23	69.22
338	343	Soft red sl.; bedding 30°; cleavage 55°; angle of cleavage & bedding ± 90°	6.81	.27	70.27				6.81	.27	70.27
343	347	Light red sl.; cleavage and bedding vertical	10.70	.86	65.60				10.70	.86	65.60
347	351.5	Red clay and sl.; bedding 27°; some wad	9.73	.19	68.21				9.73	.19	68.21
351.5	356.5	Red sl.; dk. gray sl. only slightly altered at 354'; bedding 35°; cleavage 20°	11.35	.15	67.60				11.35	.15	67.60
Average									9.38	.31	68.29
356.5	360.5	Soft dark gray slate	9.57	.55	69.07	11.07	2.21	65.21	10.33	1.40	67.10
360.5	366	Hard banded slate, dk. gray to light red; bedding 37°; cleavage 70°	7.30	.82	69.97				7.30	.82	69.97

(Continued)

Aitkin County
Sec Ref 1072

Serial No. 43
Hole No. 2 (Cont'd.)
Collar Elevation: 1213.5'
Depth of Hole: 467'
Location: N.E.- S.W.

Date completed: 10/9/50
Drilled by: U. S. Bureau of Mines
Logged by: W. A. Grosh
Type of Drilling: Diamond drill-Core

Depth From	Depth To	Material	Core Iron	Core Mang.	Core SiO_2	Sludge Iron	Sludge Mang.	Sludge SiO_2	Adjusted Average Iron	Adjusted Average Mang.	Adjusted Average SiO_2
366	371	Hard, dk.gray sl. with streaks of iron stain; cleavage 27°	8.11	1.68	64.31				8.11	1.68	64.31
Average									8.42	1.28	67.23
371	373	Hard, dk.gray slate;rumpled bedding	5.35	4.98	53.95				5.35	4.98	53.95
373	378	Hard,reddish iron stained slate	7.19	2.29	47.57				7.19	2.29	47.57
378	383	Hard,dk.gray slate;some iron stain;cleavage 30°	8.92	.04	69.45				8.92	.04	69.45
383	388	Bedding 15°; tends to cleave on bedding planes;dk.gray slate;2' light gray slate with thin iron seams	9.40	.63	68.53				9.40	.63	68.53
388	392	Dk.gray to moderately light gray sl.; some iron stain	7.95	1.97	64.55				7.95	1.97	64.55
392	397	Light gray slate	9.40	1.61	65.16	11.23	1.95	63.70	10.24	1.77	64.49
397	402	Light gray slate	12.16	2.13	63.04				12.16	2.13	63.04
402	407	Gray slate; some iron stain	9.57	2.48	65.03				9.57	2.48	65.03
407	412	Dk.gray slate; some iron stain; uneven fracture; rumpled bedding	8.11	1.53	67.17				8.11	1.53	67.17
412	417	Moderate gray slate;some iron stained bands	7.60	2.76	65.73				7.60	2.76	65.73
417	422	Gray slate; some iron stain; bedding 35°	7.27	1.06	69.08				7.27	1.06	69.08
422	427	Gray slate; some iron stain; bedding 35°	6.63	1.81	69.98				6.63	1.81	69.98
Average									8.33	1.49	64.58

(Continued)

Aitkin County
Sec Ref 1072

Serial No. 43
Hole No. 2 (Cont'd.)
Collar Elevation: 1213.5'
Depth of Hole: 467'
Location: N.E. - S.W.

Date completed: 10/9/50
Drilled by: U.S.Bureau of Mines
Logged by: W. A. Grosh
Type of Drilling: Diamond drill-Core

Depth From	Depth To	Material	Analyses Core Iron	Core Mang.	Core SiO_2	Sludge Iron	Sludge Mang.	Sludge SiO_2	Adjusted Average Iron	Adjusted Average Mang.	Adjusted Average SiO_2
427	432	Gray slate; ± 1' badly fractured iron stained slate	8.57	.20	69.64				8.57	.20	69.64
432	437	Gray slate & red iron-stained slate	7.92	.12	71.43				7.92	.12	71.43
437	442	Dk.gray slate; bedding 40°	7.03	.12	72.82				7.03	.12	72.82
442	447	Dk. to light gray slates; some iron stain	8.08	.12	68.76				8.08	.12	68.76
447	452	Medium gray slate; several iron stained bands	8.65	.12	68.97				8.65	.12	68.97
Average									8.05	.14	70.32
452	457	Light gray slate; iron stained bands	6.95	1.18	66.44				6.95	1.18	66.44
457	462	Light gray slate; iron stained bands	8.08	2.72	62.07				8.08	2.72	62.07
462	467	Light gray slate; iron stained bands	6.47	1.57	65.27				6.47	1.57	65.27
Average									7.17	1.82	64.59
144	467	Average for hole							10.88	1.82	64.03

Aitkin County
Sec Ref 1072

Serial No. 44
Hole No. 3
Collar Elevation: 1213.1'
Depth of Hole: 340'
Location: N.E.- S.W.

Date completed: 10/6/50
Drilled by: U.S.Bureau of Mines
Logged by: W. A. Grosh
Type of Drilling: Diamond drill-Core

Depth From	Depth To	Material	Analyses: Core Iron	Core Mang.	Core SiO_2	Sludge Iron	Sludge Mang.	Sludge SiO_2	Adjusted Average Iron	Adjusted Average Mang.	Adjusted Average SiO_2
0	175	Surface									
175	181					13.05	2.25	62.54	13.05	2.25	62.54
181	185	Light grey clay & soft slate	12.13	3.90	57.80				12.13	3.90	57.80
185	188	Red, light red soft slate; bedding vertical	10.91	1.08	63.54				10.91	1.08	63.54
188	191	Soft red sl.; bedding vertical	10.99	2.32	63.84				10.99	2.32	63.84
191	194	Soft red sl.; bedding at 45°; rock breaks along bedding easily at 198'	12.21	2.60	56.90				12.21	2.60	56.90
Average									12.06	2.48	61.01
194	197	Light gray, closely folded slate; cleavage 15° (axis of folds) at 194 to 195'. Red sl.; bedding vertical; cleavage 70° at 196'	10.02	1.85	64.30				10.02	1.85	64.30
197	200	Red slate; bedding 43°	8.89	.59	65.78				8.89	.59	65.78
200	205	Soft red sl. & clay; bedding 15°	10.99	.95	62.22				10.99	.95	62.22
205	210	Light red sl.; bedding 50°; cleavage vertical (?)	11.24	1.28	62.77	14.34	1.77	61.95	13.67	1.66	62.13
Average									11.25	1.27	63.25
210	215	Light red, soft slate; some mang.	11.32	6.23	58.07	14.18	1.57	61.23	13.82	2.16	60.83
215	218.5	Dk. red clay; pale red slate; some mang.	12.94	3.31	61.50	14.50	1.68	59.92	13.85	2.36	60.58
218.5	221	Pale red slate; ± 3' mang.									
221	224	Red & pale red slate; cleavage 20°	11.16	1.69	63.04	11.28	1.93	66.25	11.25	1.87	65.41

(Continued)

Aitkin County
Sec Ref 1072

Serial No. 44
Hole No. 3 (Cont'd.)
Collar Elevation: 1213.1'
Depth of Hole: 340'
Location: N.E.- S.W.

Date completed: 10/6/50
Drilled by: U.S.Bureau of Mines
Logged by: W. A. Grosh
Type of Drilling: Diamond drill-Core

Depth From	Depth To	Material	Analyses: Core Iron	Core Mang.	Core SiO_2	Sludge Iron	Sludge Mang.	Sludge SiO_2	Adjusted Average Iron	Adjusted Average Mang.	Adjusted Average SiO_2
224	230	Some good mang. at 224'; pale red sl.; bedding 45°	14.15	3.27	55.70	14.34 11.03	4.18 1.12	62.01 64.03	13.20	2.94	60.98
230	233	Some mang. at 230'; red sl.; bedding 22°; cleavage 50°	14.96	3.84	58.16	10.87	1.33	65.34	12.34	2.23	62.76
Average									12.86	2.33	62.17
233	235	Soft, pale red slate									
235	237	No core	19.40	4.49	51.74	14.42	4.43	58.84	14.74	4.43	58.39
237	240	Pale red sl.; cleavage 52°	10.19	2.96	63.84				10.19	2.96	63.84
240	242.7	Pale, red sl.; little core; mostly mang.									
242.7	244	Clay, most of core good mang.; bedding 30°	16.49	9.00	46.80	12.24	3.43	64.01	13.59	5.20	58.55
244	247	Soft clay	15.20	5.14	55.87				15.20	5.14	55.87
247	250	Pale red sl.; some mang.									
250	253	Red slate; cleavage 47°; bedding ± horizontal; some mang.(?)	11.24	3.43	61.53	11.84	3.11	63.31	11.65	3.21	62.76
253	256	Little core; all mang.	11.48	20.23	42.10	9.70	2.64	74.42	9.87	4.29	71.38
Average									12.57	4.13	61.63
256	258	Soft red sl. or clay									
258	262	Dk. red clay; some mang.	13.10	3.51	62.35	12.08	1.77	65.60	12.34	2.21	64.78
262	265	Soft red sl.; bedding 10°; cleavage 10° in opposite directions									
265	268	No core	9.65	2.34	66.15	12.81	2.17	64.15	12.14	2.21	64.58
268	271	Red clay	13.42	1.71	63.15				13.42	1.71	63.15
Average									12.48	2.11	64.37

(Continued)

Aitkin County
Sec Ref 1072

Serial No. 44
Hole No. 3 (Cont'd.)
Collar Elevation: 1213.1'
Depth of Hole: 340'
Location: N.E. - S.W.

Date completed: 10/6/50
Drilled by: U.S. Bureau of Mines
Logged by: W. A. Grosh
Type of Drilling: Diamond drill-Core

Depth From	Depth To	Material	Core Iron	Core Mang.	Core SiO_2	Sludge Iron	Sludge Mang.	Sludge SiO_2	Adjusted Average Iron	Adjusted Average Mang.	Adjusted Average SiO_2
271	274	Soft, pale red to red slate	12.29	.95	67.69	9.99	.63	67.56	10.87	.87	66.58
274	277	Red clay	10.51	.95	65.54						
277	280	Soft, pale red slate	9.54	.89	68.06	10.51	1.10	67.02	9.84	1.34	65.51
280	283	Red slate	9.54	1.77	62.98						
283	286	Soft, pale red slate	9.86	.79	67.33	12.13	1.32	67.00	12.10	.82	65.18
286	289	Red slate, rather hard; bedding 30°; cleavage 30°	12.61	.24	62.44						
Average									10.94	1.01	65.76
289	295	Red slate; 2 good bands of mang.	10.51	4.83	63.10	10.91	2.82	69.11	10.80	3.36	67.49
295	298	Red slate; 1 good band of mang.									
298	301	Red slate; some mang.	10.19	1.40	68.67	11.96	2.44	69.36	11.49	2.16	69.17
301	304	Red slate; bedding 70°									
304	307	Pale red sl.	10.35	.77	64.63	11.88	1.64	65.55	11.25	1.28	65.17
307	310	Red slate; 2 bands mang.; cleavage vertical (?)									
310	313	Pale red sl.; some mang.	12.29	7.46	54.32	13.42	2.44	62.91	12.99	4.35	59.65
313	316	Pale red sl.; some mang.									
316	319	Red slate; some mang.	13.10	5.48	58.23	64.88	3.55	61.20	14.39	4.09	60.37
319	322	Pale red sl.; some ochre; bedding 70°; cleavage 15°									
322	325	Red slate	10.02	1.30	65.33	11.16	3.51	60.02	10.35	2.53	65.71
325	328	Darker red sl.									
328	331	Some mang.; red slate; bedding 30°; cleavage vertical (?)	12.29	1.41	62.33	13.98	2.25	64.25	13.52	2.02	63.72

(Continued)

Serial No. 44
Hole No. 3 (Cont'd.)
Collar Elevation: 1213.1'
Depth of Hole: 340'
Location: N.E.- S.W.

Aitkin County
Sec Ref 1072

Date completed: 10/6/50
Drilled by: U.S.Bureau of Mines
Logged by: W. A. Grosh
Type of Drilling: Diamond drill-Core

Depth From	Depth To	Material	Core Iron	Core Mang.	Core SiO_2	Sludge Iron	Sludge Mang.	Sludge SiO_2	Adjusted Average Iron	Adjusted Average Mang.	Adjusted Average SiO_2
331	333	Dk.red slate									
333	337	Dk.red slate; bedding 35°	6.30	4.45	62.97	14.71	3.80	60.00	12.39	3.98	60.82
337	340	Gray slate; some good mang.	11.48	1.50	62.24	14.63	3.64	60.30	13.81	3.08	60.80
340		Bottom of hole									
Average									12.28	2.98	63.82
175	340	Average for hole							12.15	2.53	63.17

Aitkin County
Sec Ref 1072

Serial No. 45
Hole No. 4
Collar Elevation: 1213.3'
Depth of Hole: 370'
Location: N.E.- S.W.

Date completed: 10/26/50
Drilled by: U. S. Bureau of Mines
Logged by: W. A. Grosh
Type of Drilling: Diamond drill-Core

Depth From	Depth To	Material	Core Iron	Core Mang.	Core SiO_2	Sludge Iron	Sludge Mang.	Sludge SiO_2	Adjusted Average Iron	Adjusted Average Mang.	Adjusted Average SiO_2
0	143	Surface material									
143	148	Iron form.; drilled with chopping bit				8.94	.39	48.30	8.94	.39	48.30
148	151	Reddish brown clay & slate									
151	154	Reddish brown clay & slate; bedding 35°	13.23	.20	52.56	16.21	.32	52.20	14.46	.25	52.41
154	157	Soft red sl.	12.58	.24	53.66				12.58	.24	53.66
Average									13.09	.30	51.21
157	160	Soft red-gray slate	15.40	1.45	47.72				15.40	1.45	47.72
160	163	Red & dk.gray to black sl. (some mang.?) bedding 45°	22.90	2.21	36.24				22.90	2.21	36.24
163	166	Dk.red slate; bedding 40°	22.26	3.62	36.48				22.26	3.62	36.48
166	169	Soft red sl.									
169	172	Dk.red slate	15.65	3.11	43.90				15.65	3.11	43.90
172	175	Dk.red slate	17.34	2.09	46.18	16.05	2.29	50.82	16.98	2.15	47.27
Average									18.14	2.61	42.62
175	178	Red slate; bedding 50°; some mang,	15.16	1.89	45.92				15.16	1.89	45.92
178	182	Red slate; bedding 45° at 180; 35° at 181									
182	187	Red slate with dark streaks; mang.?; rolling bedding at 183; 180 at 184	14.03	1.77	45.40				14.03	1.77	45.40
187	192	Red slate; bedding vertical at 330	10.32	1.02	54.82				10.32	1.02	54.82
192	197	Red slate; bedding vertical at 199; wavey at 201,	15.81	1.65	45.76				15.81	1.65	45.76
197	202	approx. 70°	16.61	2.29	42.04				16.61	2.29	42.04
202	207	Red slate	8.22	.59	56.26				8.22	.59	56.26

(Continued)

Aitkin County
Sec Ref 1072

Serial No. 45
Hole No. 4 (Cont'd.)
Collar Elevation: 1213.3'
Depth of Hole: 370'
Location: N.E.- S.W.

Date completed: 10/26/50
Drilled by: U.S.Bureau of Mines
Logged by: W. A. Grosh
Type of Drilling: Diamond drill-Core

Depth From	Depth To	Material	Analyses: Core Iron	Core Mang.	Core SiO_2	Sludge Iron	Sludge Mang.	Sludge SiO_2	Adjusted Average Iron	Adjusted Average Mang.	Adjusted Average SiO_2
Average									13.33	1.54	48.15
207	212	Red slate	14.03	4.96	47.56	12.84	2.52	51.08	13.42	3.72	49.36
212	217	Red slate; some mang.; rolling bedding	12.34	2.76	49.84				12.34	2.76	49.84
217	222	Red slate; bedding 15°; some mang.	11.94	1.49	54.10				11.94	1.49	54.10
222	227	Red slate	12.42	2.44	50.40				12.42	2.44	50.40
227	232	Red slate; quartz & mang.	9.68	2.29	68.60	9.63	2.29	66.46	9.64	2.29	66.93
Average									11.95	2.54	54.13
232	235	Red slate; some mang.	22.26	7.96	31.48	14.12	2.84	55.70	18.51	5.60	42.65
235	238	Broken red slate with thin bands of mang. (?)	21.57	6.38	34.80	20.70	6.07	36.34	21.23	6.26	35.39
238	241	Dk.red slate; some mang.									
241	244	Red slate; some mang.	29.14	6.70	28.48				29.14	6.70	28.48
244	247	Light red sl. 4" good mang.									
247	250	Light red sl. some good mang.	22.14	6.78	37.68	24.88	6.15	35.42	23.61	6.44	36.47
Average									24.21	6.36	34.66
250	253	Pink to light gray slate	9.12	2.44	56.24				9.12	2.44	56.24
253	257	Pink to light gray slate; some mang.	9.93	2.30	55.00				9.93	2.80	55.00
257	261	Same, changing to red at 260	12.37	1.30	53.98	12.20	1.53	55.80	12.30	1.40	54.72
261	265	Light red sl. vertical bedding	7.33	1.06	59.34				7.33	1.06	59.34
265	270	Light red & gray slates; folded bedding; axis of folds 10°	12.05	.55	58.88				12.05	.55	58.88
Average									10.29	1.56	56.97

(Continued)

Aitkin County
Sec Ref 1072

Serial No. 45
Hole No. 4 (Cont'd.)
Collar Elevation: 1213.3'
Depth of Hole: 370'
Location: N.E.- S.W.

Date completed: 10/26/50
Drilled by: U. S. Bureau of Mines
Logged by: W. A. Grosh
Type of Drilling: Diamond drill-Core

Depth From	Depth To	Material	Core Iron	Core Mang.	Core SiO_2	Sludge Iron	Sludge Mang.	Sludge SiO_2	Adjusted Average Iron	Adjusted Average Mang.	Adjusted Average SiO_2
270	275	Light red sl. some mang.	14.65	8.98	46.74				14.65	8.98	46.74
275	280	Red slate	11.56	2.13	52.48				11.56	2.13	52.48
280	285	Red slate	9.12	.90	54.40				9.12	.90	54.40
285	290	Red slate; some mang. in fissures	12.37	2.17	55.32				12.37	2.17	55.32
290	295	Red slate; some mang.				14.44	3.15	55.90	14.44	3.15	55.90
295	300	Gray slate; some good mang.	14.81	4.47	52.44	14.19	5.59	51.42	14.45	5.13	51.84
300	303	Gray slate; some good mang.									
303	306	Red slate; folded bedding; mang. between bedding planes	12.99	5.32	52.96	14.12	2.01	60.10	13.74	3.14	57.67
306	309	Red slate	9.91	.39	54.48				9.91	.39	54.48
Average									12.70	3.39	53.66
309	312	Red slate; some good mang.	15.51	10.44	39.90	11.55	4.89	55.92	13.98	8.30	46.08
312	315	Mostly broken-up mang.	13.80	21.12	33.50	15.25	9.65	50.10	14.95	12.00	46.70
315	318	Mostly broken-up mang.									
318	321	Red slate; bedding 30°	12.10	2.32	54.28	14.76	9.73	48.22	13.86	7.21	50.28
321	325	Light red slate	12.34	11.78	47.34				12.34	11.78	47.34
325	328	Red slate; cleavage vertical (?)	9.91	.12	52.50	10.11	1.26	63.14	9.91	.12	52.50
328	332	Red slate; 6" solid mang. & grey sl.	12.34	10.24	47.40	12.04	6.90	53.70	12.17	8.31	51.04
Average									12.94	8.04	49.18
332	335	Red slate									
335	338	Light red sl.; some good mang.	9.09	2.32	63.88				9.09	2.32	63.88
338	342	Red slate; good mang.	13.23	1.73	53.94				13.23	1.73	53.94

(Continued)

Aitkin County
Sec Ref 1072

Serial No. 45
Hole No. 4 (Cont'd.)
Collar Elevation: 1213 3'
Depth of Hole: 370'
Location: N.E.- S.W.

Date completed: 10/26/50
Drilled by: U. S. Bureau of Mines
Logged by: W. A. Grosh
Type of Drilling: Diamond drill-Core

Depth			Analyses								
			Core			Sludge			Adjusted Average		
From	To	Material	Iron	Mang.	SiO_2	Iron	Mang.	SiO_2	Iron	Mang.	SiO_2
342	345	Mostly broken mang.	11.21	11.17	49.12	9.23	4.41	60.50	9.67	5.98	57.97
345	348	Red slate; some mang.	10.39	9.81	45.44				10.39	9.81	45.44
348	352	Red slate; some mang; irregular bedding	9.42	5.20	51.40				9.42	5.20	51.40
352	356	Gray & red slate; some mang.	9.58	2.64	55.38				9.58	2.64	55.38
Average									10.15	4.15	55.68
356	360	Gray & black banded slate; vertical bedding at 35°	16.08	1.22	51.82				16.08	1.22	51.82
360	365	Gray slate banded with red slate; bedding 10°	17.21	.82	48.60				17.21	.82	48.60
365	370	Gray slate, wavy bedding at 65°	6.09	.24	62.00				6.09	.24	62.00
Average									12.92	.73	54.31
143	370	Average for hole							13.57	3.24	50.49

Aitkin County
Sec Ref 1072

Serial No. 46
Hole No. 5
Collar Elevation: 1214.0'
Depth of Hole: 349'
Location: N.E.- S.W.

Date completed: 11/4/50
Drilled by: U. S. Bureau of Mines
Logged by: W. A. Grosh
Type of Drilling: Diamond drill-Core

Depth From	Depth To	Material	Core Iron	Core Mang.	Core SiO_2	Sludge Iron	Sludge Mang.	Sludge SiO_2	Adjusted Average Iron	Adjusted Average Mang.	Adjusted Average SiO_2
0	146										
146	150	Surface				13.92	4.73	49.28	13.92	4.73	49.28
150	155										
155	157	Carb.slate	15.14	5.83	29.34				15.14	5.83	29.34
157	160	Carb.slate	14.98	4.89	31.10	14.65	4.02	31.60	14.70	4.15	31.52
160	170	Carb.slate	18.56	7.21	24.50	12.54	1.33	36.28	13.26	2.04	34.87
170	175	Altered red slate & some carb. slate									
175	178	Red slate & light gray clay	11.74	6.30	30.54	10.58	3.66	33.80	10.88	4.33	32.97
178	181	Red to dk. red slate; bedding 35°	18.07	5.04	28.58				18.07	5.04	28.58
181	182	Gray slate									
182	185	Gray slate to 183, red slate 183 to 185	20.19	2.60	31.84	22.06	3.47	42.22	21.23	3.08	37.61
Average									14.44	3.55	33.40
185	189	Dk.red slate; bedding 18°; cleavage 70 to 90°(?)	16.20	.70	44.22	18.88	2.84	46.80	17.06	1.38	45.05
189	193	Dk.red slate; bedding 15°; cleavage vertical (?)	17.58	1.45	46.50				17.58	1.45	46.50
193	198	Dk.red slate; bedding 55°; cleavage vertical	18.72	1.81	44.04				18.72	1.81	44.04
198	203	Dk.red slate & clay	16.44	3.94	42.54	17.26	3.62	45.00	16.90	3.76	43.91
Average									17.59	2.18	44.77
203	206	Red slate; bedding 50°									
206	209	Red & light red slates; bedding 35°; cleavage vertical	13.70	.63	48.10				13.70	.63	48.10

(Continued)

Aitkin County
Sec Ref 1072

Serial No. 46
Hole No. 5 (Cont'd.)
Collar Elevation: 1214.0'
Depth of Hole: 348'
Location: N.E.- S.W.

Date completed: 11/4/50
Drilled by: U.S.Bureau of Mines
Logged by: W. A. Grosh
Type of Drilling: Diamond drill-Core

Depth From	Depth To	Material	Analyses: Core Iron	Core Mang.	Core SiO_2	Sludge Iron	Sludge Mang.	Sludge SiO_2	Adjusted Average Iron	Adjusted Average Mang.	Adjusted Average SiO_2
209	213	Red slate & clay; a little mang.	15.49	3.70	42.60				15.49	3.70	42.60
213	218	Red slate; bedding 30°; bedding vertical	14.19	3.35	44.62				14.19	3.35	44.62
218	221	Red slate; bedding 20°	9.87	4.49	49.30				9.87	4.49	49.30
221	226	Light red slate	13.86	2.36	44.88	19.37	3.31	48.40	15.54	2.65	45.95
Average									14.02	2.70	46.08
226	231	Red slate; bedding 25°	12.39	1.53	52.02				12.39	1.53	52.02
231	236	Red slate	8.72	.90	57.48				8.72	.90	57.48
236	241	Red to light red slate; bedding 25°	9.95	1.10	54.92				9.95	1.10	54.92
Average									10.35	1.18	54.81
241	246	Light red sl.; bedding 33°	5.71	.59	59.90	15.71	5.08	47.62	9.47	2.28	55.28
246	250	Light red sl.	9.13	3.15	54.44				9.13	3.15	54.44
250	253	Light red sl.; some chert	15.49	6.34	45.20	15.47	6.07	49.40	15.47	6.13	48.42
253	256	Red slate; cleavage 35°									
256	259	Red slate; some mang.	8.81	.55	58.66	15.95	1.65	53.00	12.34	1.09	55.86
259	262	Red & light red bands of slate; some mang.	10.44	5.36	56.16				10.44	5.36	56.16
262	265	Red slate; some mang.; rumpled bedding	11.50	2.68	53.32	15.55	3.47	37.80	13.37	3.04	46.15
265	268	Light red to red slates; little mang.	12.07	2.29	54.64				12.07	2.29	54.64

(Continued)

Aitkin County
Sec Ref 1072

Serial No. 46
Hole No. 5 (Cont'd.)
Collar Elevation: 1214.0'
Depth of Hole: 348'
Location: N.E.- S.W.

Date completed: 11/4/50
Drilled by: U. S. Bureau of Mines
Logged by: W. A. Grosh
Type of Drilling: Diamond drill-Core

Depth			Analyses								
			Core			Sludge			Adjusted Average		
From	To	Material	Iron	Mang.	SiO_2	Iron	Mang.	SiO_2	Iron	Mang.	SiO_2
268	273	Red slates; bedding 40°	7.34	.12	60.46	15.38	4.06	52.70	13.68	3.23	54.34
273	279	Red slates; some mang.; bedding 38°	8.97	3.74	54.42	15.63	5.83	51.56	13.14	5.05	52.63
279	282	Red & light red slates; some mang.									
282	285	Red slate	6.85	4.73	52.10	11.31	5.67	55.52	8.81	5.14	53.60
285	289	Red slate; some mang.	11.42	4.45	50.26	10.58	4.69	56.44	11.34	4.47	50.86
289	293	Red slate	10.44	2.29	57.00				18.92	2.29	57.00
293	298	Red slate	18.92	8.27	41.50	11.88	3.55	54.86	12.70	4.10	53.31
298	304	Red slate	15.49	6.38	42.06	12.78	2.56	56.46	14.85	5.47	45.49
304	308	Red to light red slate; bedding; cleavage at 90° to bedding(?)	10.19	4.02	51.06				10.19	4.02	51.06
Average									12.34	3.80	52.68
308	313	Red slates	10.52	1.18	51.70				10.52	1.18	51.70
313	317	Banded red & gray slates; bedding 30°	10.44	.98	53.70				10.44	.98	53.70
317	322	Red slate	6.36	.78	61.66	10.91	1.26	56.48	10.00	1.16	57.52
322	325	Banded red & gray slates; bedding 35°	8.81	1.10	53.90				8.81	1.10	53.90
325	330	Banded red & gray slates; bedding 35°	11.58	1.18	50.40				11.58	1.18	50.40
330	335	Light red slate	9.79	6.38	47.24	17.58	8.39	40.92	15.98	7.98	42.22
335	338	Gray slate with red & black bands	13.86	1.45	48.70				13.86	1.45	48.70
Average									11.67	2.30	51.06

(Continued)

Aitkin County
Sec Ref 1072

Serial No. 46
Hole No. 5 (Cont'd.)
Collar Elevation: 1214.0'
Depth of Hole: 348'
Location: N.E.- S.W.

Date completed: 11/4/50
Drilled by: U. S. Bureau of Mines
Logged by: W. A. Grosh
Type of Drilling: Diamond drill-Core

Depth			Analyses								
			Core			Sludge			Adjusted Average		
From	To	Material	Iron	Mang.	SiO_2	Iron	Mang.	SiO_2	Iron	Mang.	SiO_2
338	343	Gray slate with red & black bands; bedding 30°	9.62	.66	53.62				9.62	.66	53.62
343	348	Same, bedding 30°; cleavage 55°	10.44	.66	53.26				10.44	.66	53.26
Average									10.03	.66	53.44
155	348	Average for hole							12.98	2.88	47.96

Aitkin County
Sec Ref 1072

Serial No. 47
Hole No. 6
Collar Elevation: 1213.8'
Depth of Hole: 334'
Location; N.E. - S.W.

Date completed: 11/16/50
Drilled by: U. S. Bureau of Mines
Logged by: W. A. Grosh
Type of Drilling: Diamond drill-Core

Depth From	Depth To	Material	Analyses: Core Iron	Core Mang.	Core SiO_2	Sludge Iron	Sludge Mang.	Sludge SiO_2	Adjusted Average Iron	Adjusted Average Mang.	Adjusted Average SiO_2
0	138	Surface									
138	143	Iron form. (chopped sample)				15.93	2.92	53.48	15.93	2.92	53.48
143	148	Dk.red clay & soft slate; a few mang. nodules in clay	12.55	2.36	52.52	11.02	3.03	58.78	11.23	2.94	57.92
148	155	Soft dk.red clay & slate	14.80	2.13	48.84				14.80	2.13	48.84
155	160	Red slate; bedding 52 to 55°;cleavage 25° (?)	13.52	2.92	47.66				13.52	2.92	47.66
160	165	Dk.red slate	14.72	1.77	49.20				14.72	1.77	49.20
165	170	Dk.red slate	11.26	1.57	52.30				11.26	1.57	52.30
170	175	Dk.red slate	17.70	2.52	48.62				17.70	2.52	48.62
175	180	Dk.red slate & clay; bedding 60°	18.18	1.81	44.80	14.48	2.09	55.78	16.21	1.96	50.64
180	185	Dk.red slate; bands of chert 184 to 185	13.60	2.52	52.20				13.60	2.52	52.20
185	190	Dk.red slate; chert band at 185.5;chert slate contact 75°;bedding 65°;cleavage (?)50°,approx. right angles to bedding; bedding 60° at 188	16.89	2.68	50.22				16.89	2.68	50.22
Average									14.59	2.38	51.02
190	195	Dk.red slate chert (± 1') 194 to 195	18.18	17.81	30.00	12.55	8.98	55.20	14.07	11.36	48.40
195	200	Some red sl; considerable chert; some mang.	15.77	28.37	19.40	15.77	12.61	46.06	15.77	14.86	42.25
200	203	Some red sl.; considerable chert	12.71	7.88	60.90	7.56	3.55	67.64	8.44	4.29	66.47

(Continued)

Aitkin County
Sec Ref 1072

Serial No. 47
Hole No. 6 (Cont'd.)
Collar Elevation: 1213.8'
Depth of Hole: 334'
Location: N.E. - S.W.

Date completed: 11/16/50
Drilled by: U. S. Bureau of Mines
Logged by: W. A. Grosh
Type of Drilling: Diamond drill-Core

Depth From	Depth To	Material	Analyses: Core Iron	Core Mang.	Core SiO_2	Sludge Iron	Sludge Mang.	Sludge SiO_2	Adjusted Average Iron	Adjusted Average Mang.	Adjusted Average SiO_2
203	206	Red slate; some mang.; cleavage 20° (?)									
206	210	Red slate; some mang.	14.28	7.92	47.20				14.28	7.92	47.20
210	215	Red slate; some mang.	14.20	7.80	43.00	13.84	5.08	54.20	13.97	6.03	50.30
215	218	Red slate; bedding 25°	10.43	2.36	54.60				10.43	2.36	54.60
218	222	Red slate; some mang. & chert	18.46	13.67	34.80				18.46	13.67	34.80
222	227	Red slate; some mang. & chert	24.71	8.71	39.22	16.89	1.73	54.08	17.69	2.44	52.56
Average									14.54	8.20	48.66
227	230	Red clay									
230	234	Red to dark red slate; bedding 36°	19.58	.96	47.06				19.58	.96	47.06
234	239	Red slate & clay; cleavage 25°(?)	17.81	2.48	53.60	20.11	1.93	51.80	19.16	2.16	52.55
239	242	Red slate; considerable chert; some mang.(?)	12.76	6.86	63.46	17.22	6.70	55.40	16.13	6.74	57.37
242	249	Red slate; some chert	11.31	3.03	58.00				11.31	3.03	58.00
Average									16.38	2.68	53.19
249	254	Red slate; irregular bedding	11.23	.76	53.34				11.23	.76	53.34
254	259	Red slate	18.37	.53	55.92	11.58	.39	58.88	13.41	.43	60.75
259	263	Red slate	11.39	.21	64.24				11.39	.21	64.24
263	268	Red slate; cleavage 43° (?)	12.32	.15	64.24				12.32	.15	64.24
Average									12.12	.40	60.45
268	273	Red slate & clay; a little gray slate	14.32	3.70	53.18				14.32	3.70	53.18

(Continued)

Aitkin County
Sec Ref 1072

Serial No. 47
Hole No. 6 (Cont'd.)
Collar Elevation: 1213.8'
Depth of Hole: 334'
Location: N.E. - S.W.

Date completed: 11/16/50
Drilled by: U.S.Bureau of Mines
Logged by: W. A. Grosh
Type of Drilling: Diamond drill-Core

Depth From	Depth To	Material	Analyses Core Iron	Core Mang.	Core SiO_2	Sludge Iron	Sludge Mang.	Sludge SiO_2	Adjusted Average Iron	Adjusted Average Mang.	Adjusted Average SiO_2
273	278	Red & gray slates; bedding 50°; cleavage 30° approx.right angles to bedding	8.00	.96	58.84	11.26	1.77	58.40	9.95	1.45	58.58
278	281	Red & gray slates; irregular bedding;some red clay									
281	285	Red & gray slates;folded bedding;axis of folds 38°	9.36	2.17	60.64				9.36	2.17	60.64
285	290	Red & gray slates	6.88	5.99	53.36	8.53	5.16	55.92	8.30	5.28	55.56
290	294	Gray slate with iron bands;bedding 28° at 290	8.24	2.13	53.36				8.24	2.13	53.36
294	299	Dk.gray slate; bedding 65°; cleavage 22°; some soft mang. (?)	6.64	4.14	61.50				6.64	4.14	61.50
Average									9.50	3.11	57.48
299	304	Banded red & gray slates; bedding 35°	6.40	.24	61.84				6.40	.24	61.84
304	309	Dk.gray slate; cleavage(?)45°; few iron stains	7.36	.37	59.50				7.36	.37	59.50
309	314	Gray slate, some red slate; gray slate highly fractured at 309'; quartz filling in fractures; bedding 35° at 311;cleavage (?) 46°	7.37	.56	61.22				7.37	.56	61.22

(Continued)

Aitkin County
Sec Ref 1072

Serial No. 47
Hole No. 6 (Cont'd.)
Collar Elevation: 1213.8'
Depth of Hole: 334'
Location: N.E. - S.W.

Date completed: 11/16/50
Drilled by: U.S.Bureau of Mines
Logged by: W. A. Grosh
Type of Drilling: Diamond drill-Core

Depth From	Depth To	Material	Analyses Core Iron	Core Mang.	Core SiO_2	Sludge Iron	Sludge Mang.	Sludge SiO_2	Adjusted Average Iron	Adjusted Average Mang.	Adjusted Average SiO_2
314	319	Gray slate; bedding 50°	8.00	.15	59.56				8.00	.15	59.56
319	324	Gray slate; some iron bands; bedding 45°; vertical band of iron 1/2 inch wise 320 to 322	10.08	.12	57.64				10.08	.12	57.64
324	329	Gray slate; some iron bands; bedding 15°	6.40	.09	62.10				6.40	.09	62.10
329	334	Gray slate; few iron bands; cleavage (?) 30°	7.36	.18	61.32				7.36	.18	61.32
334		Bottom of hole									
Average									7.57	.24	60.45
138	334	Average for hole							12.48	3.05	54.44

Aitkin County
Sec Ref 1072

Serial No. 48
Hole No. 7
Collar Elevation: 1214.3'
Depth of Hole: 392'
Location: N.E. - N.E.

Date completed: 12/2/50
Drilled by: U.S.Bureau of Mines
Logged by: W. A. Grosh
Type of Drilling: Diamond drill-Core

Depth			Analyses								
			Core			Sludge			Adjusted Average		
From	To	Material	Iron	Mang.	SiO_2	Iron	Mang.	SiO_2	Iron	Mang.	SiO_2
0	140	Surface									
140	145					12.36	1.41	55.02	12.36	1.41	55.02
145	151		11.84	.33		10.83	1.14	60.00	11.02	.98	
151	154	Red Slate	12.48	.45		13.80	1.53	54.40	13.30	1.12	
154	157	Red-Light Red Slate	13.92	.76					13.92	.76	
Average									12.33	1.09	
157	160	Red-Light Red Slate. Bedding 50°	25.28	2.36					25.28	2.36	
160	163	Red Slate. Bedding 55° Cleavage 35° Same direction	14.24	1.12		18.13	2.25	50.20	14.63	1.03	
163	166	Red Slate. Cleavage(?) 40°									
166	169	Lt.Red Slate Folded Bedding. Axis of folds 35°	10.80	1.52					10.80	1.52	
169	173	Lt.Red Slate	14.72	.15		17.92	.49	51.00	17.14	.41	
173	176	Pink Slate	4.72	.06		14.88	.51	56.28	12.91	.42	
176	179	Pink-Lt.Red Slate. Bedding 40°	11.76	.68		11.20	1.22	60.60	11.55	.88	
179	182	Lt.Red Slate Bedding 52°	13.36	1.04		13.44	2.13	58.70	13.40	1.53	
182	185	Lt.Red Slate Bedding 25° at 153. Bedding 70° at 154. Cleavage along bedding.	16.61	3.15					16.61	3.15	
185	190	Red Slate. Bedding 45° at 186. Bedding 25° at 188. Cleavage (?) 60°	9.60	.37					9.60	.37	
190	195	Red Slate	20.56	1.77					20.56	1.77	
195	200	Red Slate. Bedding 30°	8.56	.68		15.60	1.10	58.40	13.66	.98	
200	205	Red Slate.	13.76	.80		13.44	.76	62.20	13.51	.77	

(Continued)

Serial No. 48
Hole No. 7 (Cont'd.)
Collar Elevation:
Depth of Hole: 392'
Location: N.E. - N.E.

Aitkin County
Sec Ref 1072

Date completed: 12/2/50
Drilled by: U.S.Bureau of Mines
Logged by: W. A. Grosh
Type of Drilling: Diamond drill-Core

Depth From	Depth To	Material	Core Iron	Core Mang.	Core SiO_2	Sludge Iron	Sludge Mang.	Sludge SiO_2	Adjusted Average Iron	Adjusted Average Mang.	Adjusted Average SiO_2
205	208	Red slate. Bedding 20°. Cleavage 50°.	14.72	.84					14.72	.84	
Average									14.63	1.19	
208	213	Lt.red slate. Bedding 60°.	17.84	.30		13.60	5.79	55.90	14.60	4.50	
213	216	Red slate. Bedding 50°.	9.12	4.57					9.12	4.57	
216	221	Lt.red slate.	9.92	4.61		14.32	6.03	51.90	13.38	5.72	
221	224	Red slate.Some good mang.	9.52	5.16		14.24	4.89	53.30	13.01	4.96	
224	227	Red slate.	10.08	6.19		8.48	4.41	61.30	8.91	4.89	
227	230	Red slate. Bedding 48°.									
230	235	Red slate. Bedding 50°.	10.40	.53					10.40	.53	
235	240	Red slate. One small piece of mang. oxide.Bedding 45°.	10.48	.37		11.68	3.07	61.20	11.11	1.78	
240	245	Red slate.A little chert. Some mang. oxide,Bedding 35°.	14.64	3.31		20.96	4.53	51.28	19.18	4.19	
Average									16.64	3.47	
245	250	Red slate. Bedding 50°.	9.92	.06					9.92	.06	
250	255	Red slate. 6" of solid chert or qtz.	10.24	.80		16.96	.90	63.80	15.88	.88	
255	258	Red slate. Bedding 48°.	13.36	6.62					13.36	6.62	
258	263	Red slate. Bedding 48°.	21.28	1.30		17.12	1.41	59.26	18.38	1.38	
263	268	Red slate. Bedding 48°.	16.96	.18					16.96	.18	
268	273	Red slate. Bedding 53°. Cleavage 27°.	8.72	.12					8.72	.12	
Average									13.91	1.18	

(Continued)

Aitkin County
Sec Ref 1072

Serial No. 48
Hole No. 7 (Cont'd.)
Collar Elevation:
Depth of Hole: 392'
Location: N.E. - N.E.

Date completed: 12/2/50
Drilled by: U.S.Bureau of Mines
Logged by: W.A.Grosh
Type of Drilling: Diamond drill-Core

Depth From	Depth To	Material	Core Iron	Core Mang.	Core SiO_2	Sludge Iron	Sludge Mang.	Sludge SiO_2	Adjusted Average Iron	Adjusted Average Mang.	Adjusted Average SiO_2
273	278	Red slate. Some chert & mang. oxide. Bedding 50°. Cleavage(?) 25°.	12.00	2.92					12.00	2.92	
278	283	Red & gray slate.	15.76	.68		21.28	3.03	53.26	20.15	2.55	
283	285	Chert.	6.72	4.26					6.72	4.26	
285	290	Red slate. Some chert, little mang. oxide. Chert slate contact 10°. (almost vertical)	22.24	10.32		21.60	3.07	54.04	21.76	4.93	
290	295	Red slate.	23.52	12.61		22.40	3.66	48.22	22.48	4.30	
295	298	Red slate.	20.40	2.72		21.12	2.52	51.08	20.73	2.63	
298	301	Red slate. Bedding 48°.	15.68	2.13		18.72	2.29	58.64	17.08	2.20	
Average									18.17	3.45	
301	304	Red slate. Irregular bedding.	24.40	1.49					24.40	1.49	
304	307	Red slate. Bedding 50°. Cleavage 30°.	16.24	2.01					16.24	2.01	
307	312	Red slate. 6" chert at 312.	14.40	1.65		20.08	1.89	55.60	18.04	1.80	
312	317	Red & gray slates.	10.40	2.36		16.96	1.53	59.72	15.86	1.67	
317	320	Red slate. Some chert. Bedding 40°.	24.16	1.06					24.16	1.06	
320	325	Gray slate. Bedding 45°.	10.40	2.13		15.04	1.14	67.28	14.40	1.28	
Average									18.16	1.56	
325	330	Red slate. Bedding 65°.	22.40	.68					22.40	.68	
330	335	Red slate. Bedding 45°.	19.84	1.33		15.84	.70	64.28	17.80	1.01	
335	340	Red slate. Bedding 45°.	23.28	1.41					23.28	1.41	
340	345	Red slate. Bedding 20°.	19.92	.45		26.24	.45	47.46	24.78	.45	

(Continued)

Aitkin County
Sec Ref 1072

Serial No. 48
Hole No. 7 (Cont'd.)
Collar Elevation:
Depth of Hole: 392'
Location: N.E. - N.E.

Date completed: 12/2/50
Drilled by: U.S.Bureau of Mines
Logged by: W. A. Grosh
Type of Drilling: Diamond drill-Core

Depth From	Depth To	Material	Analyses: Core Iron	Core Mang.	Core SiO_2	Sludge Iron	Sludge Mang.	Sludge SiO_2	Adjusted Average Iron	Adjusted Average Mang.	Adjusted Average SiO_2
345	350	Red slate. Some chert at 350. Bedding 45°.	19.20	1.06					19.20	1.06	
350	355	Red slate. Bedding 35°.	16.64	1.02		16.32	.30	60.86	16.46	.61	
355	358	Red slate. Bedding 35°.									
358	360	Gray slate. Some red slate chert. Bedding 35°.	14.72	1.18					14.72	1.18	
360	362	Red slate. Bedding 40°.	20.32	.45		16.00	.53	60.42	17.11	.51	
362	366	Red slate. Some gray slate at 365. Bedding red slate 35°. Gray slate 25°.	14.48	.60					14.48	.60	
Average											
366	367	Dk.red slate & chert.							19.15	.86	
367	372	Red slate. Bedding 45°.	14.64	1.37					14.64	1.37	
372	377	Red slate. Some chert.	22.24	.76		17.92	1.06	60.80	19.06	.98	
377	382	Red slate. Folded bedding. Axis of folds 5°.	25.92	2.13		18.72	1.61	57.02	21.14	1.78	
382	387	Red slate. Some chert. Gray slate at 385'. Bedding 50°.	18.56	1.45					18.56	1.45	
387	392	Red & gray slates. Some chert. Bedding 45°. Cleavage 20°.	16.48	1.30					16.48	1.30	
Average									17.85	1.38	
140	392	Average for hole							16.55	1.77	