PUMP TEST OF NEW WELL AT LUCKY LAGER BREWERY, VICTORIA

With the cooperation of Pacific Water Wells and the Lucky Lager Brewery, observations of the recovery of the water level in the new rock well, drilled by Pacific Water Wells, were taken following the pump test made by Pacific.

The well was pumped for exactly 24 hours starting at 9:40 A.M. on Monday, May 27th. The well was pumped at 25 Imp. g.p.m. for the entire test, the pumping rate being measured by using a 5-gallon pail and stop watch. Observations of the level in the well were taken by Pacific during the pumping period but we have not yet obtained these data. Our observer, Mr. Fahey, was on hand when the pump was stopped. He continued to take periodic observations for about a week at the end of which time the well had reached its original static level which, at that time was 1.82' below the top of the new pipe which is 3.36' above ground level. All observations have been converted to this datum to avoid (+) and (-) values.

The results have been plotted in order to use the standard Theis recovery method. In this method, the drawdown s is plotted against log

$$\frac{\text{time after start of pumping}}{\text{time after stopping pump}}$$

using semi log paper. In using this method, the following assumptions are made.

1. Artesian conditions prevail.
2. The aquifer is infinite.
3. The well fully penetrates the aquifer.
4. The aquifer is hydrologically homogeneous and isotropic.

It is obvious that these assumptions cannot be made in this case. Artesian conditions prevail until the drawdown falls below about 20' (which is the bottom of the confining layer of till) when water table conditions prevail near the well. The aquifer is not infinite and in this location must be cut off in the upper part in approaching the harbour on the north east. The well does not fully penetrate the aquifer which extends for an unknown depth. Fractured rock is notoriously non-homogeneous hydrologically.

However, the assumptions are not as bad as they sound especially in the recovery situation where flow is slow. The change from water table conditions to artesian conditions probably accounts for the fact that there is a change in slope in the curve until the drawdown becomes less than about 10 feet.

Since the mathematical model for this method is based on artesian conditions, the portion of the curve in which these conditions are believed to prevail will be used in this analysis. When time since pumping ceased (t') becomes great the expression for the residual drawdown (s) in the well becomes

$$s = \frac{114.6\ Q}{T} \log_{10} \frac{t}{t'}$$

where Q = the pumping rate in gal./min.
T = transmissibility of aquifer in gal/day/ft. of width
t = time since start of pumping
t' = time since pump was stopped

to solve for T: $T = \frac{114.6\ Q}{s} \log_{10} \frac{t}{t'} = 114.6Q \frac{\log_{10} \frac{t}{t'}}{s}$

thus if s is plotted vs $\log_{10} \frac{t}{t'}$ using semi-log paper, the slop of the curve is proportional to T.

$$T = \frac{264Q}{\Delta s}$$ where Δs = the change in s for one log cycle of $\frac{t}{t'}$.

In this case $\Delta s = 41.5$, T = 159 gal/day/ft.width.

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This is probably close to the true transmissibility of the fractured rock surrounding this well. It is not possible to compute the coefficient of storage (s) of the aquifer using this method. When artesian conditions prevail, it is probably small; when water table conditions prevail it should be quite a bit larger.

This probably explains why the change per log cycle on the plot is much less in the portion of the curve where the water has been drawn down below the confining layer in other words where water table conditions prevail here. In this case, more water is taken from storage so the drawdown is slower for a given pumping rate. The recovery is, of course, slower as more water is returned to storage.

To make use of T in predicting drawdown, we must assume a value for S. S for artesian aquifers ranges from about 10^{-3} to about 10^{-5} so a value of 10^{-4} will be used here.

Using the Theis non-equilibrium relations

$$s = \frac{114.6\ Q\ W(u)}{T} \qquad \text{where } u = \frac{1.87\ r^2 s}{T\ t}$$

from the U.S.G.S. tables Wu is about 15 near the well when t is assumed at 100 days continuous pumping.

For a pumping rate of 13 g.p.m. which would be equivalent to about 40 g.p.m. for one shift each day

$s = 10.8\ (Q) =$ about 140 ft.

The actual drawdown would probably be less than this because once the drawdown became greater than about 20 ft. water table conditions prevail and more water will be drawn from storage. However, the recovery under these conditions would be slower and the capacity of the well is probably being exceeded. Other unknown factors also may be important. Such extensive drawdown may cause more rapid recharge which would increase the well capacity.

If the well is not used on weekends or holidays, the drawdown would, of course, be less.

One should, of course, realize that this analysis uses theory which does not really apply to rock wells of this type but it may give some basis for guessing the capacity of this well. We shall be very much interested to know just how it works out.

E Livingston
July '63

Pacific WATER WELLS LTD.
DRILLING CONTRACTORS
NANAIMO & LANGLEY

R. R. 2, NANAIMO, B.C.
SKYLINE 3-4621

LUCKY LAGER BREWERIES LTD.

PUMP TEST - 9:20 A.M. Monday, May 27 to 9:40 A.M. Tuesday, May 28.

Pump set at 141'6"
Readings taken from 14" above ground

Time	Pumping Level D.D.	Rate
9:20 A.M.	+1	0
9:21	3	25
9:25	13	25
9:30	15.3	25
9:35	16.6	25
9:40	17.5	25
9:45	18.2	25
9:50	18.8	25
9:55	19.0	"
10:00	19.5	"
10:05	20.5	"
10:10	21.0	"
10:15	21.45	"
10:30	22.3	"
10:40	23.8	"
10:50	24.7	"
11:00	25.5	"
11:10	26.0	"
11:20	26.6	"
11:30	27.0	"
11:40	27.7	"
11:50	28.15	"
12:00	28.8	"
12:10	29.05	"
12:20	29.4	"
12:30	29.7	"
12:40	30.1	"
12:50	30.0	"
1:00	30.6	"
1:10	31.1	"
1:20	31.6	"
1:30	32	"
1:40	32.3	"
1:50	32.4	"
2:00	32.85	"
2:10	33.05	"
2:20	33.3	"
2:30	33.7	"

Time	Pumping Level D.D.	Rate
2:40 P.M.	34.0	25
2:50	34.0	"
3:00	34.5	"
3:10	34.45	"
3:20	34.55	"
3:30	34.9	"
3:40	35.4	"
3:55	35.9	"
4:00	35.85	"
4:10	36.2	"
4:20	36.5	"
4:30	36.55	"
4:40	36.7	"
4:50	36.75	"
5:00	36.8	"
5:10	37	"
5:20	37.5	"
5:30	37.7	"
5:40	38.2	"
5:50	38.4	"
6:00	38.8	"
6:10	38.8	"
6:20	39	"
6:30	39.35	"
6:40	39.6	"
6:50	39.7	"
7:00	40.05	"
7:20	40.5	"
7:30	40.8	"
7:40	40.9	"
7:50	41.3	"
8:00	41.6	"
8:10	41.8	"
8:20	41.9	"
8:30	42.15	"
8:40	42.4	"
8:50	42.55	"
9:00 P.M.	42.65	"

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Pump Test - Page 2

Time	D.D.	Rate
9:10 P.M.	42.7	25
9:20	42.8	"
9:40	43.1	"
9:50	43.15	"
10:00	43.35	"
10:10	43.6	"
10:20	43.85	"
10:30	43.7	"
10:40	43.7	"
10:50	44	"
11:00	44.25	"
11:10	44	"
11:20	44	"
11:30	44.45	"
11:40	44.55	"
11:50	44.8	"
12:00	45.1	"
12:10 A.M.	45.2	"
12:20	45.4	"
12:30	45.6	"
12:40	45.8	"
12:50	45.75	"
1:00	45.8	"
1:10	45.9	"
1:20	45.9	"
1:30	46.1	"
1:40	46.35	"
1:50	46.5	"
2:00	46.75	"
2:10	46.85	"
2:20	46.95	"
2:30	47	"
2:40	47.15	"
2:50	47.3	"
8:00	47.4	"
3:10	47.5	"
3:20	47.6	"
3:30	47.7	"
3:40	47.8	"
3:50	47.9	"
4:00	48.05	"

Time	D.D.	Rate
4:10 A.M.	48.15	25
4:20	48.3	"
4:30	48.4	"
4:40	48.6	"
4:50	48.75	"
5:00	48.85	"
5:10	49.5	"
5:20	49.6	"
5:30	49.4	"
5:40	49.	"
5:50	49.	"
6:00	49.	"
6:10	49.	"
6:20	49.	"
6:30	48.95	"
6:40	48.7	"
6:50	48.65	"
7:00	48.7	"
7:10	48.2	"
7:20	48.1	"
7:30	48.45	"
7:40	48.75	"
7:50	48.4	"
8:00	48.2	"
8:10	48.85	"
8:20	48.85	"
8:30	48.8	"
8:40	48.7	"
8:50	48.65	"
9:00	49.	"
9:10	48.95	"
9:20	48.8	"
9:30	48.8	"
9:40 A.M.	49.05	"

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LUCKY LAGER BREWERIES LTD.

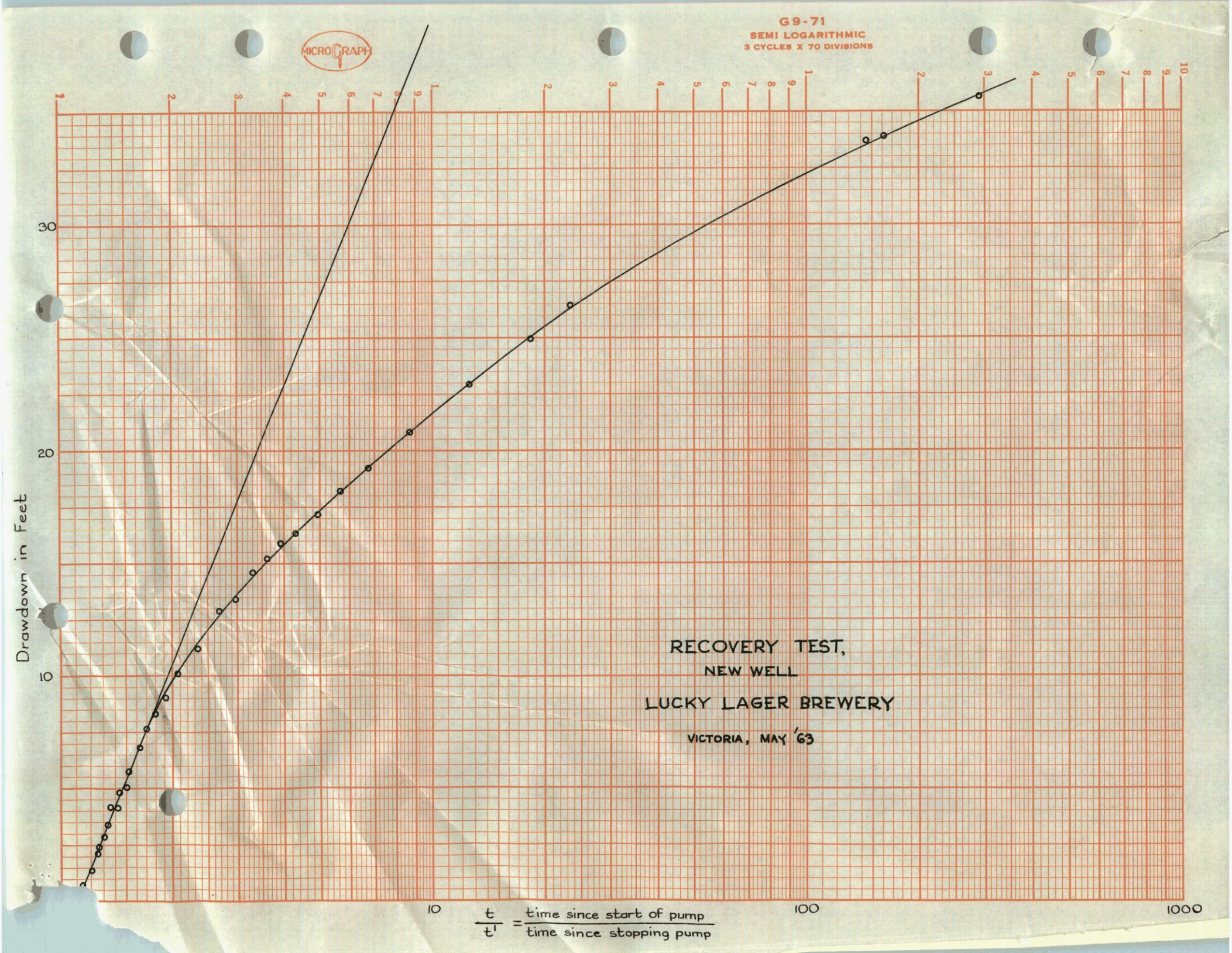
Pump Test - Page 3

Recovery

Time	D.D.
9:41 A.M.	42.8
9:42	38.-
9:43	37.
9:44	36.
9:45	35.35
9:46	34.8
9:47	34.3
9:48	33.85
9:49	33.55
9:50	33.25

Pulled Pump

10:43	26.1
10:48	25.8
10:53	25.35
10:58	25.00
11:03	24.7
11:08	24.4
11:13	24.1
11:18	23.85
11:23	23.6
11:33	23.15
11:45	22.65


G9-71
SEMI LOGARITHMIC
3 CYCLES X 70 DIVISIONS
MICROGRAPH
Drawdown in Feet
30
20
10
10
100
1000
$\frac{t}{t'} = \frac{\text{time since start of pump}}{\text{time since stopping pump}}$
RECOVERY TEST,
NEW WELL
LUCKY LAGER BREWERY
VICTORIA, MAY '63

100

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S

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LOGARITHMIC 359-1125L
KEUFFEL & ESSER CO. MADE IN U.S.A.
3 X 5 CYCLES

.00001

.0001

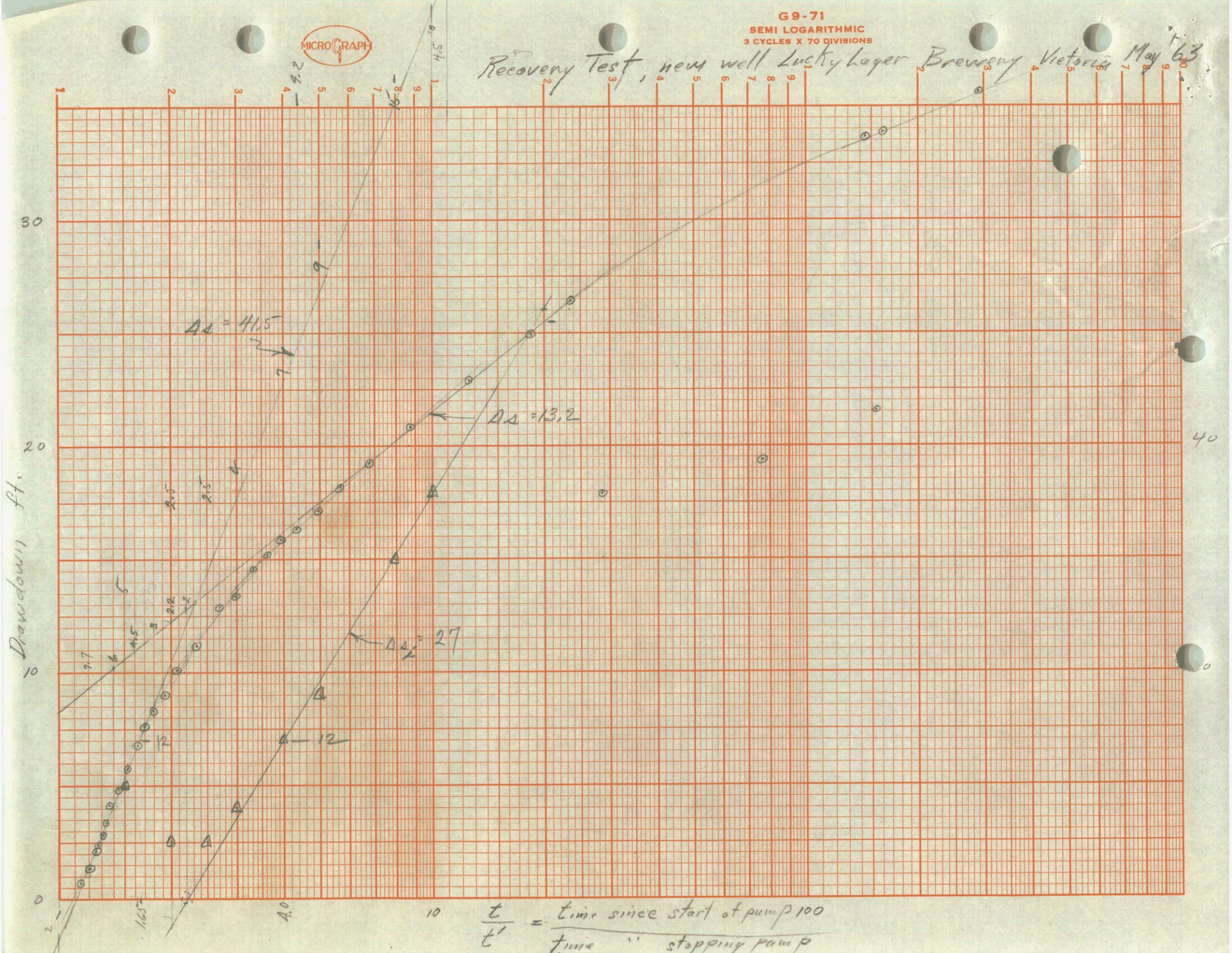
.001

.01

.1

1

$\frac{1}{t}$


G9-71
SEMI LOGARITHMIC
3 CYCLES X 70 DIVISIONS
MICROGRAPH
Recovery Test, new well Lucky Lager Brewery Victoria May 63
Drawdown Ft.
Δs = 41.5
Δs = 13.2
Δs = 27
t/t' = time since start of pump / time " stopping pump

Observations on Recovery [redacted] new well at Lucky Lager Brewe[redacted] Victoria. Observer J. Fahey. Starting May 28, 1963. Well was pumped 24 hours @ 25 gal/min. Pump stopped 9:40 A. M., May 28th.

Time	Measurements	Corrected Level	Drawdown	t = time since start min	t' = time since stop min	$\frac{1}{t'}$	$\frac{t}{t'}$
9:40	49.05						
9:41	42.8	44.99	43.07	1441	1	1.	1441
9:42	38.0	40.19	38.37	1442	2	.5	771
9:43	37.0	39.19	37.37		3	.33	
9:44	36.0	38.19	36.37		4	.25	
9:45	35.35	37.54	35.72	1445	5	.2	289
9:46	34.8	36.99	35.17		6	.14	
9:47	34.3				7		
9:48	33.85				8		
9:49	33.55	35.74	33.92	1449	9	.11	161
9:50	33.25	35.44	33.62	1450	10	.1	145
10.43	26.1	28.29	26.47	1503	63	0.16	23.8
10:48	25.8						
10.53	25.35						
10:58	25.4						
11:03	25.1	26.76	24.94	1523	83	.012	18.4
11:08	24.8						
11:13	24.5						
11:18	24.25						
11:23	24.0						
11:33	23.6						
11:45	23.1	24.76	22.94	1565	125	.008	12.55
12:15	22.0						
12:45	21.03	22.69	20.87	1625	185	.0054	8.78
13:15	19.7						
13:45	19.02	21.05	19.23	1685	245	.0041	6.9
14:15	18.45						
14:45	18.00	20.03	18.21	1745	305	.0033	5.7
15:15	17.48						
15:45	17.0	19.03	17.21	1805	365		4.96
16:45	16.2	18.23	16.41	1865	425		4.39
17:45	15.6	17.63	15.81	1925	485		3.97
18:45	14.95	16.98	15.16	1985	545		3.61
19:45	14.37	16.40	14.58	2005	605	.00165	3.32
21:45	13.25	15.28	13.46	2165	725		2.99
23:45	12.4	14.73	12.91	2285	845		2.71
3:30	11.0	13.03	11.21	2510	1070	.00093	2.34
7:45	9.84	11.87	10.05	2765	1325		2.09
11:45	8.82	10.85	9.03	3005	1565	.00064	1.92
15:45	8.08	10.11	8.29	3245	1805		1.8
19:45	7.35	9.38	7.56	3485	2045	.00049	1.71
00:00	6.58	8.61	6.79	3740	2300		1.63
7:45	5.5	7.53	5.71	4205	2765		1.52
15:45	4.6	6.63	4.81	4685	3245	.00031	1.445
23:45	3.85	5.88	4.06	5165	3725		1.385
7:45	3.24	5.27	3.45	5645	4205		1.34
15:30	2.67	4.70	2.88	6110	4670		1.315
23:40	2.23	4.23	2.41	6600	5160	.00019	1.28
7:45	1.85	3.88	2.06	7085	5645		1.255
15:45	1.47						
23:45	.95		1.37	8525	7090	.000141	1.205
4:40	.72						
14:00	.54						
23:30	.5		.70	9470	8030	.000125	1.14
11:50	.08				8770		
15:35	2.18						
8:30	1.82						
13:00	1.82				10280		