OCT '64
ARIZONA

Ralph
we could do you
Think
Fro

Fine -
see costs on
2nd page
Both

THE UNIVERSITY OF ARIZONA
TUCSON

COLLEGE OF LIBERAL ARTS
DEPARTMENT OF ANTHROPOLOGY

September 24, 1963

Dr. Froelich Rainey, Director
The University Museum
University of Pennsylvania
Thirty-Third and Spruce Streets
Philadelphia 4, Pennsylvania

Dear Fro:

I was really delighted with your response of September 11 about the possibility of testing out some instruments at Snaketown.

The site itself is a rather large one geographically. It includes approximately half a square mile on the upper terrace of the Gila River south southwest of Chandler, Arizona. Features which stand above the desert terrain are mounds, and those we tested in 1934 were all of trash. The assumption is that all of them, meaning approximately 60, large and small, are composed of rubbish. The highest of these is about 3 meters. Taking this depth with what usually occurs below desert floor, we may expect a total cultural depth of 5 meters in some localities. Another prominent feature which sticks above the surface is the ball court, that is, the sides of it, perhaps 2 meters high. Otherwise, the big flat areas between the mounds are where one finds the cremation areas and the houses. Of these there is no hint whatsoever on the surface. There is also, along the southern margin of this site, a prehistoric canal which is quite easily traceable, at least in some parts.

The soil is soft throughout. In fact, it is one of the nicest places I have ever dug in from that point of view. Softness of the soil of course makes it difficult in some instances to trace features. This must be done largely by color and content changes, sometimes on hardness differences. There are no rocks native to the locale, and when rocks are found you can be sure that man has brought them in.

My plans are to get started on the project in October, 1964, a little over a year hence. If I can raise

the necessary support, I hope to have 20 to 25 men working for 6 to 7 months. In addition to hand labor, we intend to employ some power equipment, including a backhoe scraper, front-end loader, and hopefully a ditcher. It will be necessary to do extensive testing as quickly as possible so as to localize the areas that are going to be most productive of the kind of things we are looking for. One of these is the strengthening of the early end of the Snaketown chronology and pushing it back into pre-ceramic times if possible. The oldest evidences at Snaketown already indicate settled village life at around the time of Christ, which presupposes a form of agriculture in this arid country, and we would like to know just what this came out of and whether or not we can pin down more closely the beginnings of settled existence.

The budget will be a large one, in excess of $100,000, and I don't know if I can swing it but I'm going to try. Which leads me to ask what should be included in the budget to cover any involvement with your organization and any doodlebugs you have in your kit bag.

It would be fine if we could sit down and talk this thing over.

Best regards,

Emil W. Haury

Emil W. Haury per VB.

EWH:vg

Signed in Dr. Haury's absence

Suggest that our expenses would be travel for 3?

air cost Phila.-Tucson & return = $256 ; for 3 plus local transportation, approx. $1000

plus lodging at the site

Beth

February 4, 1965

Professor Emil Haury
Snaketown Project
P. O. Sacoton, Arizona

Dear Professor Haury:

Fro Rainey and Hugh Bergh returned with enthusiastic accounts of your project at Snaketown. I have enclosed a copy of Hugh's summary of the initial work with instruments.

I am wondering if it would be worthwhile sending Hugh's report of the hearth finds with the magnetometer to Martin Aitken (Research Laboratory for Archaeology and the History of Art (Oxford) for publication in Archaeometry. If so, would you like to add an introduction and a few comments? The deadline for publication this year was supposedly Jan. 31st, but we might be lucky. If not, perhaps a more comprehensive report for publication later would be better.

About the return of the proton magnetometer, Fro wants me to take it to Gordion, Turkey, and I am planning to leave on March 13th. Because of the wet batteries, it is not easy to ship. Also, we have found from past experience that if you drain batteries that have been in use for some time, they do not last long when refilled. Therefore, would it be convenient for you to give it to a friend of mine who will be near Pheonix from about February 10 to approximately the end of February? If this plan is suitable, her name is Ethlyn Davis and she will be staying at the Camelback Inn, Scottsdale, Arizona. If she does not contact you, could I trouble you to have someone get in touch with her? If by any chance, you finish with the instrument very soon, it would be easier for her if you ship the bottle, charger, spare parts, etc. ahead of time. Then, she would have to carry only the instrument and batteries. If not, I'm sure that she will be willing to bring all of the parts.

I hope that you are continuing to make good finds with the magnetometer.

Sincerely yours,

EKR:pc

Elizabeth K. Ralph

2/5/65

INSTRUMENT SURVEYS AT SNAKETOWN, ARIZONA

by

Hugh Bergh

Applied Science Center for Archaeology
University Museum, University of Pennsylvania

Three instruments - proton magnetometer[1], geohm[2], and seismiktron[3] - were tried out at the Snaketown site(4) in the Arizona desert during the week Jan. 15-20, 1965. The site, in occupation from about 0-1400 A.D. is characterized on the surface by numerous large trash mounds, a well-marked ball court and a clearly defined ridge formed by the filling in of a former irrigation canal and at least one subsidiary canal. The excavations are well advanced and a large number of hard packed floors have been exposed. These house floors usually have a small clay firepit just inside the entrance and are, on the average about 2-3 feet below the present surface. A large gash has been cut through the center of one of the trash mounds, giving a clear picture of about 1000 years of layering. Several deep tunnels have been cut across the canal system so that details of this are apparent at a number of different points along its length. A few extremely large firepits have been found on the site - These are so large (and deep) that one wonders how they were used. Looking at them a hungry gleam comes into the eye of anyone intending a magnetometer survey of the site.

Preliminary experiments on the excavated house floors were not encouraging. The small firepits gave magnetic anomalies of 5 γ or less and the compact floors showed very little contrast in resistivity from the surroundings.

Magnetometer readings were then taken along two parallel lines about 500 yds. long and 20 yds. apart, extending eastward from the excavated portions of the site. Readings were taken approximately every 1 meter (i.e. 1 pace) & 11 interesting spots were marked with stakes and afterwards carefully surveyed. The results were extremely rewarding - contours obtained by surveying two of these "hotspots" are shown in Figs. 1 and 2. These were excavated immediately after surveying and firepits were found as marked on the figures. Nearly all the other hot spots gave anomalies just as well defined, though the one shown in Fig. 1 was the most intensely magnetic. One interesting point worth mentioning here is the well-defined direction from the center of the anomaly to the center of the reverse anomaly (marked .... in figs. 1 & 2). This direction should be roughly the same as that of the geomagnetic field at the time of last firing of the clay lining. [This statement should not be taken too literally as there are several complicating factors - however, it should hold in certain cases]. Assuming this and having some knowledge of the variation in declination of the geomagnetic field with time for the region considered, a rough relative chronology could be built up and applied to these firepit anomalies <u>before</u> excavating. This would be a further incentive for doing a thorough magnetometer survey of the unexcavated area round the site and then picking out anomalies lying in an age-range of most interest. Dr. R. L. Dubois of the University of Arizona is at present engaged in archaeomagnetic work on

material from the Snaketown site. Even a very rough curve of declination versus time from his work will be good here and, in return, the magnetometer survey might help him in the selection of more suitable material.

Magnetometer and resistivity surveys were also run across the canal system (Fig. 3). Both showed sharp anomalies over a grey silt layer north of the main canal and were not nearly as specific in showing the actual canal positions. More work on this areais planned by the archaeologists on the site (the magnetometer has been left with them). In addition they intend to run long magnetometer lines parallel to the canal bank - the most likely place for dwelling sites.

Resistivity measurements across the ballcourt clearly picked up the well compacted central floor area. Of interest here also is the fact that readings were unchanged on traversing across the mounds on either side of the central floor.

The trash mound investigated with the geohm showed very little variation. This was disappointing as several hard "capping" layers were evident in the cut made through the mound. However, they were not very thick and this most probably accounts for the geohm's failure to detect them.

The seismiktron worked very nicely and consistently. Unfortunately refraction seismology appears to have very little application to archaeological sites of this nature. The instrumentis designed to pick up features of relatively large horizontal extent and this it does well. However, such features are usually more of geological, rather than archaeological significance.

Footnotes

1. Elsec proton magnetometer is manufactured by the Littlemore Scientific Engineering Co., Oxford, England.
2. The Geohm is manufactured by the Gossen Company, Erlanden, Germany (U.S.A. sales agent is National Electronics, Box 1237, Sheridan, Wyoming).
3. The Seismiktron is manufactured by Advanced Systems Laboratories, Inc., 9 Fayette Street, Rockville, Md. (We are grateful to Mr. Manuel Cebollero, President of Advanced Systems Laboratories for the loan of this instrument for these tests).
4. The archaeological program at the site is under the direction of Professor Emil Haury , Dept. of Anthropology, University of Arizona, Tucson. Due to the excellent organization and collaboration of Dr. Haury and his associates, most of the anomalies found were excavated immediately. This enabled them to be interpreted without delay.

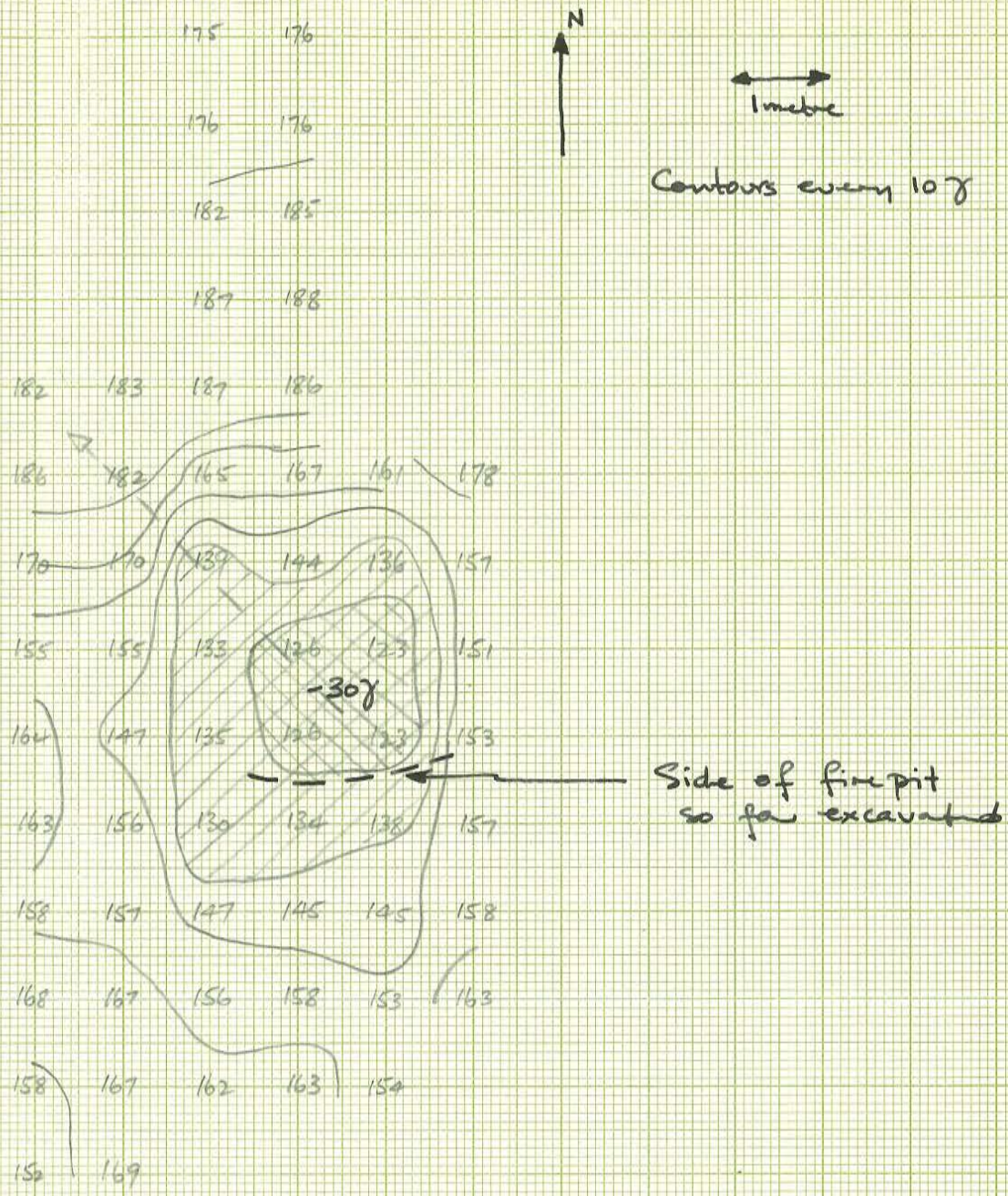

N
1 metre
Contours every 10 γ
-30γ
Side of firepit so far excavated

Fig. 2

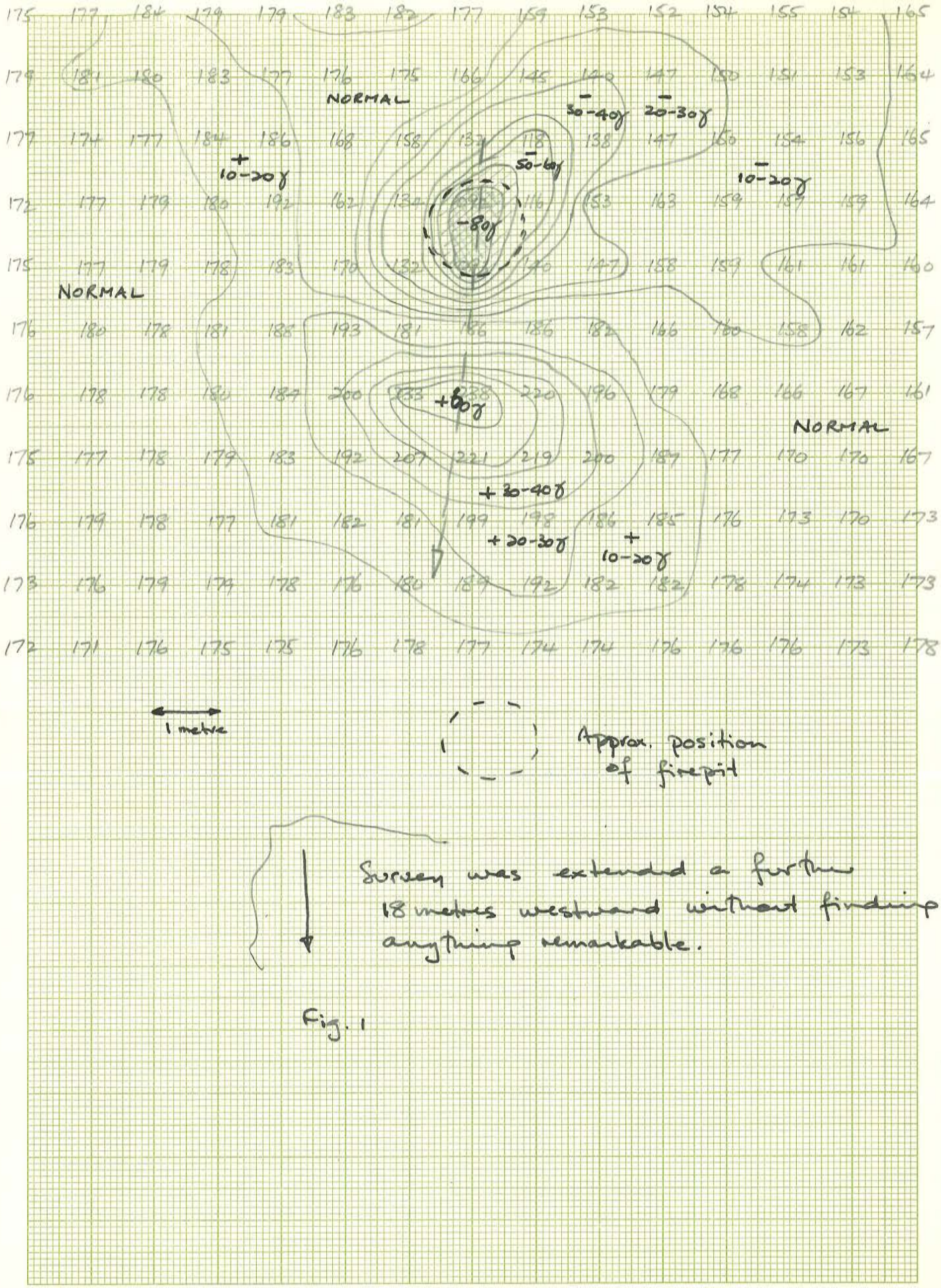

N
CONTOURS AT 10γ INTERVALS
NORMAL
30-40γ
20-30γ
50-60γ
10-20γ
10-20γ
-80γ
NORMAL
+60γ
NORMAL
+30-40γ
+20-30γ
+
10-20γ
1 metre
Approx. position of firepit
Survey was extended a further 18 metres westward without finding anything remarkable.

Fig. 1

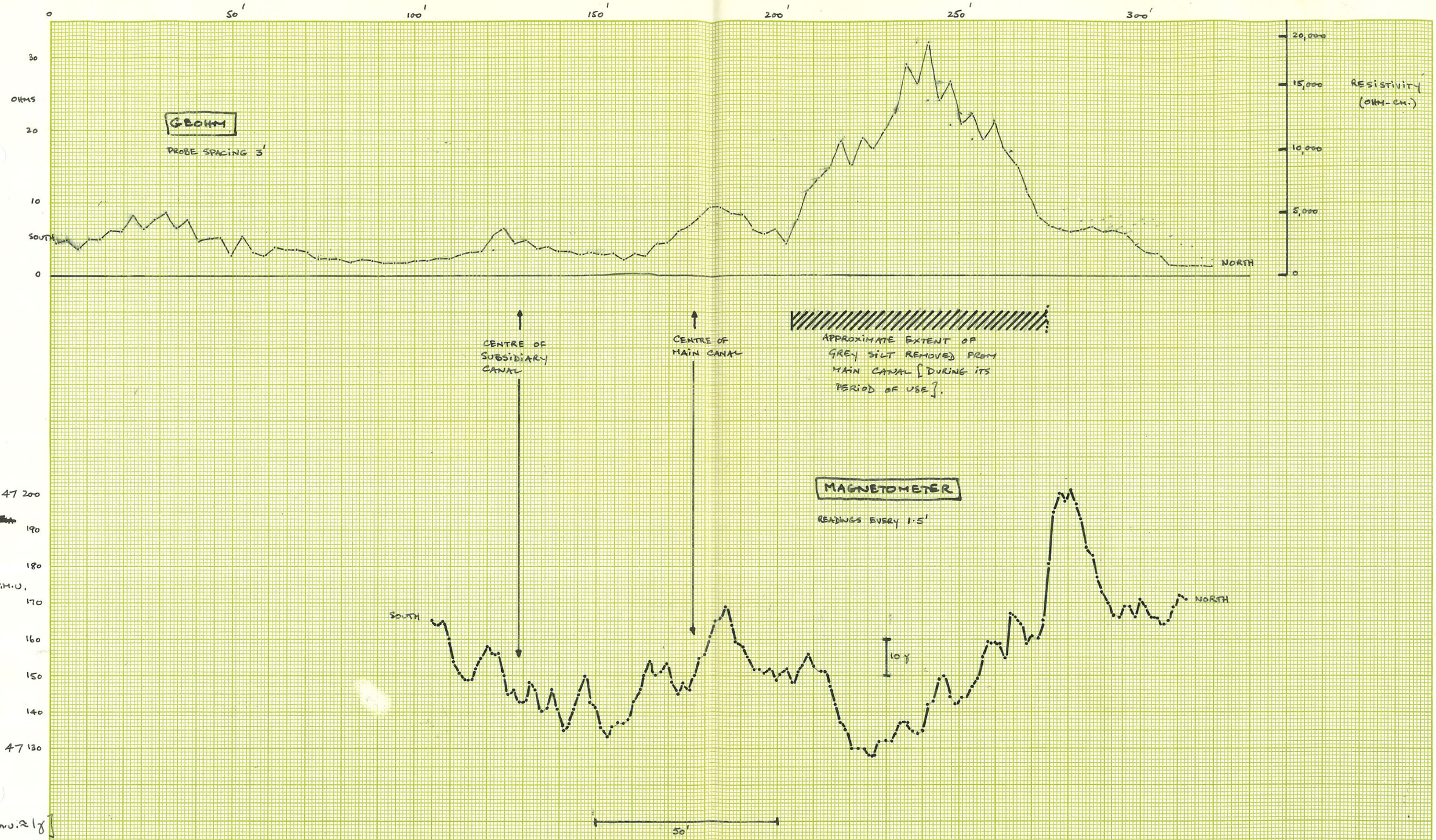


Fig. 3

TYPICAL MAGNETIC AND RESISTIVITY SURVEYS ACROSS CANAL SYSTEM

GEOHM + MAGNETOMETER READINGS
ACROSS EXCAVATED FLOORS

— 11 —

Not much contrast found.

One Resistivity vs. depth profile shows high resistivity layer at about 7' depth.

MAGNETIC FIELD AT SNAKETOWN — 0.51 oersted

P.M. READINGS 47100 – 47200 p.m.u.

Thus 1 pm.u. ≈ 1 γ .

Part of report by Hugh Bergh of surveys conducted at Snaketown, Ariz. Jan. 15-20, 1965.

Applied Science Center for Archaeology
University Museum
33rd & Spruce Sts.
Phila. 4, Pa.

(2) P.M. READINGS ACROSS SMALL FIREPITS IN EXCAVATED HOUSES.

2'

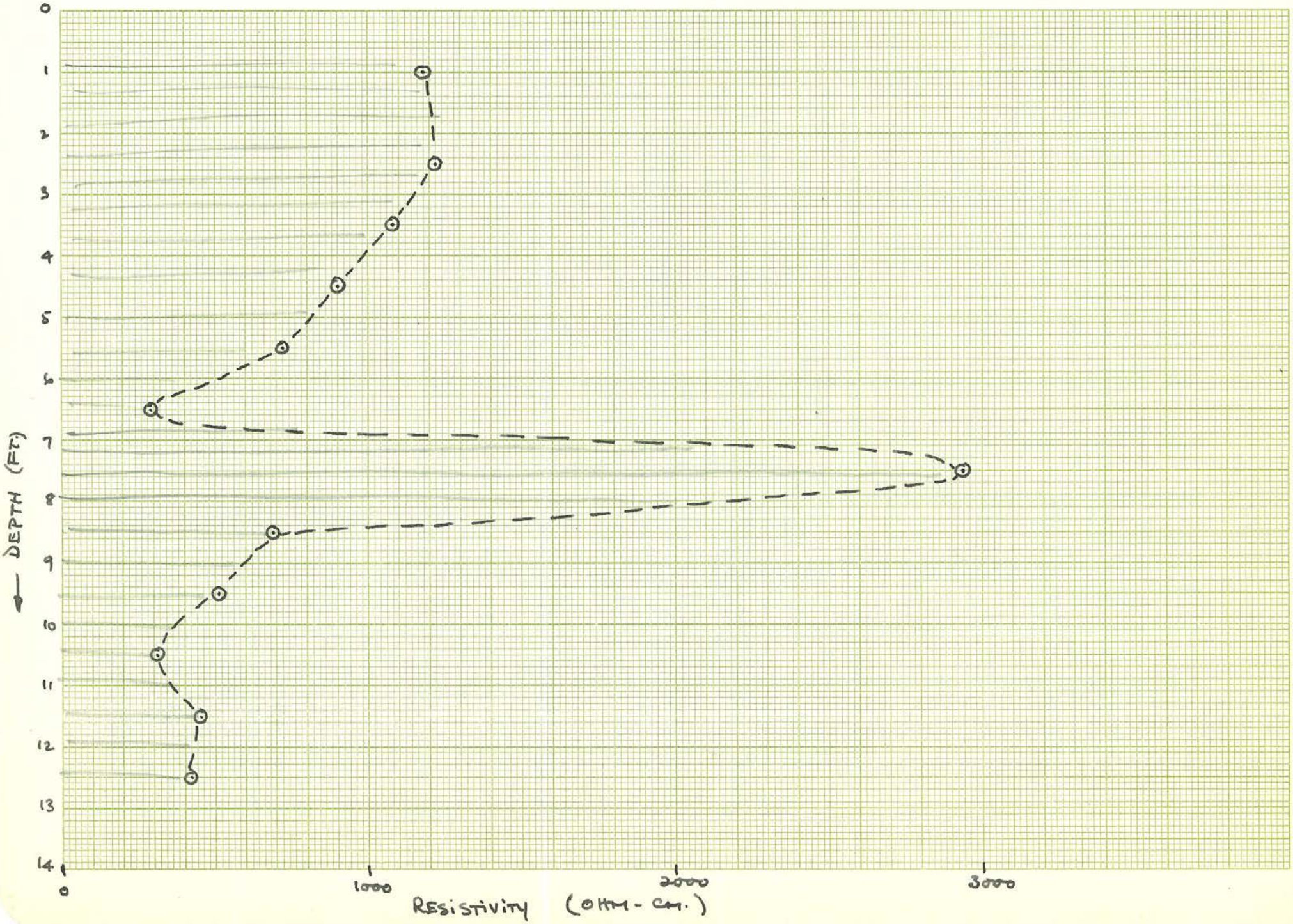
10γ

↑ marks centre of fireplace

Readings every foot.

Firepits about 1' in diameter + clay-lined.
Anomalies (when detected) are extremely small.
In some cases floor of house had been baked by fire.

③ RESISTIVITY - DEPTH PROFILE ~~[illegible]~~ CENTRED AT POINT SHOWN IN ①



SEISMIC

General conclusion - method not sensitive enough to [redacted] archaeological features.

Surface soil velocity: 600 ft/sec.

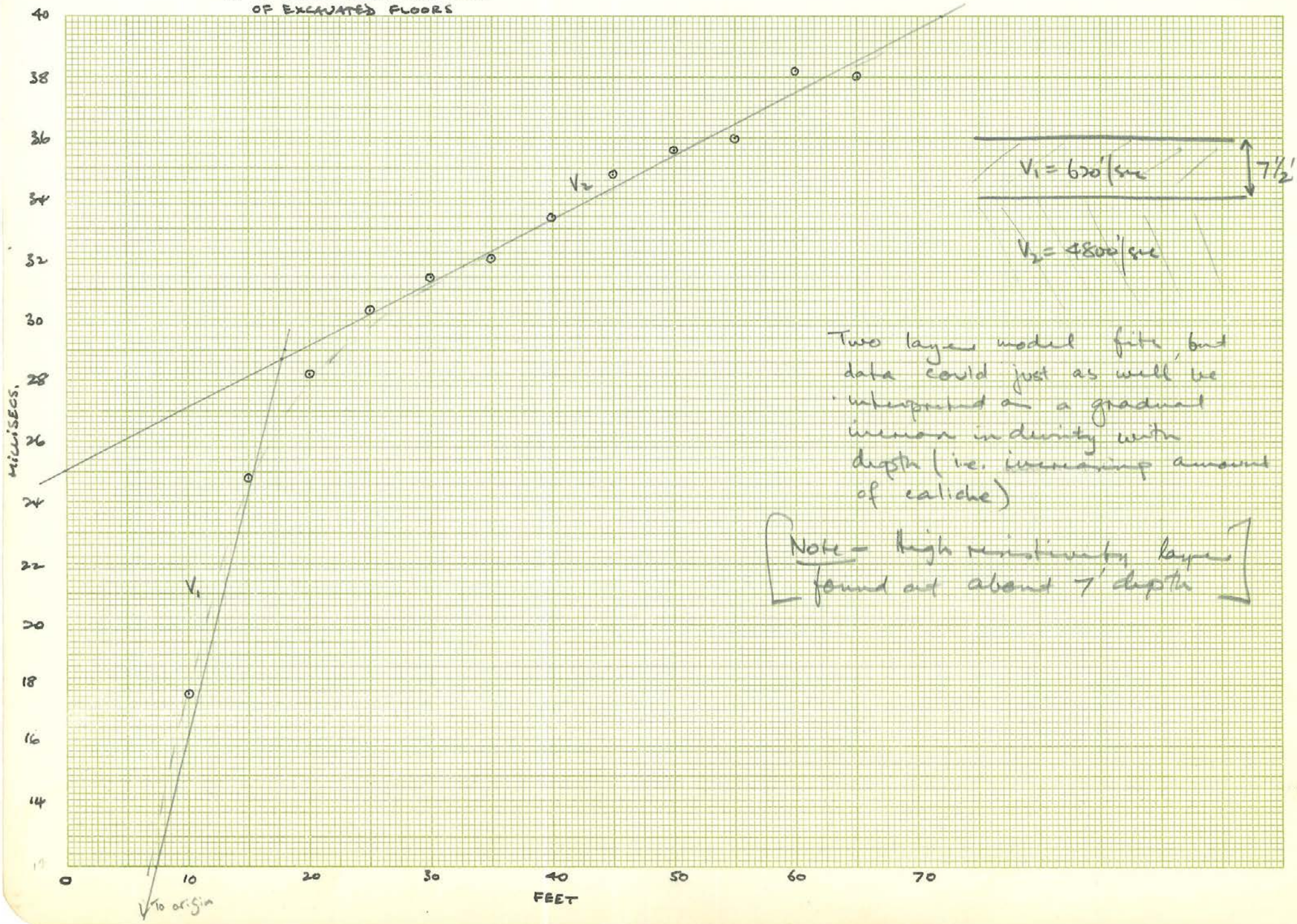
Compacted caliche layer velocity: 5000 ft./sec.

(1)

1-15-65

FIRST ROUGH SEISMIC TRYOUT

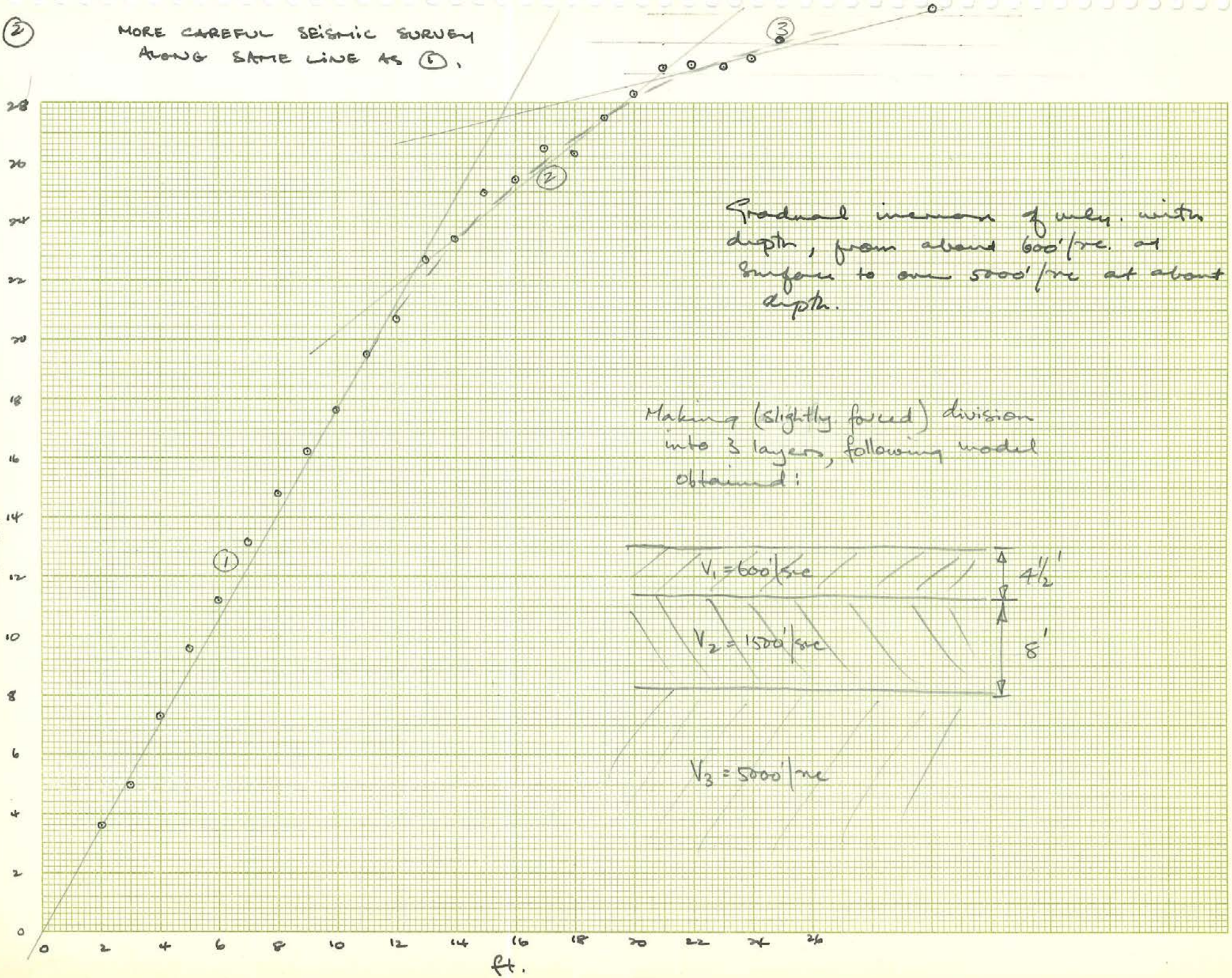
N-S ALONG ROAD JUST WEST OF EXCAVATED FLOORS



Two layer model fits, but data could just as well be interpreted as a gradual increase in density with depth (i.e. increasing amount of caliche)

[Note – high resistivity layer found at about 7' depth]

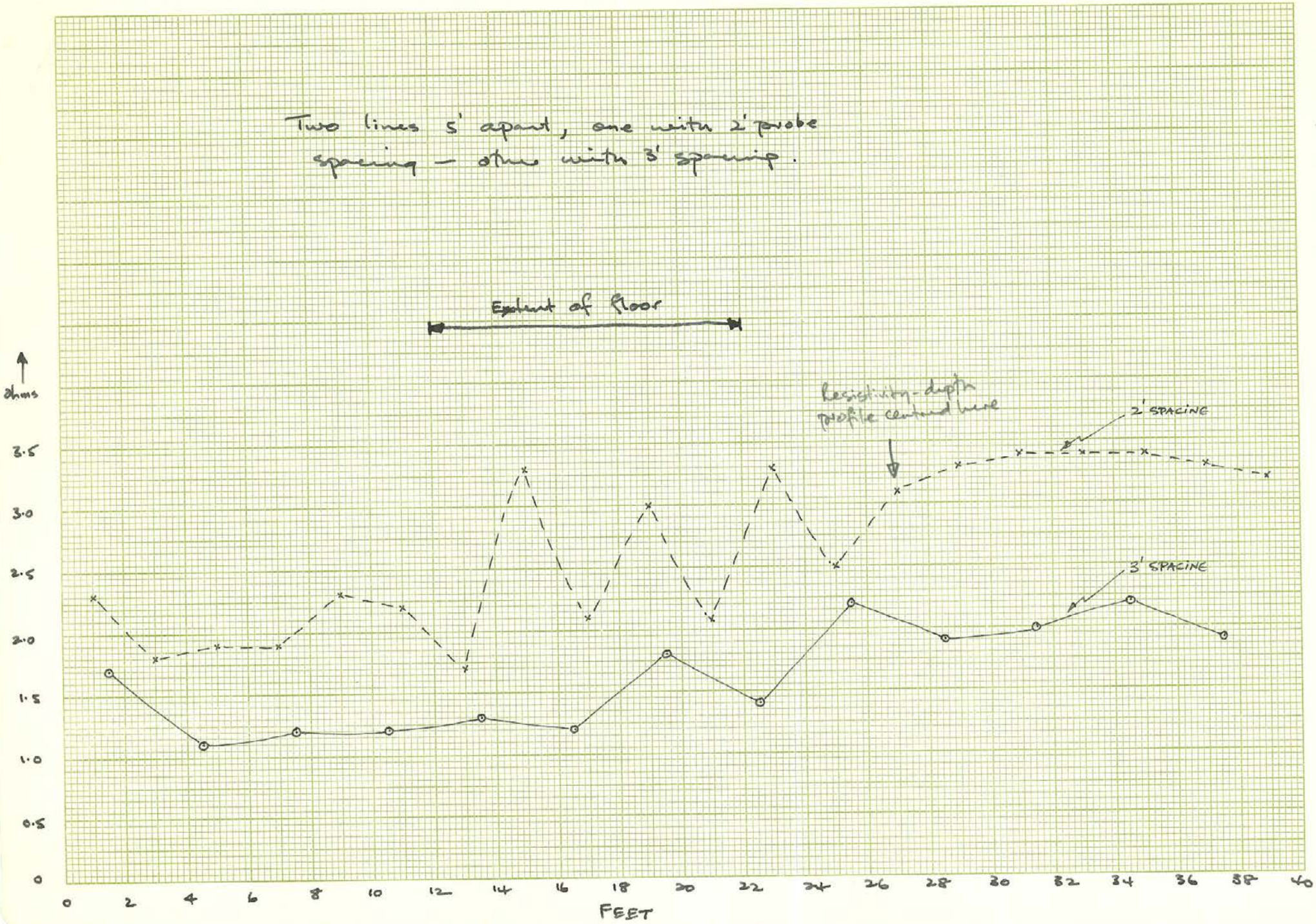
(2) MORE CAREFUL SEISMIC SURVEY ALONG SAME LINE AS (1).

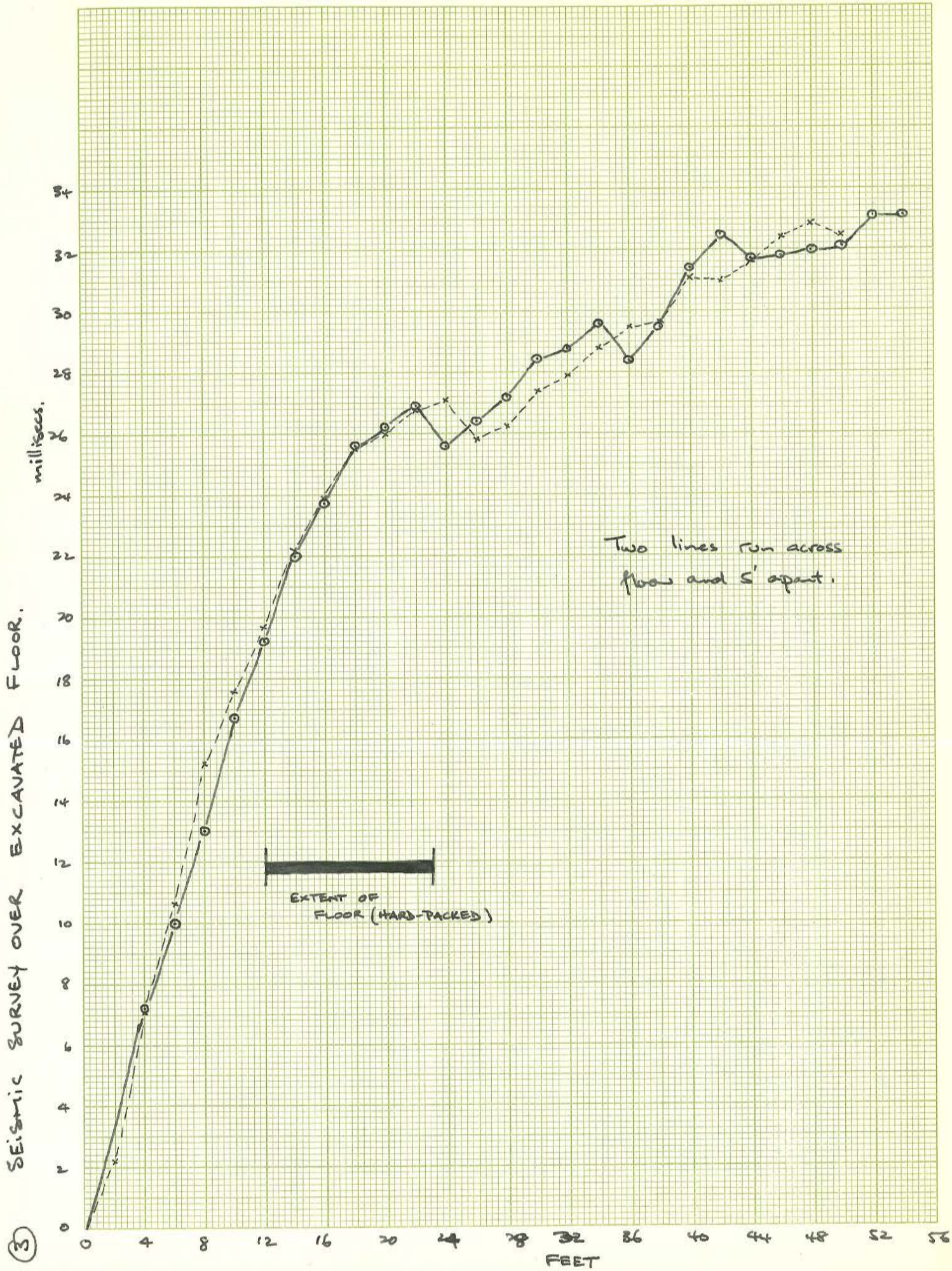


Gradual increase of vely. with depth, from about 600'/sec. at surface to over 5000'/sec at about 12' depth.

Making (slightly forced) division into 3 layers, following model obtained:

(1) RESISTIVITY MEASUREMENTS ACROSS EXCAVATED FLOOR.




SEISMIC SURVEY OVER EXCAVATED FLOOR.
milliseccs.
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
0
4
8
12
16
20
24
28
32
36
40
44
48
52
56
FEET
Two lines run across floor and 5' apart.
EXTENT OF FLOOR (HARD-PACKED)

(3)

JANUARY 15

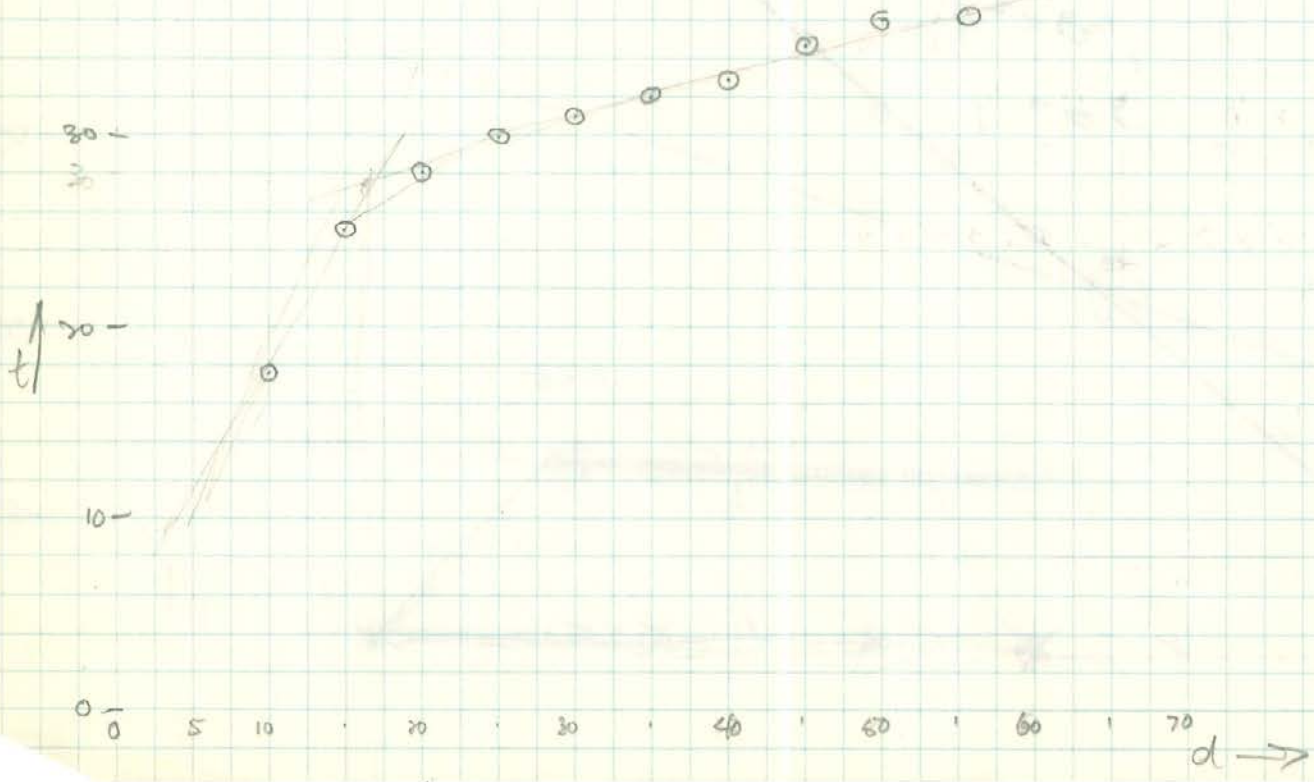
Seismic tryout along road

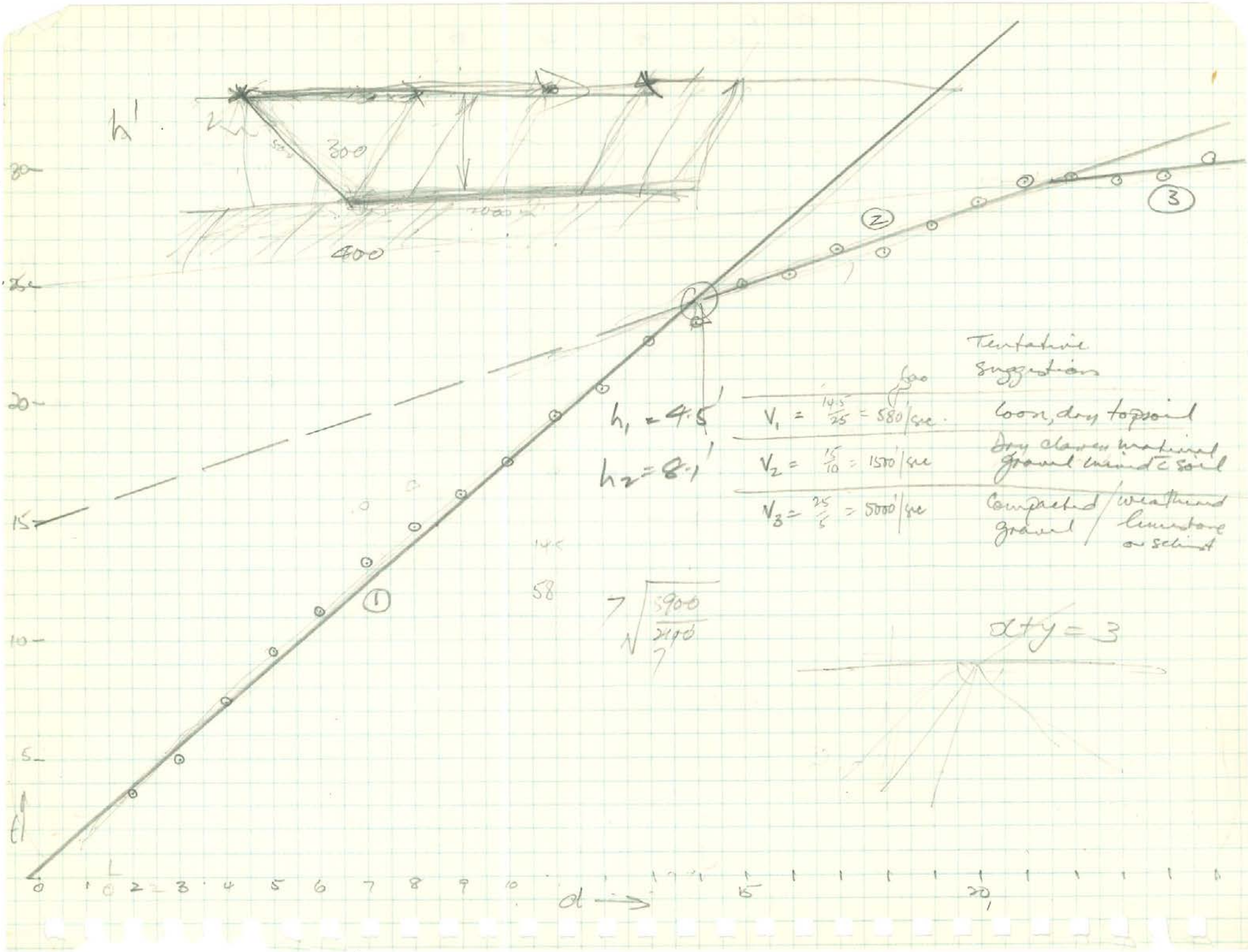
Jan 15, 1965

Dist (ft)	Time (msec)							Mean
10'	17.8	17.8	17.4					17.7
15	24.3	25.0	25.1					24.8
20	28.0	~~29.5~~	28.3	28.4				28.2
25	30.0	30.6	30.4					30.3
30	31.2	31.5	31.4					31.4
35	31.7	32.6	31.7	32.2				32.0
40	33.5	33.3	33.3					33.4
45	34.9	34.5	34.6	35.0				34.8
50	34.7	35.0	35.5	36.8	36.0			35.6
55	35.8	36.1	36.0					36.0
60	~~49.6~~	37.4	38.4	38.4	38.5			38.2
65	40.0	39.4	37.8	36.1	38.0	38.0	36.4	38.0

5 5.6
7.9

d	t					
2	~~2.7~~	3.5	3.3	3.9	3.6	3.6
3	4.9	5.1				5.0
4	7.2	~~6.4~~	7.5	7.3		7.3
5	9.6	9.6				9.6
6	11.1	11.4				11.2
7	13.1	13.3				13.2
8	14.7	14.9				14.8
9	16.5	15.9				16.2
10	18.0	17.3				17.6
11	19.5	19.5			13.7	19.5
12	20.8	20.4				20.7
13	~~21.8~~	22.8	22.6			22.7
14	23.5	24.3	22.8	23.1		23.4
15	25.3	24.4	25.4			25.0
16	25.5	25.4				25.4
17	26.2	26.9				26.5
18	26.4	26.1				26.3
19	27.1	27.9				27.5
20	28.5	28.3				28.4
21	29.1	29.3				29.2
22	29.4	29.1				29.3
23	29.2	29.2				29.2
24	29.6	29.4				29.5
25	30.2	30.1				30.1


80
30
t
20
10
0
0
5
10
20
30
40
50
60
70
d


h'
300
400
2000
30
25
20
15
10
5
t
0
1
2
3
4
5
6
7
8
9
10
15
20
d
1
2
3
$h_1 = 4.5'$
$h_2 = 8.1'$
58
$\sqrt{\frac{5900}{2400}}$
$x + y = 3$
Tentative suggestion
$V_1 = \frac{14.5}{25} = 580/sec$
loose, dry topsoil
$V_2 = \frac{15}{10} = 1500/sec$
dry clayey material gravel mixed c soil
$V_3 = \frac{25}{5} = 5000/sec$
Compacted gravel / weathered limestone or schist

$A = 13.8$

$T_1 = 15.0$

$T_2 = 25.0$

$B = 8.5$

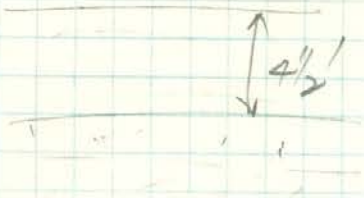
$A = 13.8$

$.65$ $\quad 4.55$

0.43

36

$125 \overline{)700}$ $\quad 5/7$



$$h_1 = 6.9\sqrt{\frac{900}{2100}} = 6.9\sqrt{0.4286} = 6.9 \times .65 = 4.5'$$

$$h_2 = \left\{25 \times 10^{-3} - \frac{9\sqrt{5000^2 - 600^2}}{5000 \cdot 600}\right\}\left\{\frac{1500 \cdot 5000}{2\sqrt{5000^2 - 1500^2}}\right\}$$

$$= \left\{25 \times 10^{-3} - \frac{\overset{30}{\cancel{900}}\sqrt{\overset{49.5}{2464}}}{30 \times 10^5}\right\}\left\{\frac{75 \times 10^{\cancel{5}}}{\cancel{200}\sqrt{2275}}\right\}$$

67.6

$$= \left(25 \times 10^{-3} - 148 \times 10^{-3}\right) \times 787$$

$$= 10.2 \times 0.787$$

$$= 8.1'$$

5×10^3

25×10^6

50×10^2 $\quad 6 \times 10^2$

2500×10^4

36×10^4

2464 $\quad 15 \times 10^2$

2500×10^4

225×10^4

2275

148.5×10^{-5}

$\times 10^{-3}$

$$\frac{75}{95.2} \times 10^3$$

$.787$

HOUSE 16
10F

Swimming Crawling known

LINE #1

N					Mean Flow
2	6.1	5.3	2.3	2.4	
	~~10.8~~	~~15.9~~	~~14.9~~		
4	7.1	7.4			7.2
6	9.7	10.2			10.0
8	12.8	13.3			13.0
10	16.6	16.8			16.7
12	19.2	19.1			19.2
14	21.6	22.4			22.0
16	23.4	24.0			23.7
18	25.4	25.8			25.6
20	26.1	26.4			26.2
22	26.4	27.2	27.0		26.9
24	24.9	25.7	26.4		25.6
26	26.3	26.4			26.4
28	27.3	27.2			27.2
30	27.7	28.9	28.6		28.4
32	28.7	28.8			28.8
34	29.6	29.7			29.6
36	28.2	28.6			28.4
38	29.2	29.7			29.5
40	31.4	31.4			31.4
42	32.1	32.5	32.0		32.5
44	31.8	31.6			31.7
46	31.9	31.6			31.8
48	32.2	31.1	31.9	31.9	32.0
50	32.3	31.9			32.1
52	33.2	31.3	33.1	33.3	33.1
54	33.2	33.0			33.1

FLOOR

S

$A = 13.8$

$T_1 = 15.0$

$T_2 = 25.0$

$B = 8.5$

$A = 13.8$

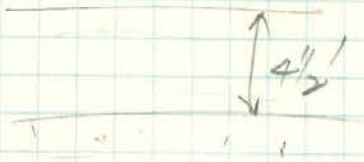
$.65$

0.43

36

$125 \overline{)700}$

455



$$h_1 = 6.9\sqrt{\frac{900}{2100}} = 6.9\sqrt{0.4286} = 6.9 \times .65 = 4.5'$$

$$h_2 = \left\{25 \times 10^{-3} - \frac{9\sqrt{5000^2 - 600^2}}{5000 \cdot 600}\right\}\left\{\frac{1500 \cdot 5000}{2\sqrt{5000^2 - 1500^2}}\right\}$$

$$= \left\{25 \times 10^{-3} - \frac{\overset{30}{\cancel{900}}\sqrt{\overset{49.5}{2464}}}{30 \times 10^5}\right\}\left\{\frac{75 \times 10^5}{\cancel{200}\sqrt{2275}}\right\}$$

47.6

$$= \left(25 \times 10^{-3} - 148 \times 10^{-3}\right) \times 787$$

$$= 10.2 \times 0.787$$

$$= 8.1'$$

5×10^3

25×10^6

50×10^2 $\quad 6 \times 10^2$

2500×10^4

36×10^4

2464 $\quad 15 \times 10^2$

2500×10^4

225×10^4

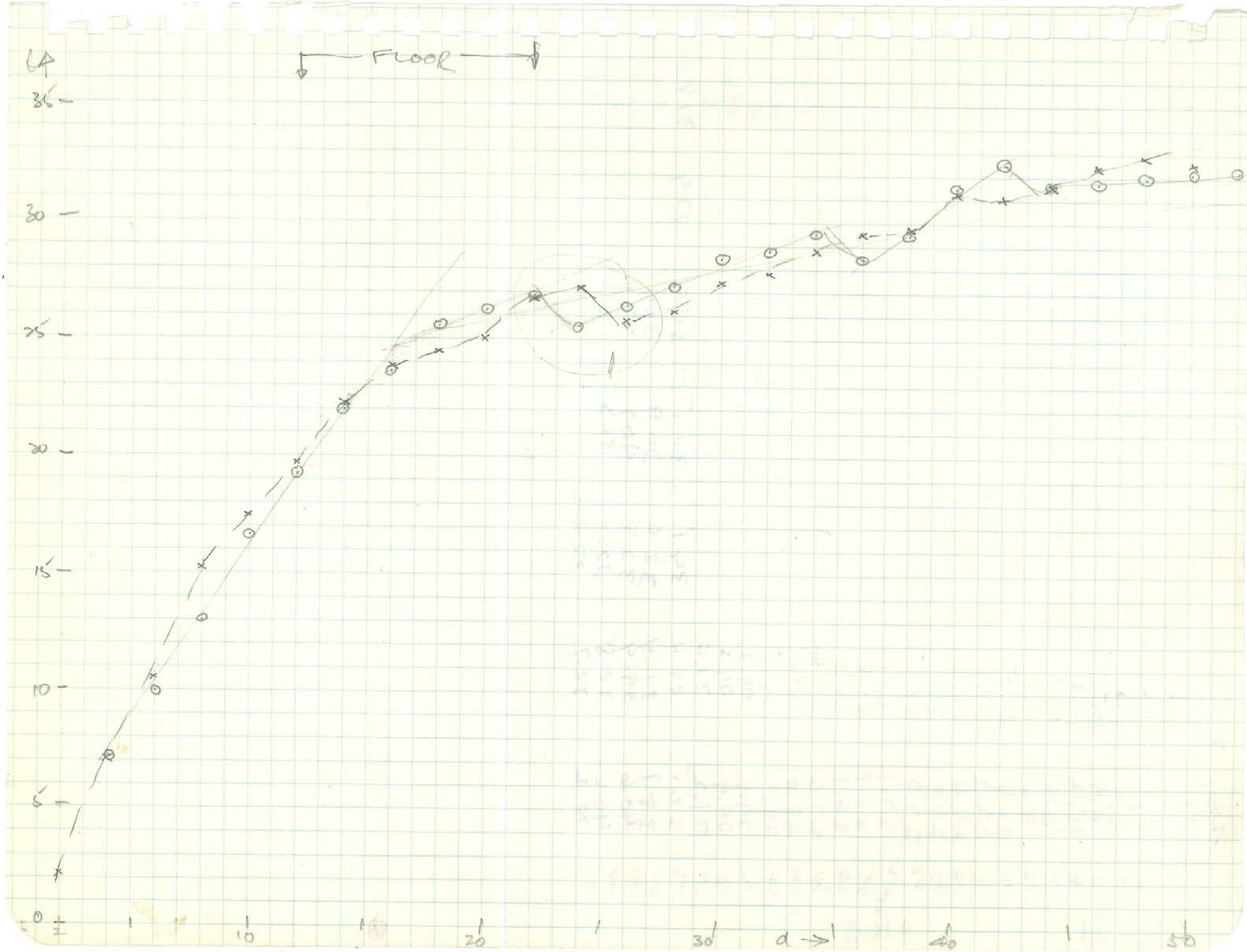
2275

148.5×10^{-5}

$\times 10^{-3}$

$\frac{75}{95.2} \times 10^3$

$.787$


FLOOR
35
30
25
20
15
10
5
0
10
20
30
d
40
50

LINE #2 (5' E of #1) Seismicktron

		1						Mean
	2	2.3	2.2					2.2
	4	6.9	7.3					7.1
door	6	10.7	10.4					10.6
	8	15.2	15.3					15.2
	10	16.3	18.0	17.5	18.5			17.6
	12	19.6	19.8			15.7		19.7
	14	21.9	22.5					22.2
	16	22.3	24.9	23.5	25.0			23.9
	18	24.4	24.6					24.5
	20	24.9	25.0					25.0
	22	27.0	26.5					26.8
	24	27.1	27.1					27.1
25 step	26	25.8	25.8					25.8
	28	26.1	26.3					26.2
	30	27.6	27.2					27.4
	32	28.0	27.8			6.3		27.9
	34	29.1	28.5					28.8
	36	29.4	29.7					29.5
	38	29.9	29.3					29.6
	40	31.2	31.0					31.1
	42	37.5	38.4	39.1	30.5	30.8	27.9	31.8 31.0
	44	38.7	31.4	32.6	30.9	31.4		31.6
	46	40.6	39.4	32.8	40.7	32.1		32.4
	48	40.6	32.8	32.7	33.3			32.9
	50	39.2	32.7	32.2				32.5

N

GEOHM

0	1.7
3	1.1
6	1.2
9	1.2
12	1.3
15	1.2
18	1.8
21	1.4
24	2.2
27	1.9
30	2.0
33	2.2
36	1.9
39	1.8
42	1.8
45	1.7
48	1.9

S

LINE 2

LINE #1 2' Spacing

0	2.29
2	1.85
4	1.88
6	1.87
8	2.32
10	2.20
12	1.67
14	3.30
16	2.14
18	2.96
20	2.05
22	3.34
24	2.50
26	3.05
28	3.34
30	3.36
32	3.35
34	3.36
36	3.29
38	3.19
40	3.22
42	3.26
44	3.32
46	3.10
48	3.44
49	3.26
50	
51	

$$\rho = \frac{191 \times d}{C}$$

depth (ft)

Conductivity (mhos)

1175

LINE #1 $\rho(z)$ with centre at 27

Spacing (ft.)	R	LAYER	CONDUCTIVITY TO LAYER BOTTOM	COND. OF LAYER	ρ_{layer} (ohm-m)
2	3.08	0-2	0.325	0.325	1180
3	2.08	2-3	0.481	0.156	1220
4	1.52	3-4	0.658	0.177	1080
5	1.15	4-5	0.870	0.212	900
6	0.88	5-6	1.137	0.267	720
7	0.56	6-7	1.786	0.649	290
8	0.54	7-8	1.851	0.065	2940
9	0.47	8-9	2.128	0.277	690
10	0.40	9-10	2.500	0.372	510
11	0.32	10-11	3.122	0.622	310
12	0.22	11-12	4.548	0.426	450
13	0.20	12-13	5.000	0.452	420
14	0.21	13-14	4.760	?	
15	0.20	14-15	5.000		
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					

!!?

GSL LINE ACROSS CANAL [FOLLOWING BACKHOE DITCH + JUST EAST OF IT]

S

0 — 4.41
3 4.84
6 3.64
9 5.0
12
15 — 5.0
6.1
6.0
8.2
6.4
30 — 7.7
8.6
6.5
7.6
4.72
45 — 5.0
5.1
2.68
5.4
3.09
60 — 2.70
3.90
3.5
3.5
3.1
75 — 2.2
2.2
2.1
1.8
2.1
90 — 2.0
1.7
1.7
1.7
2.0
105 — 2.0
2.4
2.4
2.8
3.2
120 — 3.3
5.5
6.5
4.4
4.8
135 — 3.6

135 — 3.9
3.4
3.3
2.9
150 — 3.1
2.9
3.0
2.2
3.0
165 — 2.7
4.1
4.5
6.0
6.8
180 → 8.2
9.5
9.4
8.5
8.4
195 → 6.2
5.6
6.4
4.3
7.6
210 → 11.8
13.5
14.8
18.5
15.1
225 → 18.9
17.5
20.0
22.4
29.0
240 → ~~26.4~~ 32.0
24.0
26.7
20.6
255 — 22.2
18.6
21.4
17.1
15.1
270 — 11.4

270 — 8.1
6.8
6.4
6.0
285 — 6.4
6.7
6.0
6.2
5.7
300 — 4.1
3.2
3.0
1.5
1.4
315 — 1.4
1.4
1.3

Main Canal
177-centre

beginning of hill
large on surface

Probe spacing 3'

High readings coincided with green weed tape on N-side of main canal.)

(27 center of 2nd canal
127 - 132 [illegible])

177
129
48'

$$\rho = \left[191 \times d(ft) \times R(\text{ohms}) \right] \text{ ohm cm}$$

$$= 573 R$$

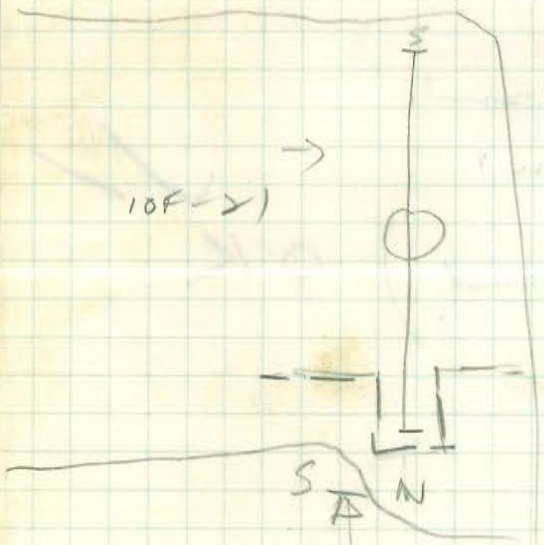
ρ ohm cm	R
5730	10
17,190	30
5000	8.7
10000	17.4
15000	26.1
	32.8
~900	1.7

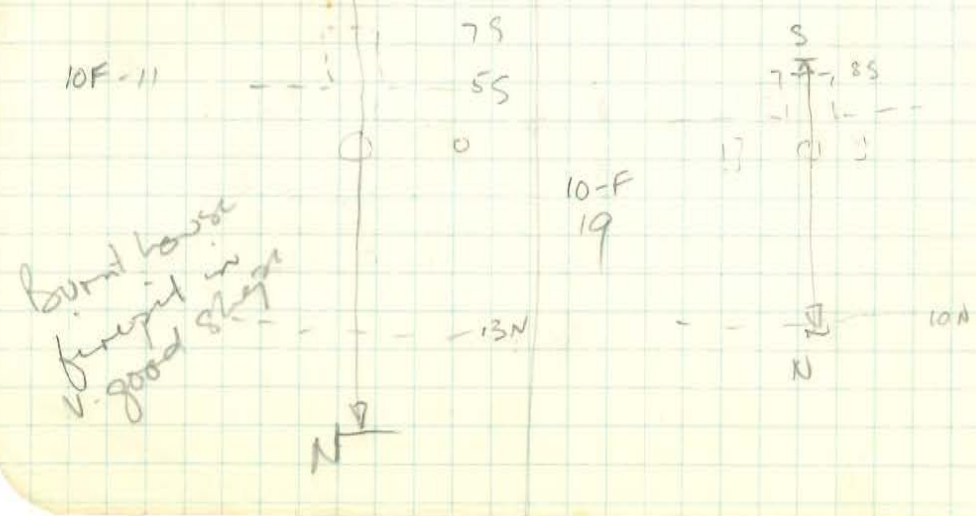
Average resistivity of topsoil on site ~ 900 ohm-cm.

(Correspond to v. dry sand.) OK

P.M. testing of fireplaces in excavated building

	10F-21		10F-11		10F-19
SOUTH 5'	(47) 194	S 13	189	58	217 ✓
	194		191		194 ✓
4'	194		194		187
	194	10	198	5	187
3'	193		205 ✓		186
	193		200 ✓		184
2'	192		189 ✓		185
	191		188		183
1'	189	5	193 ✓	0	183
	189		191		184
0 →	187		189		183
	189		185		189
1	188		183		185
	187	0	185	5	185
2	186		192		185
	187		191		184
3	187		191		184
	187		193		185
4	187	5	193	10	188
	187		192		180 Bank
NORTH 5	186		193	N	
			192		
			190		
		10	190		
			194		
			192		
			186 ✓		
			185		
		15	188		
			188		
		N	189		
			187		





burnt house
fireplace in
v. good shape

PM – 10G #4 ~~W → E~~

13' W	175
	174
	179
10'	186
	184
	181
	179
	180
5'	180
	179
	179
	180
	177
0	176
	179
	180
	180
	180
5	179
	179
	181
	183
	186
10	194
	206
← 3' → ← 3' →	207 ← 3' → ← 3' →

			180	169	162
		168	174	169	162
15	150	164	169	168	163
	143	159	168	170	163
	144	156	167	169	164 → S
← N	143	153	168	169	162
	148	150	168	167	165
20	149	153	169	169	163
	149	153	168	169	164
	151	155	169	169	166
	152	155	170	172	165
E	155	159	173	171	164
25	153	160	177	174	169
	148	163	179	173	173
	149	165	181	173	173
	152	168	180	173	173
	157	168	179	174	171
	157	168			
	157	167			

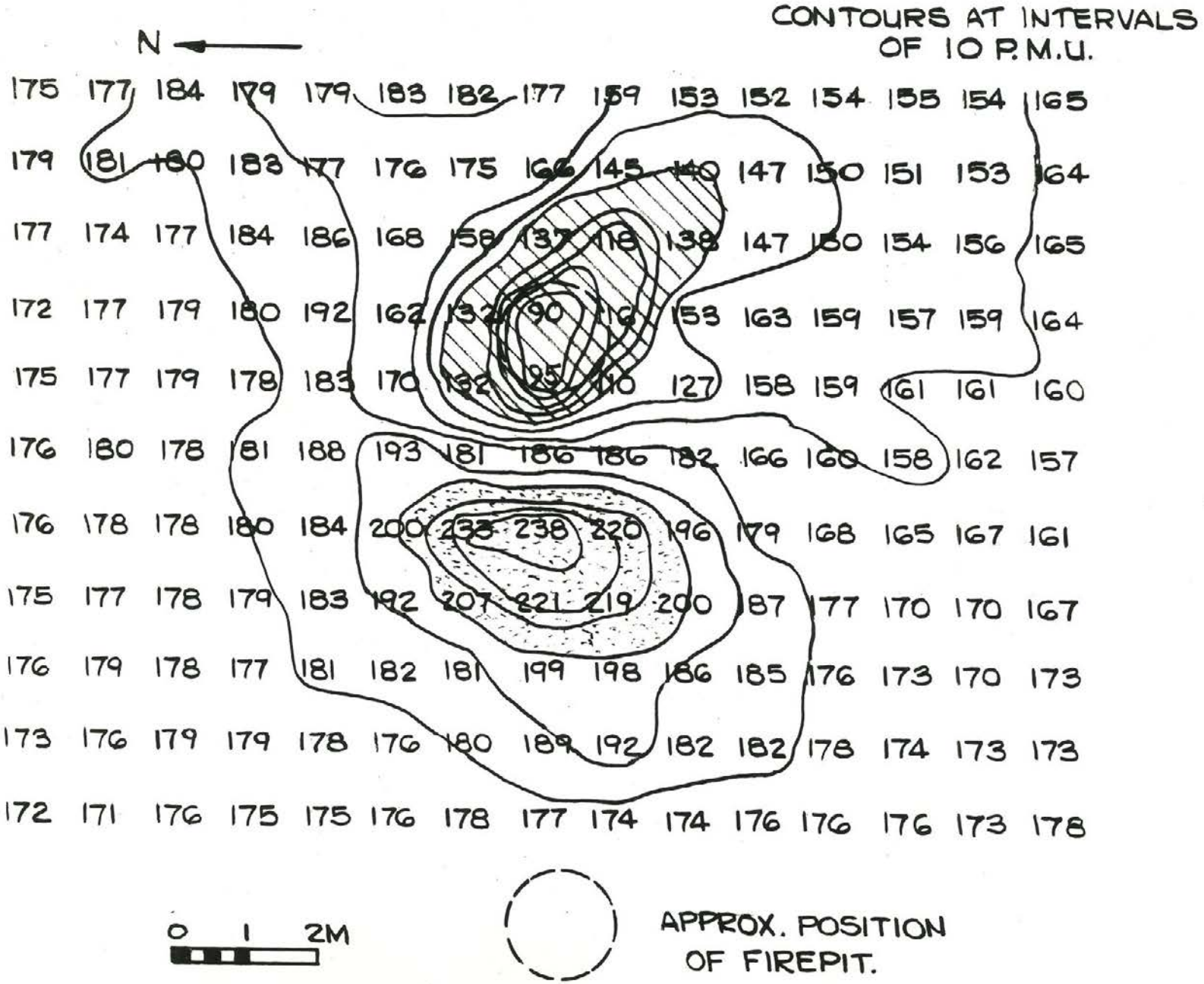
W → E

along side of pool ( )

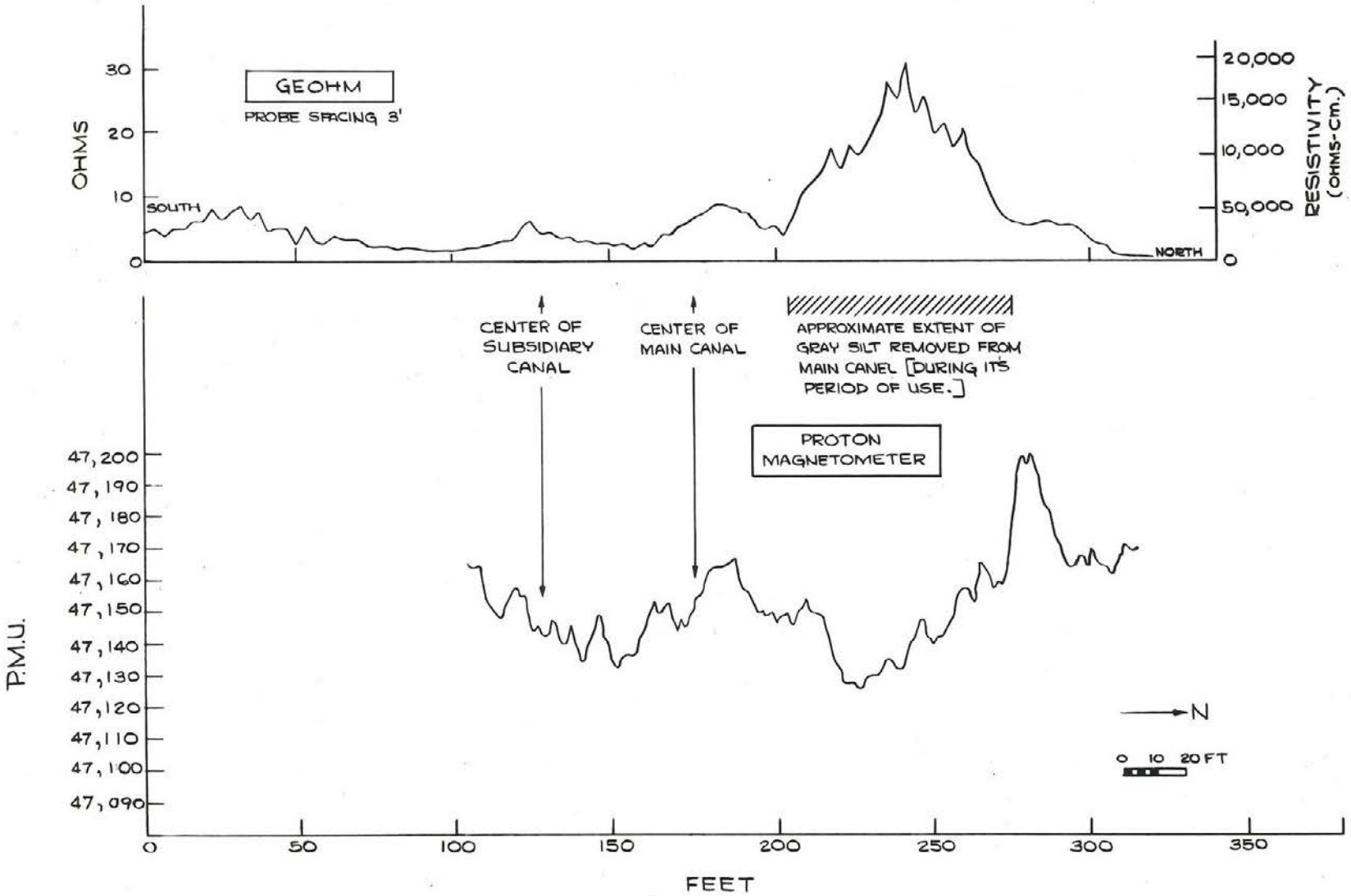
W 0'	edge of pool
	172
	166
	165
	164
1	162
5	163
	165
	168
	167
1	166
10	165
	164
	169
	169
1	172
15	171
	175
	172
	171
1	172
20	169
	168
	167

E

separated this area using land and giant (see other back)


CONTOURS AT INTERVALS OF 10 P.M.U.
N
175 177 184 179 179 183 182 177 159 153 152 154 155 154 165
179 181 180 183 177 176 175 166 145 140 147 150 151 153 164
177 174 177 184 186 168 158 137 118 138 147 150 154 156 165
172 177 179 180 192 162 132 90 110 153 163 159 157 159 164
175 177 179 178 183 170 132 95 110 127 158 159 161 161 160
176 180 178 181 188 193 181 186 186 182 166 160 158 162 157
176 178 178 180 184 200 233 238 220 196 179 168 165 167 161
175 177 178 179 183 192 207 221 219 200 187 177 170 170 167
176 179 178 177 181 182 181 199 198 186 185 176 173 170 173
173 176 179 179 178 176 180 189 192 182 182 178 174 173 173
172 171 176 175 175 176 178 177 174 174 176 176 176 173 178
0 1 2M
APPROX. POSITION OF FIREPIT.

Snaketown

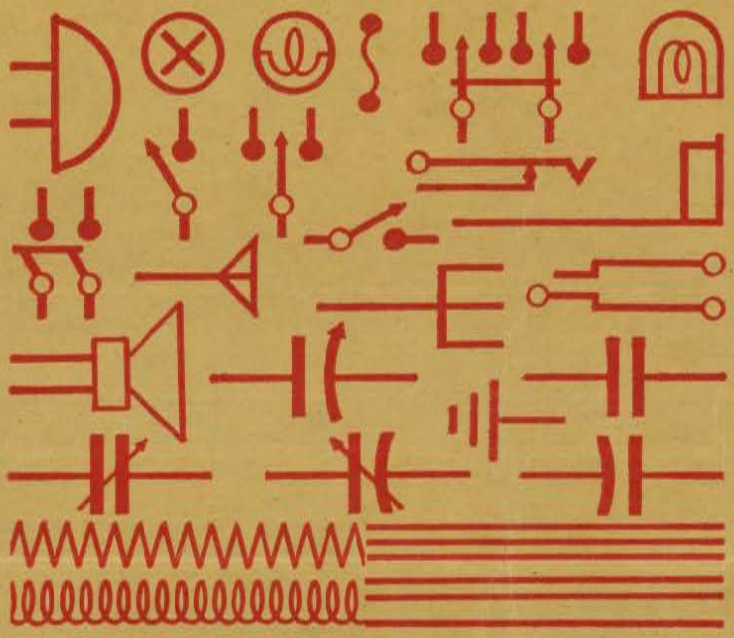

GEOHM
PROBE SPACING 3'
OHMS
30
20
10
0
SOUTH
NORTH
20,000
15,000
10,000
50,000
0
RESISTIVITY (OHMS-CM.)
CENTER OF SUBSIDIARY CANAL
CENTER OF MAIN CANAL
APPROXIMATE EXTENT OF GRAY SILT REMOVED FROM MAIN CANEL [DURING IT'S PERIOD OF USE.]
PROTON MAGNETOMETER
P.M.U.
47,200
47,190
47,180
47,170
47,160
47,150
47,140
47,130
47,120
47,110
47,100
47,090
N
0 10 20 FT
0
50
100
150
200
250
300
350
FEET

Snaketown

SNAKETOWN,
ARIZONA

JAN, 1965

SCIENCE NOTEBOOK



50 SHEETS

LINED ONE SIDE AND
20 SQUARES TO THE INCH
ON OTHER SIDE

NATIONAL

MADE IN U. S. A.

No. 33-620

NAME

ADDRESS

SUBJECT

50¢

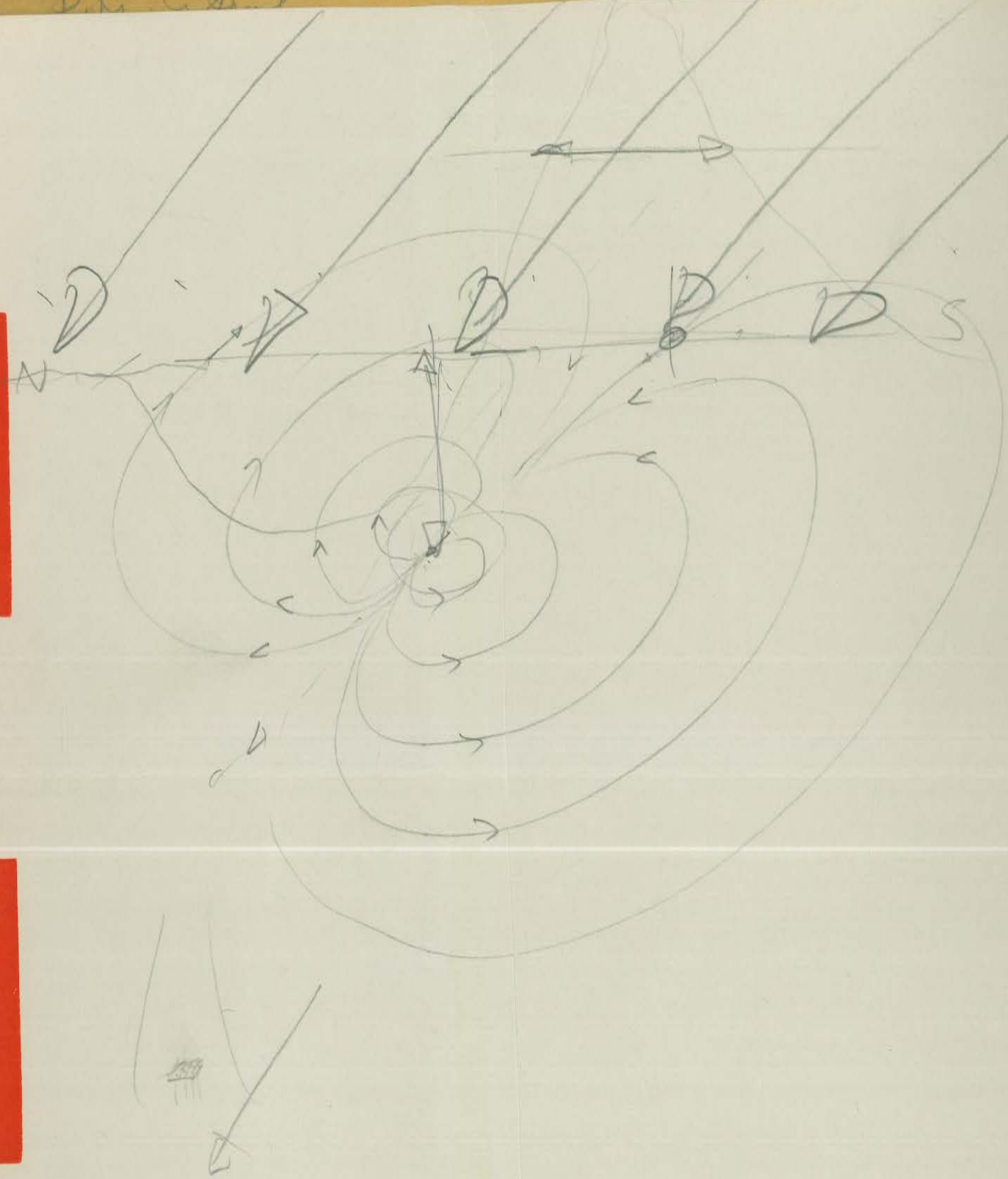
P.M. Saffire

9, 59, 1

USE THIS ENVELOPE FOR LOOSE PAPERS.

NATIONAL

SUBJECT



(471 - -)

JANUARY 16

A

1m.

69	73	76	72	74	76	69	72	67	166	163
71	61	65	68	71	72	74	66	66	67	67
64	62	62	66	69	75	69	68	66	63	68
68	66	66	69	70	71	74	64	55	55	68
69	66	66	64	64	64	56	54	55	48	63
75	71	66	63	64	68	65	56	52	62	68
65	67	64	63	64	64	64	65	64	60	55
64	66	67	67	66	68	68	69	67	64	59
65	64	65	63	66	60	61	63	63	66	65
69	70	77	79	74	69	70	71	72	74	71
70	81	89	92	85	83	83	83	82	83	81

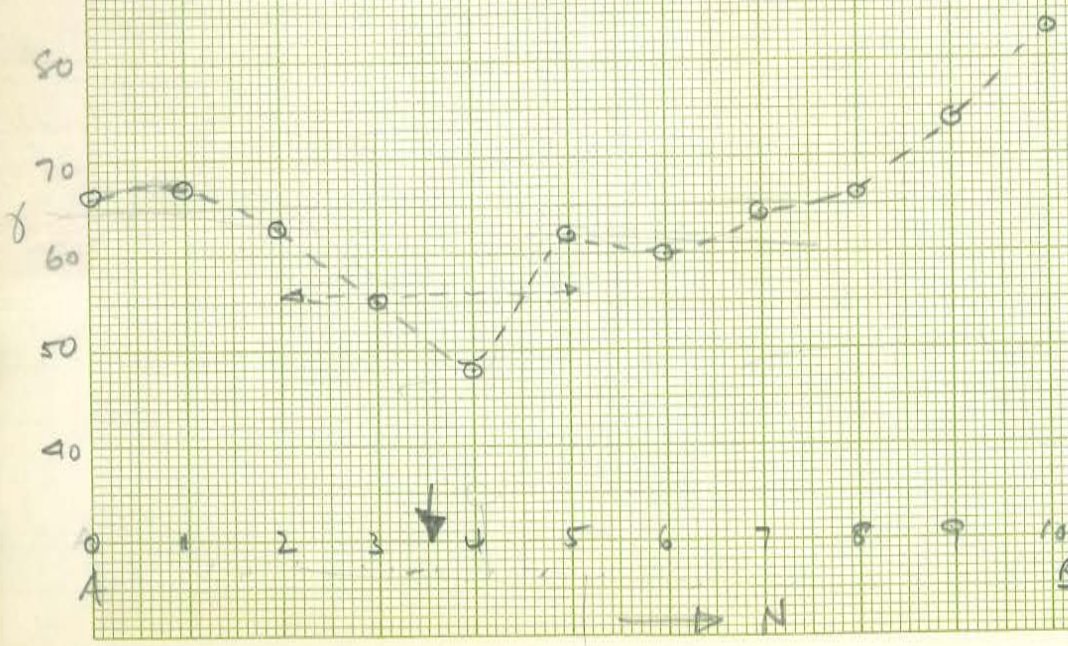
Bank

Bank

B

1m.

Bottle height



N (approx)

Profile S→N along line AB

Jan. 16, 1965

Arm. grid (10m x 10m) just west of house 10G #4

Jan 16

GR across ballcourt S → N

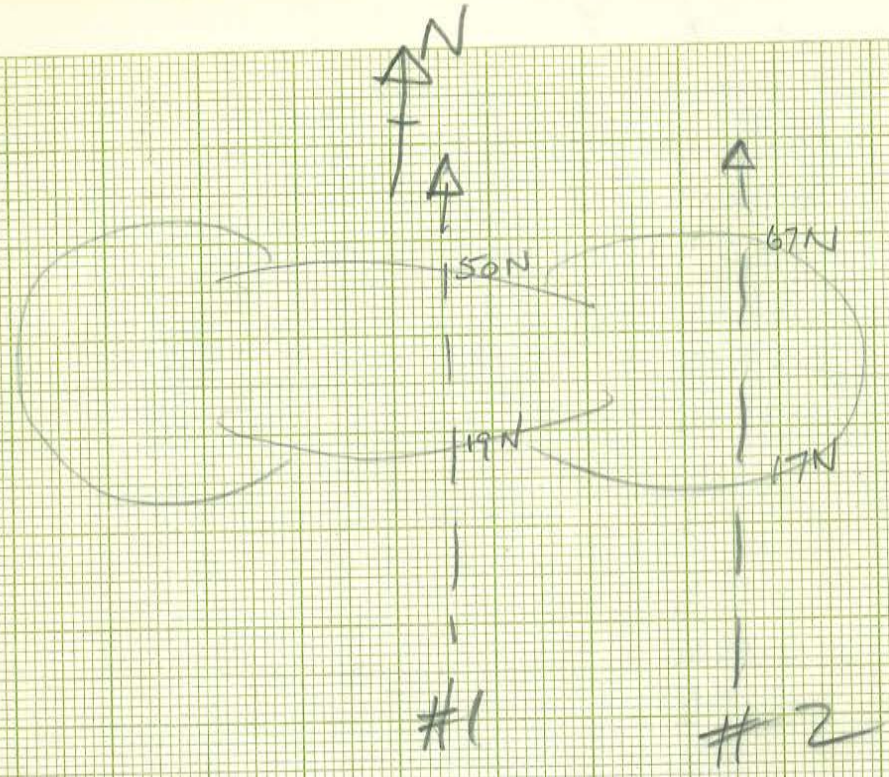
line #1

S

N

1		16.4
2	3.1	21.2
3	2.8	24.0
4	3.1	31.0 } middle court
5	2.2	23.4
6	2.3	30.4
7	1.9	15.8
8	1.8	15.0
9	1.9	8.5
10	1.5	4.8
	1.7	3.1
	1.5	2.0
	1.4	1.5
	1.3	1.6
15	1.1	1.6
	1.2	1.8
	1.4	1.7
	1.6	2.0
	1.8	1.8
20 (crest of rise)	2.2	2.0 ← crest of rise
	2.1	2.1
	2.9	1.5
	2.0	1.7
	2.4	1.8
25	2.0	1.9
	2.7	1.9
	5.7	2.0
	10.9	2.0
	9.7	
30	16.8	

N


N
150N
67N
19N
17N
#1
#2

LINE # 2

S

0	
1	1.5
2	1.3
3	1.3
4	1.4
5	1.4
	1.6
	1.7
	1.9
	1.6
10	2.0
	1.7
	1.9
	1.7
	1.9
15	1.7
	2.4
	1.6
	2.6
	2.0
20	1.9
	2.0
	2.6
	3.5
	3.2
25	3.4
	1.9
	1.9
	1.4
	1.4
30	1.5

30	
31	1.7
32	2.2
33	2.6
34	2.8
35	2.9
	2.9
	2.8
	2.7
	2.8
40	2.8
	3.1
	3.0
	2.8
	2.8
45	2.1
	2.2
	2.1
	2.4
	2.2
50	2.2
	2.1
	2.1
	2.2
	2.4
55	2.5
	2.5
	2.1
60	N

2.54 cm = 1''

.3048 m. = 1'

$1m = \frac{1}{0.305}'$

$\boxed{1m = 3.27'}$

$\therefore \rho = 191 \times 3.27 \times R$ ohm cm

in ohms

$= 628 R$ ohm cm

R	ρ
10	6,280
20	12,560
30	18,840
7.95	5000
15.9	10,000
23.85	15,000
31.8	20,000
1.6	1000
3.2	2000
4.8	3000
5.4	4000

S

JANUARY 18

LARGE BACKHOE TRENCH THRU MOUND 39

GR line about 4' N of trench & running E—W.

1m spacing

0		30		60
	1.8		1.6	
	1.9		1.7	
	1.8		1.8	
	2.1		1.5	
5	2.2	35	1.4	65
	2.3		1.6	
	3.1		1.4	
	3.2		1.4	
	4.1		1.3	
10	3.9	40	1.4	70
	3.6		1.2	
	3.2		1.3	
	2.2		1.3	
	2.1		1.3	
15	2.1	45	1.3	
	2.0			
	2.0			
	2.0			
	1.7			
20	1.6	50		
	1.4			
	1.6			
	1.4			
	1.6			
25	1.9	55		
	1.6			
	1.9			
	1.8			
	1.8			
30	1.9	60		

N 14	13	12	11	10	9	8	7N	6	5	4	3	2	1	S 0	
75	77	84	79	79	83	82	77	59	53	52	54	55	54	65	0 E
79	81	80	83	77	76	75	66	45	40	47	50	51	53	64	1
77	74	77	84	86	68	58	32	18	38	47	50	54	56	65	2
72	77	79	80	92	62	34	092	16	53	63	59	57	59	64	3
75	77	79	78	83	70	32	093	40	47	58	59	61	61	60	4
76	80	78	81	88	93	81	86	86	82	66	60	58	62	57	5
76	78	78	80	84	200	233	238	220	96	79	68	66	67	61	6
75	77	78	79	83	92	207	221	219	200	87	77	70	70	67	7
76	79	78	77	81	82	81	99	98	86	85	76	73	70	73	8
73	76	79	79	78	76	80	89	92	82	82	78	74	73	73	9
72	71	76	75	75	76	78	77	74	74	76	76	76	73	78	10
71	67	74	77	81	81	81	77	71	74	75	77	78	77	74	11
71	67	72	76	78	79	79	77	70	70	74	76	76	77	76	12
74	71	72	73	77	78	76	72	67	66	73	77	73	74	76	13
71	69	72	70	73	71	78	73	66	68	68	75	81	72	77	14
76	75	70	72	75	78	75	73	68	66	68	73	76	75	74	15
74	76	75	75	76	69	78	76	73	68	70	75	76	78	74	16
81	85	85	85	82	88	85	85	85	80	76	79	88	88	90	17
78	81	81	83	83	88	90	85	85	84	76	81	87	86	88	18
78	81	80	82	80	87	89	86	86	85	84	83	79	85	88	19
85	79	78	85	81	83	81	89	82	85	83	80	84	85	85	20 N

471 - -

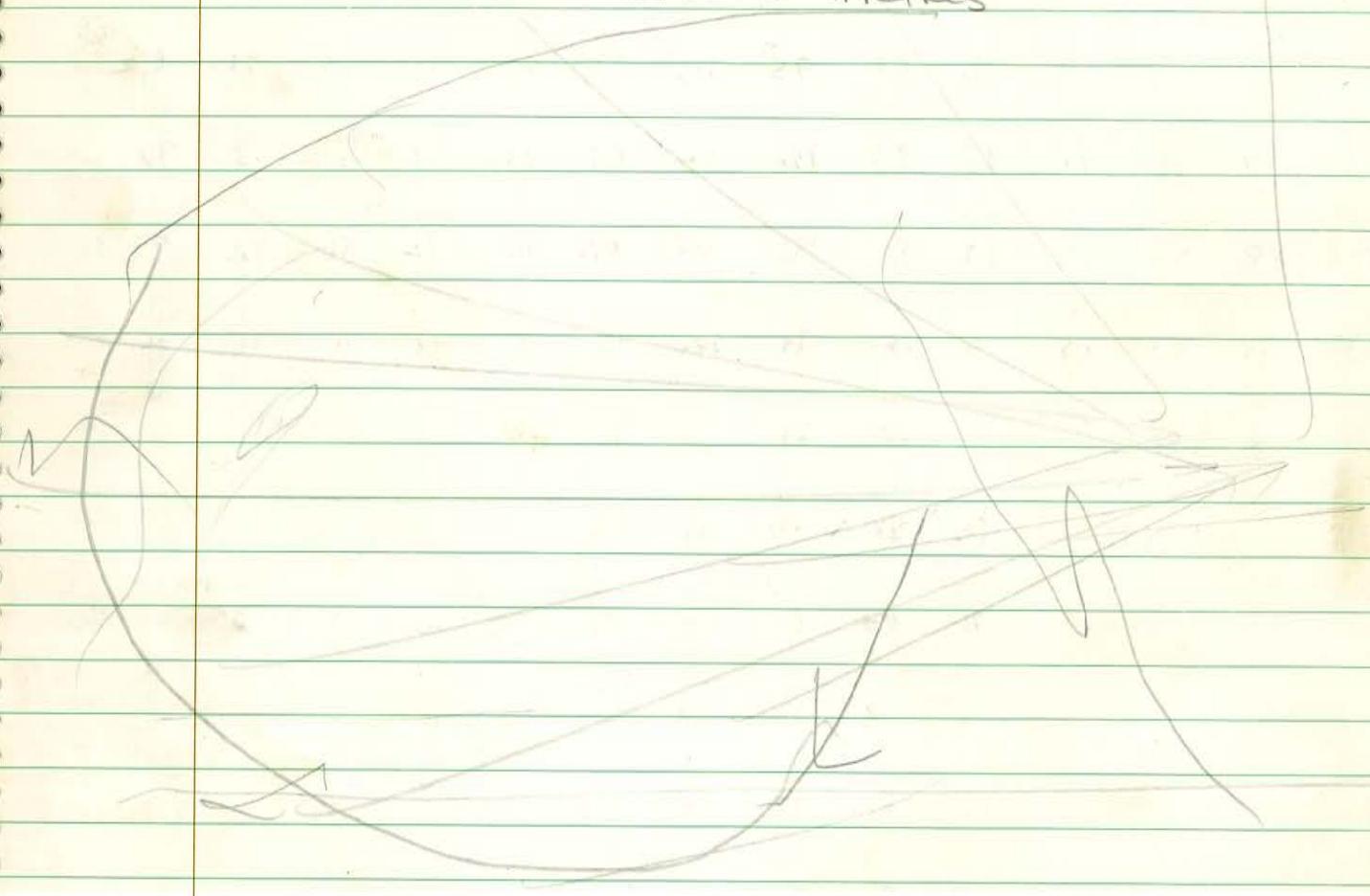
NORTH

Jan. 18

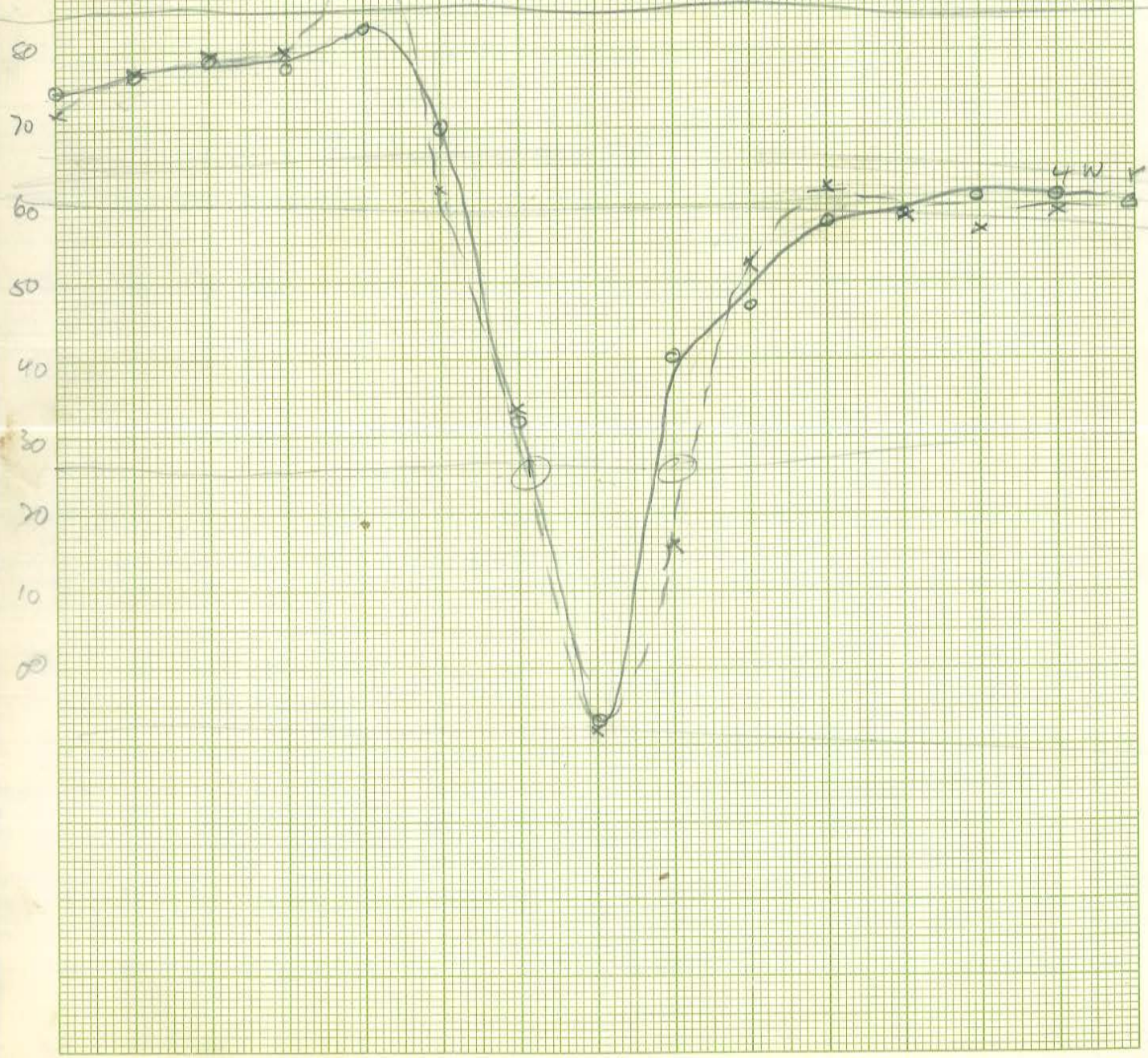
P.M.

Area cleared of brush will cost of digging

31 x 14 metres



	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
	82	76	82	84	84	81	84	89	86	85	82	87	91	88	84	21
	87	70	77	83	83	72	86	88	90	83	83	90	86	86	87	22
200		70	78	88	86	86	92	94	94	90	84	85	90	87	85	23 S
	89	83	83	87	92	96	97	95	83	89	89	90	86	92	82	24
	87	84	90	86	91	97	97	76	202	89	92	92	91	93	92	25
	88	88	88	88	89	97	95	95	93	94	94	92	86	92	92	26
	87	89	88	87	85	89	88	95	94	94	96	93	91	88	86	27
																28
																29
																30
																31



Jan. 18

GSL (km. separation) E → W along line 7N starting at 0E

0	
1	2.6
2	2.2
3	2.2
4	1.9
5	2.5
6	2.4
7	2.7
8	2.9
9	3.0
10	2.8
11	2.5
12	2.6
13	
14	

#1

N ↑

W

E

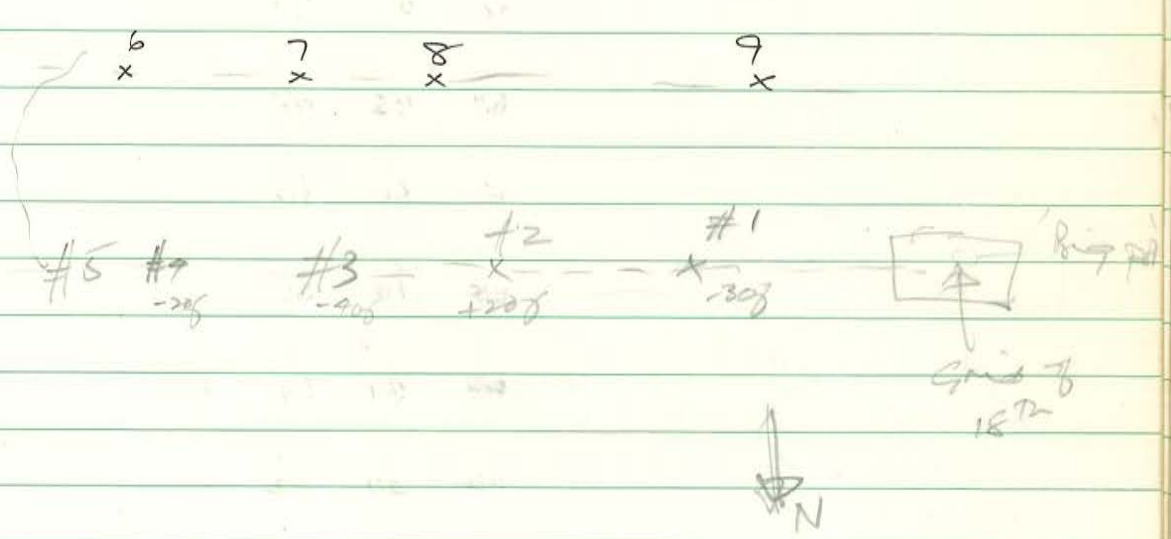
59	67	65	54	57
58	67	64	52	59
62	61	61	45	56
58	50	45	45	59
54	36	31	52	65
51	29	31	51	60
58	40	41	57	61
63	52	42	56	64
64	56	45	60	62
57	54	57	50	59
58	60	64	53	57

S

Jan. 19

Follow-up of long traverse run with P.M. (18th Jan) in area east of grid covered on 18th.
* (Bring pot)

Rough grids with spacing of about 2'.
i.e. marked out by bottle ~~[illegible]~~ cannies.



△ - Stake put in during long traverse on Jan. 18

(×) Stake marking centre of anomaly found Jan. 19.

#2

N

56	50	54
61	53	60
	66	58	57
	57	53	63
	58	56	62
	62	63	60
	60	63	62
	61	64	63
	65	68	64
	67	61	64
	64	50	62
	65	57	60
	61	46	61
		58	60
		56	59
		55	57

SS

NN

45	47	63
60	46	65
60	52	60
61	46	63
64	50	62
62	48	63

S

S

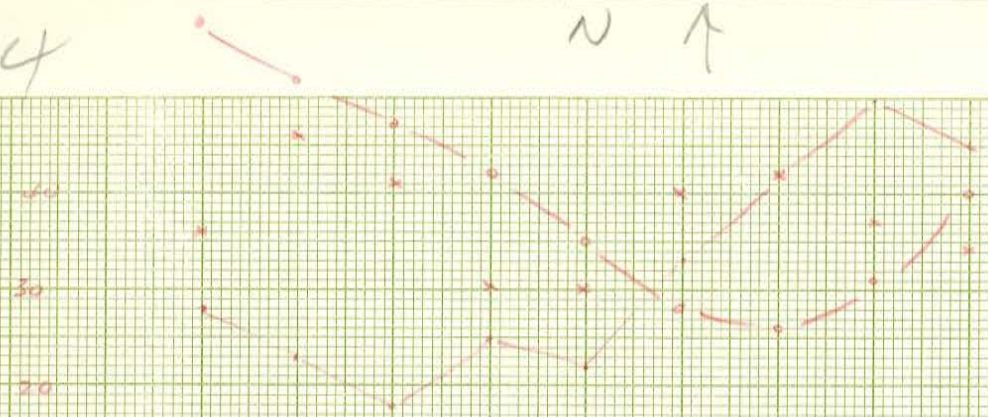
#3

N ↑

	56	51			
	56	53			
	53	58			
	51	46			
	54	60	47	47	
	65	68	57	66	53
	55	66	47	64	74
60	55	60	38	45	73
67	63	56	26	38	61
57	43	31	36	45	54
60	36	22	38	62	57
56	36	27	37	60	78
50	24	31	42	55	42
51	37	42	43		
52	43	47	43		
50	41	47	43		
47	40	51	50		
50	50	54	58		
51	55				
58	62				

#4

N ↑



46	43					
52	48					
47	47					28
54	40					23
50	42	45	56	48	54	18
48	53	45	56	42	50	25
47	32	34	46	40	47	22
44	41	35	43	30	45	33
48	24	28	35	25	51	42
36	40	38	43	35	60	50
50	45	44	50	50	60	45
54	45	53	56	51		

→ #5

Throw
included
in #5

Retaining
maintenance

Illmm

#5

N ↑

57	58				
60	58			47	61
56	58			44	60
46	52	51	53	36	48
41	47	48	51	35	41
30	42	43	40	40	40
30	35	32	38	35	43
40	28	28	36	32	48
42	26	26	35	32	45
37	31	34	36	34	55
34	40	40	43	34	58
28	48	48	46	41	54
42	52	50	52	48	
48	57	57	47	45	
52	55	56			

4+5 Continuous ?

Probably ✓

#6

N ↑

							60	58
					48	60	45	60
			55	60	48	60	38	62
54	52	48	52	58	52	61	41	56
50	45	40	43	48	35	48	35	55
41	35	41	36	46	35	46	40	53
57	43	40	22	47	40	35	38	56
50	45	35	21	44	37	44	41	56
50	40	42	26	38	46	57	46	
54	42	50	50	37	46	60	50	
58	50	51	54	52	40			
	48	52	57	56	41			
	47	60	57	57	57			

#7

N ↑

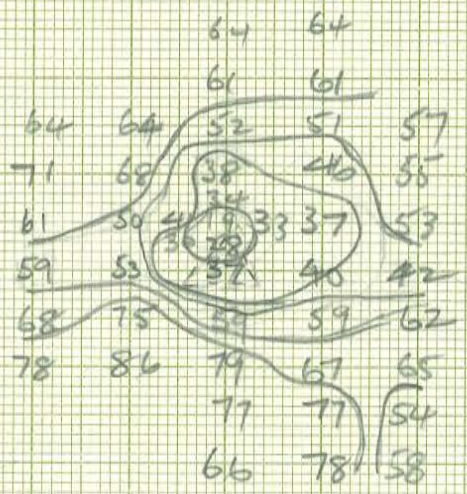
Anomaly not clearly defined

Metal?

		58	63	
		49	62	
75	57	48	61	
81	75	59	61	
88	81	60	64	52
80	75	51	61	54
74	64	60 60 58 53	72	50
71	59	50 48	353	52
69	56	51	46	50
		53	52	59
		57	45	59
		57	67	67
		64	70	70

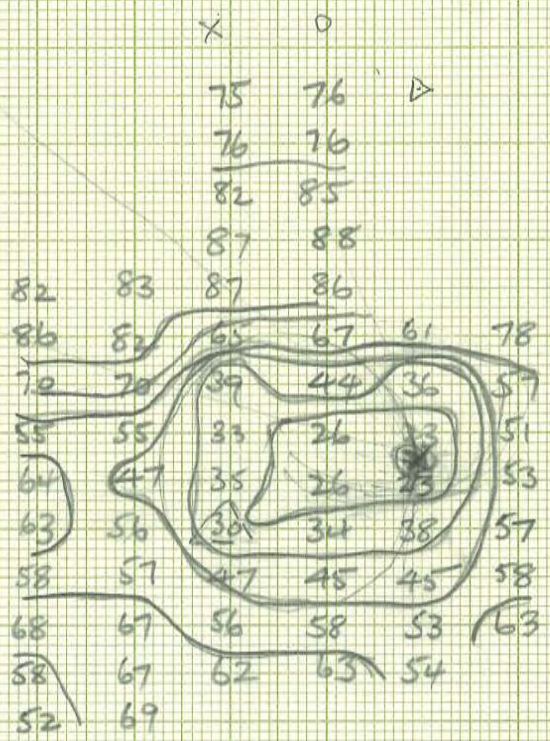
#8

N↑



Small anomaly

#9


X O
75 76
76 76
82 85
87 88
82 83 87 86
86 83 65 67 61 78
70 70 39 44 36 57
55 55 33 26 23 51
64 47 35 26 23 53
63 56 30 34 38 57
58 57 47 45 45 58
68 67 56 58 53 63
58 67 62 63 54
52 69

W → E

BACKHOE TRENCH 3

Spacing approx 3 meter

(about 11 meter N of trench)

Every meter

73		
72		16
78		16
76	73	18
81	73	22
78	74	25
76	74	29
78	76	31 ← Center of pit
80	76	30
77	76	29
65	74	23
76	74	19
76	74	20
84	73	22
74		
72		
70		
73		
76		
74		
80		
78		
77		
75		
73		
72		
74		
71		
75		
76		

W

Small pit

E

Every 6" E-W across pit

Every 6" E-W Scale

low readings due to backdirt.

1 PM

big pail

6" intervals W → E

	N side	S side
W	70	
	68	
	69	
	69	
	69	
	70	
	70	
	70	
	69	
	66	
→	67	26
	67	25
	68	25
	66	24
	66	25
	66	28
	65	24
	65	23
	65	23 ← Centre
	65	26
E	72	36
	63	42
	64	36
	65	29
	64	28
	65	26
	65	26
	68	25
	55	17
	77 63 63	18 17 16

471 —

7M S → N across canal. (1 metre spacing)

(S)

49	71
58	79
49	83
43	81
50	86
41	97
43	231
51	252
57	266
62	269
68	264
71	235
73	227
68	222
69	207
69	207
73	94
83	88
77	90
73	90
65	84
63	74
61	80
60	82
66	80
69	79
68	73
68	71
65	73
64	(NN)
66	
71	
74	
68	
57	
59	
65	
59	
62	
60	
48	
50	
51	
59	
65	

APPROX CENTRE → 66

½ m. intervals

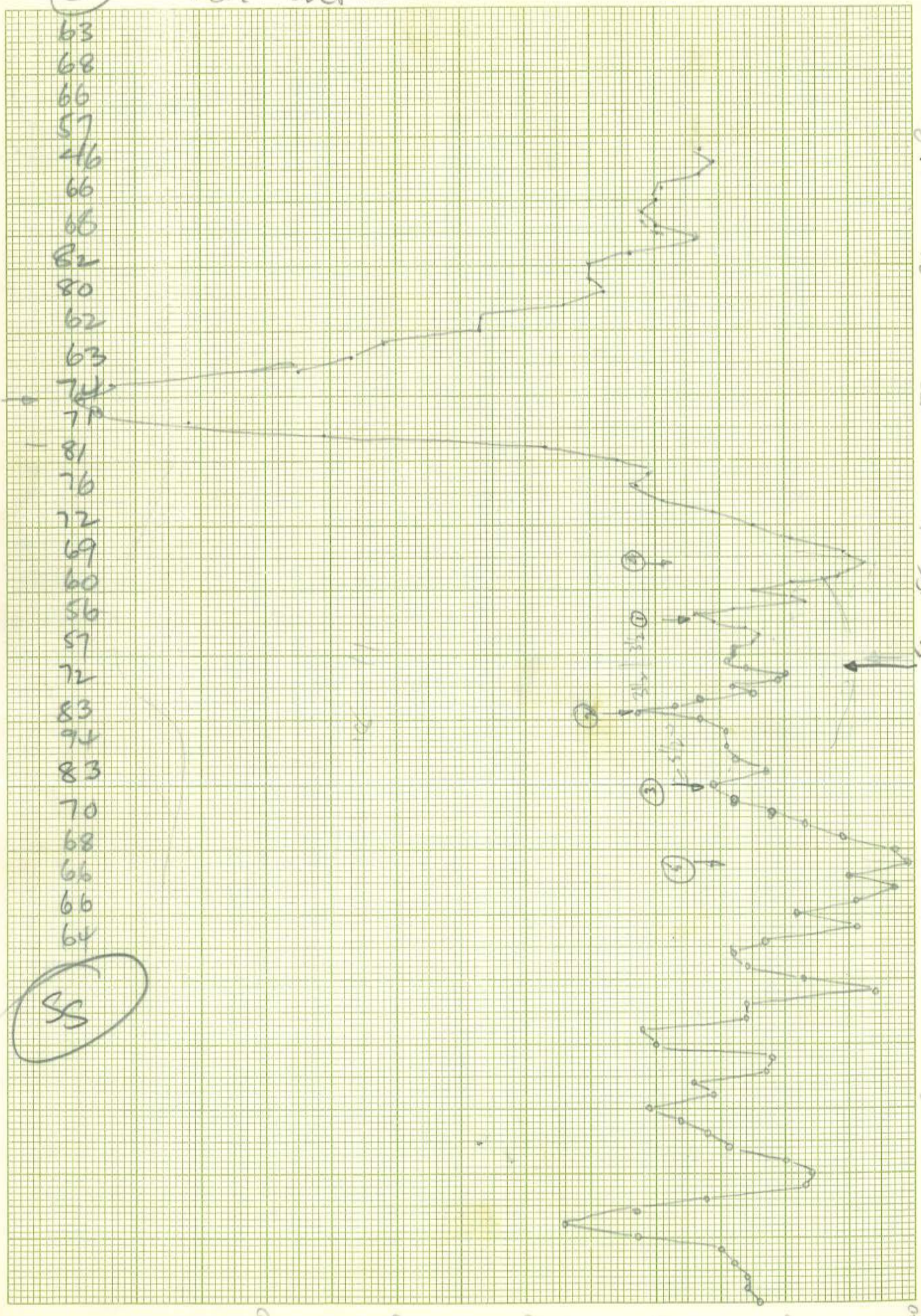
Cut east of division area

(S) lin uberoar

2

63
68
66
57
46
66
66
82
80
62
63
74
78
81
76
72
69
60
56
57
72
83
94
83
70
68
66
66
64

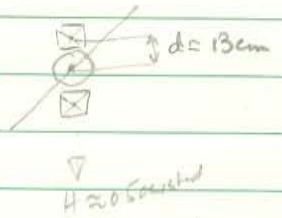
SS



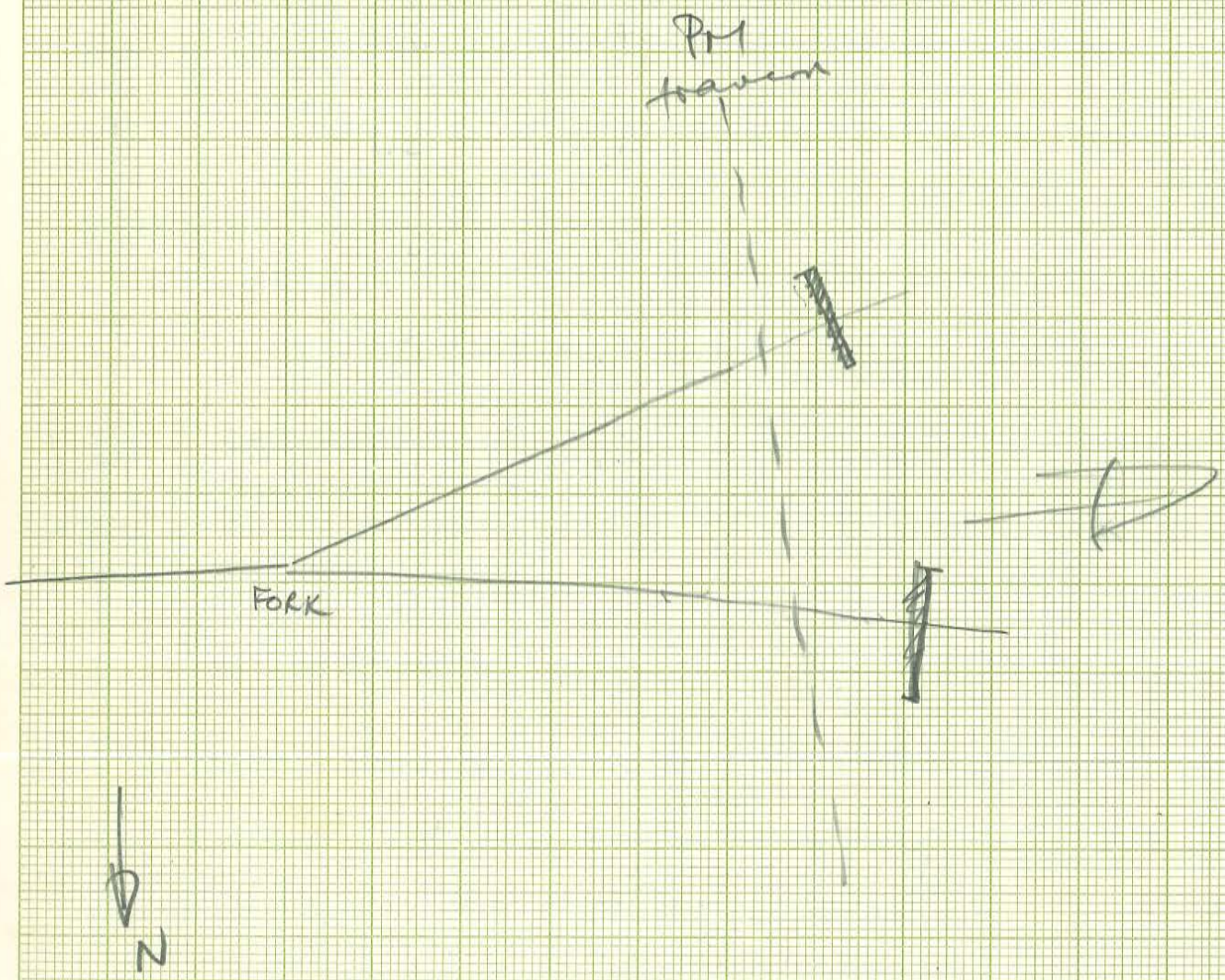
Magnetic testing of soils

Surface samples	w/o sample	Sample above		Sample Below	w/o Sample
1	148 148	143 143	(143)	143 144	148 149
2	148 148	146 144 145	(145)	144 145	148 148
3	148 148	145 144	(144)	144 144	148 148
4	148 148	143 142 142	(142)	141 141	148 148
5	148 148	143 144	(143)	142 143	148 147
6	148 148	145 146	(143)	142 142	148 148
	(148)				(148)

Mean 143-144



$$V = \pi \times (9.5)^2 \times 105 \quad cm^3$$


PM
transect
FORK
N

PM S → N Imebre intervals

Canal Cut S1 S→		~~Canal Cut N1~~	
190	212	196	205
181	213	204	207
184	211	205	194
182	209	199	193
182	206	196	206
185	202	200	212 ← North Canal
190	199	196	205
197	211	185	193
197	219	180	183
197	212	185	178
202	198	190	186
218	196	203	185
222	196	210	183
212	184	203	186
212	174	199	188
224	172	206	191
224	188	211	187
215	185	204	191
203	187	209	186
204	184	205	N
212	192	203	
215	200	199	
210	203	205	
213	202	204	
218	196	200	
214	200	198	
228	200	200	
231	199	196	
224	197	199	
224	199	197	
219	196	200	
219	193	202	
215	190	215	

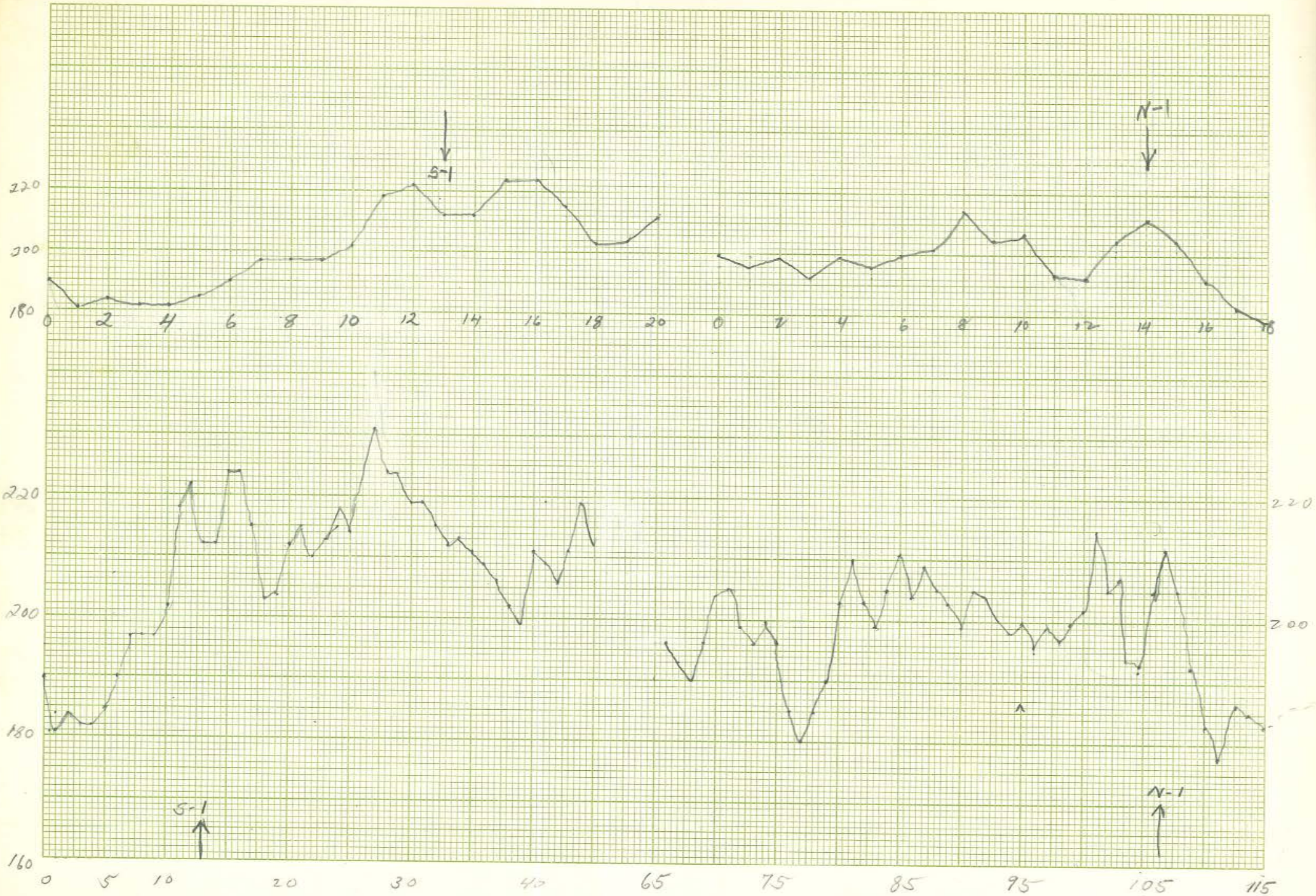
S

South end canal S1

omitted on graph

eyeball intervals from here

N


S-1
N-1
220
200
180
0 2 4 6 8 10 12 14 16 18 20
0 2 4 6 8 10 12 14 16 18
220
200
180
160
S-1
N-1
0 5 10 20 30 40 65 75 85 95 105 115

1½' spacing following holes left by GΩ probes

1½' spacing following GΩ holes

N

S

	156		166	150	165
	150		169	144	169
	145		164	142	172
	146		159	144	171
	143	← centre secondary canal	158	144	
	143		155	147	
	148		152	149	
	146		152	155	
	140		151	159	
	141		152	159	
	146		149	159	
	141		151	155	
	135		152	167	
	137		148	166	
	141	Start of [illegible]	151	164	
	145		153	159	
	150	[illegible]	156	161	
	143		153	160	
	141		151	165	
	136		151	181	
	133	backdrift	147	195	
	138		142	200	
	137		137	198	
	137		135	201	
	138		130	197	
163	143		130	193	
160	146		130	185	
156	150		128	183	
124	154		128	177	
165	150		132	173	
184	151		132	170	
165	153		132	167	
160	148		134	166	
154	145		137	169	
151	148		137	169	
149	146		135	166	
149	150	← centre main canal	134	161	
152	155		135	159	
155	156		142	166	
158	161		143	[illegible]	
156	165		149	[illegible]	

Jan. 20, 1965

PM across canals.

Same trouble as with GΩ on 15th

$$f = \frac{\mu F}{2\pi p} \quad (3.1)$$

$$= 4257.6\ F \quad \text{for protons} \quad (3.2)$$

Decade count $n = 10^5 \times \frac{1024}{f}$

$$\therefore F = \frac{24{,}050}{n} \text{ oersted}$$

$$\cong \underline{\underline{0.510}} \quad (47150)$$

47150

0.51000	47100
0.510	47200

1m

National Geographic Vol. 131, no. 5 May 1967

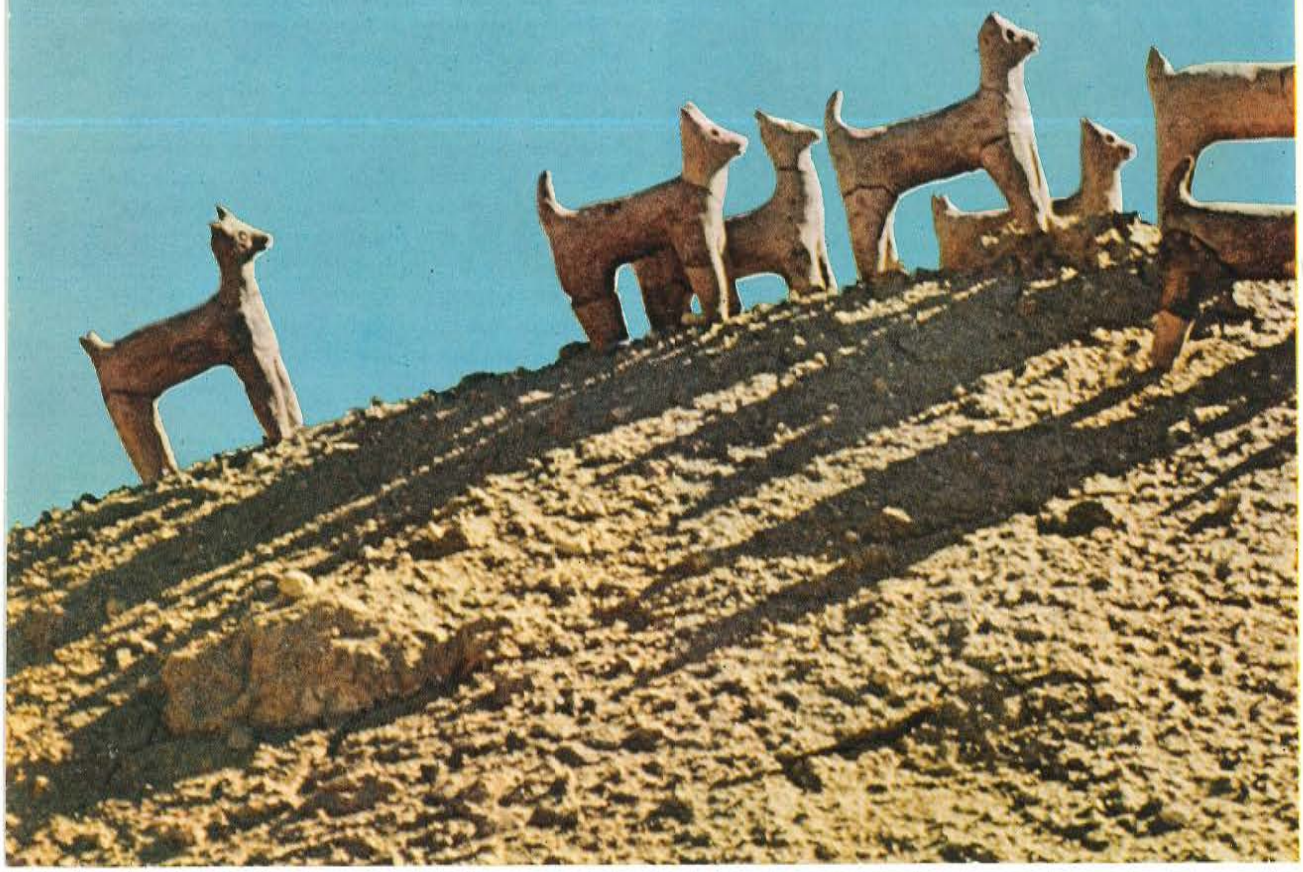
FIRST MASTERS OF
THE AMERICAN DESERT

The Hohokam

By EMIL W. HAURY

670

Photographs by HELGA TEIWES, Arizona State Museum



Lawrence country, where the great river pries open the land in its rush to offer itself to the Atlantic. Parts of eastern Canada have undergone significant changes in recent years. Brash new towns, such as Labrador City, have sprung up in the wilderness. In 17 years, the village of Sept Îles has grown from 1,200 to 14,000 inhabitants to become the third busiest port in Canada, after Montreal and Vancouver.

Much of this development springs from the discovery of almost inexhaustible quantities of iron ore in the region where Quebec joins western Labrador amid a maze of lakes and sinewy rivers. From there, ore now flows south at the rate of 80,000 tons a day.

As busy as this section of eastern Canada has become, however, it is to Montreal, deep in the funnel of the river, that the attention of the world turns in 1967. In observance of the nation's 100 years of confederation, that city of bristling activity plays host to Expo 67, the first fair in the Americas to be accorded top rating by the International Exhibitions Bureau in Paris.

A large inset at the top of the new map traces the eight-year-old St. Lawrence Seaway, which has helped make Montreal one of the busiest ports in North America, handling more than 20,000,000 tons of cargo each year.

In the long, shelving basin of the Bay of Fundy, the Canadian Government has begun new studies of an old dream—harnessing the powerful Atlantic to generate electricity. Possible sites include the Minas Basin in Nova Scotia, with tides up to 53 feet, Passamaquoddy Bay near Campobello Island, and several bays off the northern finger of Fundy.

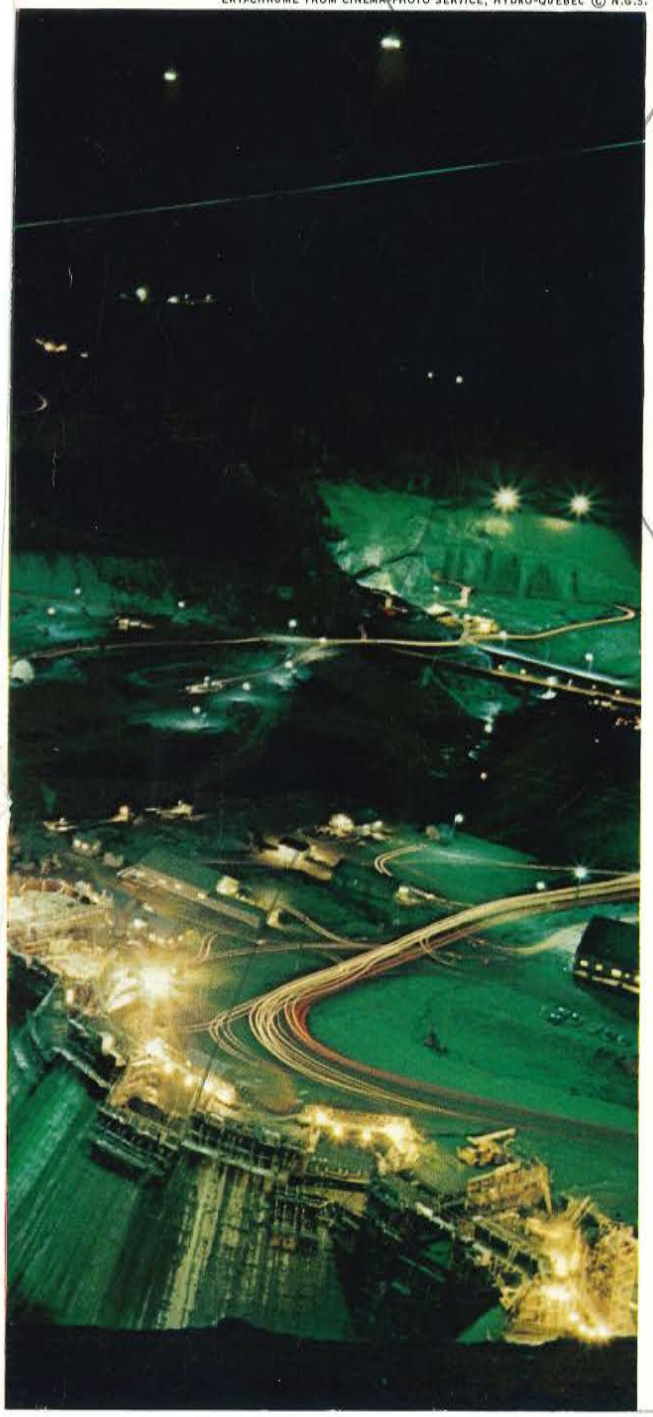
Meanwhile, another long-time dream—to connect Prince Edward Island with the mainland—has moved out of the visionary stage. Construction has started on a $148,000,000 causeway-bridge-tunnel to span treacherous Northumberland Strait between Port Borden, on the island, and the New Brunswick mainland near Cape Tormentine.

The recent surge of nationalism in sections of eastern Canada, stemming from a French heritage, has gallicized many names. Thus, Quebec's Coldwater Lake has not vanished from the map; it's still there—as Lac-à-l'Eau-Froide. Old Fort Island, off the northeast coast of Quebec, survives as Île du Vieux Fort. And Ha Ha Lake, also in Quebec, retains its joviality as Lac Ha! Ha!

In any language, eastern Canada is a big and bountiful land, with a strong heartbeat that has set the cadence for a nation's march into its second century. THE END

Additional copies of the World Atlas Map of **Eastern Canada** can be obtained for 50 cents each, postage prepaid, by writing to Dept. 403, National Geographic Society, Washington, D. C. 20036.

EKTACHROME FROM CINEMA-PHOTO SERVICE, HYDRO-QUÉBEC © N.G.S.



Woven from concrete and steel, a scallop-skirted curtain dams the plunging Manicouagan River north of Baie Comeau, Quebec. Visitors to Expo 67 will watch the progress of Manicouagan 5, the world's biggest multiple-arch buttressed dam, on a 600-square-foot color television screen.

FROM SOMEWHERE on the mesquite-studded plain, the song of the coyote broke the primeval stillness of 2,000 years ago. This thirsty land—someday it would be known as Arizona—swept for empty miles toward brown mountains. Along bleached watercourses, saguaro cacti thrust spiny arms against a smelting sun.

Yet here, cradled in dry hills, there was also the miracle of a green valley, watered by a running stream. The Gila River, bearing distant rains from the eastern mountains to the Colorado, bathed sun-warmed banks where deer and cottontail, gray fox, muskrat, and water birds found shelter.

On this stage one of the important dramas of pre-Columbian American history was played out. Here an ancient and courageous people, known today as the Hohokam, faced and conquered the desert. With only stone and wood tools, they performed feats of canal engineering unique among the achievements of early Indians north of Mexico.

Other prehistoric tribes, it is true, survived by hunting and fishing, gathering an occasional crop of

Parading out of a long-hidden past, five-inch-high clay deer and a rattlesnake-adorned potsherd fashioned by the ancient Hohokam Indians come to light at Snaketown, Arizona. Excavations in this desert valley southeast of Phoenix have revealed a remarkable farming culture lasting from several centuries before Christ to A.D. 1400-1500.

wild fruits, berries, and roots. But the Hohokam made this hard land bloom with corn, beans, and squash. They became the first irrigationists within the present-day United States, and we now know that they did it several centuries before the time of Christ.

Hohokam (pronounced ho-ho-*kam*) is a modern Pima word meaning "that which has vanished." And indeed the ancient Hohokam have long been the forgotten Americans of pre-Columbian times. It sometimes seems to me that they must have planned it that way. I have probed Hohokam ruins for more than thirty years of my professional life—and the search quickly taught me to live with frustration and disappointment.

Unlike any other early people of the Southwest, most of the Hohokam cremated their dead, preventing us from forming a clear picture of their physical appearance. The most beautiful of their artifacts—stone vessels, clay figurines, jars in human form—are almost invariably found willfully smashed. We do not know why. They left few examples of monumental architecture to attract the eyes and spades of archeologists. And the restless wind of the Arizona desert swept in soil to seal their remarkable irrigation systems, leaving only provocative traces.

But gradually, important clues came to light: caches of cult objects pieced together by meticulous technicians (pages 692-3) and ancient watercourses revealed by aerial photographs. Finally, the brush and trowel of the archeologist, aided by a massive earth-moving machine, cleared away the uncertainties.

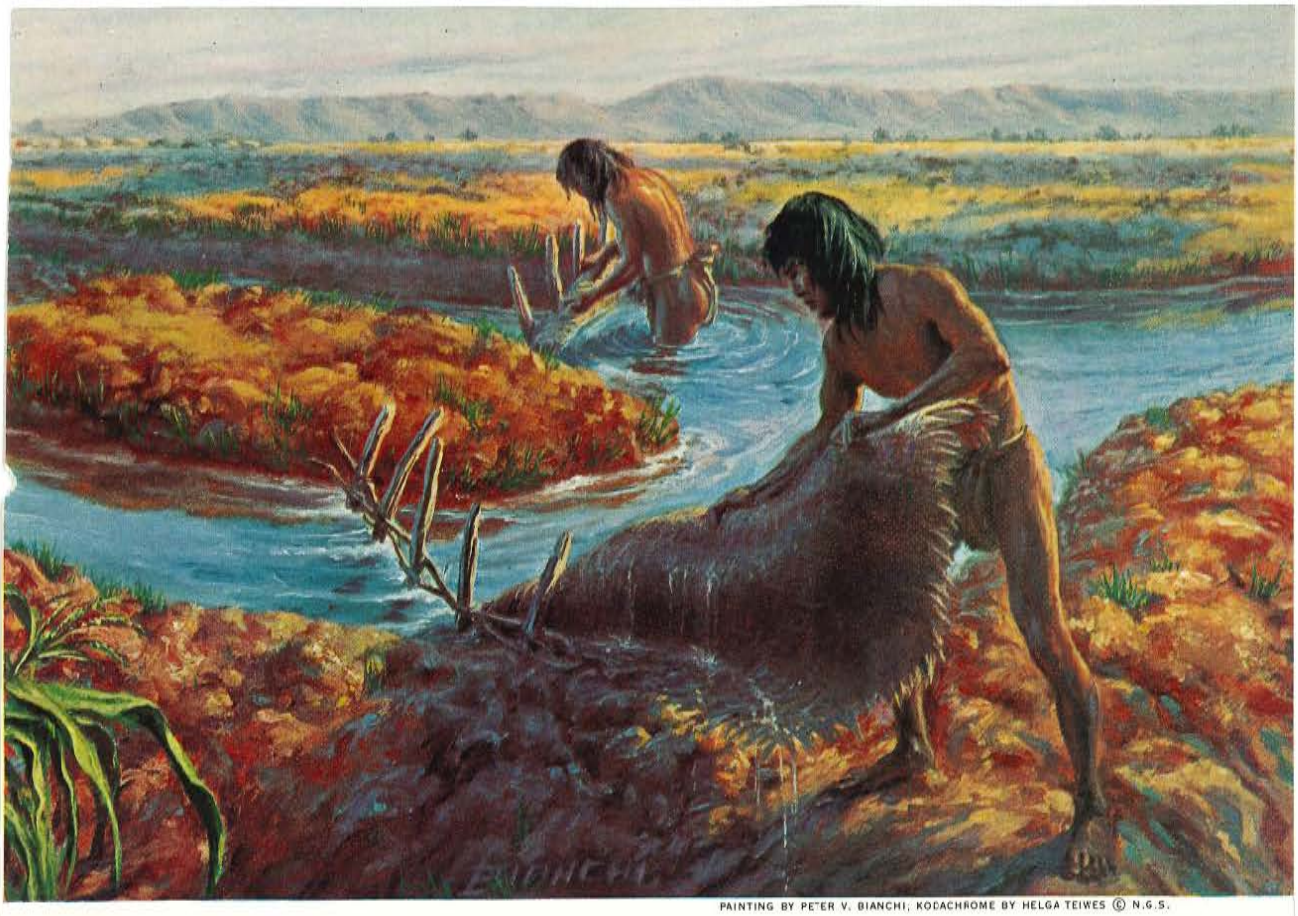
Extensive excavations in 1964-65, which I directed, have opened one of the earliest and most important chapters in the prehistory of our country. The shadowy Hohokam have emerged as the first masters of the southwestern desert, and the makers of a culture that represents a major stride toward civilization.

History Slept On in Humble Mounds

My students at the University of Arizona sometimes ask me how the Hohokam remained hidden for so long. It was, in part, the result of historical accident.

The early excavators in the Southwest, at the end of the last century, were naturally drawn first to the Four Corners Country, where Arizona, New Mexico, Colorado, and Utah come together. There, in the land of the Anasazi cliff dwellers, spectacular ruins on mesas and in high-arched caves of canyon walls attest to a high level of civilization.*

Few scientists of that time were tempted to



PAINTING BY PETER V. BIANCHI; KODACHROME BY HELGA TEIWES © N.G.S.

grub in the less promising sites of the scorching desert to the south. But those who did invariably found clues to the presence of a numerous, gifted, and ancient people.

In 1887-88 a colorful explorer, Frank Hamilton Cushing, led the first organized archeological expedition into southern Arizona. He and his diggers collected more than 5,000 Hohokam specimens from the Salt River Valley near Phoenix. From the ruins he examined, Cushing concluded that the desert had been the home of a "greater if not further advanced ancient population" than the Pueblo people to the north.

But American archeology was then a young science, and few diggers realized that a trash dump may be a greater treasure than a temple. The Hohokam's story remained buried in their house pits and their humble mounds.

Years passed, and to most people southwestern archeology still meant only one thing: cliff dwellers. Finally, in 1934, Harold S. Gladwin, Director of the Gila Pueblo Archaeological Foundation, organized a landmark

*The emerging story of the Anasazi has been told in NATIONAL GEOGRAPHIC in "Ancient Cliff Dwellers of Mesa Verde," by Don Watson, September, 1948; "Searching for Cliff Dwellers' Secrets," by Carroll A. Burroughs, November, 1959; and "Solving the Riddles of Wetherill Mesa," by Douglas Osborne, February, 1964.

First irrigationists of the Southwest, the Hohokam flood a field with water brought three miles from the Gila River. One man wades in to dam the main canal with a mat of woven fiber; his companion lifts out a similar barrier, diverting water to a side canal. Others lead off the precious flow to irrigate their staple crop, corn.

Modern Indian (below), a Pima living near Snaketown, uses the same methods, sometimes following a watercourse laid down by the vanished Hohokam.

excavation at a Hohokam site in the Gila Valley. I had the privilege of serving as field director of that excavation; thus began a lifelong interest in this forgotten culture.

The site, then as now, was a wide expanse of undulating mounds and slopes in the open desert southeast of Phoenix (maps, opposite and page 699). It lay within the Gila River Indian Reservation, home of the gentle Pima. The Pima called it Skoaquik, Place of the Snakes—to us, Snaketown. And indeed snakes still inhabit the area, feeding on rodents that tunnel into the ancient trash mounds.

The village itself had long ago vanished under the earth. Only the strangely brittle surface of the hillocks, paved with literally thousands of potsherds, remained to prove that a settled people had once lived here.

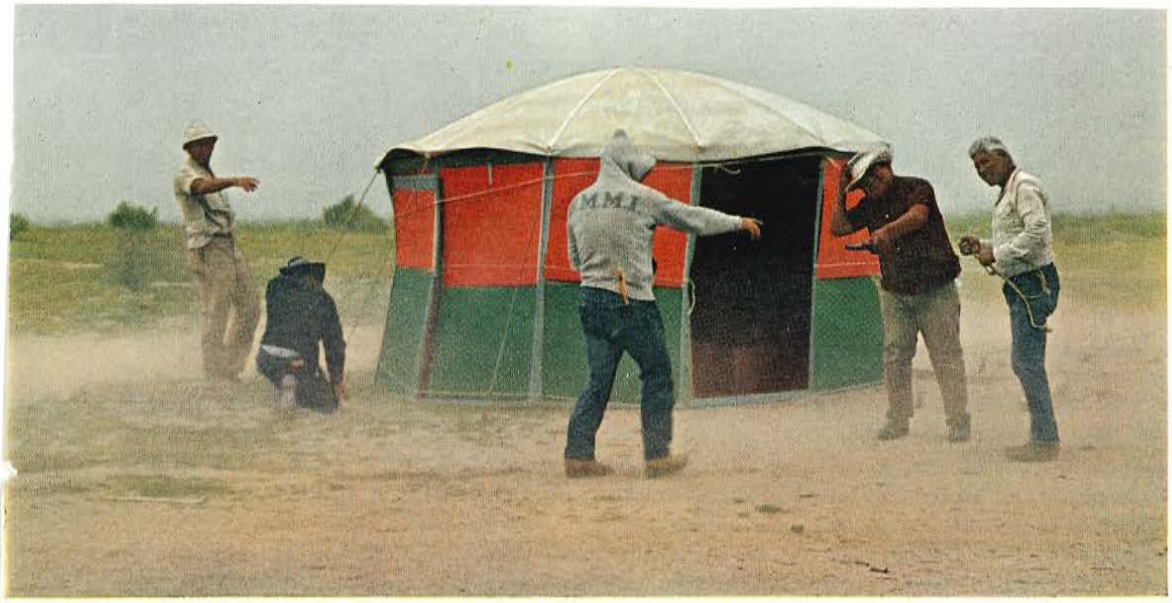
The Pima who helped us dig the site were irrigation farmers. Their forebears lived in round houses constructed very much in the manner of the Hohokam dwellings we soon encountered (page 686). The Pima way of life bore the immemorial stamp of the Southwest, a perfect adaptation to a difficult environment.

Ancient Ball Court Poses a Question

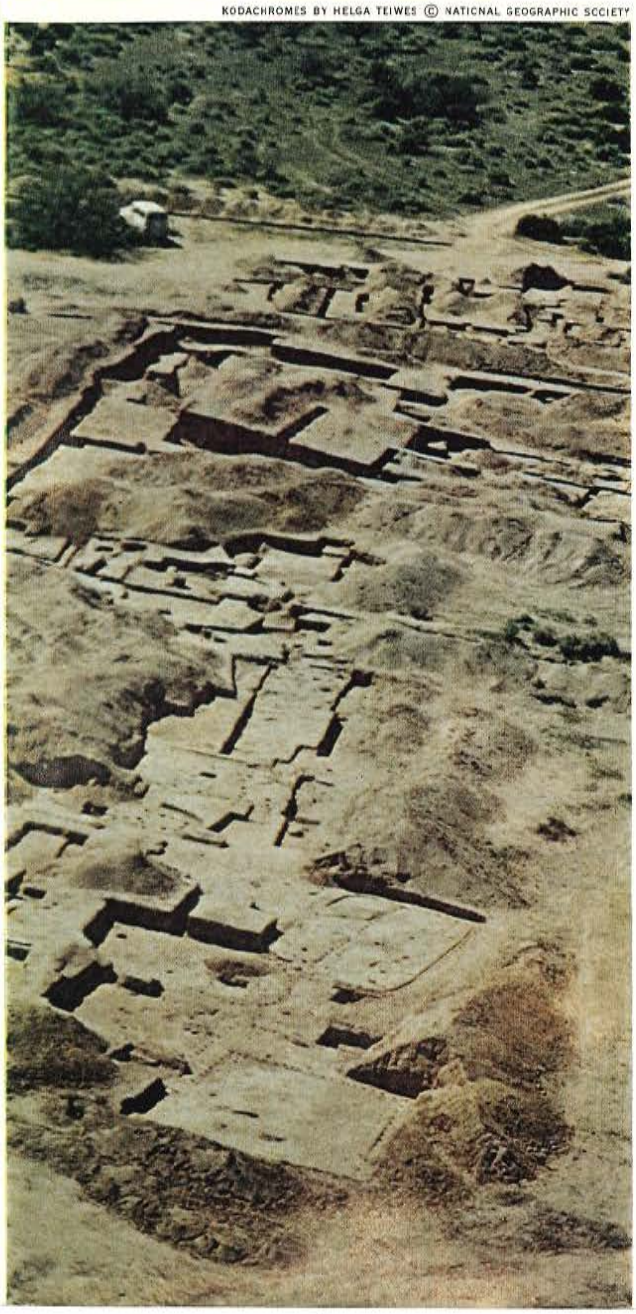
I asked myself: Is it possible that the Hohokam were the first to put that stamp there? If so, when? And what happened to them?

We found only partial answers during that first dig. But we also uncovered some surprises.

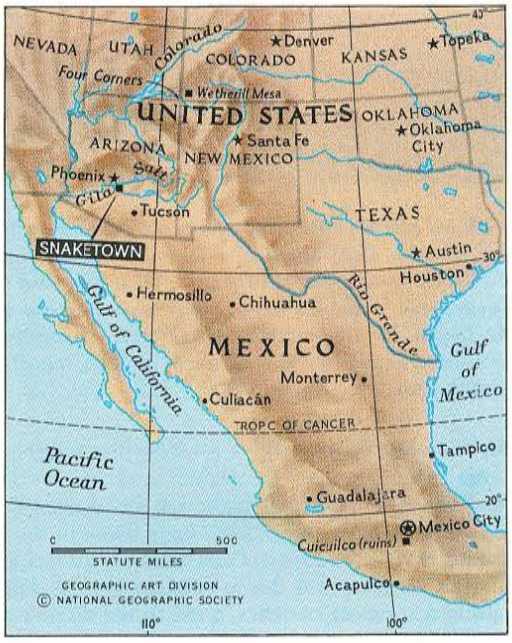
A curious depression flanked by ridges lay not far from the largest of Snaketown's



KODACHROMES BY HELGA TEIWES © NATICNAL GEOGRAPHIC SCCIETY



Biting windstorm buffets members of the Arizona State Museum expedition to Snaketown as they lash down a storage shelter. Led by Dr. Emil Haury, the museum's retired director (far left), a team of archeologists and Pima Indian helpers spent seven months in 1964-65 studying the ancient Hohokam village. The National Science Foundation and the University of Arizona aided the project, and the Gila River Indian Community Council gave it their blessing. Mosaic of house floors at left spans more than 1,000 years and seven cultural phases. Dr. Haury's team has pieced together the history of an agricultural people who wandered into Arizona from the south and stayed in their irrigated valley for more than 1,500 years. Craftsmanship of surpassing quality and the absence of any sign of warfare suggest that the Hohokam led a peaceful and prosperous life.



mounds. As we peeled back the centuries of earth, it began to look familiar. When the bright desert sun finally shone on it again, we saw that we had cleared a ball court reminiscent of those found in ruined cities far to the south in Mexico (pages 678-9).

There were other surprises. The highest of the mounds, No. 29, yielded seven distinct cultural phases stretching further back into time than anyone had a right to expect. On the floor of a burned house, amid refuse from the beginning of Snaketown's fifth phase, we unearthed pottery imported from the pueblos to the north. That pottery carried, almost as clearly as a maker's mark, an unquestionable date of A.D. 500. It derives from the Douglass tree-ring calendar, in which the varying annual growth rings of certain trees have given a year-by-year record of variations in weather over the centuries. Compiled by a series of National Geographic Society expeditions, this remarkable yardstick can tell archeologists the precise year when a beam or post in one of Arizona's prehistoric ruins was cut from a living tree. Thus pottery and other artifacts found in the ruins can also be dated.

From other imported shards we were able to estimate that the last three phases of Hohokam history at Snaketown—beginning about A.D. 500—had lasted around 200 years each. Yet there were four earlier phases here! Even a conservative estimate pushed the beginnings of the settlement toward the opening of the Christian Era.

There were strong affinities with Mexico in addition to the ball court. Aptly enough, one of the enduring favorites of the Hohokam craftsman was the snake. We found him writhing around the sides of pots, forming the circlet of a shell bracelet, coiling at the rim of a stone incense burner. Quite often a bird is attacking the snake, a very old motif south

KODACHROMES © N.G.S.

With an artist's care, the author and team member Al Lancaster at left brush away the desert soil covering charred remnants of a Hohokam house. Dr. Haury says, "If it were not for the National Geographic Society, I might never have become an archeologist." He began his distinguished career as a member of a Society-sponsored expedition to Cuicuilco, Mexico, reported in NATIONAL GEOGRAPHIC of August, 1923.

Dirt-moving behemoth, a combination backhoe and front-end loader, was tamed by Dr. Haury to do the work of an army of hand shovelers. Once thought too ponderous for archeological excavations, such power tools have come to the aid of scientists rushing their work ahead of new highways, dams, and urban development. "It saved the day at Snaketown," Dr. Haury claims. "By cutting a series of trenches, it led to the discovery of a primitive canal that proved the Hohokam's primacy as irrigationists."

of the Rio Grande—and one that survives to this day on Mexico's flag.

Among the many thousands of artifacts gathered, we found countless stone tools and arrowheads, but it was a small number of decorated marine shells, dated to about A.D. 1000, that intrigued us most. We were baffled by the incredible fineness of the working of horned toads, snakes, and geometric forms that adorned them.

Hohokam Discovered Etching Process

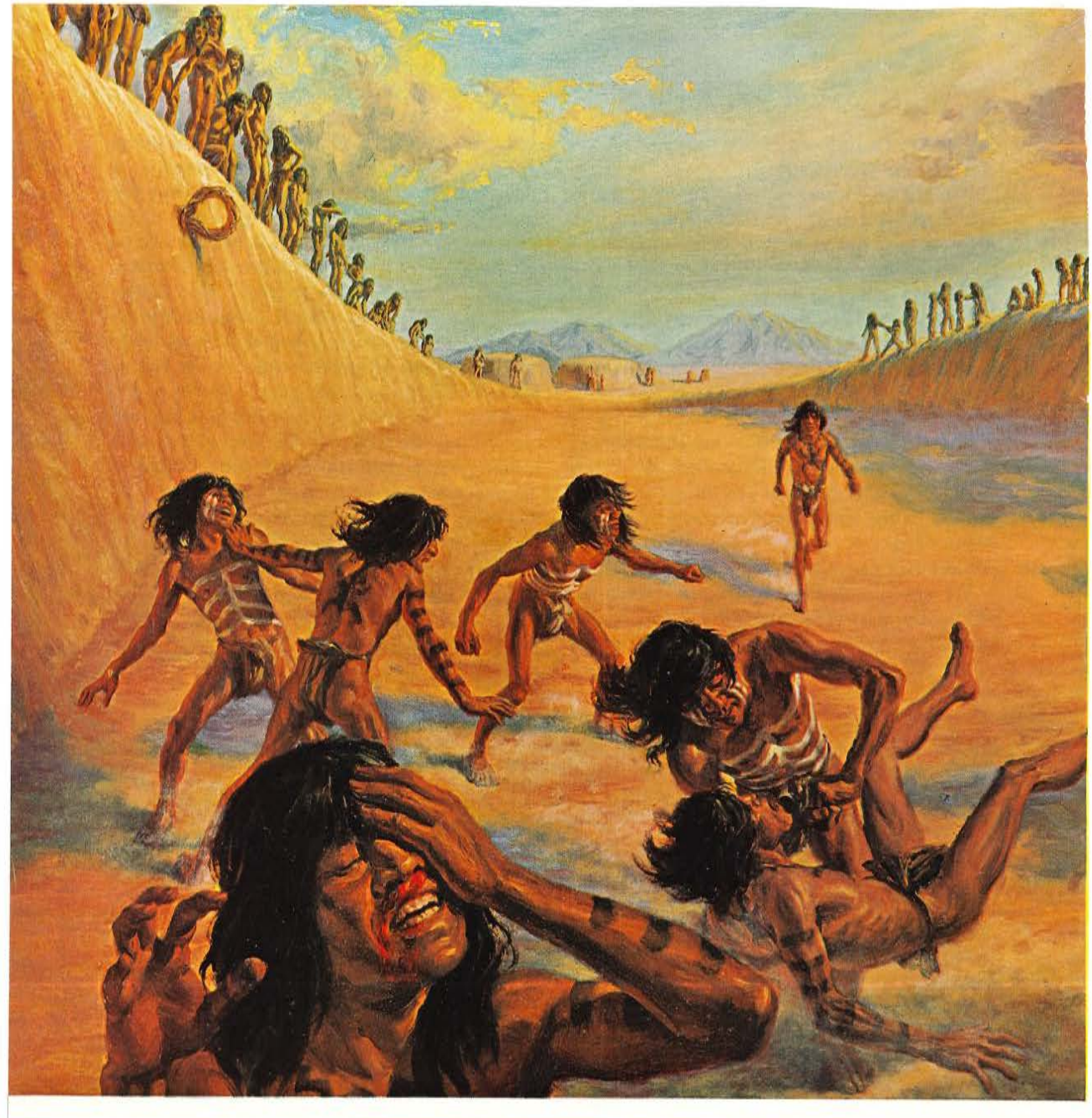
Our study pointed to only one plausible hypothesis: The shells were etched. We knew full well that this meant crediting the Hohokam with the first etched artifacts in history —hundreds of years before Renaissance armorers in Europe came upon the technique.

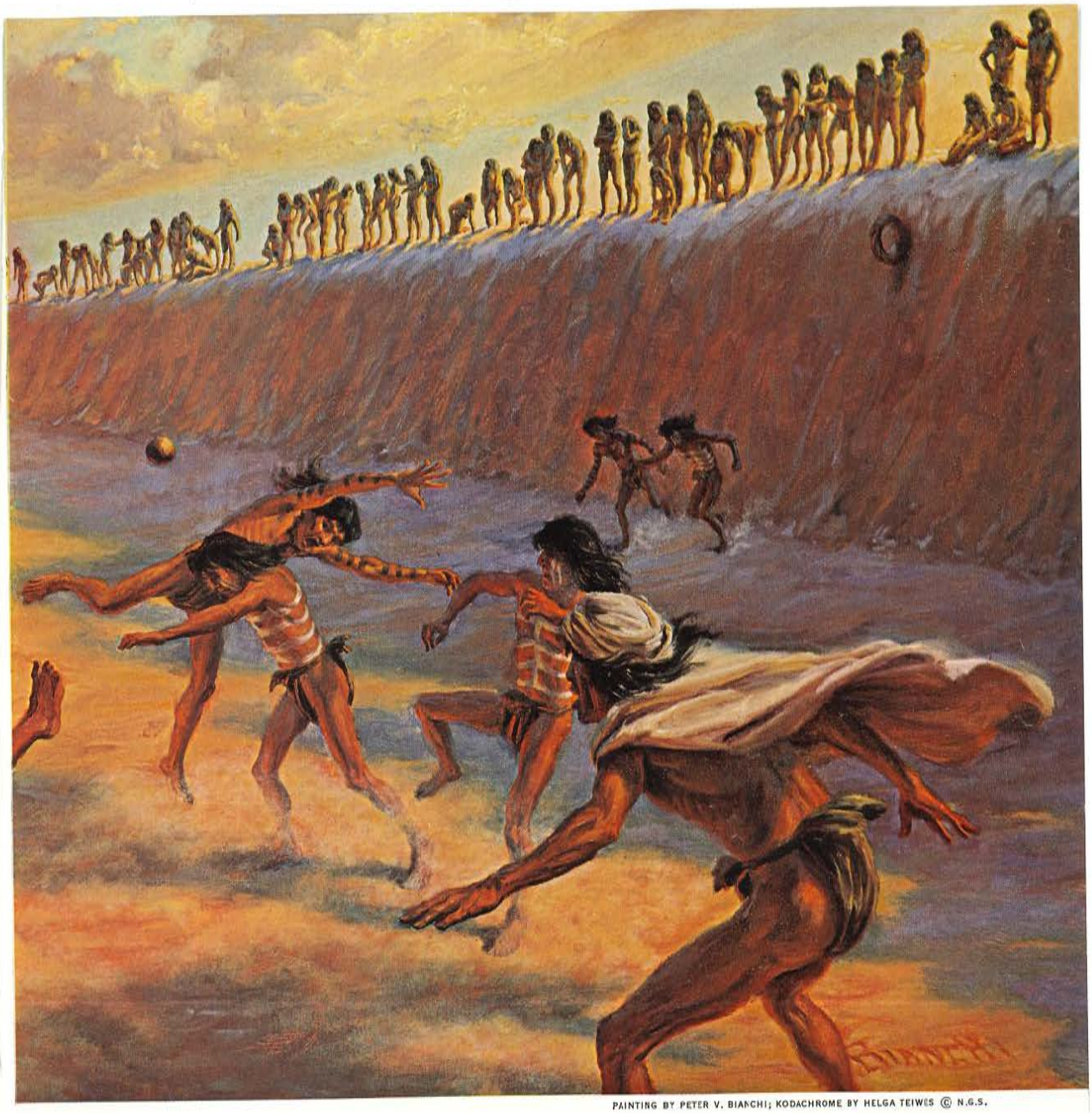
We speculated that an Indian artisan accidentally discovered the corrosive power of fermented cactus juice, which produces a weak acetic acid. Shells soaked in the vinegar would be eaten away unless protected by a resistant substance, such as pitch. Hence the procedure, by simple reasoning: Form a design of pitch on a shell, soak it in acid, scrape off the pitch, and the result is an etched design.

Recently I was able to prove this theory with the finding of a shell prepared for an acid treatment never completed (page 680). The invention of etching enabled the Hohokam to create some remarkable works of art.

A final major surprise of that first dig into the Hohokam past was the excavation of a canal system that implied a long period of technological growth. The canals stretched for miles along the upper terrace of the river valley, safe from sudden floods yet near at hand for maintenance and water control and for directing water to the fields.

A cross section of the prehistoric canals showed one imposed upon another as changes





PAINTING BY PETER V. BIANCHI; KODACHROME BY HELGA TEIWES © N.G.S.

More battle than sport, a Snaketown ball game may have resembled ancient Mexican contests described by the Spanish. Forbidden to throw or kick the rubbery ball—probably made from guayule, a desert bush—players tried to knock it through rings on the walls with hips, knees, or elbows. So rarely did a goal occur that the scorer could claim the clothing and jewelry of the spectators. Thus when a goal was scored, the contest ended; viewers took to their heels, pursued by friends of the victor. The ball court, first excavated in 1934, shows later erosion (left).

were made over a long period of time. The earliest we had found thus far, dated to A.D. 800, seemed every bit as well planned and executed as the latest, dug about 1200.

Today's Pima Indian also irrigates his fields with ditches (page 673), some of which follow the tracks of the ancient Hohokam. Likewise, 19th-century Mormon farmers used some of these prehistoric canals.

Vanished Ones First Tamed the Desert

When that first dig ended, we had pieced together part of a remarkable story—how settlers from the south moved into a desert land and built a canal system that led to centuries of peace and prosperity.

The presence of plain brown pottery in the earliest levels meant that the once-scorned Hohokam of the

EKTACHROME (ABOVE) BY CHARLES W. HERBERT, WESTERN WAYS; KODACHROMES BY HELGA TEWES © N.G.S.

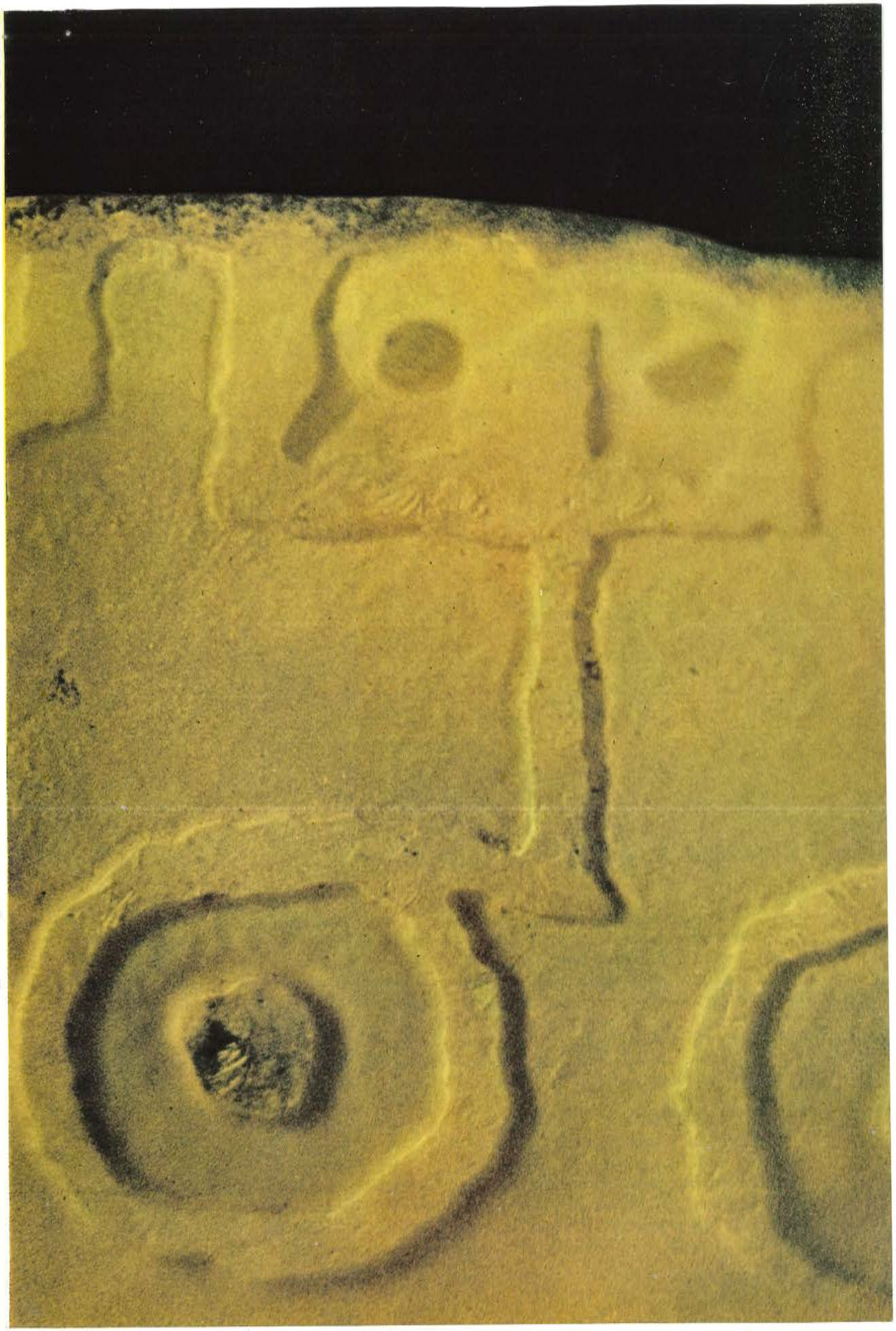
Hohokam triumph – the world's first etchings

MOST STARTLING artistic achievement of the Hohokam was their invention of etching with acid. Centuries before European armorers developed a similar process in the middle 1400's, Hohokam craftsmen learned to fashion delicate designs on sea shells obtained in trade with tribes on the Gulf of California.

Coating a shell with pitch in the shape of an animal, they soaked it in a weak acid solution—probably the fermented juice of the saguaro-cactus fruit (upper right). The acid slowly gnawed away the unprotected surface of the shell, leaving a raised design like the horned toad (lower right). Shells found in earlier excavations had led archeologists to surmise that the Hohokam had discovered etching; the theory found dramatic proof with the discovery of an artifact still wearing a coat of pitch (above, left). The shell had never reached the acid bath.

Sevenfold enlargement of another shell shows fine detail of a stylized snake design etched along its outer rim.

KODACHROME FROM ARIZONA STATE MUSEUM © N.G.S.



southern desert were producing ceramics centuries before the northern Pueblo Indians.

We concluded that Snaketown was a flourishing neolithic community, with a highly developed art, a stable domestic architecture, and a successful farming economy, long before the first pueblo had been built. We were convinced that we had found the first irrigation farmers of the Southwest.

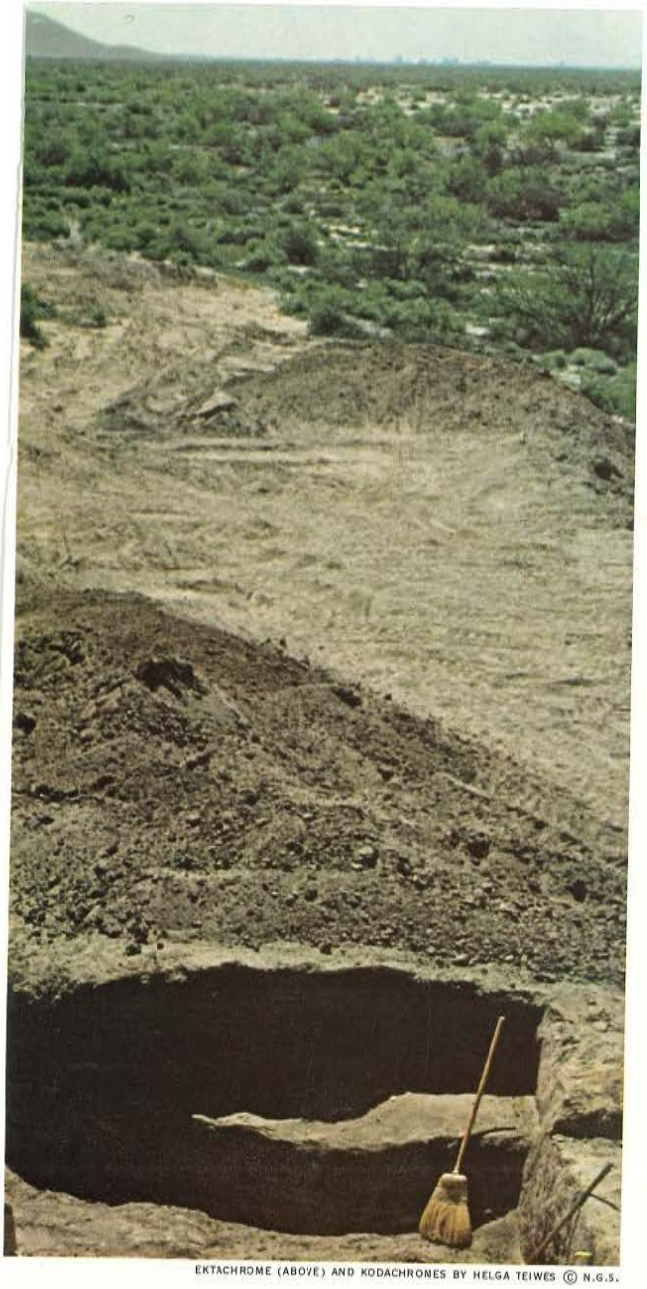
New Expedition Seeks Final Proof

These results threw sand into the face of accepted archeological theory, and it was clear that further proof was needed to establish our thesis. The Hohokam threatened to fade again into anonymity, the trail lost once more in the trample of scholarly footprints.

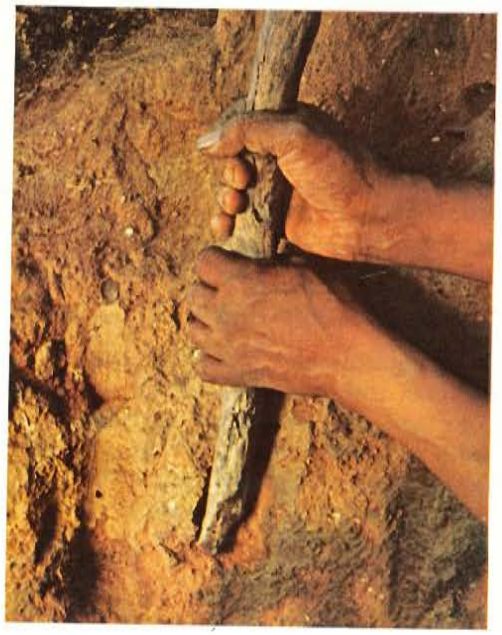
The opportunity, though, finally came in 1964, when the Arizona State Museum, with National Science Foundation and University of Arizona support, sponsored a major dig to clarify the questions of Hohokam origin.

It was a clear and hot autumn afternoon when I returned to Snaketown. Far to the west, the Sierra Estrella stood silhouetted in a blue haze like postcard mountains pasted to the sky. Before us stretched the 300 acres of the once-thriving town.

I chose an area south of old Mound 29 as a likely place to start the dig, and I further decided to counter any stratagems of the elusive Hohokam by a piece of magic. A seminar class at the University of Arizona had given me a "good-digging" token, a silver trowel

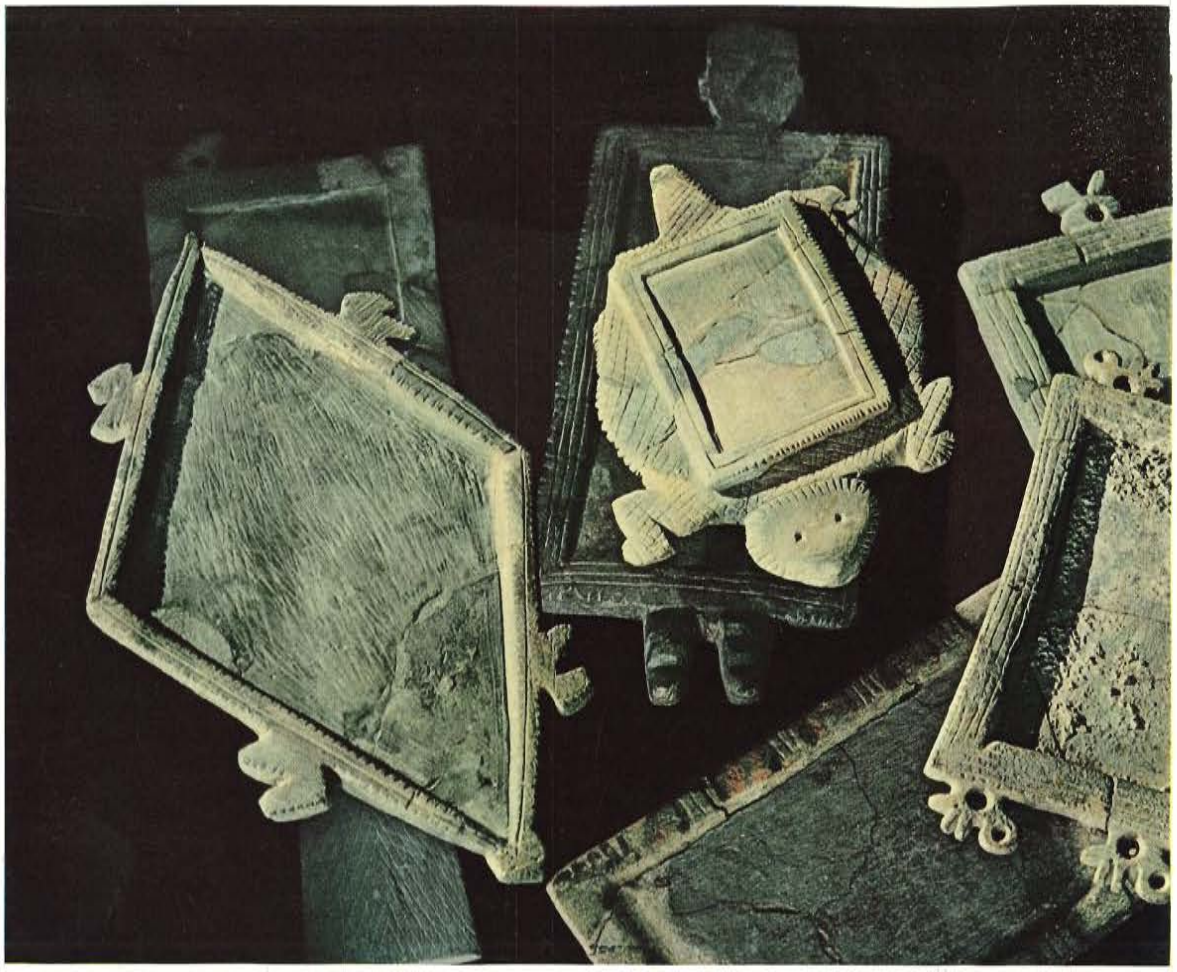


EKTACHROME (ABOVE) AND KODACHROMES BY HELGA TEIWES © N.G.S.



Ancient lifelines in the desert, hand-dug canals made Snaketown's long existence possible. Such relics of primitive engineering extend for miles through Arizona's Salt River and Gila River Valleys. The earliest canal, broad and curving (above, left), dates from three centuries or more before Christ; later ditches went deeper and narrower to reduce evaporation (above). Previous excavations had unearthed a canal dug around A.D. 800, leading scholars to suggest that the Hohokam were late-comers to the Southwest. The 1964-65 expedition, however, uncovered traces of far earlier canals, clinching the Hohokam claim to antiquity.

Grooves in the wall of a pit indicate how the Hohokam gouged their canals with sharp sticks; modern hands show the method.



Prized possessions of the ancients, carved stone palettes held pigments with which the Hohokam painted their bodies for games and religious ceremonies. Example at center, measuring just over 6 inches, shows a favorite motif: the horned toad. The author believes that Snaketown artisans devel-

bearing an inscription from Shakespeare's *Julius Caesar:* "You are not wood, you are not stones, but men." A better epigram for the archeologist's work has never been written.

Standing in the old village, I hurled the shining trowel into the air. Jones Williams, a 72-year-old Pima who had been with me on Hohokam adventures before, turned the first spade of earth at the place where it landed.

And sure enough—that proved to be the least productive spot in the whole village! I gave up the business of magic and went back to the hardheaded work of excavation.

Our crew included an assistant director, three archeologists, a cartographer, a photographer, two laboratory assistants, 30 Pima with shovels and screens, and a mechanical monster usually found digging ditches—a combination front-end loader and backhoe (pages 676-7). That excavating machine symbolizes a change that has come to archeology.

In my early years in the field, the use of such a tool would have been unthinkable. But the archeologist today often finds himself in a desperate race against the highway and dam builder. Salvage archeology fights fire with fire by adopting the tools of the construction engineer.

Mechanical Shovel Saves the Day

At Snaketown we had to sink numerous trenches with limited personnel, in a limited time, on a limited budget. We stood to gain more than we could lose by employing the big machine; it ended up by saving the day.

We worked through the entire winter and

KODACHROMES © N.G.S.

oped the palettes—here stacked on glass shelves—from the metate, a slab of stone used to grind corn.

Country cousins to similar effigies found in Mexico, these Hohokam figurines—shown nearly twice actual size—date from the first few centuries of the Christian Era. Indians probably used the slit-eyed statues in fertility rites.

spring. Once again, our digging evoked memories of ancient Mexico.

Among our finds were two examples of monumental architecture. The first was a platform mound, a low structure filled with dirt and trash and capped with a thick pad of clay. It dated to about A.D. 500, the time when mounds were rising out of the Mexican jungles to serve as stages for ceremonial dances and religious rituals. At Snaketown the footsteps of the dancers, if any, long ago vanished, and the sounds of the bells, flutes, and drums were gone with the desert wind.

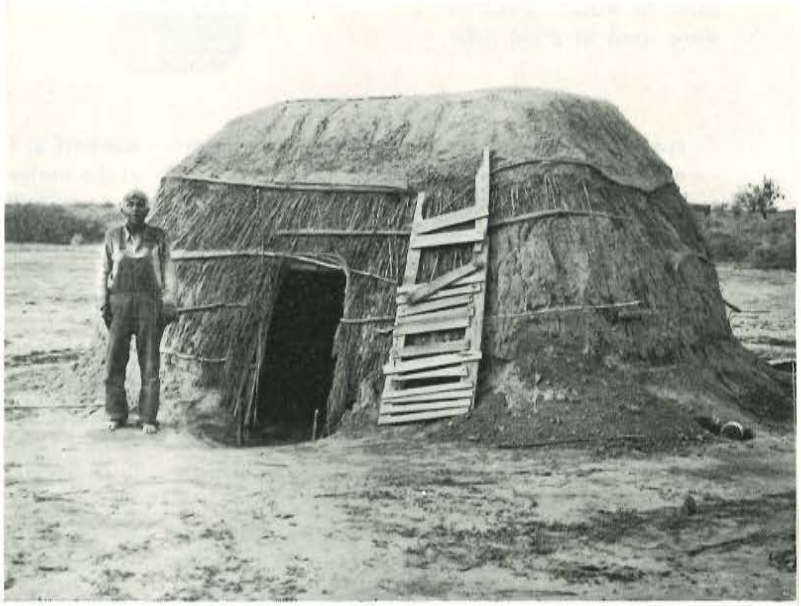
Not far from the platform mound, archeologist Jim Sciscenti was removing a thin veneer of earth from another structure that gave me a deep sense of nostalgia. At the very beginning of my career as an archeologist, I had worked at Cuicuilco, near Mexico City. One of the major remains there had been a 90-foot-high conical mound, preserved by a lava flow that partially covered it.*

At Snaketown, on what I vowed would be my last dig, Sciscenti uncovered a strikingly similar truncated cone, though much smaller. This one was made of clean desert soil. Perhaps by now the Hohokam had come to realize that the gods merited something better than a refuse heap!

In Mexico, such dirt structures gave rise to the famous temple pyramids. At Snaketown, we found a single step going up to a surface 50 feet across and only 3 feet high.

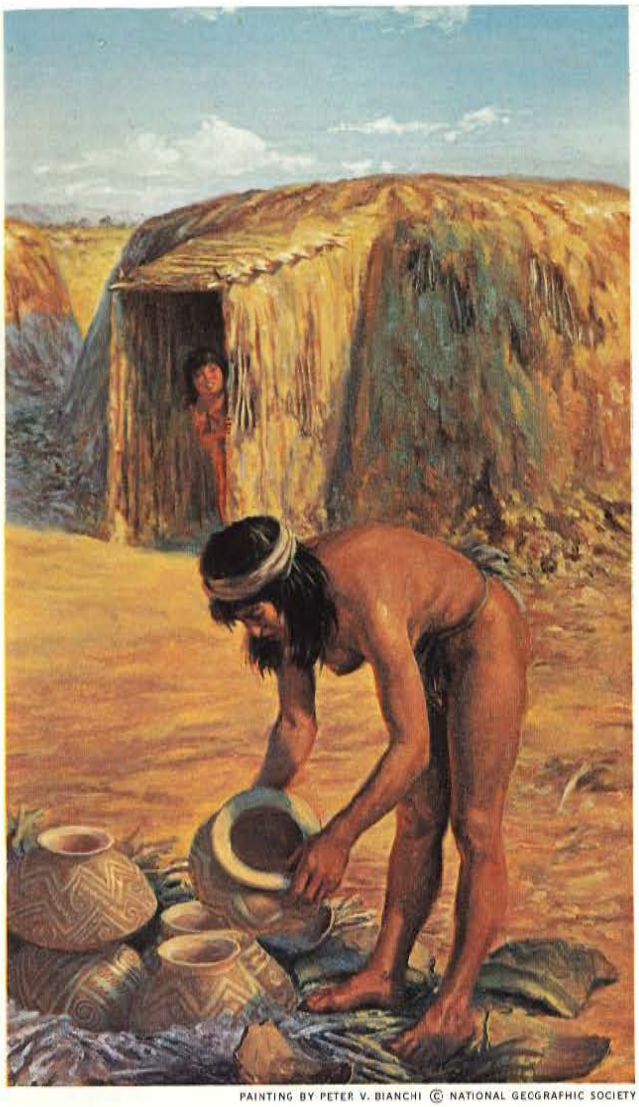
*See "Ruins of Cuicuilco May Revolutionize Our History of Ancient America," by Byron Cummings, NATIONAL GEOGRAPHIC, August, 1923.

Men gone hunting or farming, Snaketown resounds with the cries of children and the gossip of women. Mother at center kneads clay before shaping it into pots like that being molded by hands and paddle at left. Beyond, a son helps tend a kiln of sticks atop raw pottery. Woman at right covered her vessels with pieces of broken pottery to protect colors during firing. In the distance a villager adds to a trash mound, which archeologists will someday sift to reconstruct scenes like this.



Last Pima round house, photographed in 1935, shows its descent from Hohokam houses of two thousand years ago.

EMIL W. HAURY FOR GILA PUEBLO ARCHAEOLOGICAL FOUNDATION



PAINTING BY PETER V. BIANCHI © NATIONAL GEOGRAPHIC SOCIETY

Meanwhile we were building a little mountain of our own with broken pottery. Snaketown's mounds are packed with the shards of pots once used to cook a family's dinner, store water and food, and gather a harvest.

Happily for the archeologist, there are few things more fragile than a pot, and few things more durable than its broken pieces. And because styles change, these pieces can serve as a kind of time clock to date other features, such as the houses in which they are found.

To make our pottery time clock at Snaketown, we examined more than 1,500,000 fragments. Tens of thousands were mechanically screened from the rest and carried to a field laboratory set up at an unused school building 12 miles from Snaketown. There a staff of five women cleaned, sorted, mended, and catalogued each day's take—a load of "washing" of monumental proportions. Yet these pieces represent only 1/500 of those available on the site.

Over the centuries, we found, Hohokam pottery became more and more elaborate. The original settlers of Snaketown made a plain, thin-walled ware carefully built up from damp coils of clay and pounded into shape with a flat paddle. A thousand years later, using the same technique, the potters were turning out a dazzling array of jars, bowls, and scoops painted with vivid geometrical elements repeated many times.

One type of design in particular attracted our attention. One staff member whimsically suggested that the Hohokam liked alphabet soup, for the pottery of this period carries painted characters strikingly like our own A B C's. In others mammals, birds, reptiles, and humans scramble about in cartoon fashion, over and over in endless circles.

I have the notion—and I admit I fetched it from afar—that these elements, found nowhere else in the Southwest, derive from the calendrical symbols common in Mexico. If so, their original significance was lost in transmission, and they were picked up by the Hohokam to the north only as art forms.

Snaketown's flourishing art showed itself also in a remarkable series of stone palettes—collectors' items among a varied and complex assortment of stone tools and utensils.

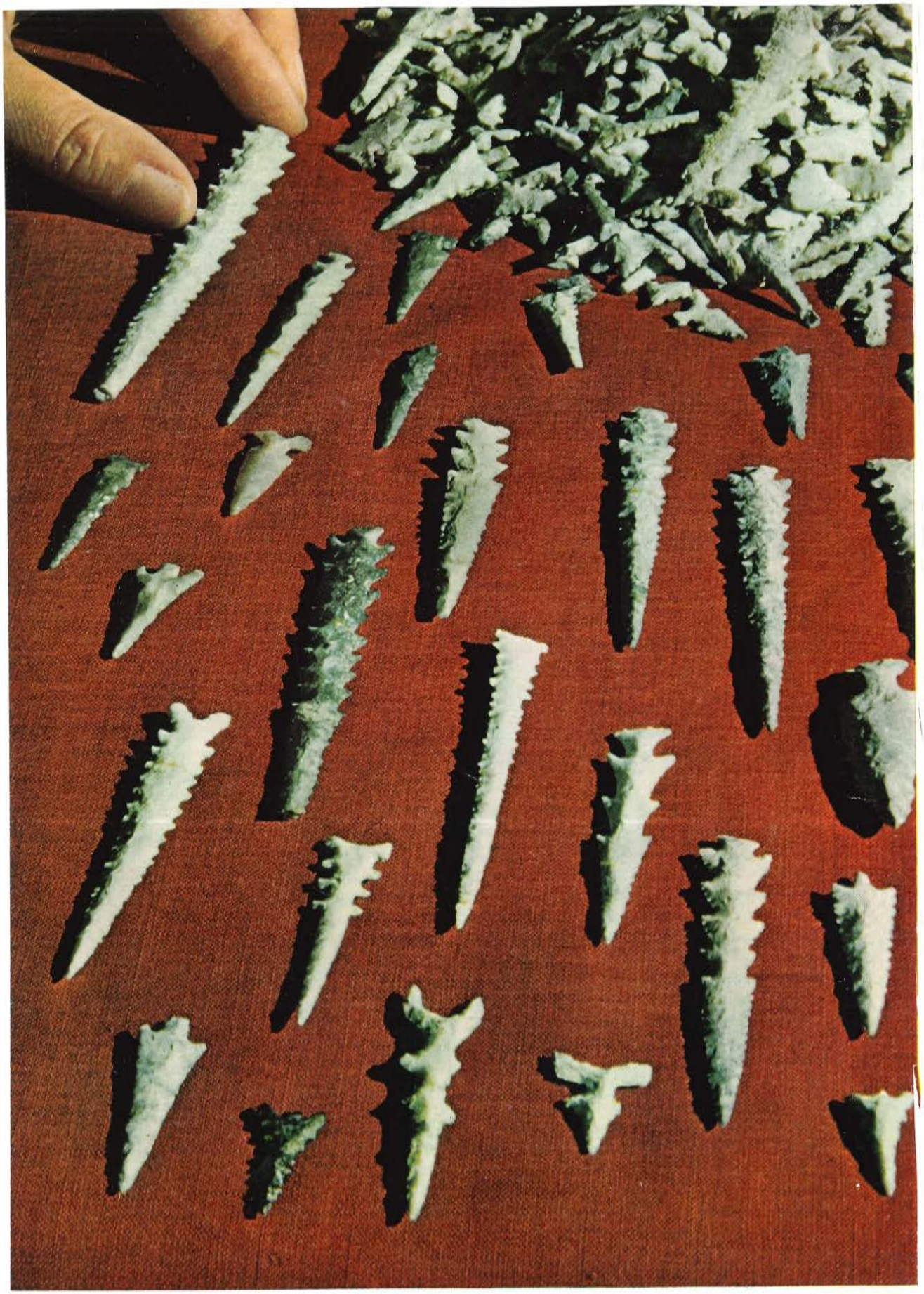
The early Hohokam brought with them a basic kit of tools that included hammering stones, stone knives, small projectile points, mortars, pestles, and troughed stones called metates, for making corn meal.

From this lowly kitchen utensil came the beautiful palettes of later ages (pages 684-5). Remnants of paint told us their use. The Hohokam probably painted themselves for dances and games; they lavished great care upon the palettes used for grinding and mixing the pigments. They often gave them the stylized shapes of men or desert creatures—horned toads, lizards, snakes, and birds.

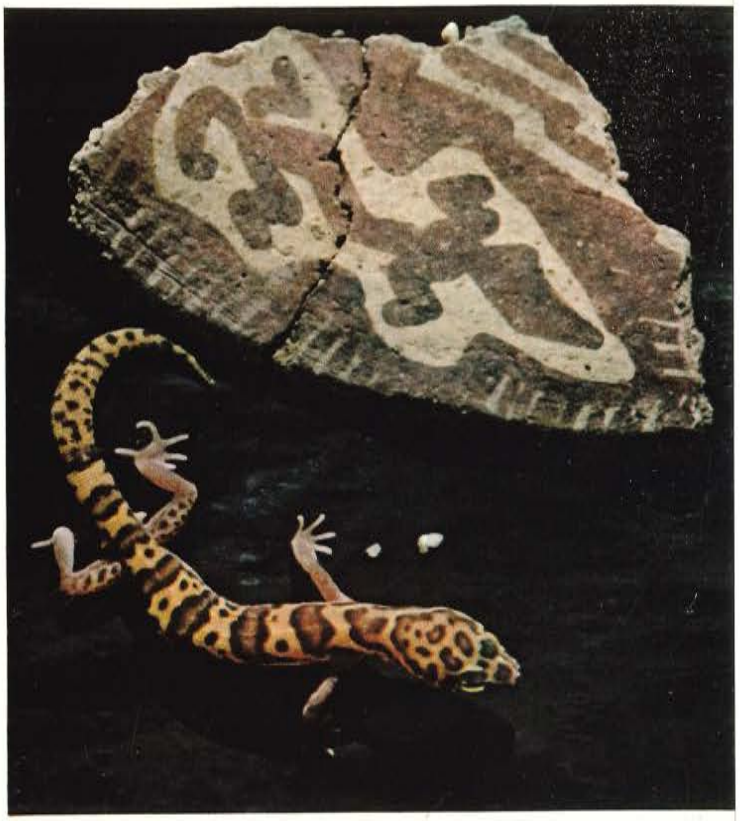
Postholes Betrayed by Telltale Sound

Through the warm winter, ancient Snaketown emerged from its long sleep under the earth. After the backhoe, in the hands of its skilled Pima operator, Fred Marrietta, had taken test bites of designated areas, the staff archeologists went to work.

Uncovering the remains of dwellings was difficult. The Hohokam sank their houses in shallow pits about a foot below the desert surface. Vertical posts set into the bottom of the pit supported flimsy brush roofs and sides of slanting poles covered with clay. When the house eventually collapsed or burned, the pit filled with debris, and if another house



KODACHROMES BY HELGA TEIWES © N.G.S.



Banded gecko found in Snaketown poses beside a Hohokam potsherd bearing the likeness of an ancestor. Today the little lizards still skitter nervously across the southern Arizona desert at night.

Saw-toothed icicles of stone, some 3,000 beautifully chipped arrowheads came to light in one ceremonial area. Hohokam archers used the handsome points to bring down rabbit, deer, fox, and muskrat when the Gila River's water greened this now-arid valley. The notches, like the serrations of a steak knife, may have given the points greater penetrating power; they also aided in holding the arrowheads' lashings to the shafts.

was not erected over the spot—as was often the case—desert winds swept the place smooth. We sometimes unearthed a succession of floors stacked like a platter of pancakes.

All that remains for the archeologist is the hard-packed house floor and the cavities where the posts stood. These postholes, we soon discovered, could be traced by the ear better than by the eye—by listening to the singing of the trowel as it was drawn over packed soil. A change in pitch indicated that a different surface, the soft scab of a posthole, was in contact with the blade.

In clearing these house floors, we would infrequently find treasure. James ("Al") Lancaster, one of the three staff archeologists, is a veteran of the campaigns at Wetherill Mesa in southwestern Colorado. Digging in a desert was a new experience for

him, yet this stranger to Hohokam archeology made one large strike after another. First he found a collection of 18 thick-walled clay vessels probably used to burn incense. I knew he had something else unusual when he called me over one morning and asked, "What do you make of this?"

With deft sweeps of the trowel he was loosening the soil from the figure of a clay animal. More troweling and brushing opened a two-foot-deep pit crammed with a herd of 19 animals (pages 670-71), three human-effigy vessels, 40 pieces of pottery, shell bracelets, and a fragment of a charred basket and remnants of other things that had been burned. The material in the pit was dated by the pottery time clock to within a few decades of a thousand years ago.

Al's good-luck streak—it seemed almost second sight, as if he had kinship with this ancient tribe—continued when he uncovered 50 sculptured stone vessels, Hohokam art at its best. Unfortunately, not one of them was intact (page 693).

Funeral offering, a clay incense burner seven inches high and resembling a mountain sheep, survives intact from a cremation of A.D. 1000. Unlike other Southwest Indians, the Hohokam burned their dead and, inexplicably, usually smashed the objects placed in their graves.

KODACHROME © N.G.S.

We silently cursed whatever custom required the smashing of these cultural treasures. We could only speculate that the objects may have belonged to a religious cult or magician and were "killed" when the cult line ended or the man died.

5,000 Houses Buried by the Desert

By season's end, we had rolled the centuries back from a wide area of dwellings. From a helicopter, we could look down on more than 12 centuries of occupation.

Two things became clear in that hovering look. The first was that Snaketown was a populous place. We estimated that a hundred houses might have stood in the village at any one time, each with a life-span of about 25 years. That would mean some 400 homes every century for more than 1,200 years—or almost 5,000 architectural units buried under the reddish soil beneath us! By dint of hard labor, we had managed to clear 167.

The second fact that seemed clear was the security of the Hohokam way of life. In the desert, choices are limited. One lives with nature or not at all. We found that the very first houses were every bit as good as the latest, and not very different from them in style. In a word, that kind of architecture worked in the desert, and the Hohokam kept it, with few changes, for more than 12 centuries.

These house floors told us many other things. From one of the earliest we recovered burned corn, confirming our belief that the founders of Snaketown were settled farmers. Finding this corn was like finding a nugget of gold—for corn must be cultivated by man and will not grow in the wild. It is absolute proof of agriculture.

That led us directly to the chief challenge of the project. If the earliest Hohokam grew crops in that parched land, they would have had to irrigate them with water brought from the Gila River. Traces of those very first canals should still be there, buried deep, their original beds marked perhaps by a layer of sand only a fraction of an inch in depth. To find that fraction, we resorted again to the power of the mechanical backhoe.

We were gambling that the first canals had not been located on the lower terrace near the river. Floods would long ago have washed those old scars clean. We were also gambling that the first Hohokam were capable of

ditching the upper terrace, a vast work that required the organization of a multitude of people and a degree of engineering skill unknown among other American Indians north of Mexico at that very early date.

The backhoe sliced 20 narrow trenches along a four-mile stretch of the later canal known from the first excavation. We found a place where four canals had been superimposed one upon another, indicating a long period of use—but not as long as we had optimistically hoped.

One of the trenches exposed a place where a lateral canal branched off from the main waterway. Here there were traces of a head gate, enabling us to reconstruct the method of Hohokam irrigation (painting, pages 672-3).

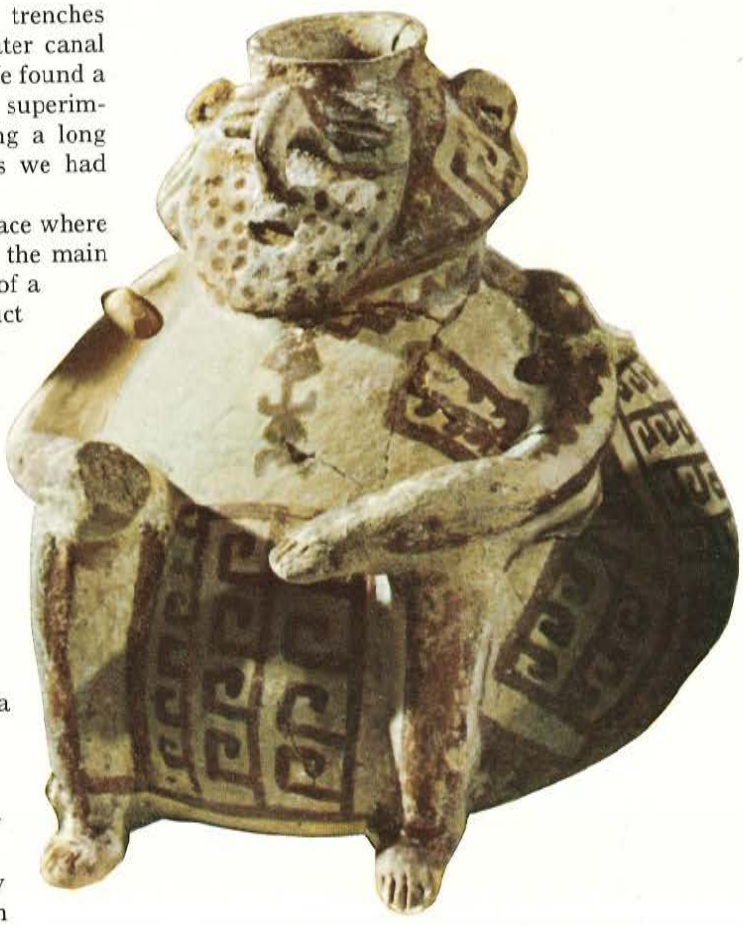
It was at this head gate that the Hohokam met with a disaster. At the height of Arizona's midsummer heat, cumulus clouds build up into dark towers. Sweeping in over the desert, they cause intense local downpours. One of these hit the upper terrace sometime before A.D. 900. The canal, filling in minutes, burst its banks, and the water gouged out a deep gully near the head gate as it raced toward the lower terrace.

Traces of this event pointed up more clearly than any theory how hard the Hohokam had to labor to keep their canals flowing. They conquered the desert only through continuous effort.

Our own dig's time and funds were running out. We probed deeper into the terrace, examining the trench walls inch by inch. At last we came upon a thin crusted layer with a slim covering of sand. Was this the bottom of a waterway? Its shape, broad and shallow, was different from the deeper and narrower canals built afterward. Pottery shards and stone implements found on its surface were consistently of the oldest kinds found at Snaketown. I began to feel that this was what we had been looking for.

The entire staff was enlisted in "Operation Big Ditch." We set to work clearing a 225-foot-long section along the axis of the canal we had found (page 682). Then we hit the jackpot. At the west end of what we were now certain was the oldest canal yet unearthed at Snaketown, we found a tangle of later ones; these confirmed a long growth upward from that earliest canal.

Painted and potbellied, a pottery vessel in grotesque human form—carefully assembled from fragments—spent more than 950 years under the desert soil. KODACHROME 3/4 ACTUAL SIZE © N.G.S.

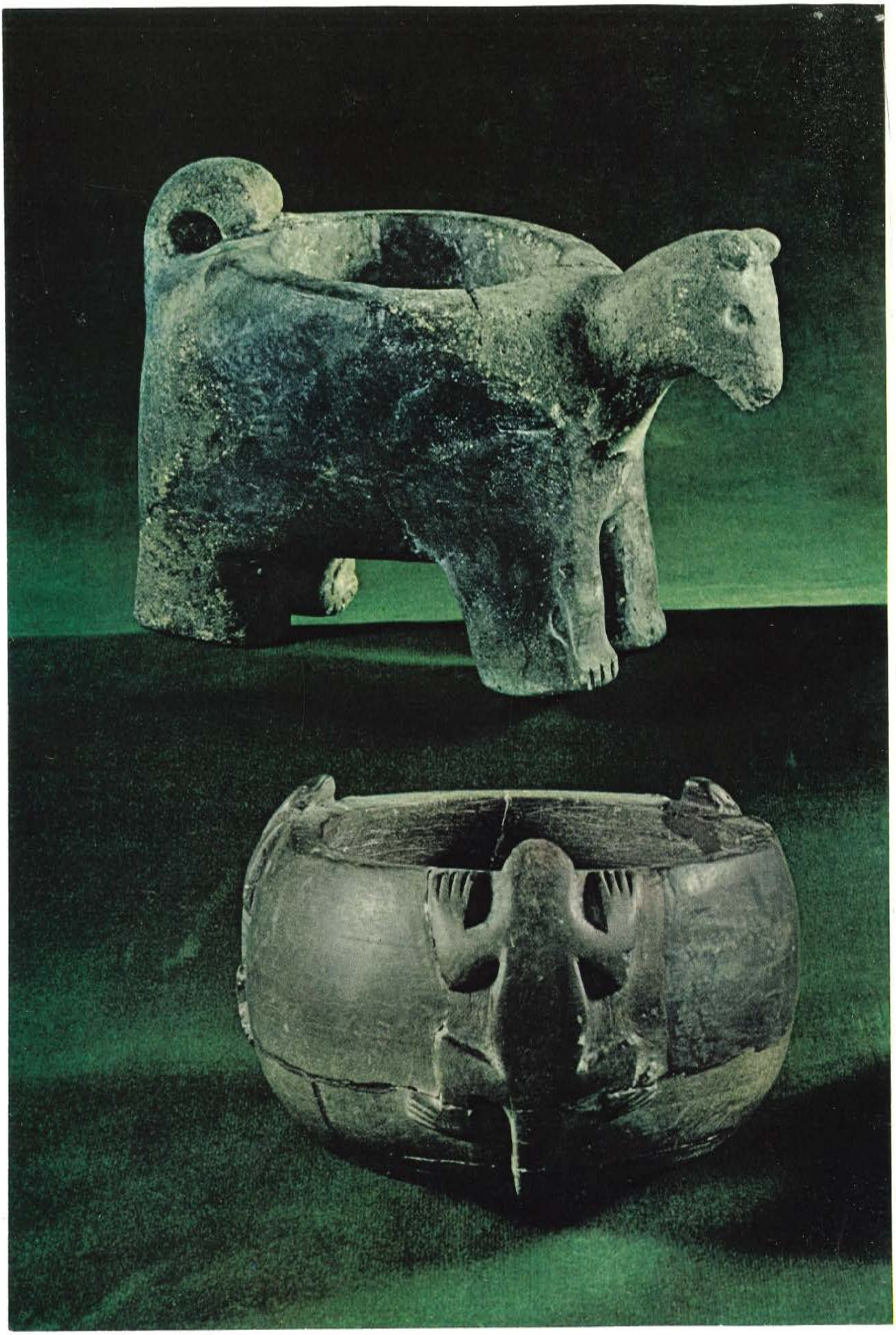


The claim for antiquity was clinched. The Hohokam had indeed reached full dependence upon irrigated agriculture well ahead of all other known people in the Southwest.

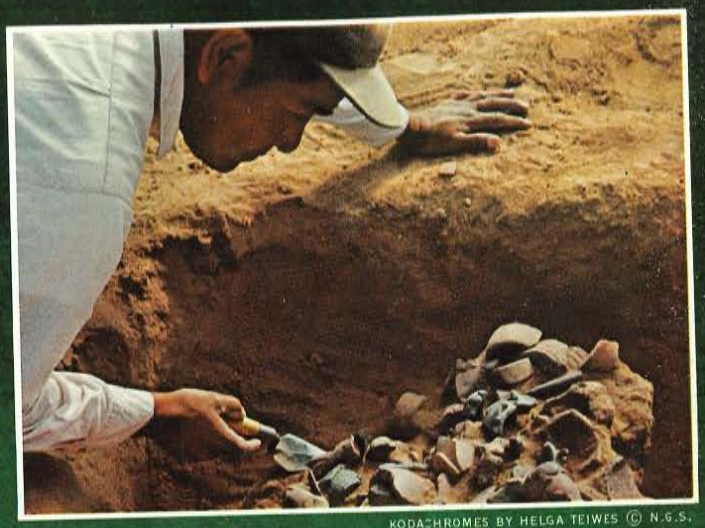
New Dating Technique Confirms Snaketown's Age

As we studied the topography of the area, we were even more impressed by the Hohokam's achievement. The intake point for the gravity-fed canal could not have been less than three miles up the Gila River from the village. Three miles of hand-dug ditch to support a developed agriculture, in Arizona, in 300 B.C. or before!

How do we know it was that long ago?



BROKEN TREASURES *restored by the Arizona State Museum: Stone incense burners or medicine cups bear stylized images of a dog, toads, lizards, and a man, perhaps with magical or religious significance. One Snaketown cache (right) held 50 such shattered vessels, superbly carved from desert rock.*



KODACHROMES BY HELGA TEIWES © N.G.S.

Snaketown goes underground again in a matter of hours, as archeologists seal the 300-acre site; bulldozer riding a protective pad of soft dirt fills the house floors to protect them from weather. Should the site be designated a national monument, the historic landmark will be re-excavated, stabilized, and opened to the public.

"A lot of cracked crockery," Dr. Haury jokingly calls the million and a half potsherds he and his associates uncovered at Snaketown. Tens of thousands of pieces were washed, sorted, and catalogued. At the Arizona State Museum in Tucson, the author works out a chronology from the changing designs and discovery positions.

Fortunately for the modern archeologist, his field opinions and deductions from pottery clocks and stratigraphy can now be tested against other measures of dating. The most famous of these is the carbon-14 method.* A charcoal sample from early Hohokam refuse has yielded a date of 425 B.C., give or take about 100 years.

The evidence at Snaketown has been supported by another ingenious method of dating —archeomagnetism. This technique is still in its formative stages; as yet, only a few scientists in the world are experimenting with it. One of them is Prof. Robert L. DuBois at the University of Arizona (see "Magnetic Clues Help Date the Past," beginning on the following page). Dr. DuBois has fixed a date of 300 B.C. for an early Hohokam fireplace.

Drama Ends in a Peaceful Invasion

We are gaining new certainty about the beginning of Hohokam culture. But what about its end? Snaketown died as a village sometime between A.D. 1100 and 1200, but its people continued to live in scattered, smaller settlements up and down the valley, still thriving on irrigation.

In the 14th century the first major social change in the long Hohokam history occurred. Pueblo builders, a mixed breed of Anasazi and Mogollon cultures we call the Salado people, spilled out of the eastern mountains and moved in large numbers into the Hohokam's ancient domain. We find no suggestion of a violent invasion, but rather a peaceful melding of cultures.

The four-story pueblo at Casa Grande National Monument, with its mixed Salado and Hohokam remains, dates from this period. Because the Pueblo Indians were comparatively well known, and the Hohokam known almost not at all, it was once erroneously suggested that the simple pit houses of the Hohokam were servants' quarters, while the masters occupied the big pueblo houses.

What happened to the Hohokam?

My own view is that they are still there, in the form of the modern Pima Indians. Strong similarities exist between early Pima and late Hohokam house types, pottery, agriculture, and way of life. Throughout the long months of excavation, our Pima workmen became convinced of this themselves.

The constant interest and good humor of these men proved major factors in our success. As April approached and the desert began to stir with new life, the Pima gathered to discuss a way in which their appreciation for this archeological experience might be shown. The result was one of the most moving ceremonies I have ever witnessed.

On April 17, after weeks of planning, the Pima gave a party. No detail was overlooked. The "traffic committee" had even arranged for a highway patrolman to direct traffic at the crossing of the dirt road with State Highway 93 when our party from Snaketown drove to the celebration. He stood in the center of the silent little road, which vanished in heat mirages toward the horizon, and held up his arms while our caravan of six dusty cars scooted across the asphalt. Nothing else was moving for miles.

The party itself was an occasion I shall never forget. A six-voice choir of old folk sang Christian hymns in the Pima language. A dance group from Gila Crossing performed. Then our staff members were given gifts—beautifully wrought baskets—and the Pima master of ceremonies expressed the thanks of his people for our efforts.

Snaketown: Moral for the Modern World

The Secretary of the Interior has already designated Snaketown as a registered national historic landmark. And, encouragingly, the National Park Service is considering a Pima request to make it a national monument. Someday, perhaps, the increasing number of tourists to the Southwest will find along the Gila Valley a reconstructed ball court, village, and canal system as Snaketown rises, like the desert phoenix, from the ashes of its ancient cremations.

After so many years of association with the vanished Hohokam, I am convinced that their achievement is instructive for our own time. Their secret of success was profoundly simple: They came to grips with, but did not abuse, nature. They became a part of the ecological balance instead of destroying it. They accepted the terms of their existence in a difficult environment, and they continued for well over 1,000 years.

For our own generation, with its soiled streams and fouled air, its massive and abrupt changes in environment, its shortages of water, its rampant misuse of shrinking open space, the achievement of Snaketown holds a profound meaning. * * *

*See: "How Old Is It?" by Lyman J. Briggs and Kenneth F. Weaver, NATIONAL GEOGRAPHIC, August, 1958.