DuPont Black Powder Works
Hagley Museum
July 1963

An archaeological survey which made use of geophysical prospecting techniques was undertaken over several locations of archaeological importance at the site of the DuPont Black Powder Works, Hagley Museum, Wilmington, Delaware. The instruments used were a portable seismograph, metal detectors, and a resistivity apparatus. The survey was directed by Hamilton H. Carson of the University Museum, Philadelphia. Dr. Walter J. Heacock, museum director, kindly permitted the use of the site for testing purposes. Mr. James Akerman, of the Hagley Museum staff, provided valuable archaeological information and assistance.

Refraction Seismograph

The major object of the survey was to test a new seismic method for the location of buried walls. The location chosen for the test was the site of a raceway near the upstream boundary of the original DuPont land purchase of 1802. Following the purchase, this portion of the race was never used and subsequently filled in. Therefore, it was thought that this structure would provide an excellent proving ground for seismic testing if it still existed beneath the surface.

Method of Survey

The primary use of the refraction seismograph is the location of bedrock depths for engineering purposes. Since bedrock conveys a sound wave at a higher velocity than that of the overlying surface material, it is proposed here that a buried wall will have the seismic properties of bedrock under certain circumstances:

1. If the density of the wall is high enough to contrast sufficiently with the density of the surrounding material. and,

2. If the level of the wall is high enough above the level of bedrock to be distinguished from it. Under these circumstances the wall will transmit a high percentage of refracted seismic waves when both the energy source and the receiver of the seismograph are placed on a line directly above and longitudinal to the line of the suspected wall. The presence of the wall will be indicated by the reception of sound waves at a high velocity at a depth too shallow to be considered as bedrock transmission.

Results of the Survey

The results of the survey are shown on the accompanying plan. The cross-hatched areas indicate high shallow velocity locations. The single lines are those points through which readings were taken. The void spaces in the cross-hatched areas indicate that the racewall, although still existing, is discontinuous at several points. **The density of cross-hatching indicates the degree of probability of archaeological features.**

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ELEUTHERIAN MILLS - HAGLEY FOUNDATION INCORPORATED

Greenville · Wilmington 7 · Delaware · OLympia 8-2401

FOR IMMEDIATE RELEASE

SUMMARY: Archaeological Search at Hagley Museum (by electronics)

Wilmington, Delaware, 19 July 1963 --- The stone walls of a now buried section of a millrace along the Brandywine, which was in existence prior to E. I. du Pont's purchase of the property for his powder mills in 1802, are being sought by a staff member of the University of Pennsylvania Museum using an "electronic divining rod." The area is now a part of the Hagley Museum property. Hamilton H. Carson, a graduate student at the University of Pennsylvania, is conducting the experiment with an engineering seismograph coupled with a drop hammer of his own invention. A ten-pound brass weight, connected to the seismograph by wires, slides down a rod approximately three feet in length and strikes a metal baseplate about ten inches in diameter. The hammer device is gradually moved away from the seismograph along a tape measure placed on the ground. Noise made by the hammer is timed over a measured distance by the seismograph in thousandths of a second. Sound waves encountering a denser material beneath the soil such as a buried stone wall pass through more rapidly. By charting the times required from various points within the search area, Carson is able to chart location of underground walls and other objects.

Last summer he used the device at the pre-Civil War rifle works at Harper's Ferry, where he discovered a stone-walled water turbine bay with a nine foot diameter. The installation was about a century old. He has plans for performing similar explorations at Fort McHenry, ~~near~~ at Baltimore. His work at Hagley will continue for this week.

Besides his work with the seismograph, Carson has also successfully attempted archaeological exploration with metal detectors, ~~similar~~ one which has greater range than to military mine detectors,

MORE

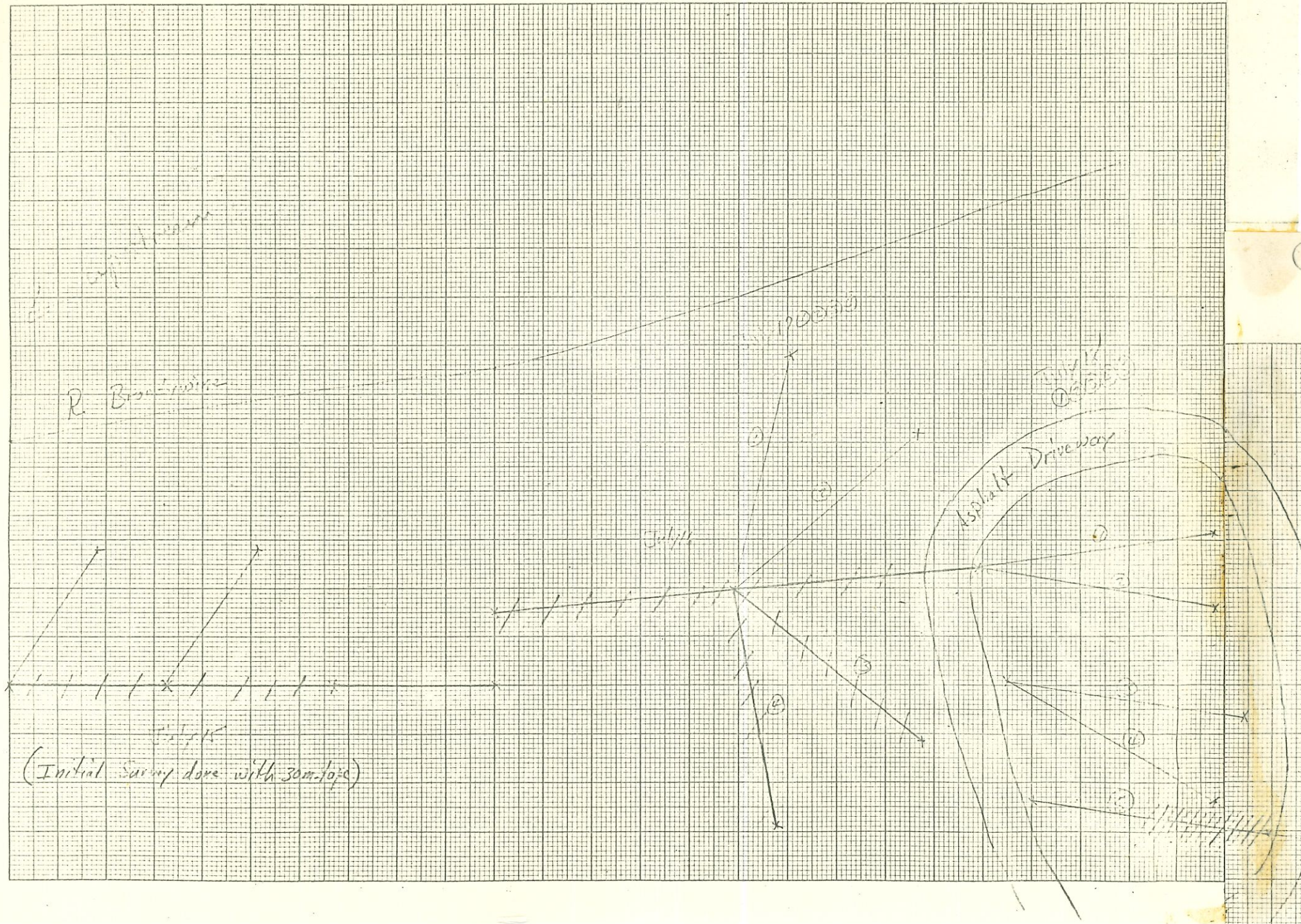
at Isle Royale in Lake Superior
particularly ~~in northern Michigan and southern Ontario~~ where he sought copper deposits which had been worked by pre-historic Indians. He has tried the device at Hagley with definite indications of metallic objects underground.

over a year
Carson has worked ~~two-and-a-half years~~ perfecting his electronic searching device. He considers the Hagley Museum property "an ideal proving ground" because location of many of the former buildings is known from property surveys in the museum's files. By first probing and charting a general area known to have been occupied by a structure, Carson can then compare his findings with the surveys. The Hagley Museum does not intend excavating the site of the original raceway, according to its director, Dr. Walter J. Heacock, but permitted Carson to conduct his experiment which should confirm the location of the race which was evidently filled when alterations were made by E. I. du Pont. The race had been dug late in the 18th century to supply water power for a textile mill operated by Jacob Broom, who sold the property to du Pont.

- 30 -

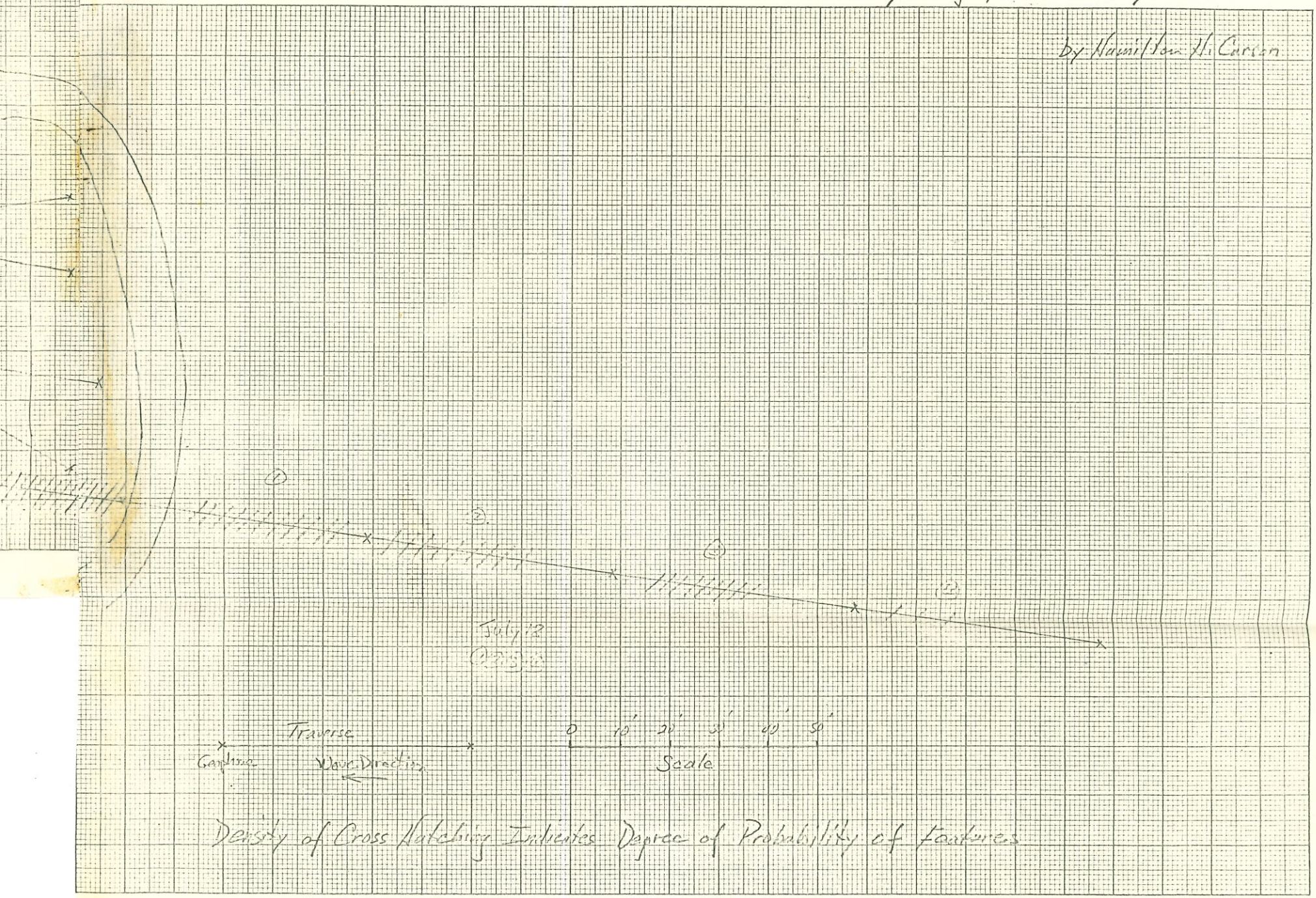
J. P. Monigle
OL 8-2401 (day)
1-215-93-2-2280 (eve)

1 Cm = 10'



Seismic Surveys Hagley Museum July 1963

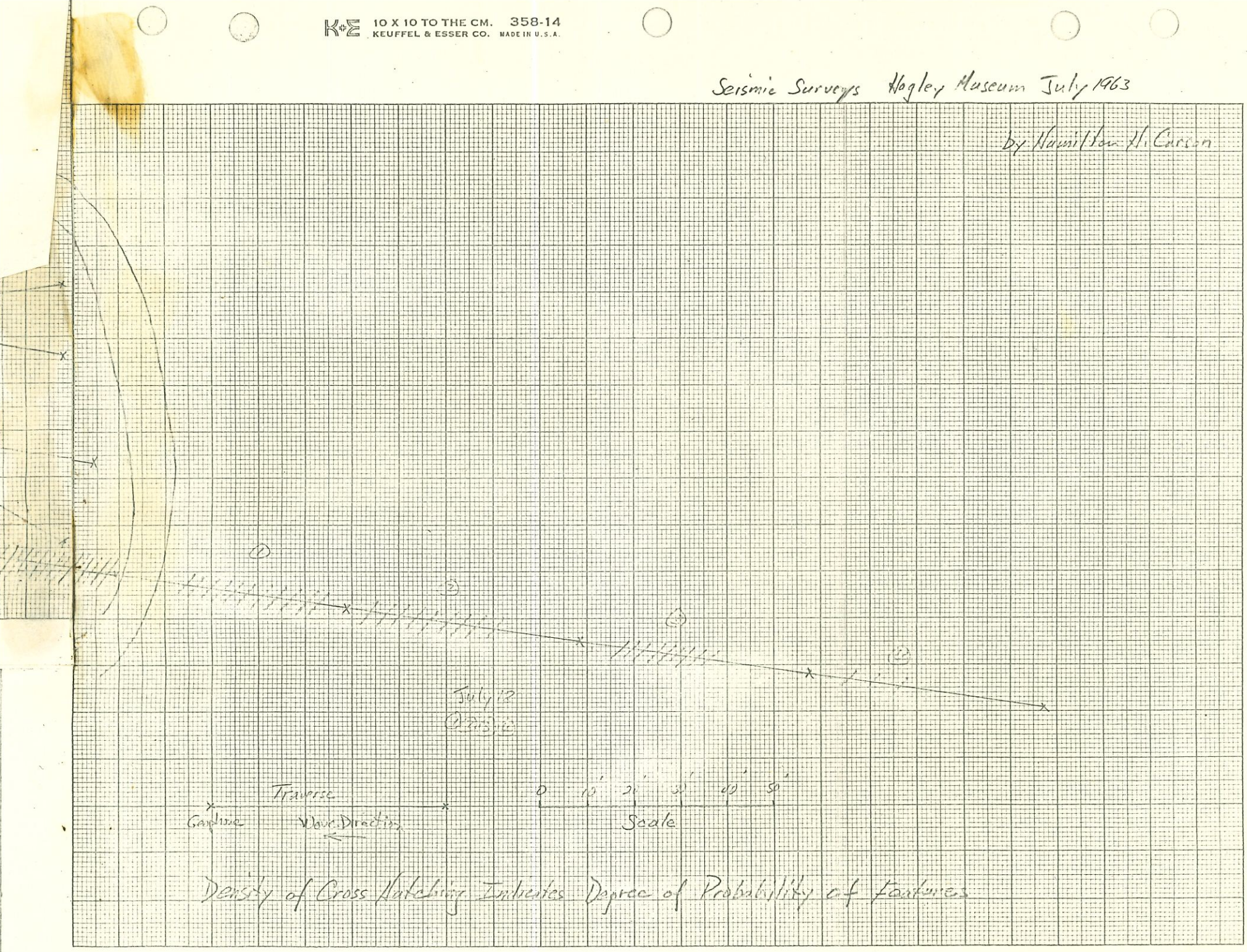
By Hamilton H. Carson



Density of Cross Hatching Indicates Degree of Probability of Features

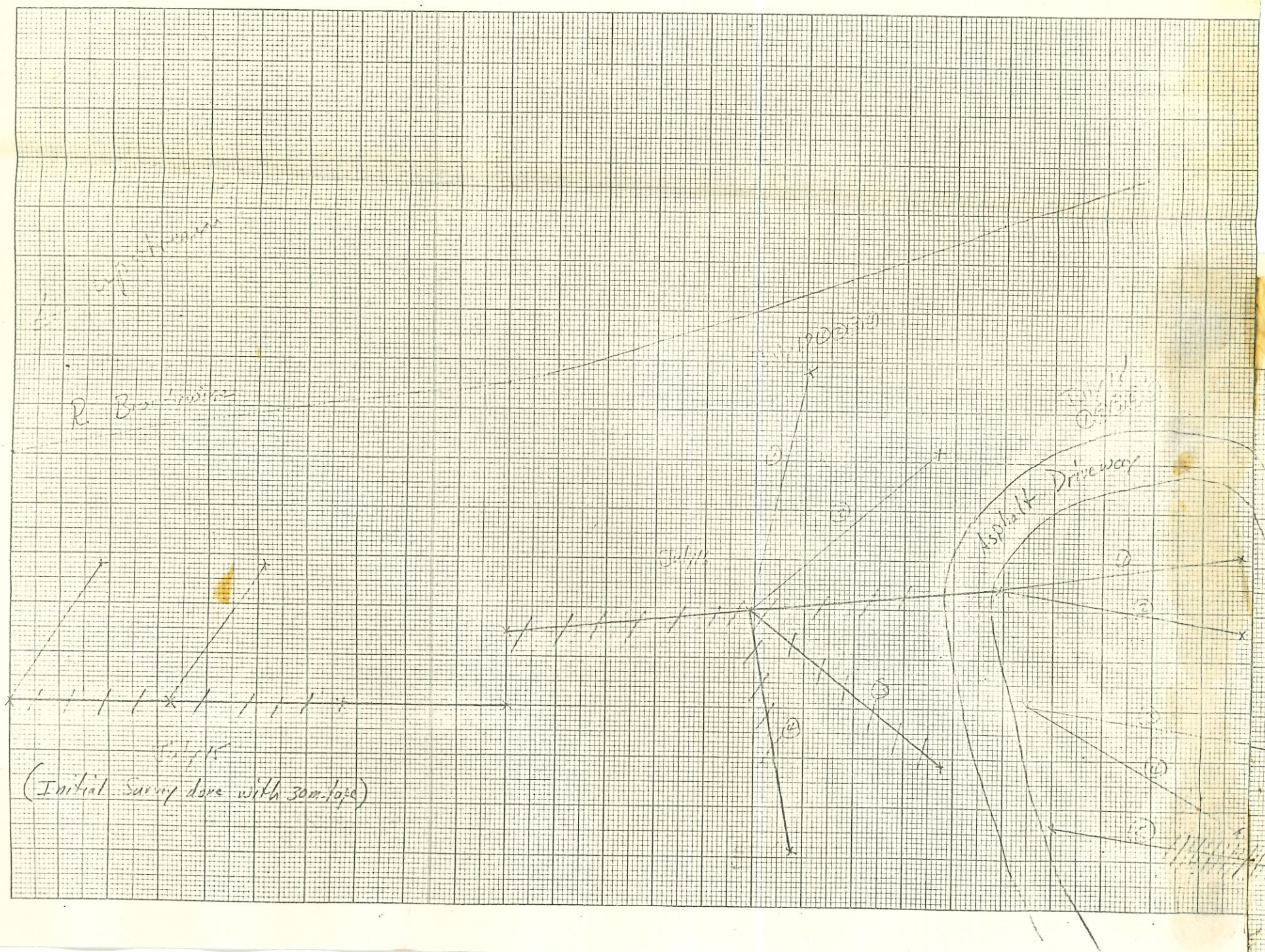
Seismic Surveys Hagley Museum July 1963

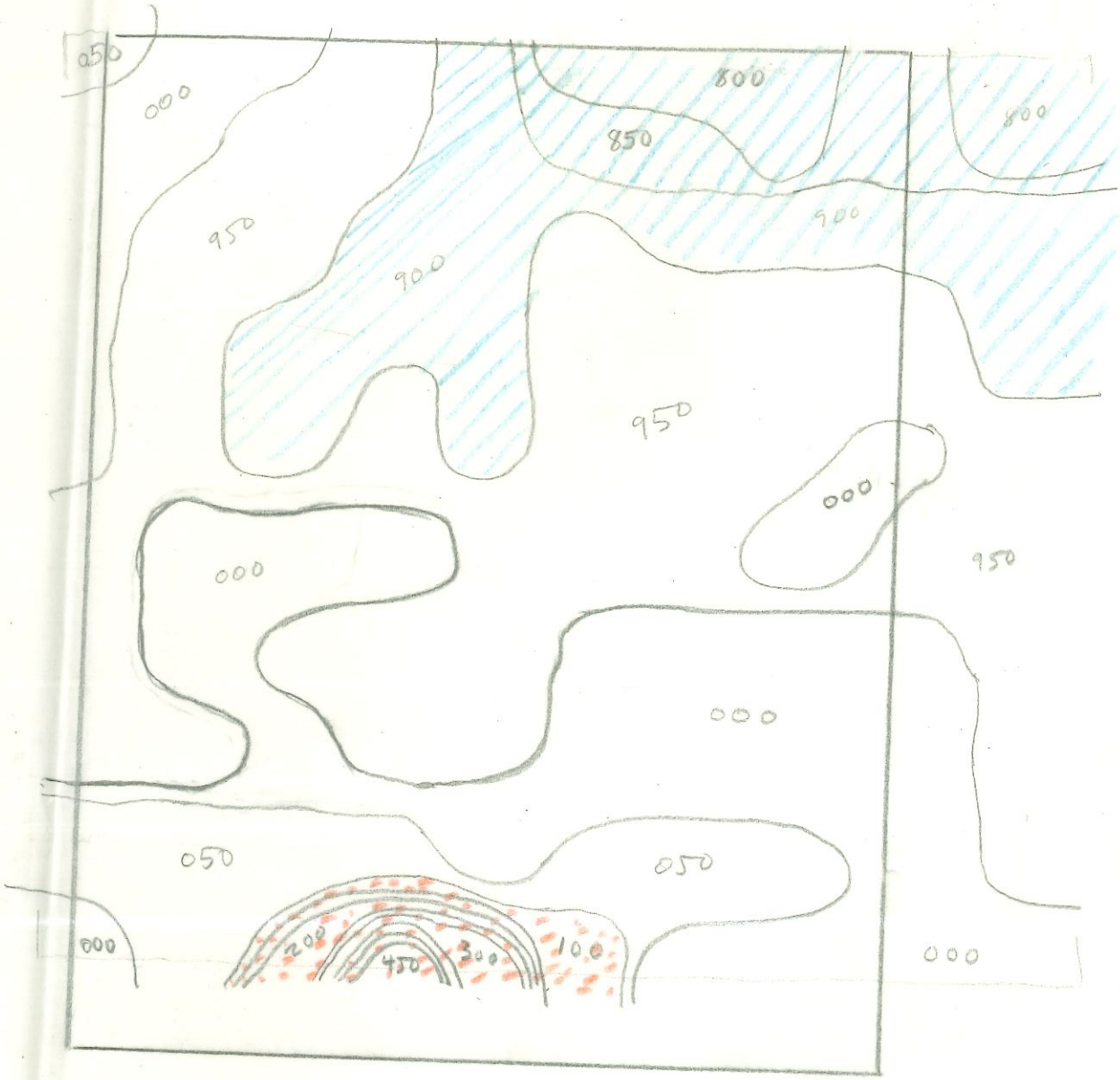
By Hamilton H. Carson



Density of Cross Hatching Indicates Degree of Probability of Features

1 Cm = 10'





range: 2766 – 3429
contour interval = 50 PMU
numbers include highest within that zone
thus: 700 = 650 – 700

grid: 8 x 10 m.

high:

low:

PROTON MAGNETOMETER
GRID # 3

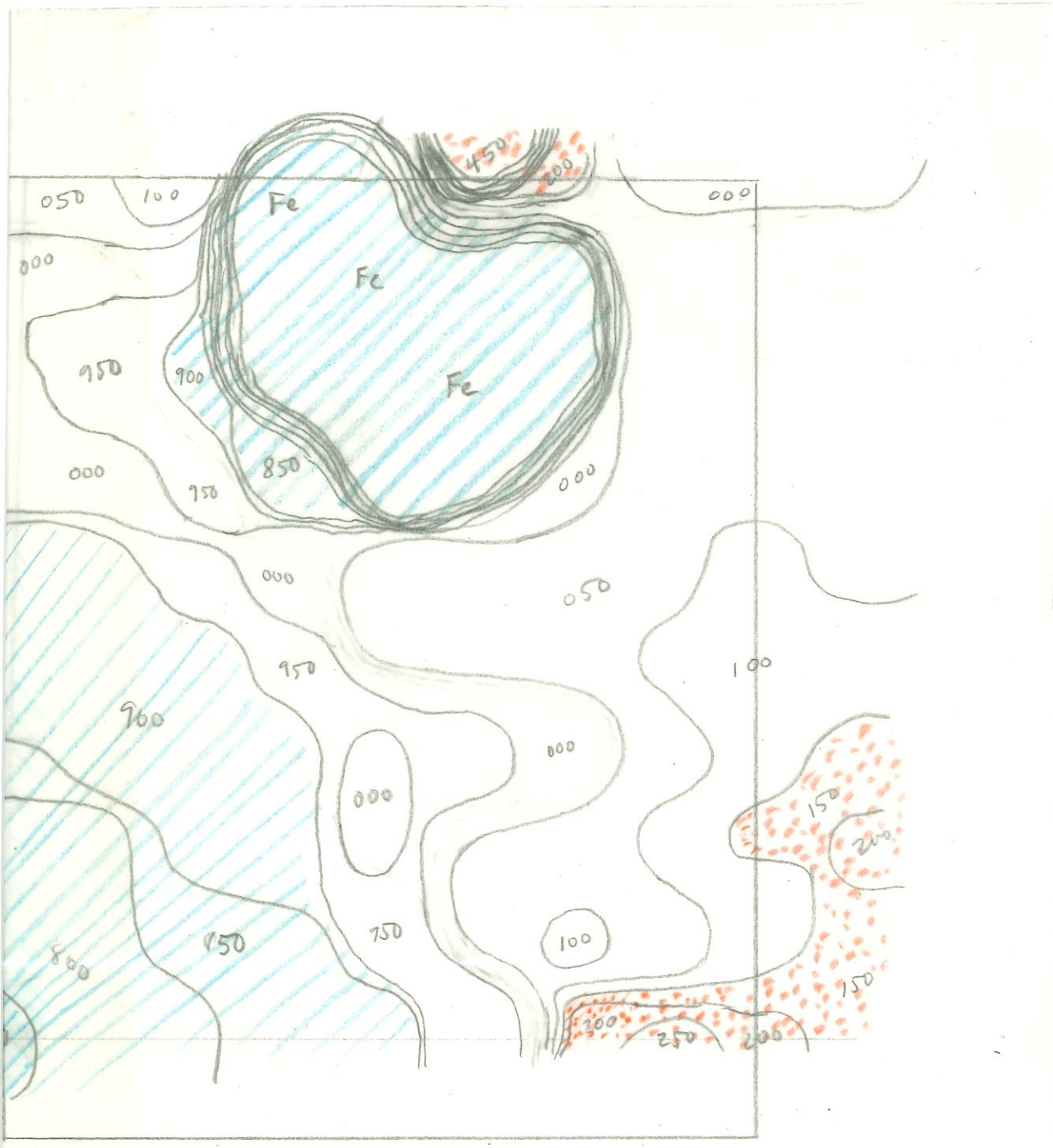
GRID #2
GEOHM

X = tree

contour intervals:
units of 2

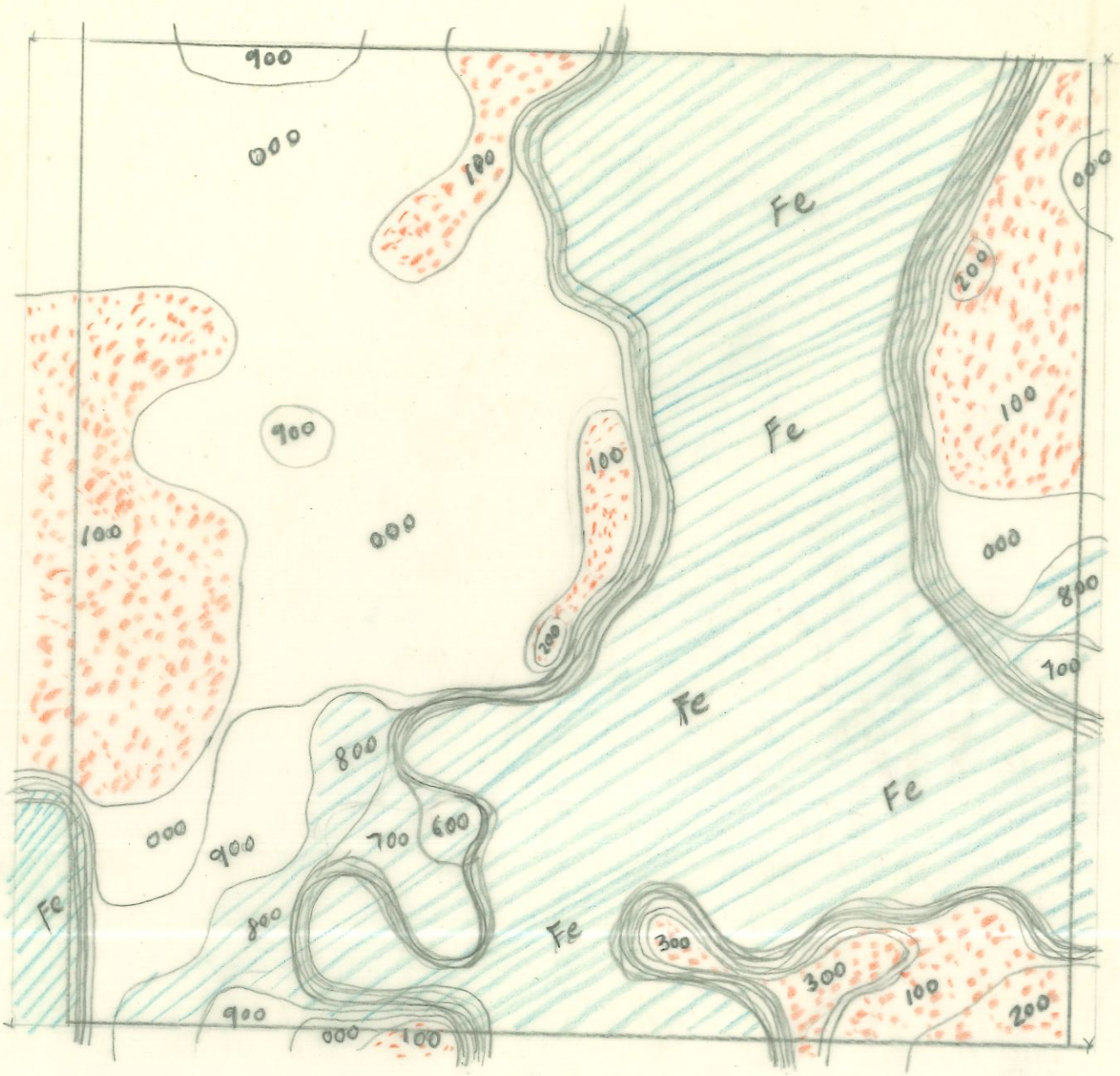
range: 8.6 - 26.5
numbers include highest in that zone
thus: 14.5 = 12.5 - 14.5

□ = grid 8 x 10
high: 20.5+
low: 12.5-



contour intervals: 50 PMU
range: 735 - 240
□ = grid 8 x 10 m
numbers include highest in that zone
thus: 800 = 750-800
▨ = low 900 -
▨ = high 150+

PROTON MAGNETOMETER
GRID 2



GRID #4

PROTON MAGNETOMETER

contour intervals = 100 PMU

range: 2546 - 3291

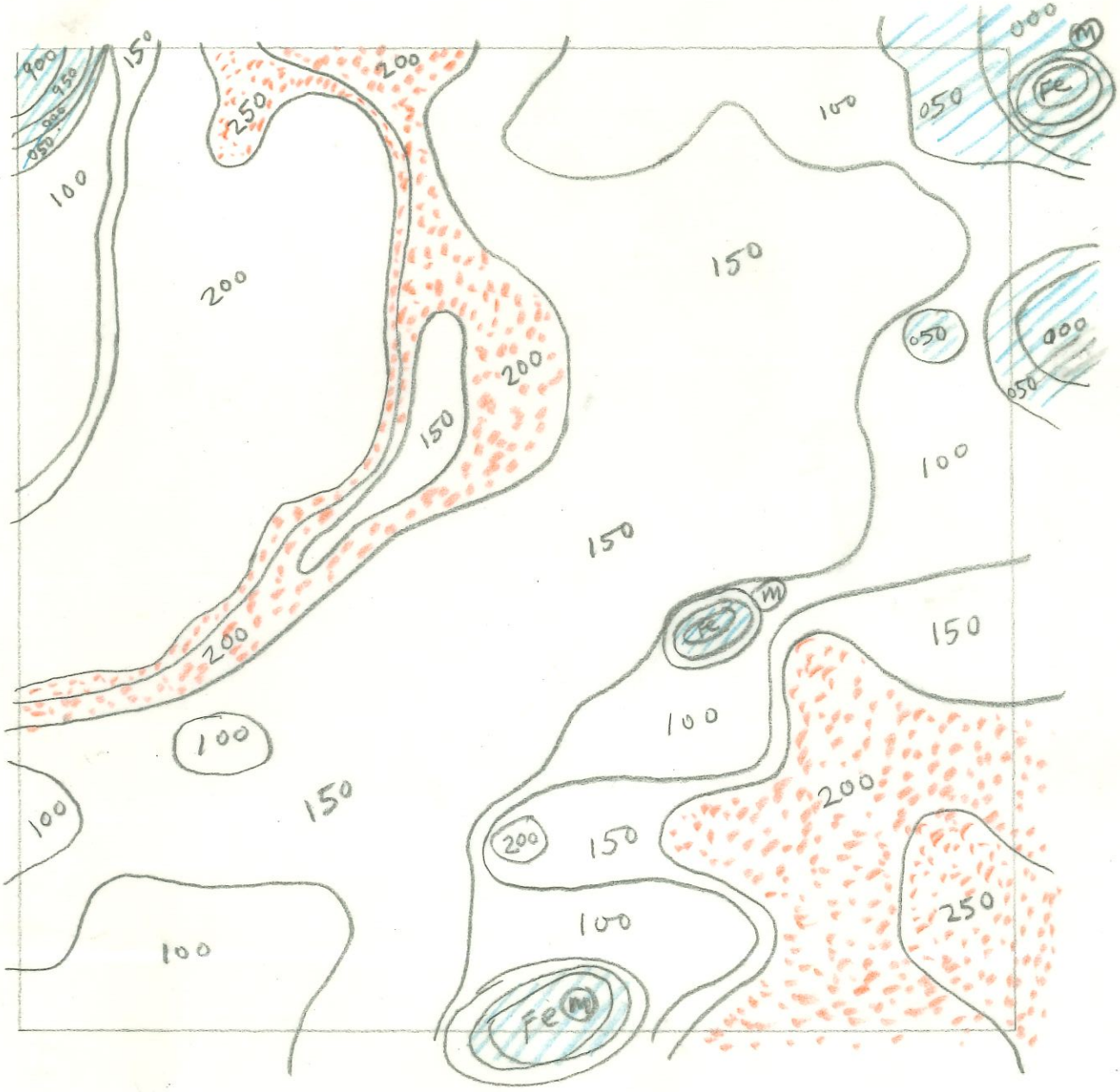
numbers include highest in that zone
ie 600 = 500-600

□ = grid 10x10m

low: 800-

high 100+

N



range: 2896 - 3248

contour interval = 50 PMU
numbers include highest in that zone

Northeast of GRID 1

□ : grid 10 x 10 m.

high : ▨

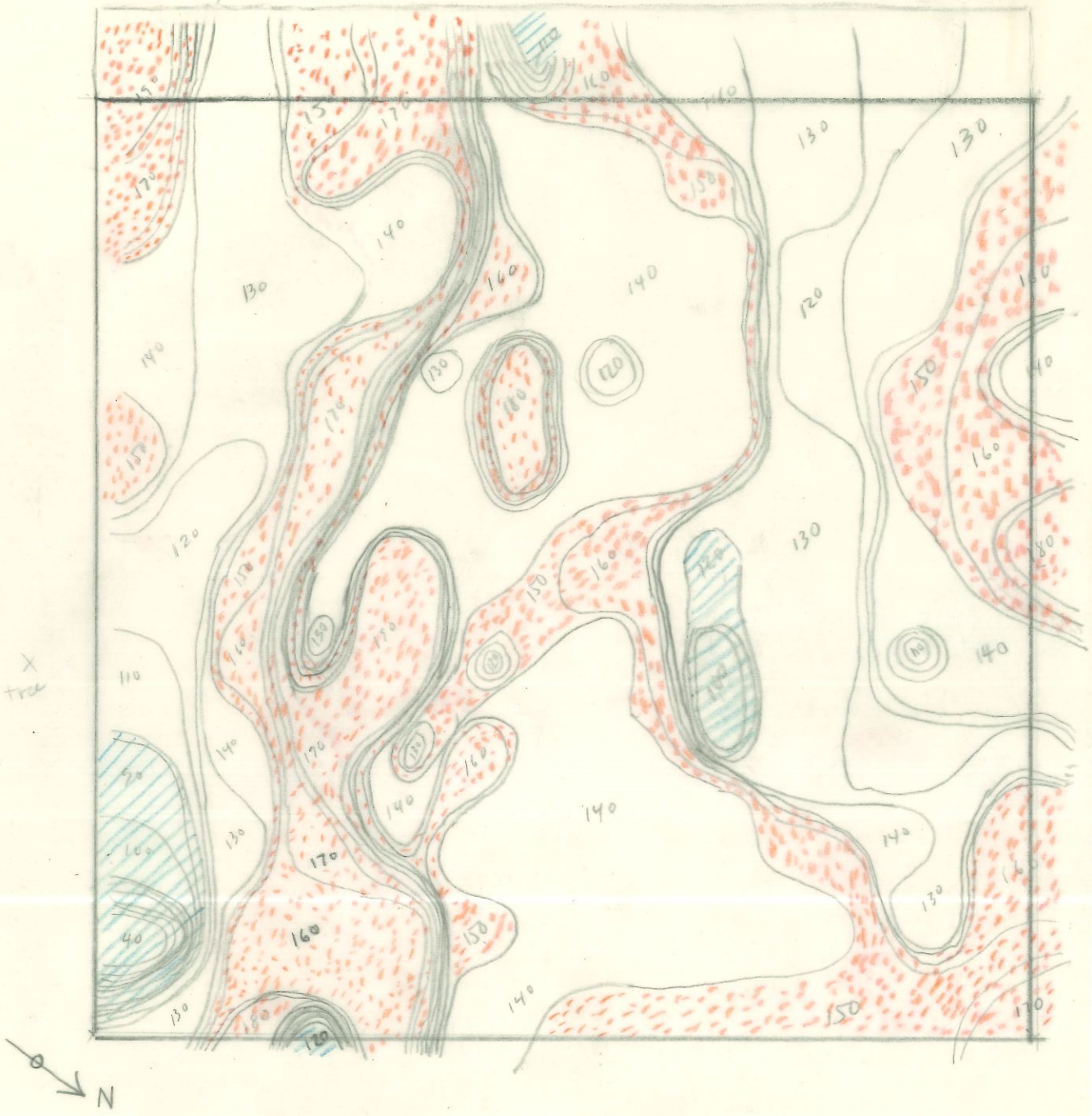
low : ▨

(M) Fe checked out by M-scope

PROTON MAGNETOMETER

GRID 5

N



GRID #1

Range = 35-190

CONTOUR Intervals = 10 PMU

resist = 40/120 (low readings)

□ = grid 10x10m.

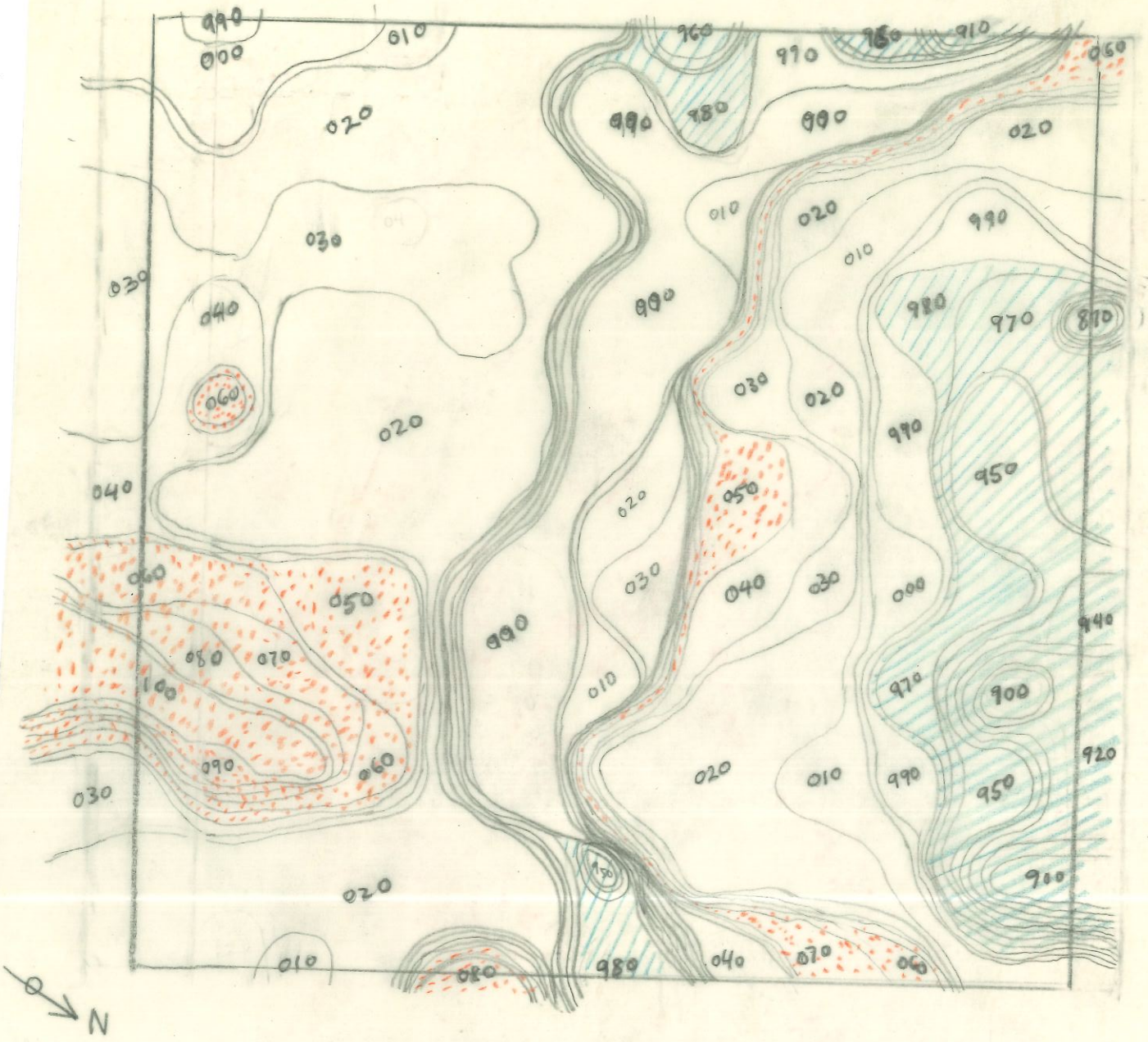
numbers include highest in that zone

ie 40 = 30-40

high: 150+

low: 120-

GEOHM



GRID 1

low:
high:

range: 856 – 993

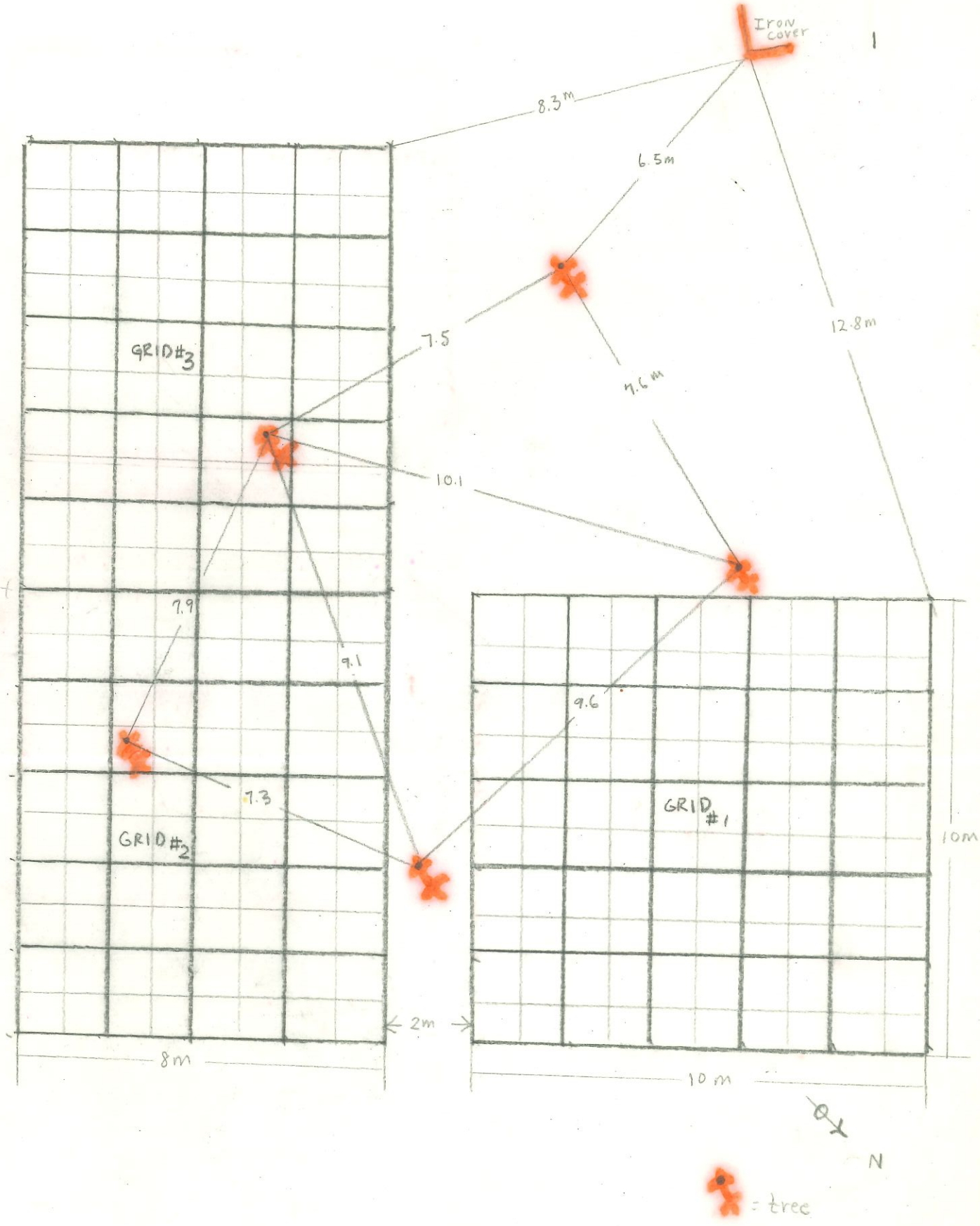
CONTOUR INTERVALS AT 10 PMU

PROTON MAGNETOMETER

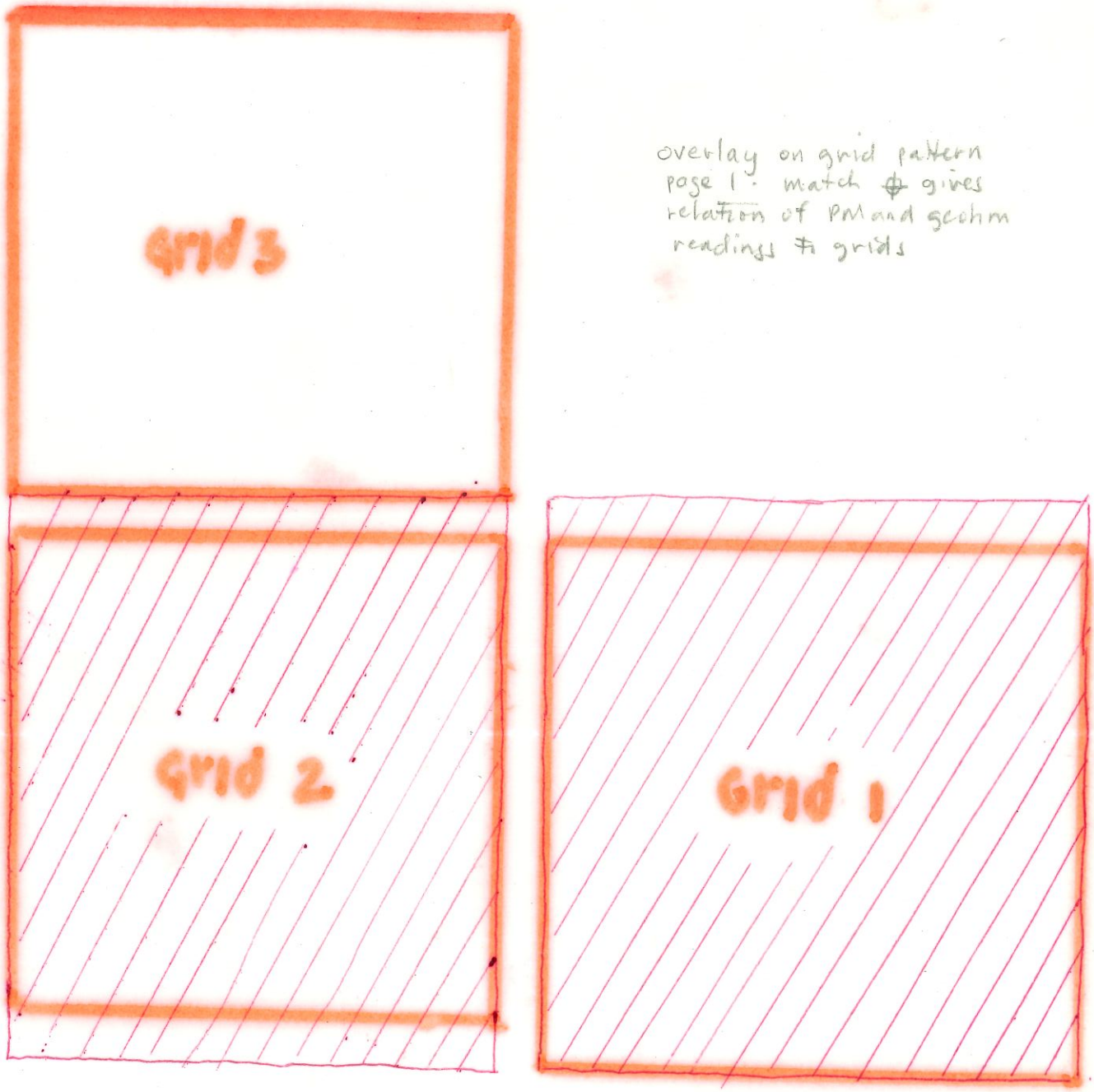
860/000 = resist. (low readings)

NUMBERS include highest in that zone (ie 860 = 850-860

□ = grid 10x10 m


Iron cover
1
8.3m
6.5m
12.8m
7.5
9.6m
10.1
7.9
9.1
9.6
7.3
GRID #3
GRID #2
GRID #1
2m
8m
10m
10m
N
= tree

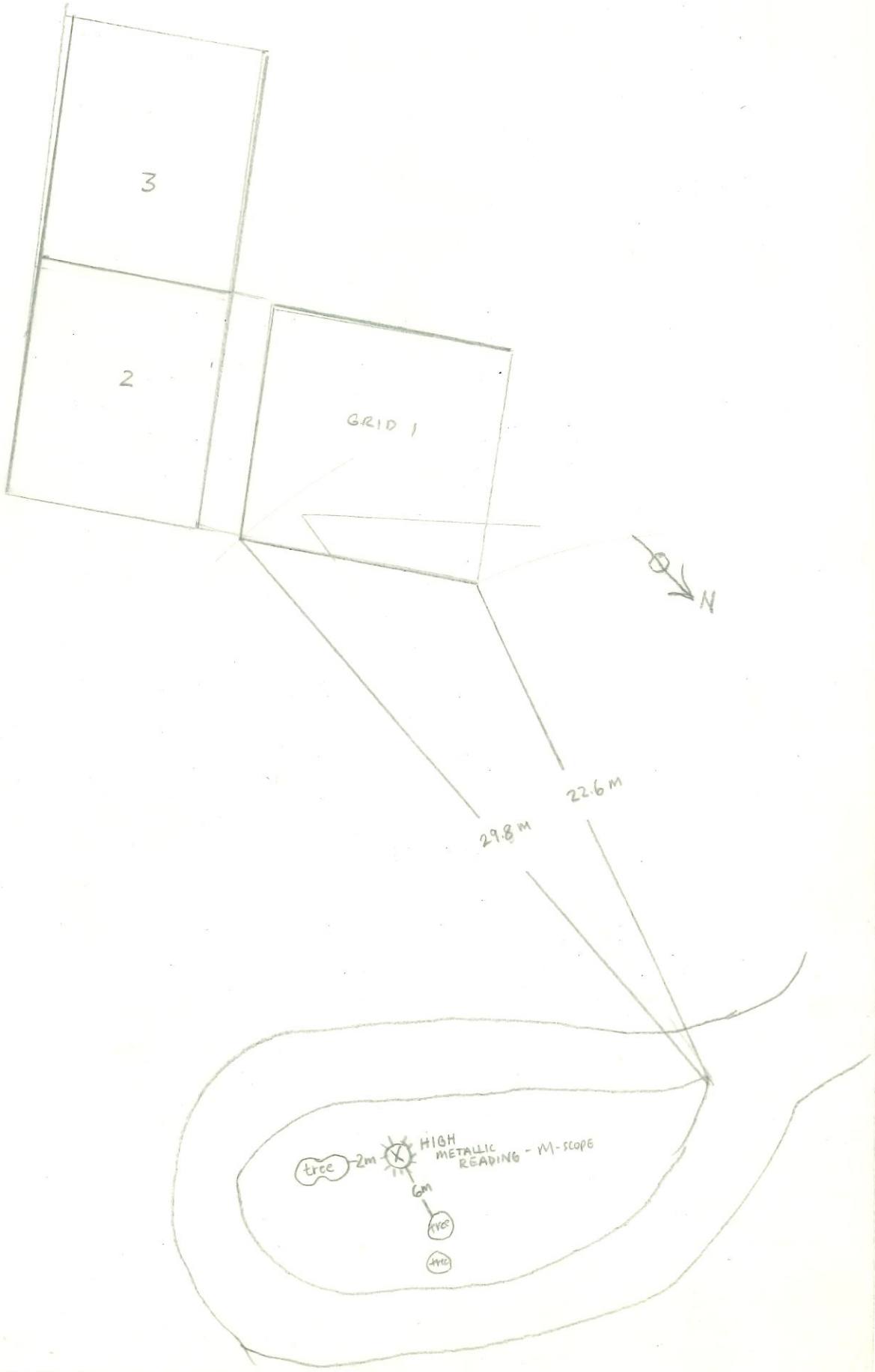
scale: 1" = 3m

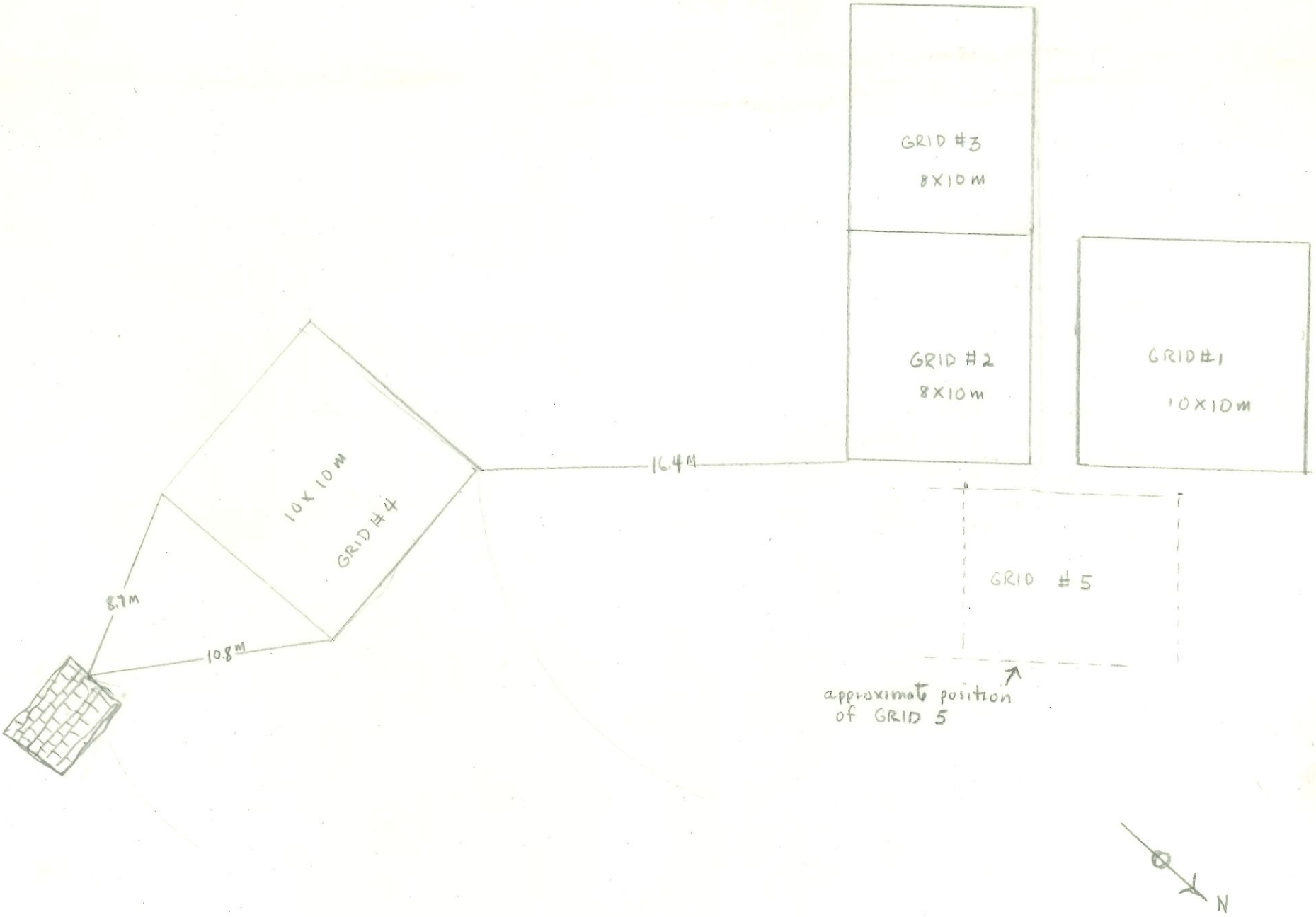


overlay on grid pattern page 1. match ⊕ gives relation of PM and geohm readings to grids

PROTON MAGNETOMETER

GEOHM READINGS


3
2
GRID 1
N
22.6 M
29.8 M
tree
2m
HIGH METALLIC READING - M-SCOPE
6m
tree
tree

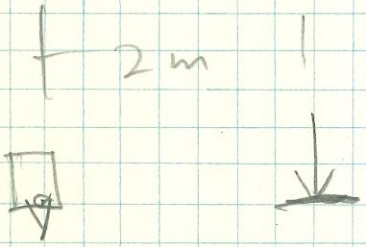

GRID #3
8X10M
GRID #2
8X10M
GRID #1
10X10M
16.4M
10X10M
GRID #4
8.7M
10.8M
GRID #5
approximate position
of GRID 5
N

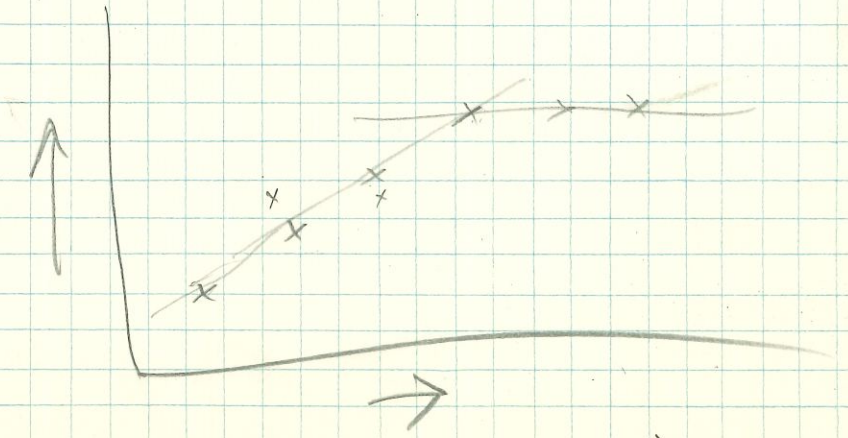
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

× 11.0 × 11.4 × 9.8 × 10.2 × 10 × 11.2 × 11.2 × 14.0 × 12.0 × 13.5 × 11.8 × 14.7 × 13.9 × 19.0 × 15.4 • 20.0 • 17.2 • 18.8 • 18.8 • 36.2 • 25.8 • 39.4 • 32.2 • 41. 41.? • ×

? ? ?

10.5





GEOHM LINE Between points = 1m.
X1 scale

N

2m	3m	4m	5m	6m
10.5	11.5	13.25	13.25	34.25
23.5	28.25	13.0	30.75	34.0
23.0	29.0	13.0	13.0	34.0
39.75	23.25	12.75	13.0	34.0
23.0	11.25	12.5	13.25	33.5

7m	8m	9m	10m	11m
61.5	40.0	83.50	68.0	71.0
61.25	40.0	68.75	68.0	70.5
61.0	47.75	65.5	68.50	70.75
61.0	17.0	64.50	68.50	71.0
61.0	39.0	65.0	68.50	70.25
	38.25			

11m	12m
74.25	76.75
73.75	77.0
74.0	76.75
73.5	78.0
73.25	76.5

1 m

6 1/2
6 1/4
18
18
6

0 m

8 1/2
22 1/4
8 1/4
7 1/4
12 1/2

- 1 m

11
10 1/2
24
11 1/4
10 3/4

- 2 m

29 1/4
12 1/4
15 3/4
12 1/4
11 3/4

- 3 m

34 1/2
26
26
17 1/2
25 3/4

- 4 m

15 1/4
201 3/4
15
14 3/4
14 3/4

- 5 m

40 3/4
28
28 1/4
27 1/4
27 1/4

- 6 m

27 3/4
196 3/4
89 1/4
17 1/2
27 1/4

- 7 m

74 1/2
10 1/2
28
28
27 3/4

- 8 m

77
77
75 1/2
76 1/2
76 1/4

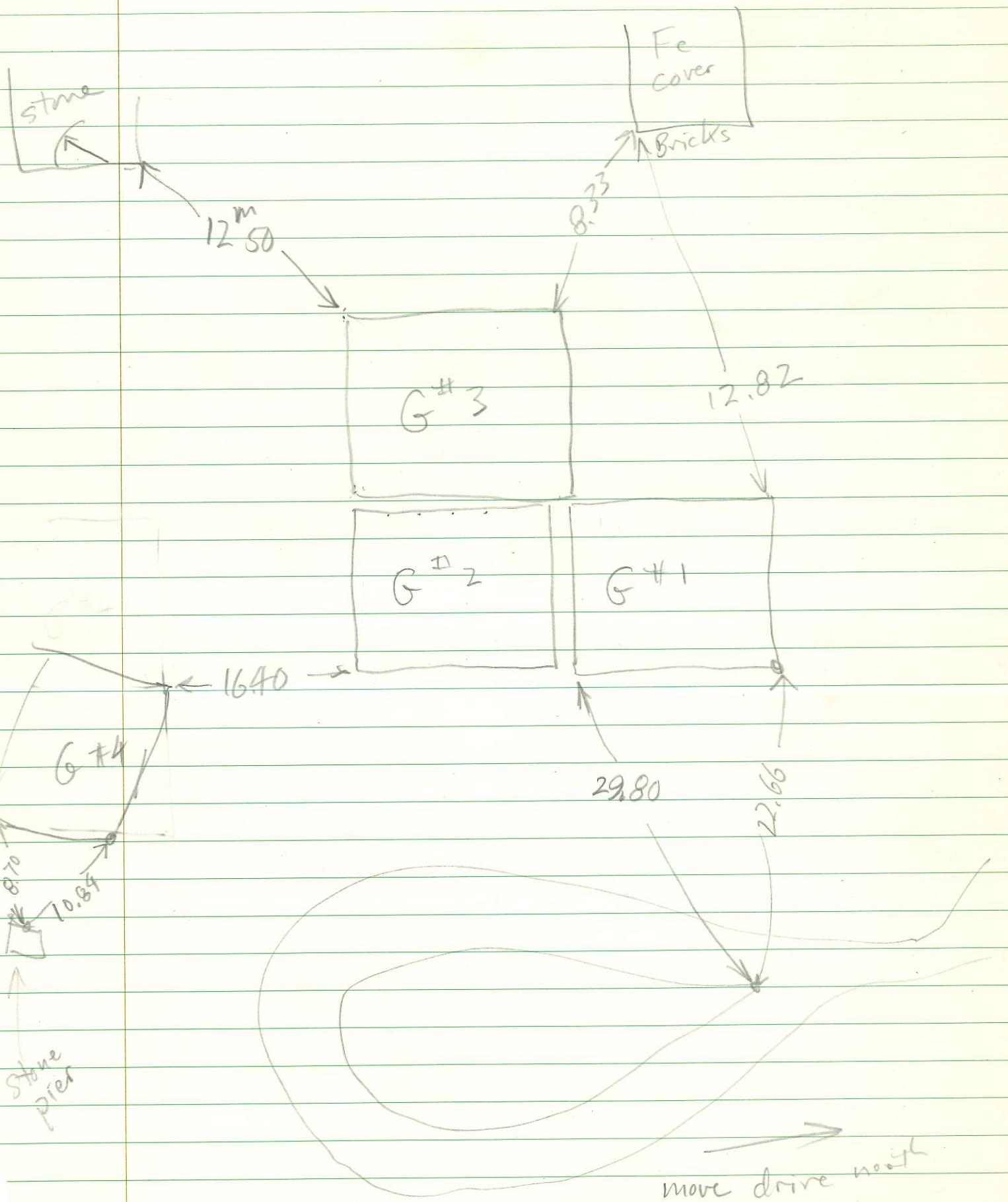
- 9 m

113 1/4
89
81 1/4
78 1/4
80 3/4

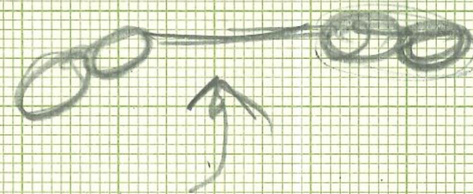
- 10 m

84 1/2
109 1/4
109 1/2
84
108 3/4

5/2/64 Hagley Mills
Upper Electrician Yard



396 **400**



=100

13

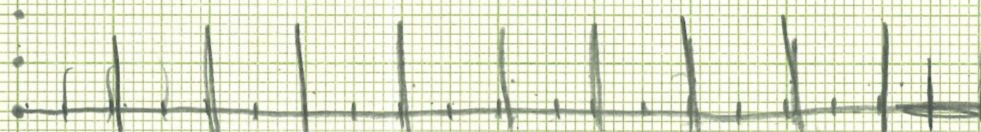
1300ft

250

1250=5

20
10
200

20
11
20
+20
220

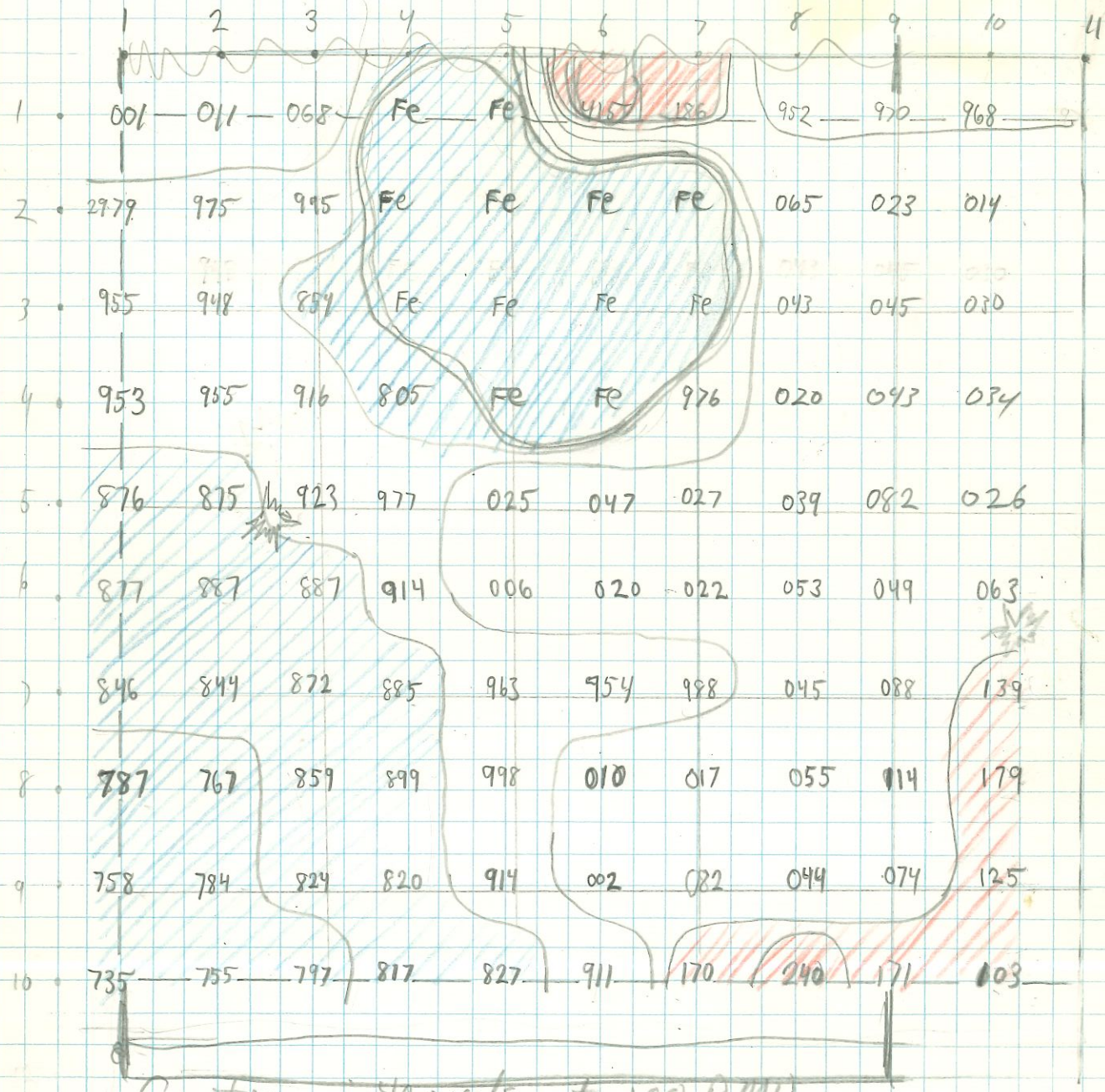


20

726

220
3.3
660
660
726.0

P. M. GRID #2 5/2/64



Contour intervals at 100 PMU

— — edge of grid

2972

42971

8 8 7
9 7 0
9 6 8

2970

2971

GRID #3 Pr. Mag.

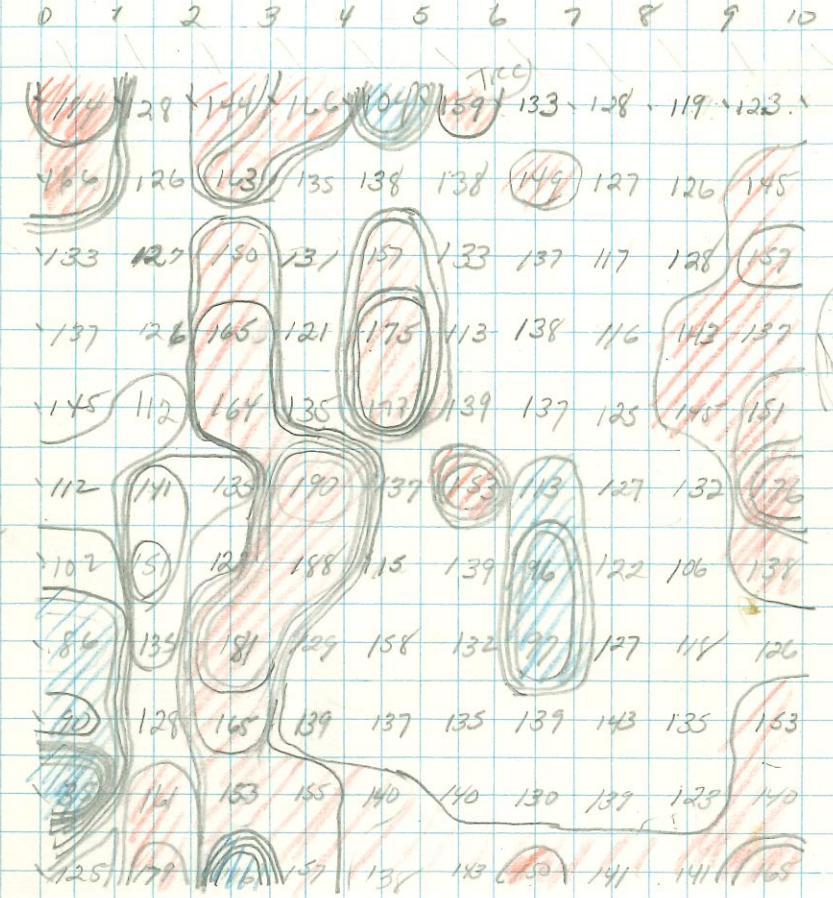
	1	2	3	4	5	6	7	8	9	10	11
1	43020	982	956	926	875	772	769	766	823	772	
2	.988	992	943	906	849	824	834	783	833	800	
3	.967	943	927	878	869	839	884	876	880	859	
4	.967	930	893	895	881	928	918	903	934	867	
5	.962	915	889	942	898	922	906	947	952	909	
6	.932	951	965	956	926	904	924	952	935	940	
7	.949	963	923	904	943	964	962	982	963	944	
8	.935	946	951	943	900	962	977	990	956	934	
9	.002	022	037	041	955	001	007	004	954	933	
10	.994	025	154	429	298	080	988	962	967	970	

on top of Grid 2

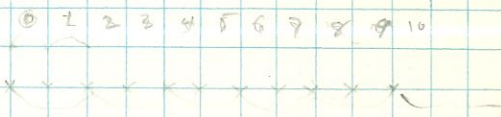
X = TREE

not: this is slightly less than should be for 10m x

Geohm Grid #1



retraced in 3 cm units



PGM GRID #1 5/2/64

	1	2	3	4	5	6	7	8	9	10	11
1	993	987	994	009	011	013	959	983	950	906	051
2	016	997	012	020	018	994	973	991	956	017	014
3	028	008	023	031	034	014	001	016	005	987	008
4	029	031	011	011	026	997	998	002	971	961	965
5	025	058	015	010	028	994	021	018	987	945	966
6	039	020	020	017	013	012	048	036	983	944	965
7	056	060	049	046	994	027	032	028	998	970	940
8	098	077	064	046	995	006	013	017	963	894	912
9	125	082	096	060	994	011	012	009	990	948	917
10	114	105	104	016	011	944	011	012	008	903	904
11	108	120	107	111	076	975	033	070	058	023	025

N

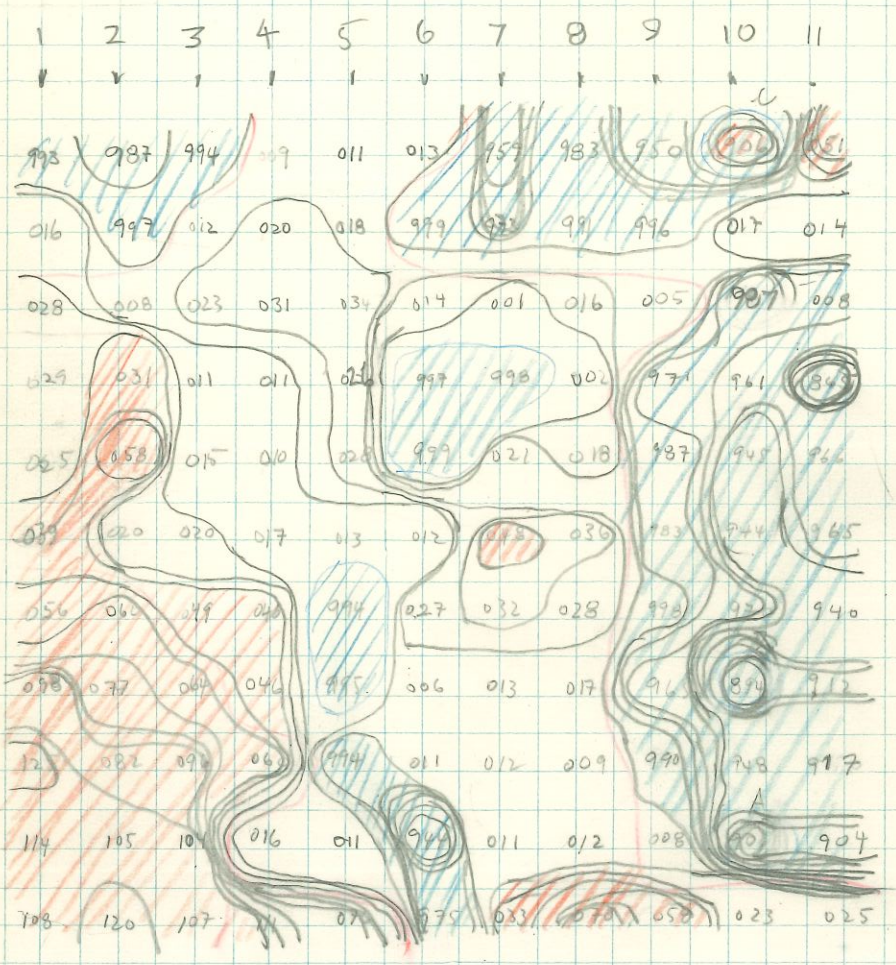
PMU = 429

--- ~~rdg~~ grid

Gerhm Grid #1

	2	3	4	5	6	7	8	9	10	11
1	184	128	144	166	104	159	133	128	119	123
2	166	126	163	135	138	138	149	127	126	145
3	133	127	130	131	157	133	137	117	128	157
4	137	126	165	121	175	113	138	116	143	137
5	145	112	164	135	177	139	137	125	145	151
6	112	141	135	190	137	153	113	127	132	176
7	102	151	127	168	115	139	96	122	106	138
8	86	135	181	129	158	132	97	127	118	126
9	90	128	165	139	137	135	139	143	135	153
10	35	161	155	155	140	140	130	139	123	140
11	125	179	116	157	138	143	150	141	141	165

P.M. GRID # 1 5/2/64



B A

A

B

A

N N

C - no

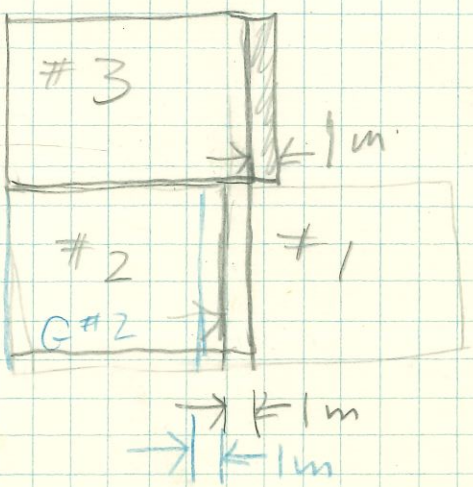
B - no

A - no

PMV = 429 - -

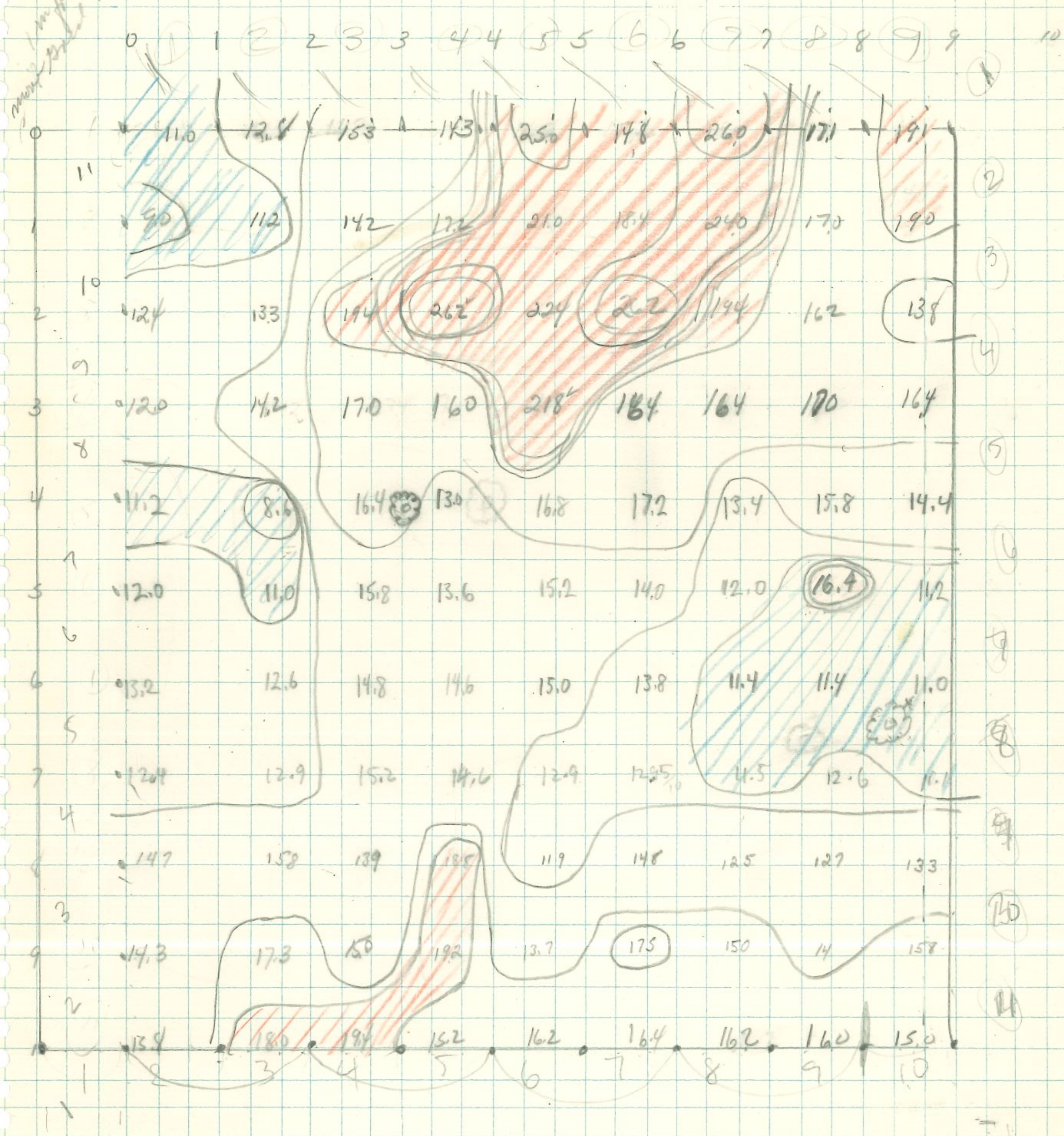
Interval = 1 m

Contour intervals at 10 PMV



Upper Eleutherian Yard
Hagley Mills

Geom Grid #2



range 8.6 – 26.2

units of 2

— edge of grid.

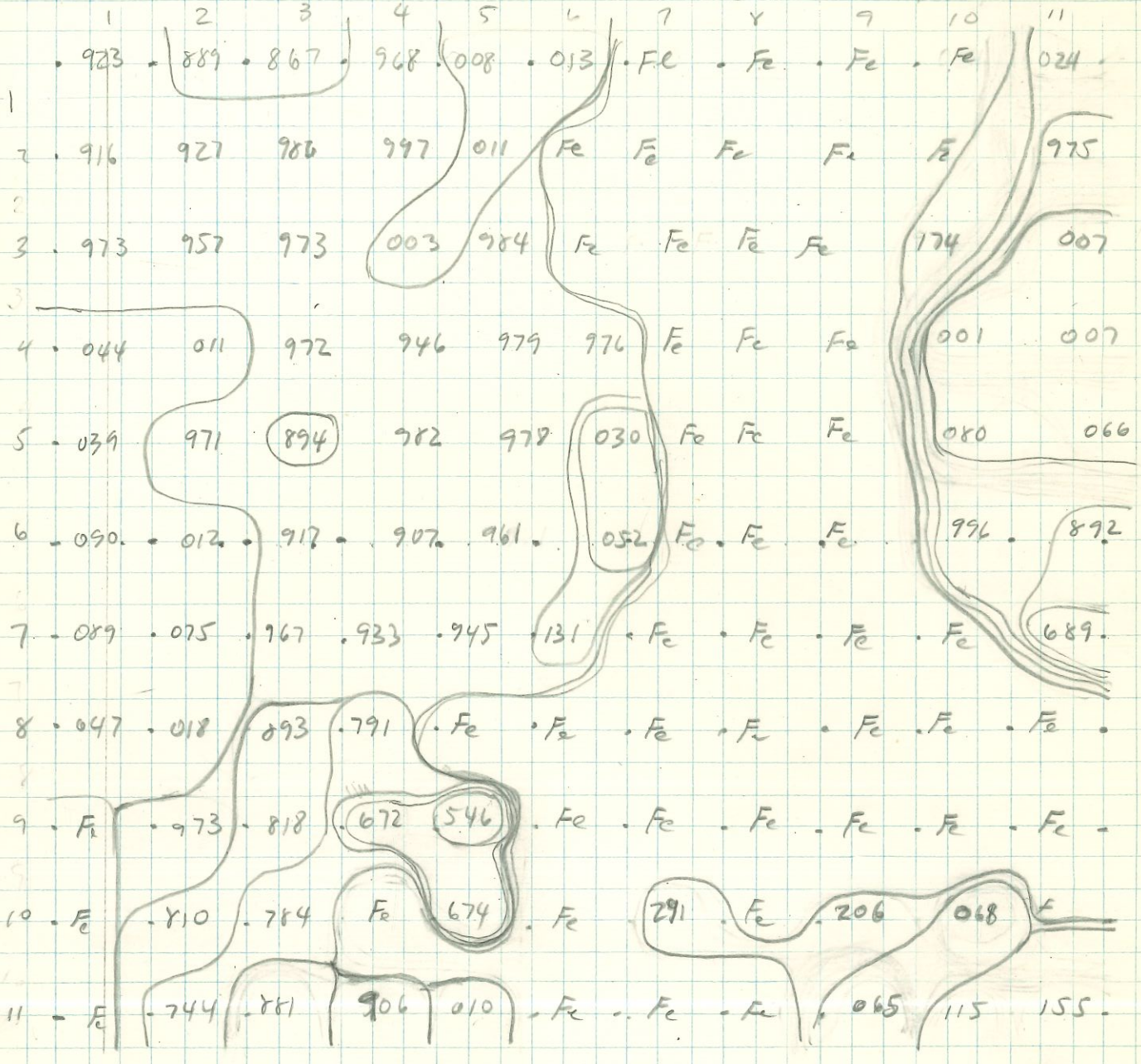
line up grid with ? PM 2 / grid 2

12^{50}

top of #3

* Tree

Prof. M. GRID #4



current contouring

contours = 100 pmu fr. 001
2546 - 3291

N

10 20 700
30 1000
20
10

43055
43055
43055
43055

w/o Henry

43045
45
46

E Henry

43054
54
54

Back of 60t. N

3053
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Back of 60t. S

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In between

E-W

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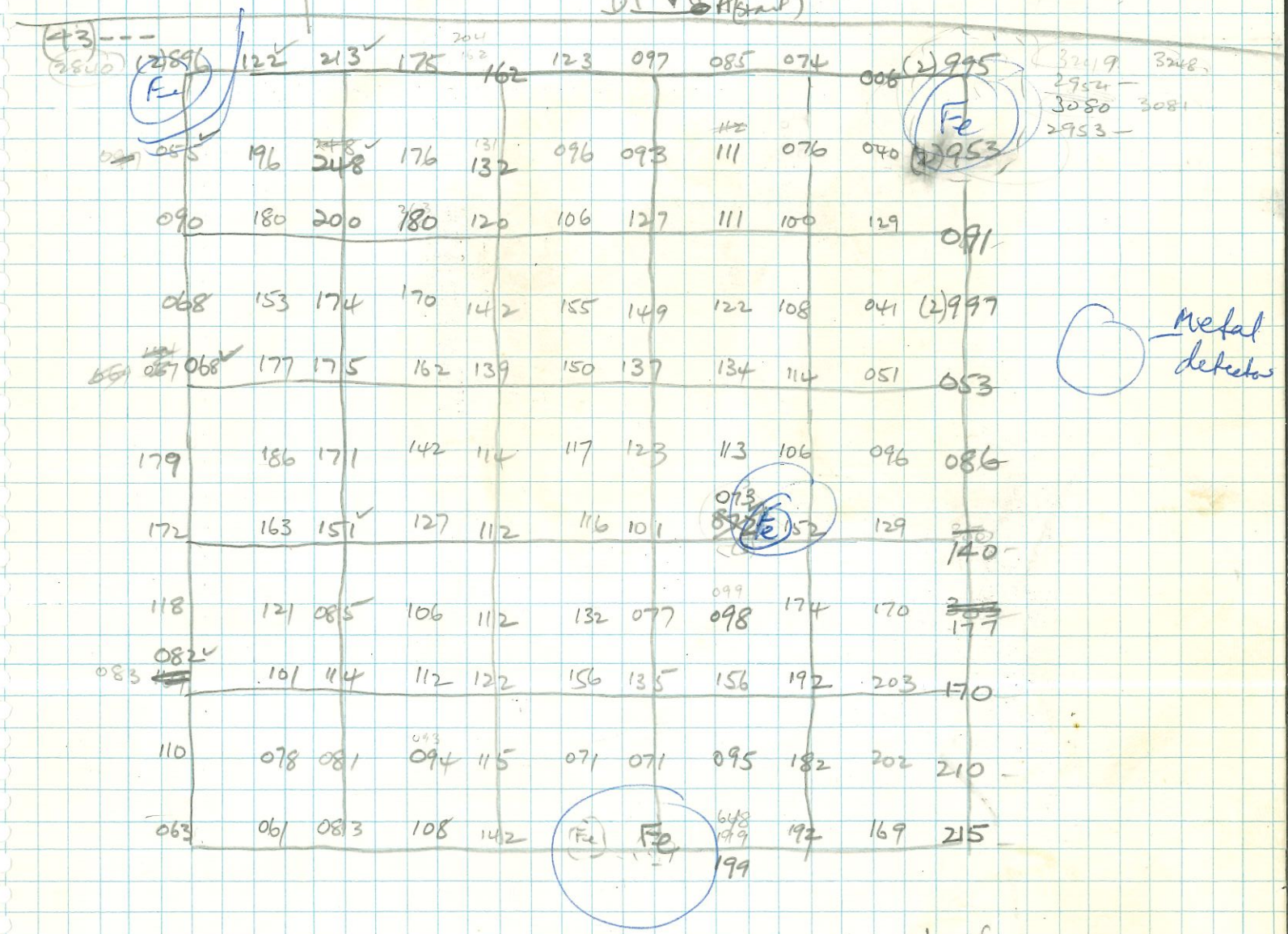
C B D A (start)



	074	2999	FE
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199	272	162	3212

grid - 5a

856	122	213	175	162	123	057	085	074	006	995
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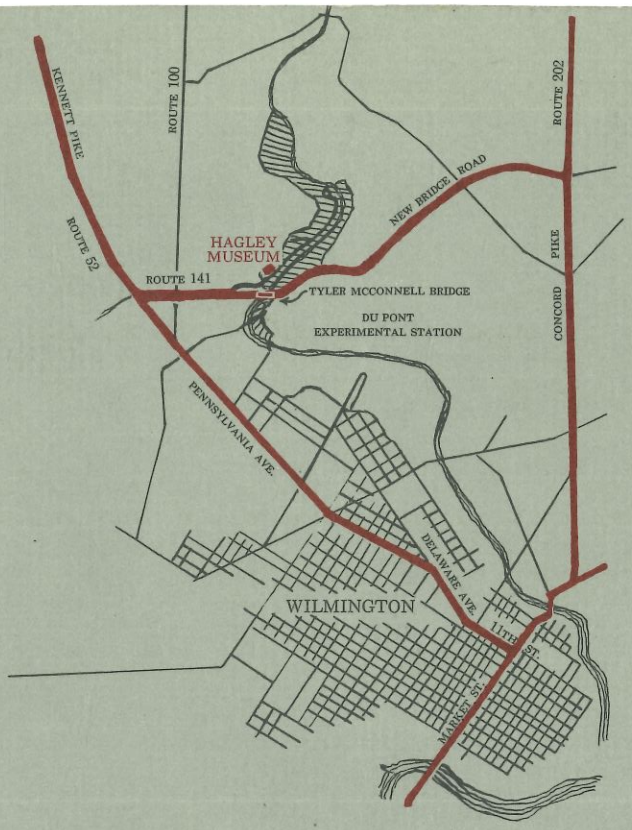
068	177	175	162	139	150	137	134	114	051	053
179	186	171	142	114	117	123	113	106	096	086
172	163	151	127	112	116	101	073	152	129	140
118	121	085	106	112	132	077	098	174	170	177
082	101	114	112	122	156	135	156	192	203	170
110	078	081	094	115	071	071	095	182	202	210
063	061	083	108	142	Fc	Fc	155	152	169	215

2896 – 3248 grid 5 at 3 spaces intervals (for contour)



DIRECTIONS

From Wilmington via 11th Street to Delaware Avenue; Delaware Avenue to Pennsylvania Avenue (Route 52, the Kennett Pike). Route 52 to Barley Mill Road. Right on Barley Mill Road (Route 141). Cross Route 100. One-tenth mile beyond this intersection bear left onto black top road, leading down to Brandywine Creek and turn left to the entrance gates of the Museum.

Visitors approaching via Route 1 should turn south onto Route 52 (the Kennett Pike) at Hamorton, Pa., and proceed to Barley Mill Road (Route 141), just beyond Greenville, Delaware. Left on Barley Mill Road. Cross Route 100. One-tenth mile beyond this intersection bear left onto black top road leading down to Brandywine Creek and turn left to the entrance gates of the Museum.

Visitors approaching via Route 202 should turn west onto New Bridge Road (Route 141) near Fairfax Shopping Center. Follow Route 141; cross Tyler McConnell Bridge over the Brandywine; turn sharp right onto black top road one-tenth mile beyond bridge and proceed down this road to Brandywine Creek and turn left to the entrance gates of the Museum.

Tuesdays Thru Saturdays
9:30 A.M. - 4:30 P.M.
Sundays 1:00 - 5:00 P.M.

Groups By Appointment

Closed Mondays **Admission Free**

the HAGLEY MUSEUM

ELEUTHERIAN MILLS-HAGLEY FOUNDATION
WILMINGTON, DELAWARE

Sesquicentennial Monument at Eleutherian Mills

BRANDYWINE INDUSTRY

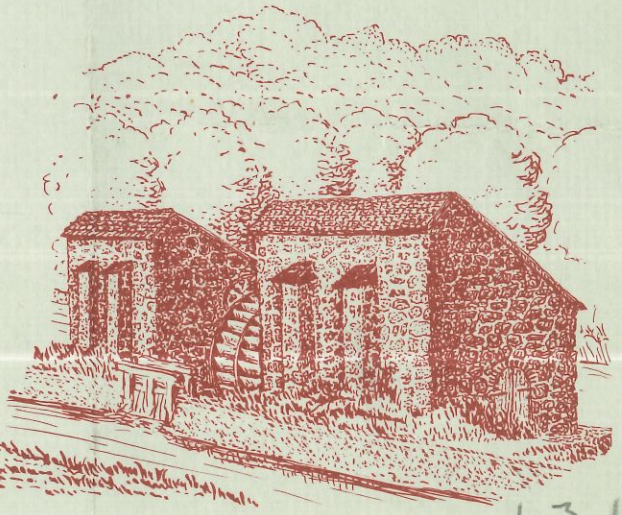
On the 18th of July, 1802, Eleuthère Irénée du Pont, powder maker and emigrant from France, settled his family in a small house on the Brandywine, four miles from Wilmington, Delaware. The property which he had selected had already been partially developed as an industrial site, for the Brandywine's water power had been attracting millers for more than a century.

Before 1690 crude dams of Swedish grist mills had first harnessed this power. All during the 18th and early 19th centuries saw mills, grist mills, slitting mills, paper mills, snuff mills, textile mills, and many others elbowed for room along the sixty-mile length of the Brandywine.

Two years after du Pont's arrival the first kegs of black powder were shipped from "Eleutherian Mills," which was expanded during the War of 1812 to include the adjacent Hagley area. For 117 years these mills on the Brandywine supplied much of the nation's needs for explosives in peace and war.

Desirous of preserving the industrial tradition of this historic area, members of the du Pont family at the time of the Company's 150th anniversary contributed 165 acres of the original powder mill property to an educational foundation created for that purpose. Further endowed by E. I. du Pont de Nemours and Company, the Eleutherian Mills-Hagley Foundation began its activities in 1952.

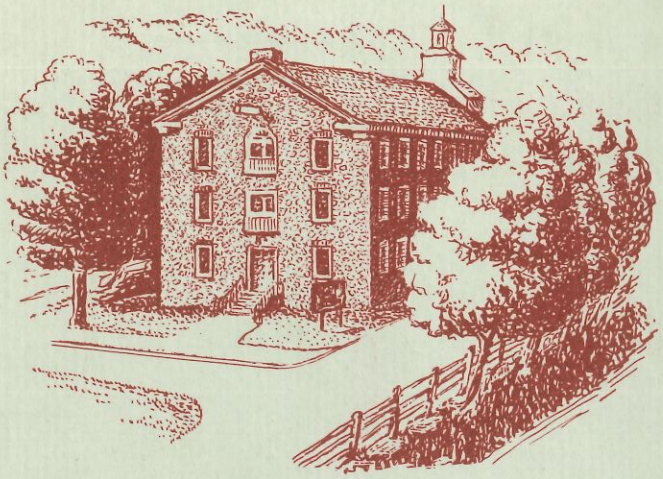
FIRST DU PONT OFFICE



BLACK POWDER MILLS

12/7/63 detected metal in this region with Fisher Al-3000

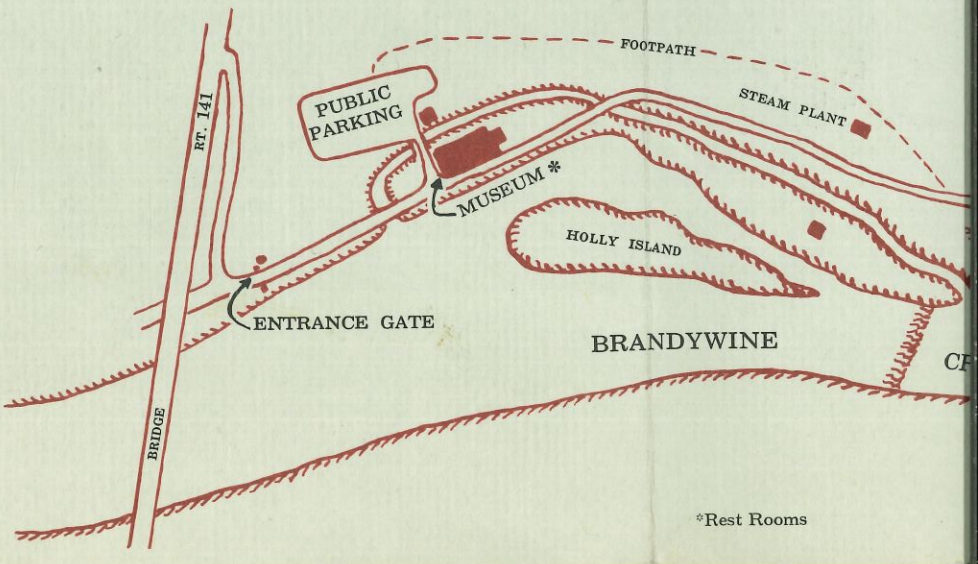
*Rest Rooms



The Hagley Museum is devoted to the industrial history of the United States. Concentrating on the Brandywine Valley, its exhibits are designed to show how the diversity of mills which drew their power from this small river in Colonial and early Federal periods epitomized the beginnings of industry throughout the nation.

In this context of early Brandywine industry the story of the founding and growth of the du Pont Company is related.

The museum building was constructed in 1814 as a textile mill by a group of five businessmen headed by E. I. du Pont. In 1884 it was converted to the manufacture of metal kegs for the adjacent powder yards, and served in this capacity as the "Henry Clay Keg Factory" until the powder works closed in 1921. For museum usage the interior was completely rebuilt, and the exterior brought into architectural conformity with its original appearance.



*Rest Rooms

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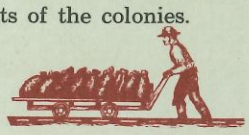
BLACK POWDER

The powder mills which E. I. du Pont founded on the Brandywine were the continuation of a 500-year-old industry. The Chinese are credited with the invention of gunpowder, but a 13th century English friar, Roger Bacon, first wrote down the formula for the explosive mixture.

America's first powder mill began its operation in Milton, Massachusetts, in 1675. It was small and primitive as were the scores of succeeding powder mills in other parts of the colonies.

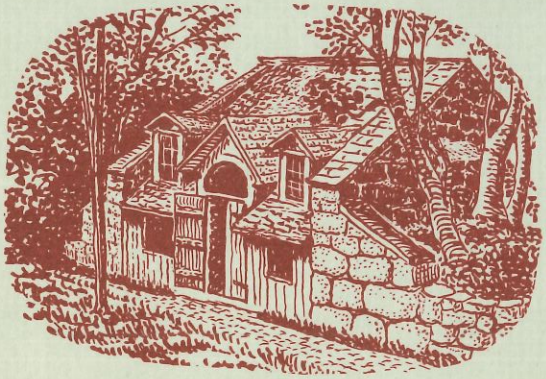


From the beginning the du Pont mills represented the best experience of European powder makers and were superior in design and in product to other American powder manufactories.

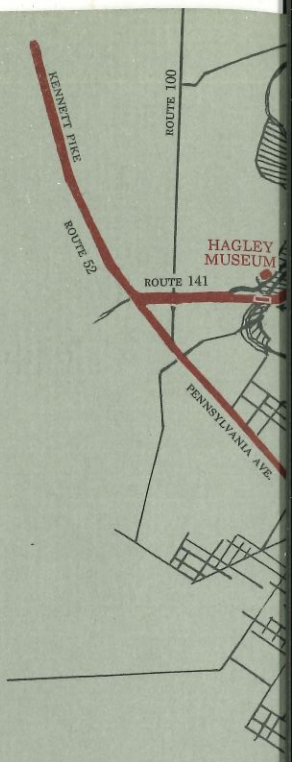
The three ingredients – saltpeter from India, sulphur from Italy, and charcoal from local willow branches – were first incorporated by batteries of mortars and pestles which were soon replaced in du Pont's mills by ponderous cast iron roll wheels. Next, the mixture, already dangerously

explosive, was pressed into cakes which were sent to a graining or corning mill to be broken into pellets of desired size. As a final step the grains of powder were sent to a glazing mill where they were coated with graphite, before being packed in canisters or kegs for shipment.

From these mills came much of the powder used in early 19th century canal building, mining, the opening of the West, and in the nation's wars.



EAGLE GLAZE MILL



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Tuesdays
9:30 A.
Sundays
Groups B

Closed Mondays