RATE-TIME METHODS:
CONVENIENT AND POPULAR:
BUT
CONTAIN INHERENT INFIRMITIES

To recognize problem (1) listed earlier - accurate determination of an individual well's production - one must look to the source of the reported production statistics to see the practical problems of field determination of individual well production rates.

One example is shown on the next page.

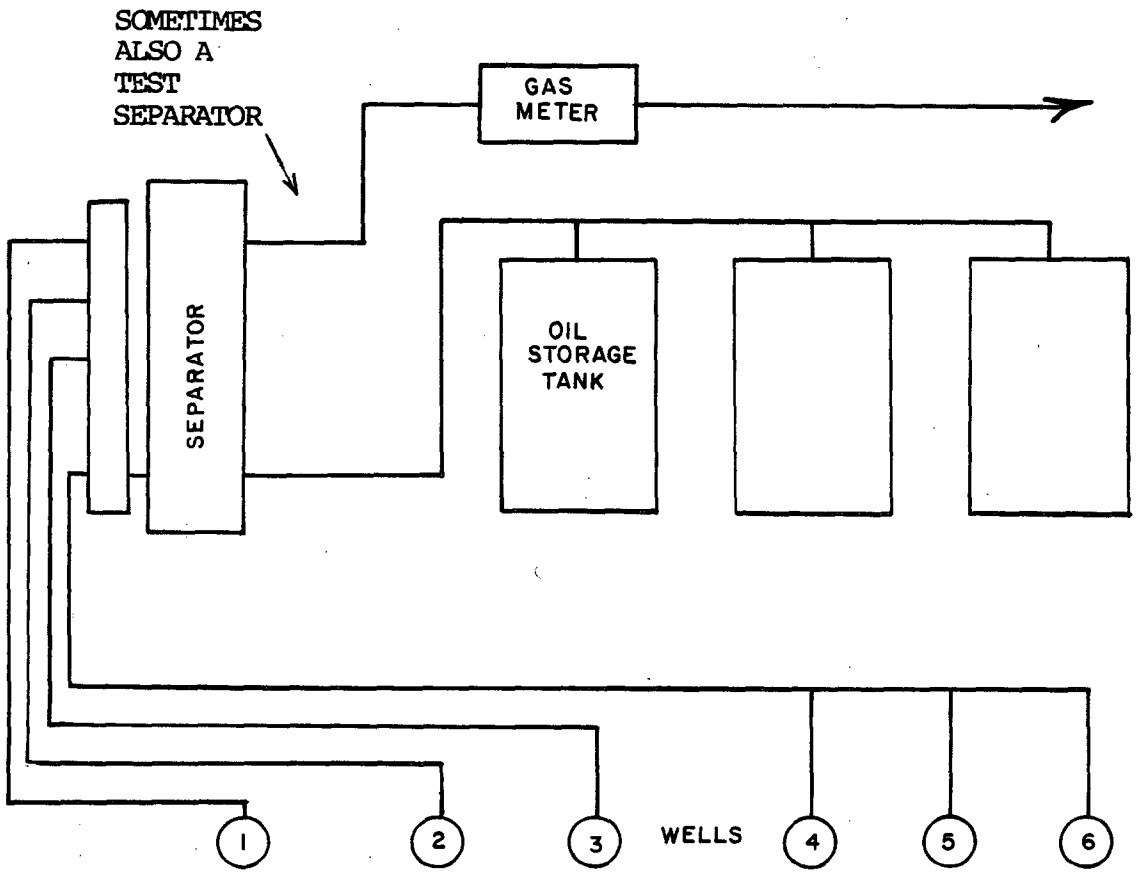
RATE-TIME METHODS:
CONVENIENT AND POPULAR:
BUT
CONTAIN INHERENT INFIRMITIES

EXAMPLE OF THE PRACTICAL PROBLEMS OF DETERMINING INDIVIDUAL WELL PRODUCTION

Ordinarily more than one well is produced into a common tank battery; and although periodic testing of individual wells is done, it is seldom possible to determine productivity with a very high degree of accuracy under the practical realities of the conditions.

However, even given accurate periodic testing of individual wells, the interim individual well production between tests is a statistic difficult to ascertain.

		Battery Total (BOPD)	Individual Well Production (BOPD)				
			#1	#2	#3	#4	#5
GOR Test First of Year		150	20	10	15	25	80
Daily Gauges for:	Feb 10	135	?	?	?	?	?
	Feb 11	145	?	?	?	?	?
	Feb 12	110	?	?	?	?	?
	Feb 13	60	?	?	?	?	?
GOR Test End of Year		104	17	8	19	20	40

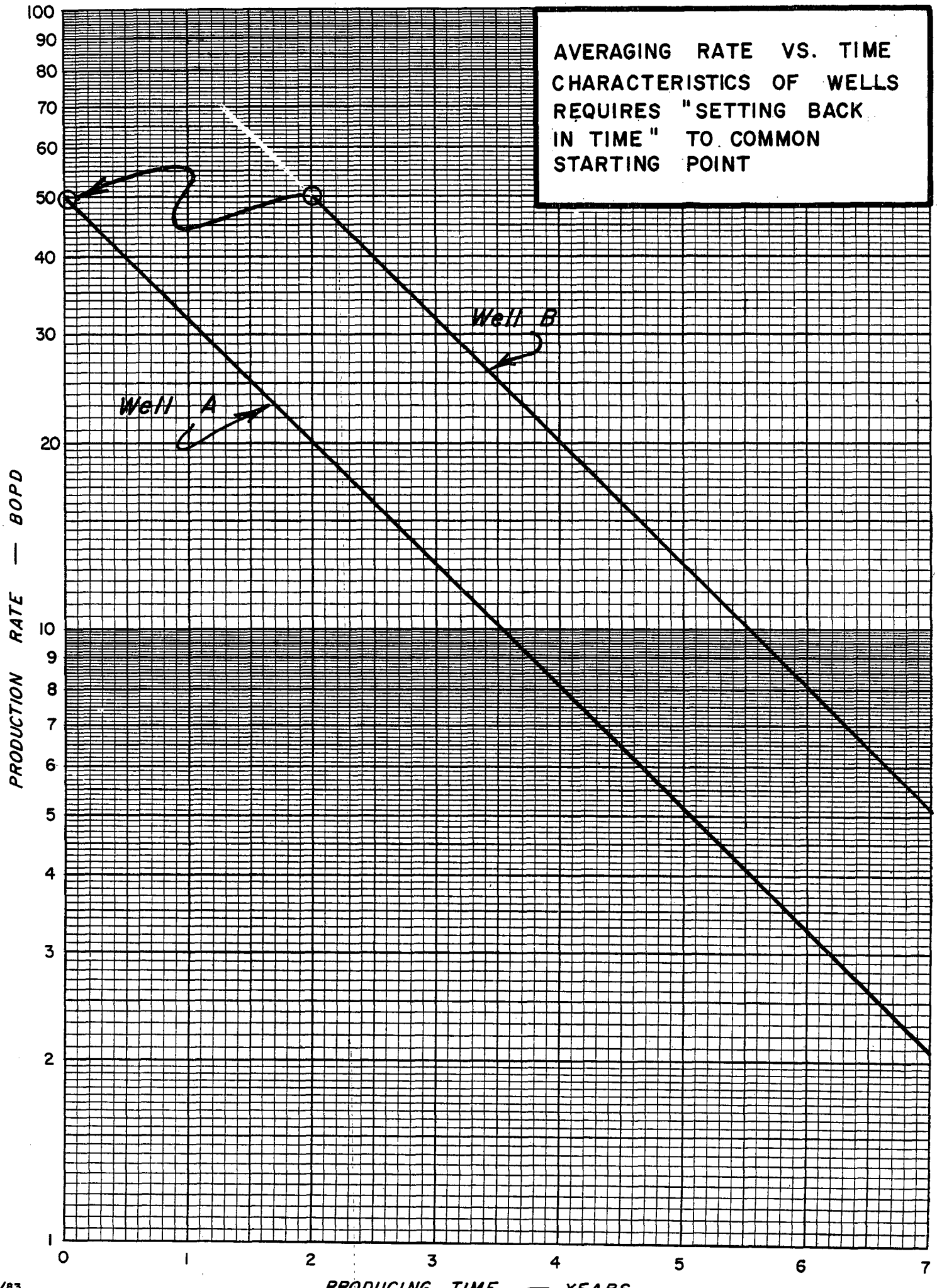


RATE-TIME METHODS:
CONVENIENT AND POPULAR:
BUT
CONTAIN INHERENT INFIRMITIES

PROBLEM (2) AS LISTED ON PAGE 4:

"Averaging of current production rates as new wells come into production will give erroneous data, so it is necessary to "set back in time" each individual well's production curve. This is especially difficult to do if wells are not produced continuously - or have long shut-in periods."

Example is shown on next page.


AVERAGING RATE VS. TIME CHARACTERISTICS OF WELLS REQUIRES "SETTING BACK IN TIME" TO COMMON STARTING POINT
Well B
Well A
PRODUCTION RATE — BOPD
100
90
80
70
60
50
40
30
20
10
9
8
7
6
5
4
3
2
1
0
1
2
3
4
5
6
7
PRODUCING TIME — YEARS

10/83

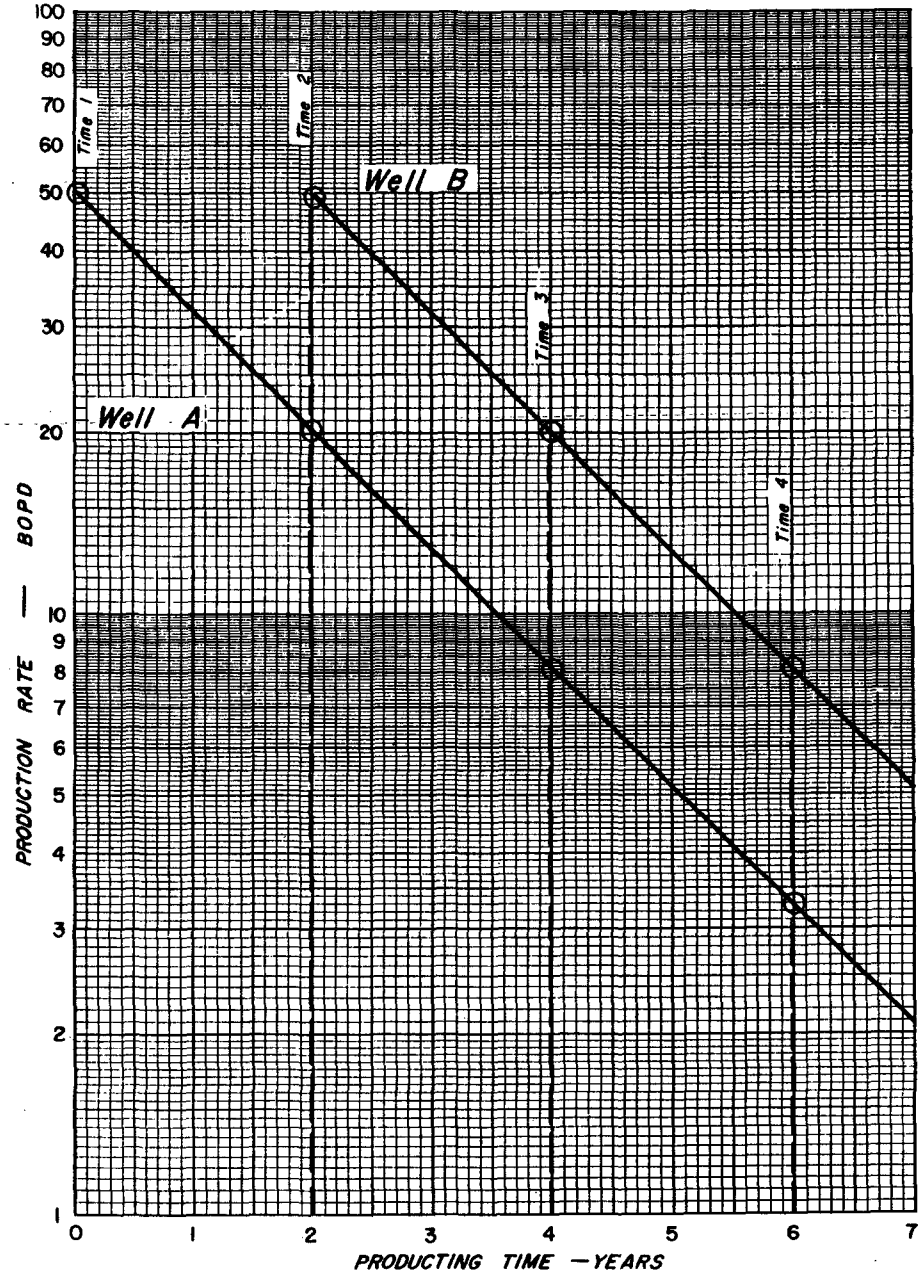
RATE-TIME METHODS:
CONVENIENT AND POPULAR:
BUT
CONTAIN INHERENT INFIRMITIES

STATISTICAL ANALYSIS OF DECLINE CURVES CONSTRUCTED FROM COMPOSITE WELL DATA

Although it is possible to construct per-well average decline curves as a composite of several individual wells producing from the same reservoir by setting back in time" each well's curve to arrive at per well average characteristics, this method has the aforementioned infirmities.

Accordingly a more direct, simpler and precise approach is to average current production rates and to plot these production rates versus per well cumulative production; and, where feasible, to do it on not only a lease basis but a company-wide basis for wells in the same pool.

Although no method is perfect, production curves constructed in this manner - except for the short time anomalies resulting from "flush" production following down time periods will more accurately reflect the facts even though wells are not produced or are shut in for considerable periods of time.



STATISTICAL ANALYSES:

PER WELL AVERAGE PRODUCTION RATE VS. CUMULATIVE PRODUCTION

$P = P_0 \div e^{dt}$

$C = \frac{(P_1 - P_2)\ 365}{d}$

P_0, P = BOPD
d = Decline Rate, Per Year (.45625)
t = Years
C = Cumulative Production — Barrels

Initial Production Rate: 50 BOPD

COMPOSITE PRODUCTION RATE (BOPD)

Time Pt. *	Well A	Well B	A + B No. Wells
1 - 1 year	50	N.P.	50
2 - 2 years	20.1	50	35.0
3 - 4 years	8.1	20.1	14.1
4 - 6 years	3.2	8.1	5.7

COMPOSITE CUMULATIVE PRODUCTION (BBLS)

Time Pt. *	Well A	Well B	A + B No. Wells
1 - 1 year	0	N. P.	0
2 - 2 years	23,939	0	11,970
3 - 4 years	33,551	23,939	28,745
4 - 6 years	37,411	33,551	35,481

* Years Of Production For Well A
(Well B Is 2 Years Less Than Well A)

RATE-TIME METHODS:
CONVENIENT AND POPULAR:
BUT
CONTAIN INHERENT INFIRMITIES

On the next sheet the statistics of the preceding page are duplicated and the data set out on a rate-cumulative plot.

STATISTICAL ANALYSES:

PER WELL AVERAGE PRODUCTION RATE VS. CUMULATIVE PRODUCTION

$P = P_o \div e^{dt}$

$C = \frac{(P_1 - P_2)\ 365}{d}$

P_o, P = BOPD
d = Decline Rate, Per Year (.45625)
t = Years
C = Cumulative Production – Barrels

Initial Production Rate: 50 BOPD

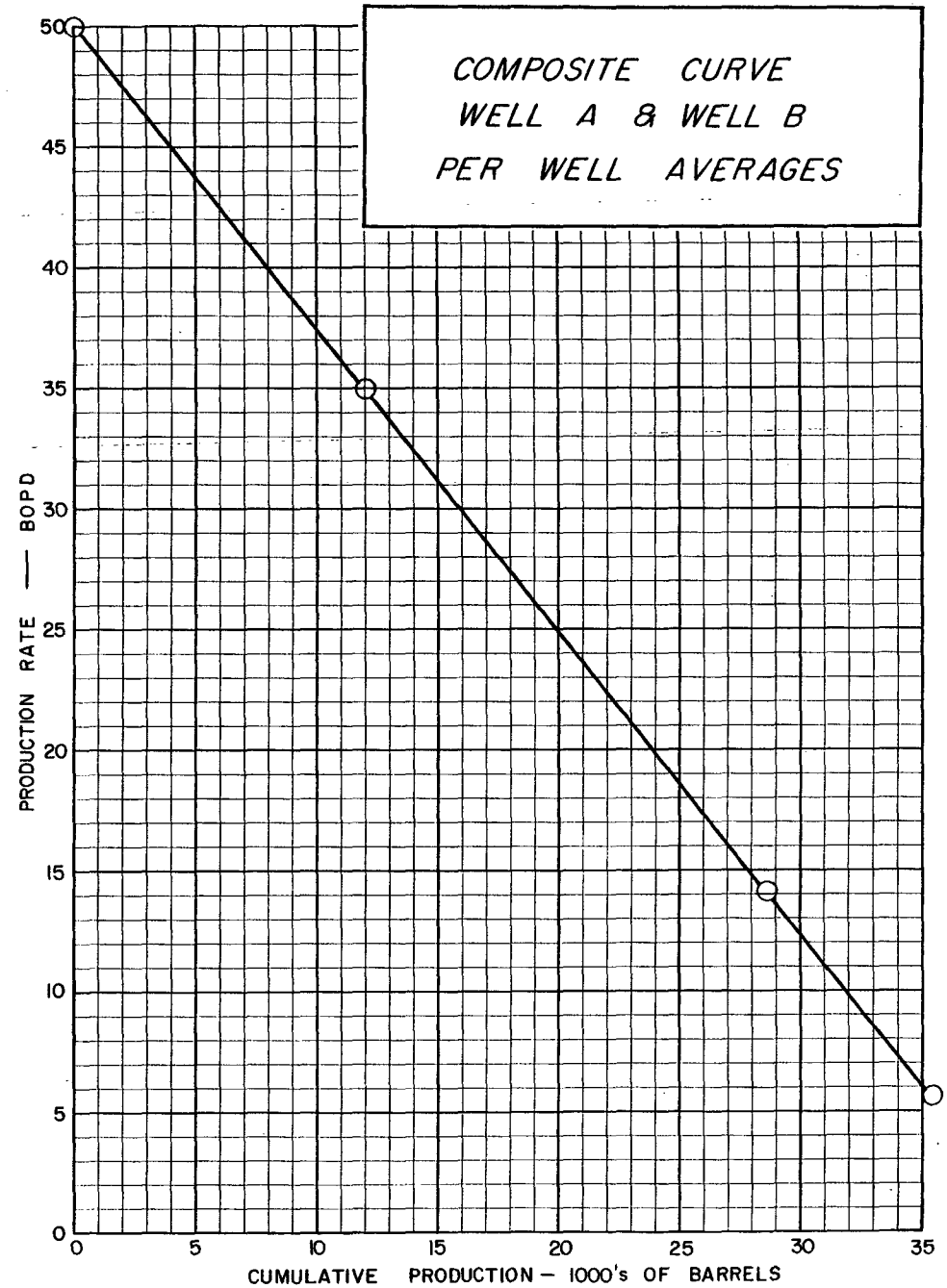
COMPOSITE PRODUCTION RATE (BOPD)

Time Pt. *	Well A	Well B	A + B / No. Wells
1 – 1 year	50	N.P.	50
2 – 2 years	20.1	50	35.0
3 – 4 years	8.1	20.1	14.1
4 – 6 years	3.2	8.1	5.7

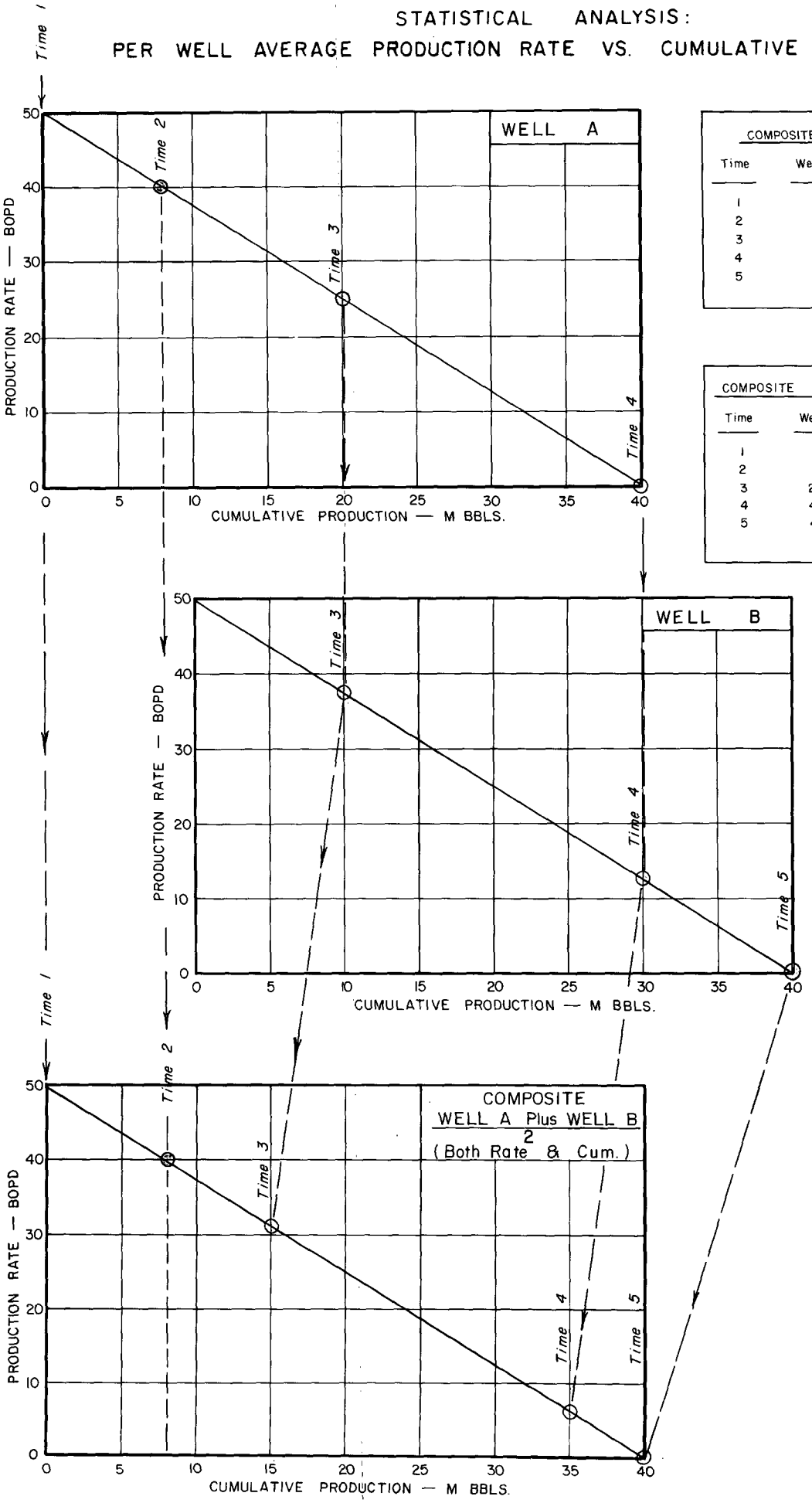
COMPOSITE CUMULATIVE PRODUCTION (BBLS)

Time Pt. *	Well A	Well B	A + B / No. Wells
1 – 1 year	0	N.P.	0
2 – 2 years	23,939	0	11,970
3 – 4 years	33,551	23,939	28,745
4 – 6 years	37,411	33,551	35,481

* Years Of Production For Well A
(Well B Is 2 Years Less Than Well A)



STATISTICAL ANALYSIS:
PER WELL AVERAGE PRODUCTION RATE VS. CUMULATIVE PRODUCTION



COMPOSITE PRODUCTION RATE (BOPD)

Time	Well A	Well B	$\frac{A+B}{\text{No. Wells}}$
1	50	N.P.	50
2	40	N.P.	40
3	25	37.5	31.25
4	0	12.5	6.25
5	0	0	0

COMPOSITE CUMULATIVE PRODUCTION (BBLS)

Time	Well A	Well B	$\frac{A+B}{\text{No. Wells}}$
1	0	N.P.	0
2	8,000	N.P.	8,000
3	20,000	10,000	15,000
4	40,000	30,000	35,000
5	40,000	40,000	40,000

10/83 cs