UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

World finding-rate studies - crude oil

by

Jennifer Cook-Clark[1]

Open-File Report 83-715

1. Reston, Virginia

1983

Although some of the numbers in the charts of this report are not legible, they are the best that are available.

for Charles A. Masters
Jennifer Cook-Clark

CONTENTS

CONTENTS (continued)

Section 1: FINDING-RATE STUDIES - CRUDE OIL

Introduction

The World Energy Resources Program (WERP) endeavors to quantify the reserves and estimate the ultimate recoverable resources of the world's oil and gas. To accomplish this task, WERP utilizes several resource assessment methodologies that are applicable to diverse sedimentary basins, regions, or countries that have varying amounts of available exploration and production data and information. One of the most valuable methods, based on past production and reserves estimation, is the extrapolation of historic rate of additions to reserves. The rate of additions to reserves permits estimates of ultimate resource recovery to be made within certain confidence levels. Note the data available for this report do not permit "finding rate" or "discovery rate" analysis. Rather, by noting the change in reserves relative to production, it is possible to calculate annual reserves additions from all sources. The ratio of those additions to exploratory wells drilled provides a measure of exploratory drilling effectiveness through time.

This study was initiated to prepare, compile, and evaluate, in a standardized manner and on a country-by-country basis, the information necessary to undertake a worldwide additions-to-reserves analysis. The sources of the data utilized in this study were chosen from the most consistent data sets presently available. Rates of reserves additions attempt to capitalize on the knowledge of past production performance in order to predict future performance in an area such as a single sedimentary basin, a country, a region, or the world, this idea being based on M. King Hubbert's concept of oil and gas production cycles. The strengths and weaknesses of such analyses, based on proved-discovery and production cycles, have been extensively discussed in the geoscience literature, and it remains a viable methodology for estimating undiscovered resources when there is a sufficiently long and consistent production history for a region. At the very least, the rate of additions to reserves analysis gives an approximation of where within the production cycle any given area might be. Most important is that from the additions rates, one can qualitatively evaluate exploration success over time, based on the number of wells drilled and whether additions to reserves may logically be expected to increase, stay stable, or decrease relative to future drilling activity.

Standardized Data Sets

The historical resource figures that are found in the literature are very difficult to compare or aggregate on a regional or global scale because of wide differences in the classification of what "reserves" or "resources" each country or agency believed constituted their discovered resource base. For example, what some countries or companies have reported as reserves might include what others had excluded (e.g., indicated or inferred), making the figures a measure of two different categories.

It is fully recognized that the most useful and potentially valuable basis for reserves additions work would be by discrete sedimentary basins, but it is impossible, practically, for a study such as this because of the absence of routine data on a basin level worldwide by countries or companies.

In this study, the measure of exploratory effort is the cumulative number of exploratory wells drilled. Granted, exploratory wells drilled are not related to reserves additions by field expansion or by secondary recovery, but we assume that a major part of reserves additions stems from new discoveries, hence there is a strong causal relationship between the two measured values.

Products

The basic data used in this study are reported yearly for each country (not including the Centrally Planned Economies and those other countries with inadequate reporting) and include the following elements:

1. Production
2. Reserves
3. Exploratory wells completed

These are included in the master data sheets for each country (see Section II).

From these basic data, the following calculated figures are available yearly for each country (also contained on the master data sheet):

1. Cumulative number of exploratory wells drilled
2. Ultimate recovery
3. Cumulative production
4. Annual changes in reserves
5. Additions to reserves
6. Additions to reserves per exploratory well

From the basic and calculated data, the following data were aggregated for successive 5-year periods for every country:

1. Number of exploratory wells completed
2. Average ultimate recovery
3. Change in reserves
4. Additions to reserves
5. Additions to reserves per exploratory well drilled during the 5-year period

The countries that have been covered are grouped into regions and include the following:

Western Europe

Austria
Denmark
France
West Germany
Italy
Netherlands
Norway
Spain
United Kingdom

South America

Argentina
Bolivia
Brazil
Chile
Colombia
Ecuador
Peru
Trinidad and Tobago
Venezuela
Mexico

Middle East

Bahrain
Iran
Iraq
Israel
Kuwait
Oman
Qatar
Saudi Arabia
Turkey
United Arab Emirates

Far East

Burma
China
India
Japan
Malaysia/Brunei
Pakistan
Taiwan
Indonesia

North Africa

Algeria
Egypt
Libya
Tunisia

Basic Data and Sources

In the interest of standardization and consistency, almost all of the data used were derived from single data sources, and each data item that is used in the accompanying tables and graphs will be explained either as from where it was obtained or how it was calculated. Each item is quoted as of a given year (y). Figure 1 shows the relative position of each data item for the master data sheet for each country.

Country name

Year (y)	Exploratory wells completed (W_y) (AAPG)	Cumulative exploratory wells completed (CW_y)	Reserves - MMBbls (R_y) (D/H)	Crude production MBbls (P_y) (D/H, WO)	Ultimate recovery rounded MMBbls ($CP_y + R_{y+1}$)	Cumulative production rounded MMBbls (CP_y)	Change in reserves ($R_{y+1} - R_y$) = AR_y MBbls	Proved additions to reserves MBbls ($D_y = AR_y + P_y$)	Proved additions to reserves per well MBbls (D_y/W_y)

Figure 1.--Location of data elements on master data sheets.

The basic data for this study consisted of numbers of exploratory wells completed, reserves, and production figures. From these, all other data were calculated. Where there were no data or a blank appeared in the original source, no data appear correspondingly in this study.

(I) Number of exploratory wells completed (W_y) - The American Association of Petroleum Geologists' (AAPG) Bulletin, "foreign developments issue" from 1940 to the present is quoted for each region and country.

(III) Reserves (R_y) - Reserves are reported according to DeGolyer and MacNaughton's Twentieth Century Petroleum Statistics and are given as of 1-1-y (except where differences are noted in their texts). The politics of changing country boundaries have created a problem in some cases; for example, Malaysia/Brunei has been referred to over the last 40 years variably as Netherlands East Indies, Sarawak, Sabah and Sarawak, Brunei and Malaysia. Where possible, the current configuration of states has been maintained. In the case above, the data appear in the Malaysia/Brunei tabulations.

(IV) Production (P_y) - Figures for production are quoted also from DeGolyer and MacNaughton but as of 12/31/-y (except where noted in their texts) from 1918 to the present. Prior to 1918, the "World Oil" chart (6/15/50) 'World Crude Oil Production by Countries, by Years, parts 1-3' was quoted depending on any given country's production history.

Calculated Data

All calculated data are derived from the basic data as given above. Numbers of cumulative exploratory wells completed were tallied assuming blanks as zeros, as were the tallies for cumulative production.

(II) Cumulative exploratory wells completed (CW_y) - Cumulative figures for the numbers of wells drilled through any given year (y) were tabulated.

(IV) Cumulative Production (CP_y) - Cumulative production was tabulated through every year of a country's production history.

(VII) Changes in Reserves (ΔR_y) - For any given year, the reserves quoted for that year are substracted from the following year's figure,

$$(\Delta R_y) = R_{y+1} - R_y.$$

(V) Ultimate recovery - The ultimate recovery quoted for any given year is calculated as the reserves at the end of that year (R_{y+1}) plus the cumulative production through the given year,

$$\text{Ultimate Recovery} = CP_y + R_{y+1}.$$

(VIII) Proved additions to reserves (D_y) - The proved additions to reserves for a year (y) is the change in reserves for that year (ΔR_y) plus the production for that year,

$$D_y = \Delta R_y + P_y.$$

(IX) Proved additions to reserves per exploratory well - Proved additions to reserves per exploratory well are calculated for every year (y) as the proved addition to reserves for that year divided by the number of exploratory wells completed that year,

$$\text{Proved additions to reserves per well} = D_y/W_y$$

5-Year Aggregate Figures

Aggregates over successive 5-year periods were computed for the following variables:

(a) number of exploratory wells drilled
(b) change in reserves
(c) average ultimate recovery
(d) proved additions to reserves
(e) proved additions to reserves by well

Figure 2 shows the locations of each item on the 5-year aggregation charts for each country. The items 'b,' 'c,' and 'e' are cumulative figures over the respective 5-year interval; whereas 'd,' average ultimate recovery, is the arithmetic mean of the ultimate recoveries for the 5 years comprising the interval.[1] Item 'f' is the proved additions-to-reserves figure in 'e' divided by the number of exploratory wells completed over the 5-year interval, 'b.'

Country Name

5-year period	Number of exploratory wells completed	Change in reserves (MMBbls)	Avg ultimate recovery (MMBbls)	Proved additions to reserves (MMBbls)	Proved additions to reserve by well (MMBbls)
a	b	c	d	e	f

Figure 2.--Location of data elements on 5-year aggregate data sheet.

[1] This number will be less than the reported additions for any 5-year period, but it compensates for significant observed fluctuations in reserve reporting producing a smoother graph.

Section II: CRUDE-OIL FINDING-RATE DATA

Introduction

Six selected curves were plotted for each country on four graphs where there were sufficient data in order to qualitatively show the status and success of exploration in each country. These plots include:

1. Ultimate crude-oil recovery (MMBbls) vs. Cumulative exploratory wells completed

2. Proved additions to crude-oil reserves per exploratory well completed (MBbls)

3. Ultimate crude-oil recovery (MMBbls) and Number of exploratory wells drilled per successive 5-year period

4. Proved additions to reserves per well and change in reserves per 5-year period

Each graph was plotted on semi-logarithmic paper because of the very wide range of figures presented. While standard arithmetic scales are preferred to preserve convenient proportions of curve extrapolations to the eye, the semi-logarithmic paper was used to preserve the upper and lower ranges of numbers, which would have been hopelessly clustered on arithmetic-scaled paper. Because the historic trend is what is necessary to do the basic extrapolation, to drop off the early, small ultimate recovery, numbers of wells, and proved additions to reserves figures seemed unwise until, in future studies, they are deemed as unnecessary or irrelevant to the extrapolation process. It must be kept in mind then that when making extrapolations, the semi-logarithmic paper greatly exaggerates the flattening of the curves when the variables increase. Also, when a variable increases exponentially, the function would then plot as a straight line on the semi-log paper. Even so, it was impossible to retain a consistent scale for the graphs and still retain figures that were less than .1, zero, or negative. In these cases, a circled point at the x-axis signifies that the data point is either less than .1 (or 1, respectively, depending on the set of graphs), zero, or negative.

The sequence of data sheets and graphs FOR EACH COUNTRY included in this study is:

1. Master data sheet (from which the following two graphs are plotted)

2. Graph of Ultimate crude oil recovery vs. Exploratory wells completed

3. Graph of Proved additions to reserves per exploratory well completed vs. Exploratory wells completed

4. 5-year aggregation data sheets (from which the following two graphs are plotted)

5. Graph of Average ultimate crude oil recovery over consecutive 5-year intervals and Number of exploratory wells completed per consecutive 5-year intervals

6. Graph of Proved additions to reserves per wells drilled in 5-year period vs. consecutive 5-year intervals and Change in reserves over consecutive 5-year intervals

WESTERN EUROPE

Austria

Denmark

France

West Germany

Italy

Netherlands

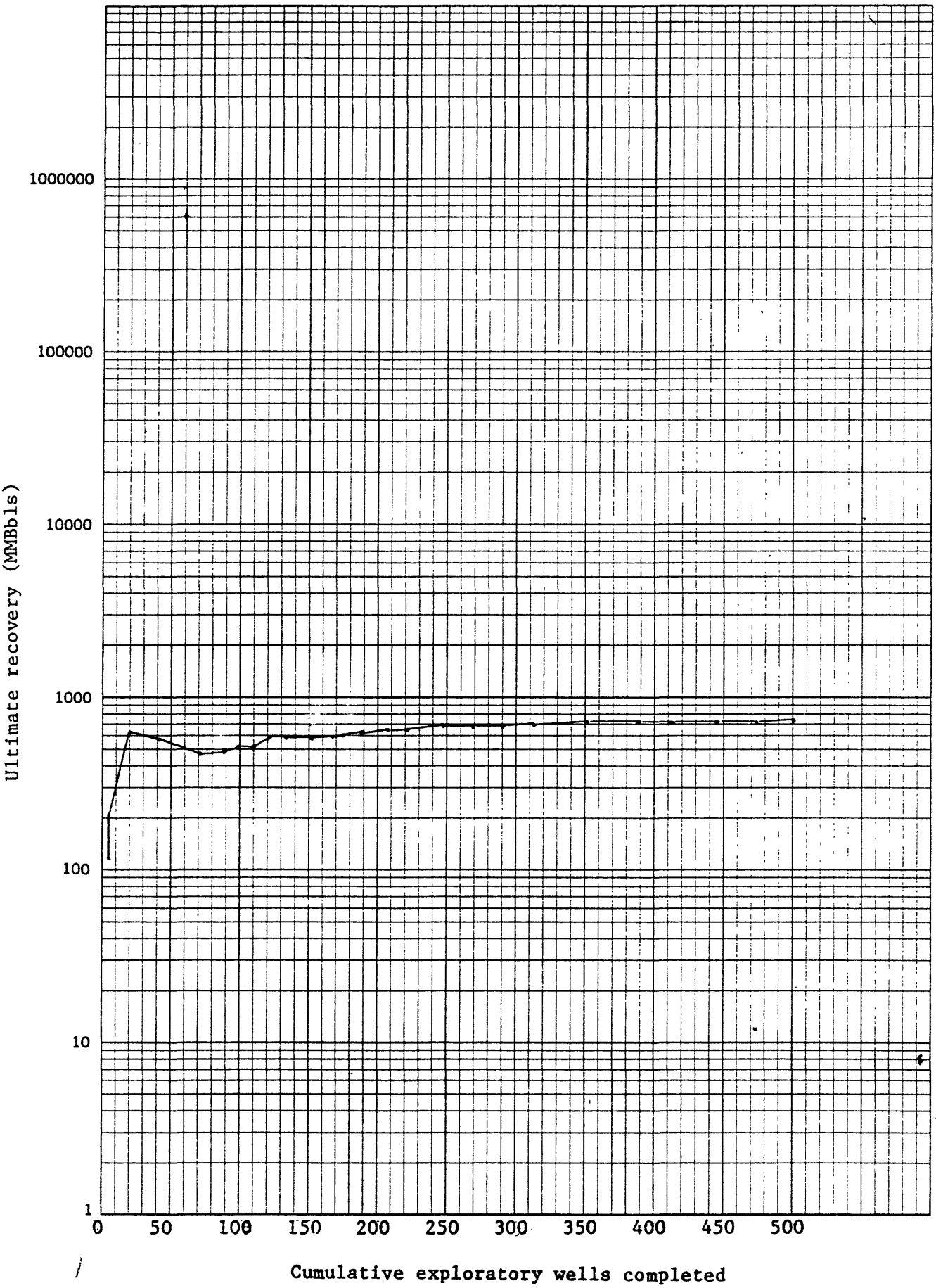
Norway

Year (y)	Exploratory wells completed (W_y) (AAPG)	Cumulative exploratory wells completed (CW_y)	Reserves - MMBbls (R_y) (D/M)	Crude production MBbls (P_y) (D/M, WO)	Ultimate recovery rounded MMBbls ($CP_y + R_{y+1}$)	Cumulative production rounded MMBbls (CP_y)	Change in reserves ($R_{y+1} - R_y$) = ΔR_y MBbls	Proved additions to reserves MBbls ($D_y = \Delta R_y + P_y$)	Proved additions to reserves per well MBbls (D_y/W_y)
1934				28					
1935				44					
1936				50					
1937				221					
1938				383	1	1			
1939				1,240	2	2			
1940				2,808	5	5			
1941				4,238	9	9			
1942				5,899	15	15			
1943				7,478	91	22	68,700	76,178	
1944			69*	8,218		31			
1945				3,074	109	34	6,000	9,074	
1946			75	5,734	110	39	-4,000	1,734	
1947			71	6,285	116	46	-1,000	5,285	
1948	5	5	70	6,149	127	52	5,000	11,149	2,230
1949			75	6,100	133	58	0	6,100	
1950			75	10,200	128	68	-15,000	-4,800	
1951	0	5	60	15,500	219	84	75,000	90,500	
1952			135	18,760	302	102	65,000	83,760	
1953			200	21,860	324	124	0	21,860	
1954			200	23,400	448	148	100,000	123,400	
1955			300	24,886	410	173	-63,000	-38,114	
1956	15	20	237	23,622	616	196	183,000	206,622	13,775
1957	21	41	420	21,955	558	218	-80,000	58,045	2,764
1958	13	54	340	19,548		238			
1959	17	71		16,946	465	255	-130,000	113,054	-6,650
1960	17	88	210	16,874	477	272	-5,000	11,874	698
1961	11	99	205	16,237	514	288	21,000	37,237	3,385
1962	11	110	226	16,694	514	304	-16,000	694	63
1963	11	121	210	18,271	584	323	51,000	69,271	6,297
1964	13	134	261	18,571	578	341	-24,000	-5,429	-418
1965	17	151	237	19,908	598	361	0	19,908	1,171
1966	16	167	237	19,228	585	380	-32,000	-12,772	-798
1967	8	175	205	18,725	600	399	-4,100	14,625	1,828
1968	14	189	201	18,999	619	418	100	19,099	1,364
1969	19	208	201	19,236	625	437	-13,340	5,896	310
1970	15	223	188	19,515	647	457	2,040	21,555	1,437
1971	25	248	190	17,549	661	474	-3,200	14,349	574
1972	21	269	187	17,284	677	492	-2,000	15,284	728
1973	21	290	185	17,982	676	510	-18,600	-618	-29
1974	24	314	166	15,609	697	525	5,660	21,269	886
1975	37	351	172	14,205	716	540	4,185	18,390	497
1976	36	387	176	13,466	715	553	-13,948	-482	-13
1977	26	413	162	12,462	702	565	-24,522	-12,060	-464
1978	33	446	137	12,486	716	578	261	12,747	386
1979	28	474	138	12,098	715	590	-12,098	0	
1980	26	500	125	10,458	723	600	-1,981	8,477	326
1981			123						

*Includes Germany

AUSTRIA

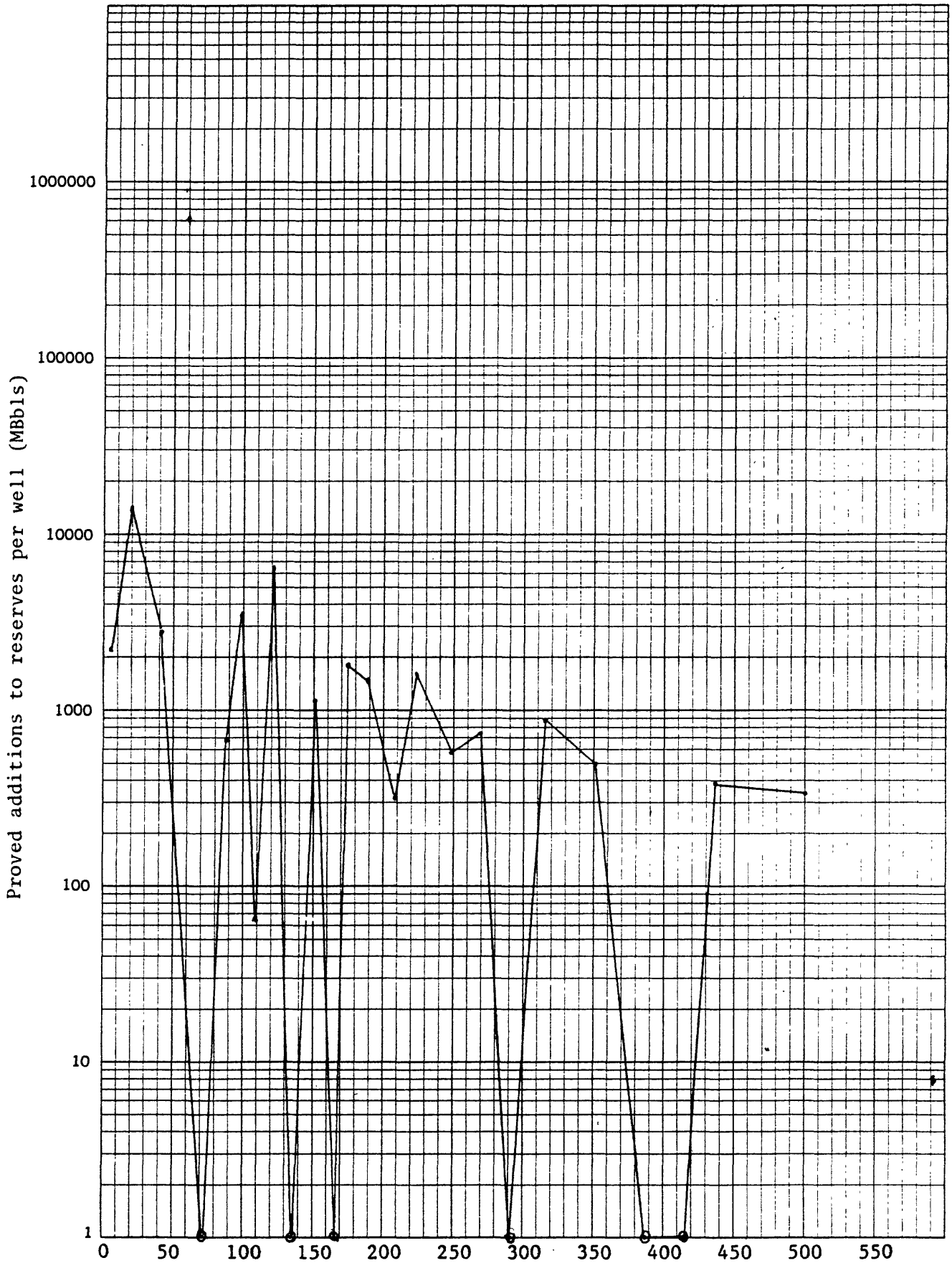
Ultimate crude oil recovery (MMBbls) vs cumulative exploratory wells completed



46 6463

K+E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

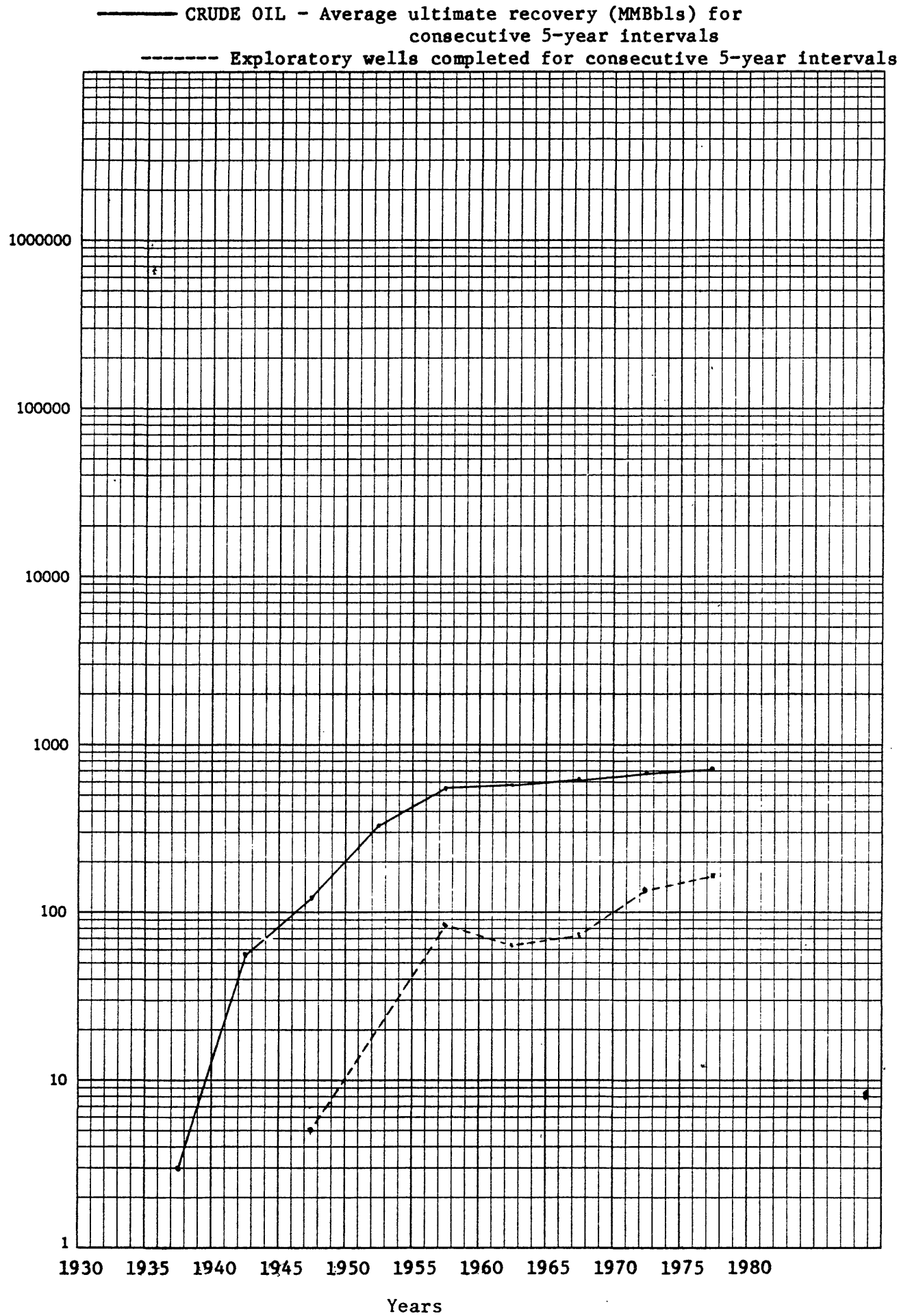
Proved additions to crude oil reserves per exploratory well completed (MBbls)
vs cumulative exploratory wells completed



AUSTRIA

5 year period	Number of exploratory wells completed	Change in reserves (MMBbls)	Avg ultimate recovery (MMBbls)	Proved additions to reserves (MMBbls)	Proved additions to reserves by well (MMBbls)
1936-1940			3		
1941-1945		75	56	85	
1946-1950	5	-15	123	19	3.8
1951-1955	0	177	341	282	
1956-1960	83	-32	529	48	.6
1961-1965	63	32	558	122	.5
1966-1970	72	-47	615	49	.7
1971-1975	128	-14	685	67	.5
1976-1980	149	-53	714	9	.1

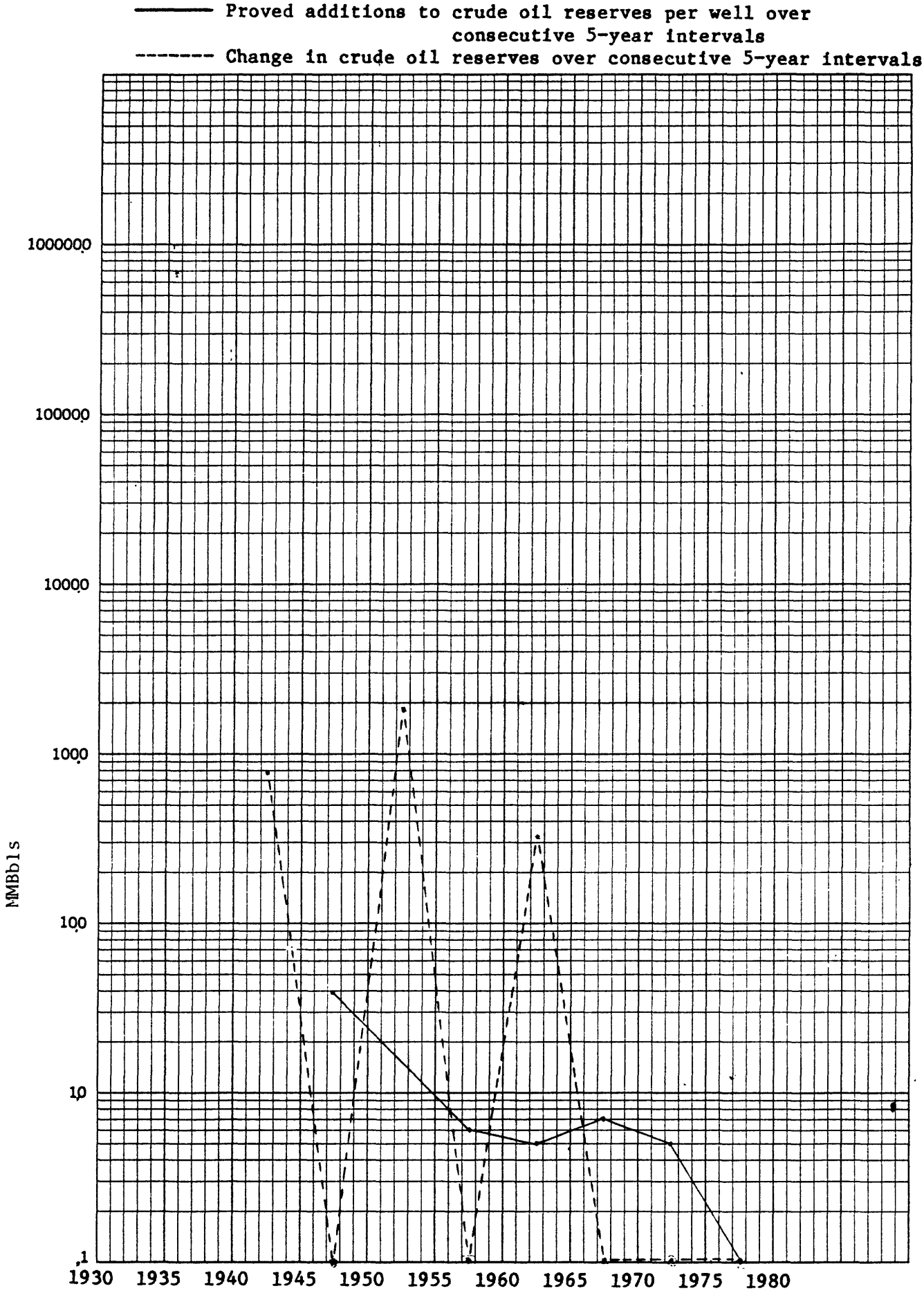
AUSTRIA



46 6463

K+E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS KEUFFEL & ESSER CO. MADE IN U.S.A.

AUSTRIA



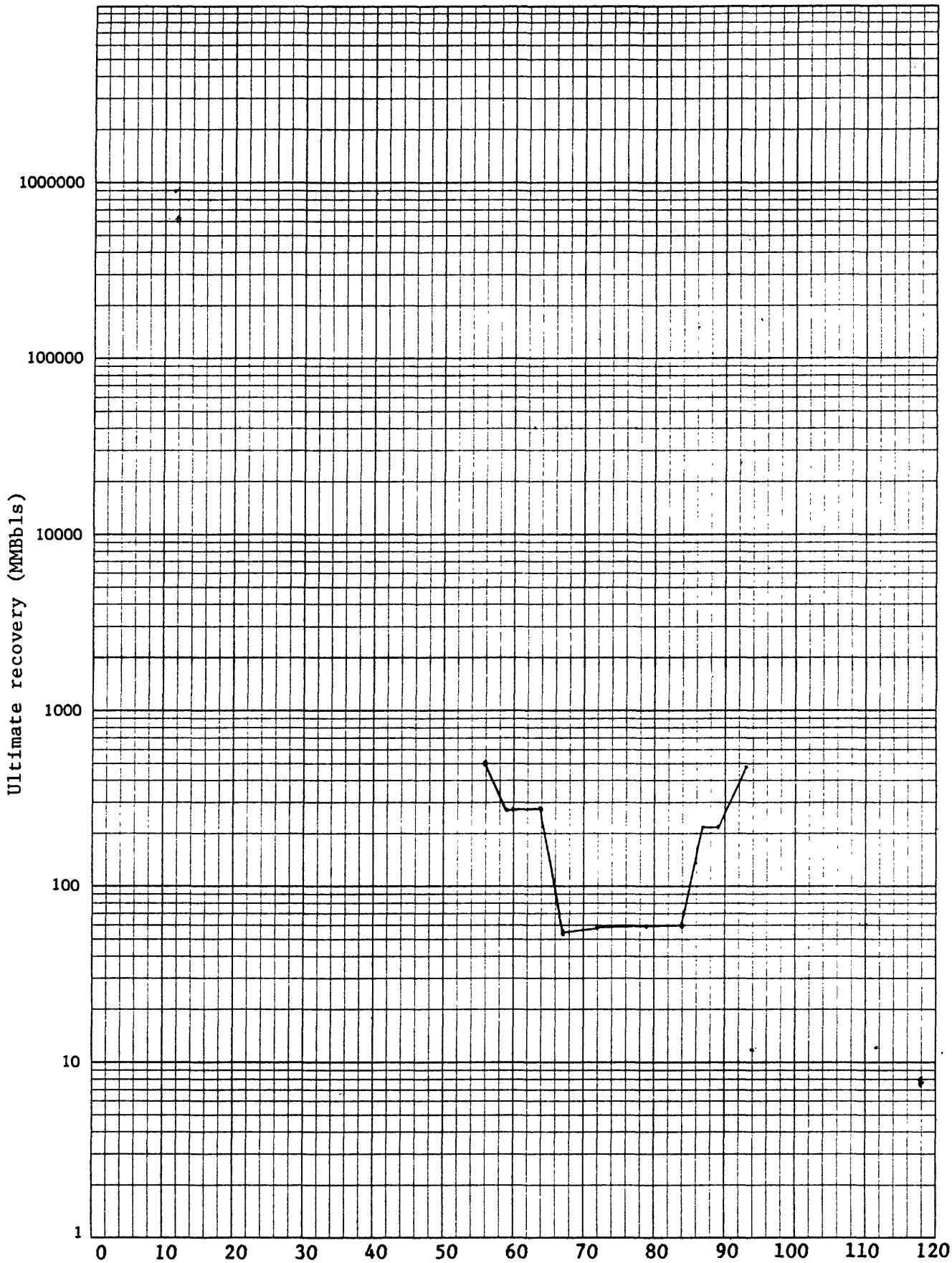
46 6463

K•E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS KEUFFEL & ESSER CO. MADE IN U.S.A.

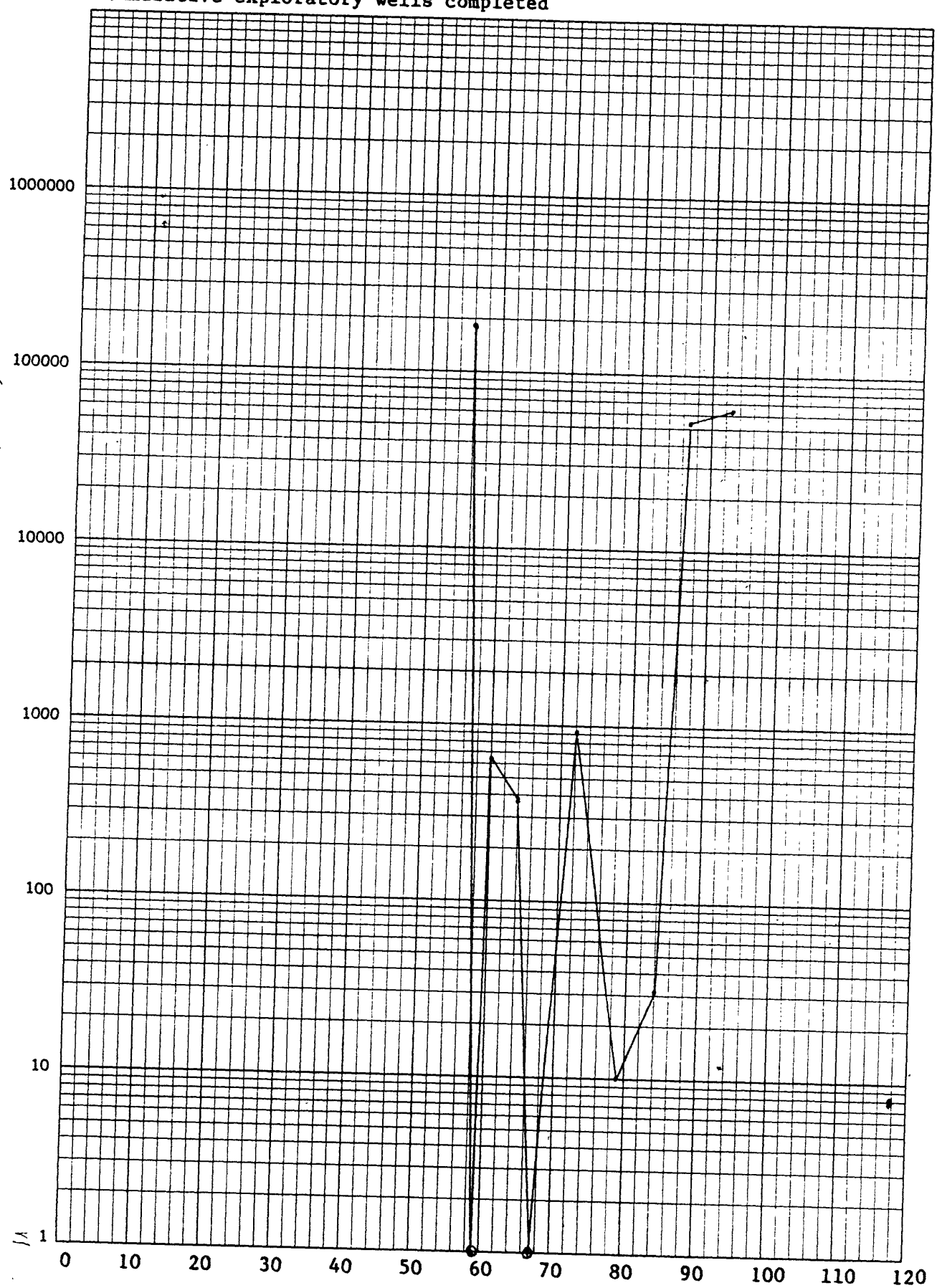
DENMARK

Year (y)	exploratory wells completed (W_y) (AAPG)	Cumulative exploratory wells completed (CW_y)	Reserves - MMBbls (R_y) (D/M)	Crude production MBbls (P_y) (D/M, WO)	Ultimate recovery rounded MMBbls ($CP_y + R_{y+1}$)	Cumulative production rounded MMBbls (CP_y)	Change in reserves ($R_{y+1} - R_y$) = ΔR_y MBbls	Proved additions to reserves MBbls ($D_y = \Delta R_y + P_y$)	Proved additions to reserves per well MBbls (D_y/W_y)
1947	1	1							
1948	0	1							
1949									
1950	2	3							
1951	20	23							
1952	1	24							
1953	3	27							
1954	0	27							
1955									
1956	2	29							
1957	0	29							
1958	9	38							
1959	2	40							
1960	0	40							
1961									
1962	0	40							
1963									
1964	0	40							
1965	0	40							
1966	3	43							
1967	1	44							
1968	7	51							
1969	2	53							
1970	3	56							
1971	3	59							
1972	1	60	500		500				
1973	4	64	250		250		500,000	500,000	166,666
1974	3	67	250	622	251		-250,000	-250,000	-83,333
1975	5	72	250	1,460	252	1	0	622	622
1976	7	79	51	689	54	2	0	1,460	365
1977	5	84	54	1,327	58	3	-199,310	-198,621	-66,207
1978	3	87	53	1,492	59	4	3,235	4,562	912
1979	2	89	51	3,285	60	6	-1,421	71	10
1980	4	93	208	3,650	221	9	-1,723	1,562	312
1981			205	3,066	221	13	156,831	160,481	53,494
			450	2,196	468	16	-3,066	0	
						18	245,454	247,650	61,913

Ultimate crude oil recovery (MMBbls) vs cumulative exploratory wells completed

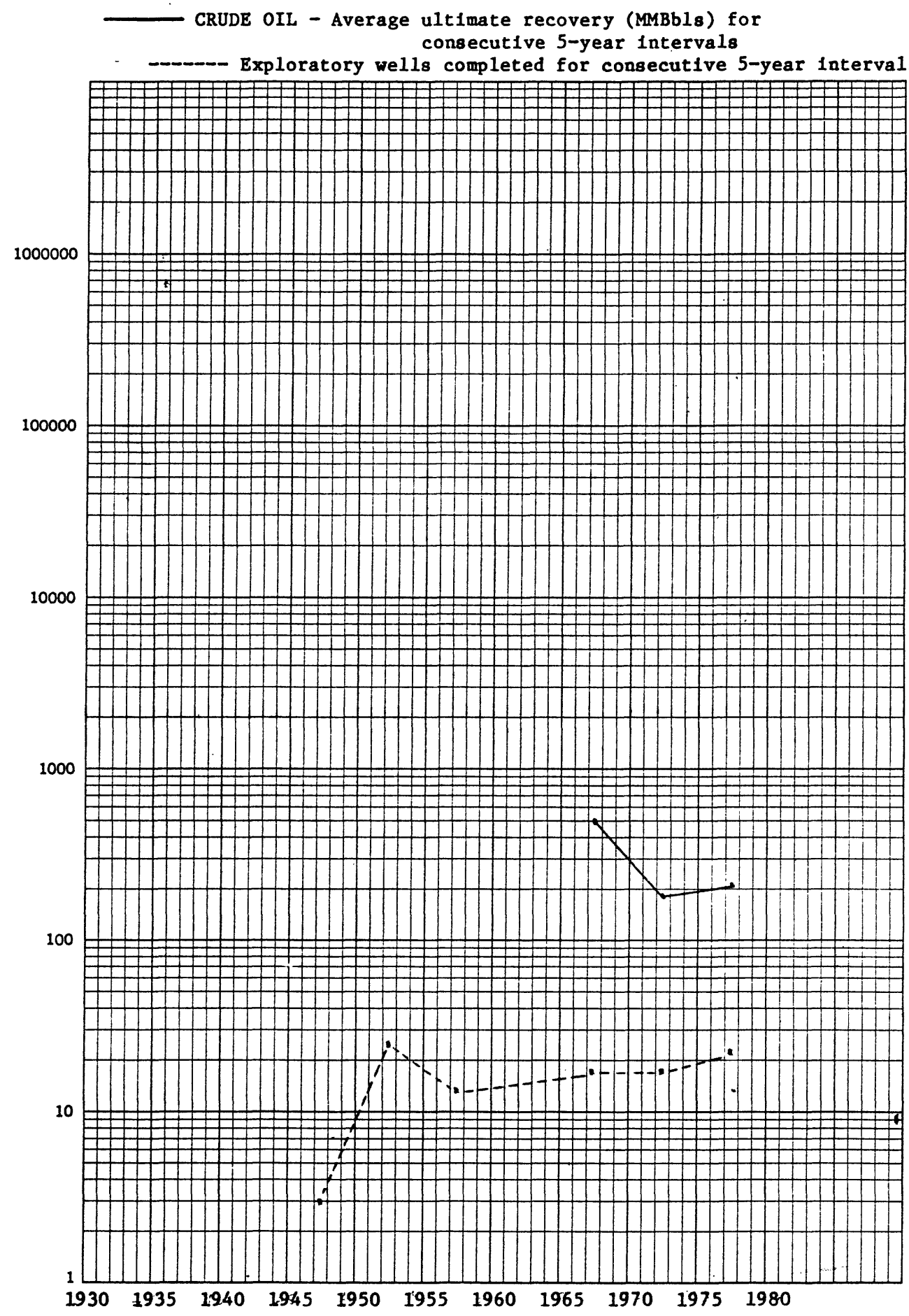


Proved additions to crude oil reserves per exploratory well completed (MBbls)
vs cumulative exploratory wells completed

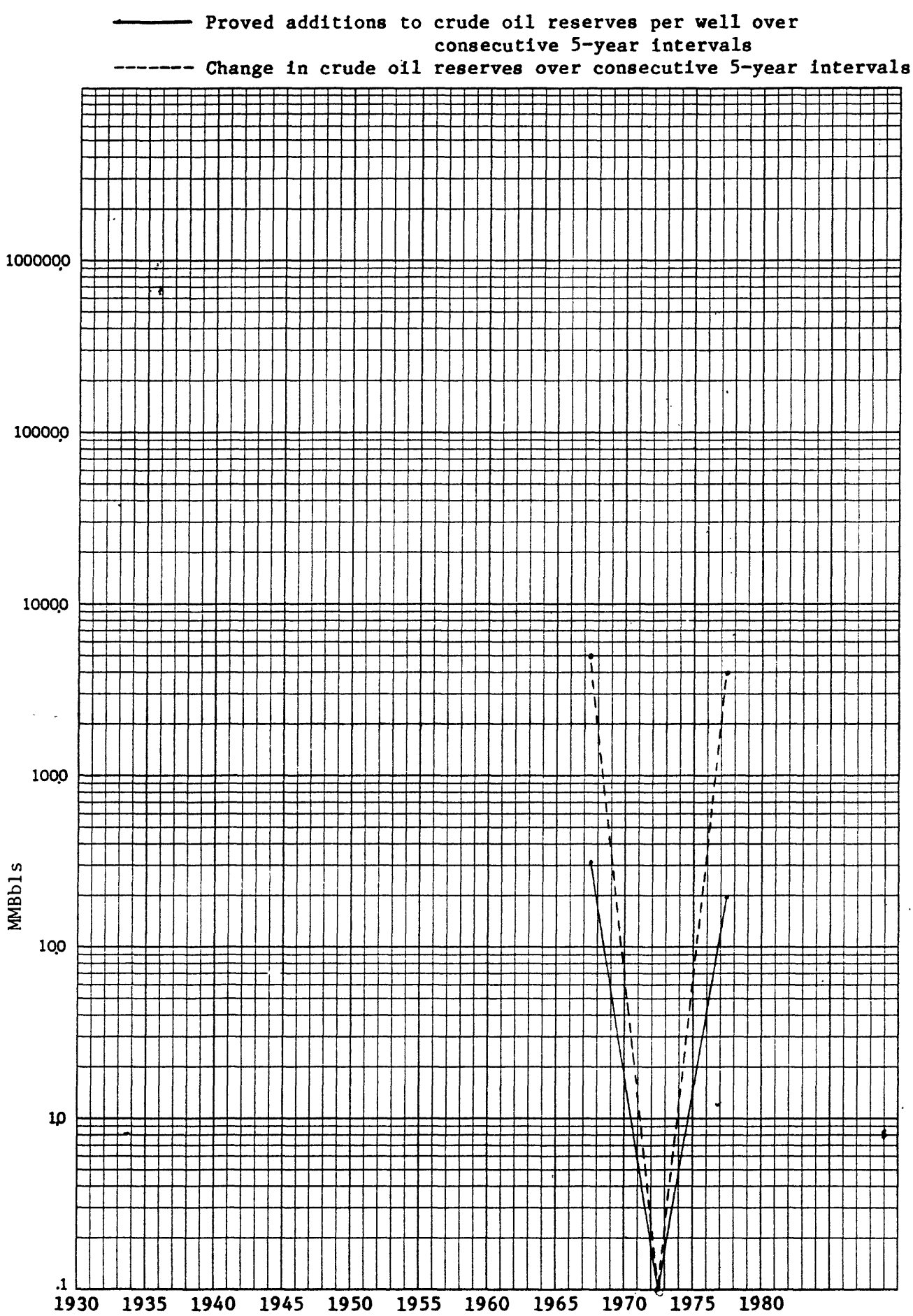


DENMARK

5 year period	Number of exploratory wells completed	Change in reserves (MMBbls)	Avg ultimate recovery (MMBbls)	Proved additions to reserves (MMBbls)	Proved additions to reserves by well (MMBbls)
1936-1940					
1941-1945					
1946-1950	3				
1951-1955	24				
1956-1960	13				
1961-1965	0				
1966-1970	16	500	500	500	31.3
1971-1975	16	-446	173	-442	-27.6
1976-1980	21	396	206	410	19.5



DENMARK

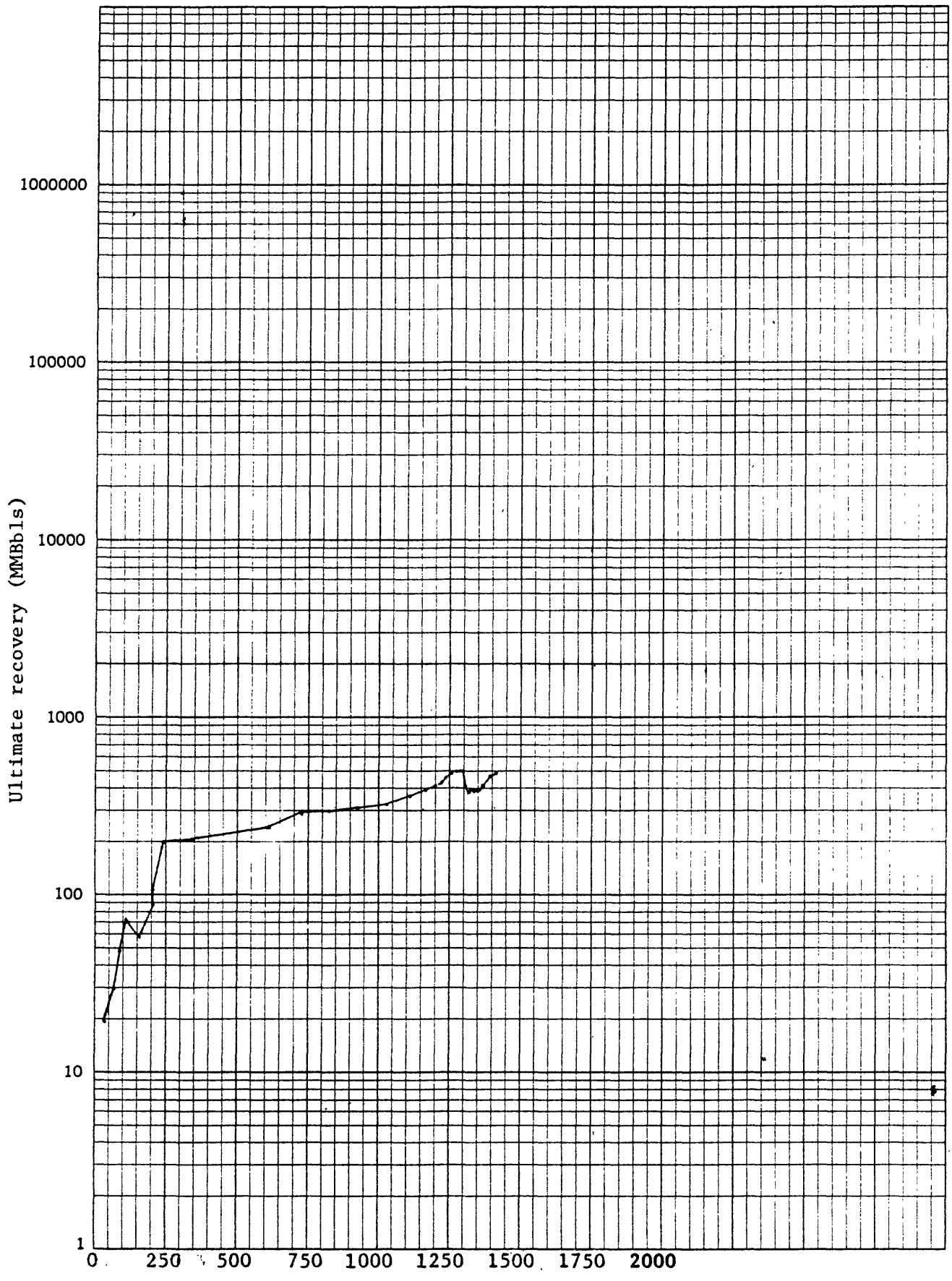


46 6463

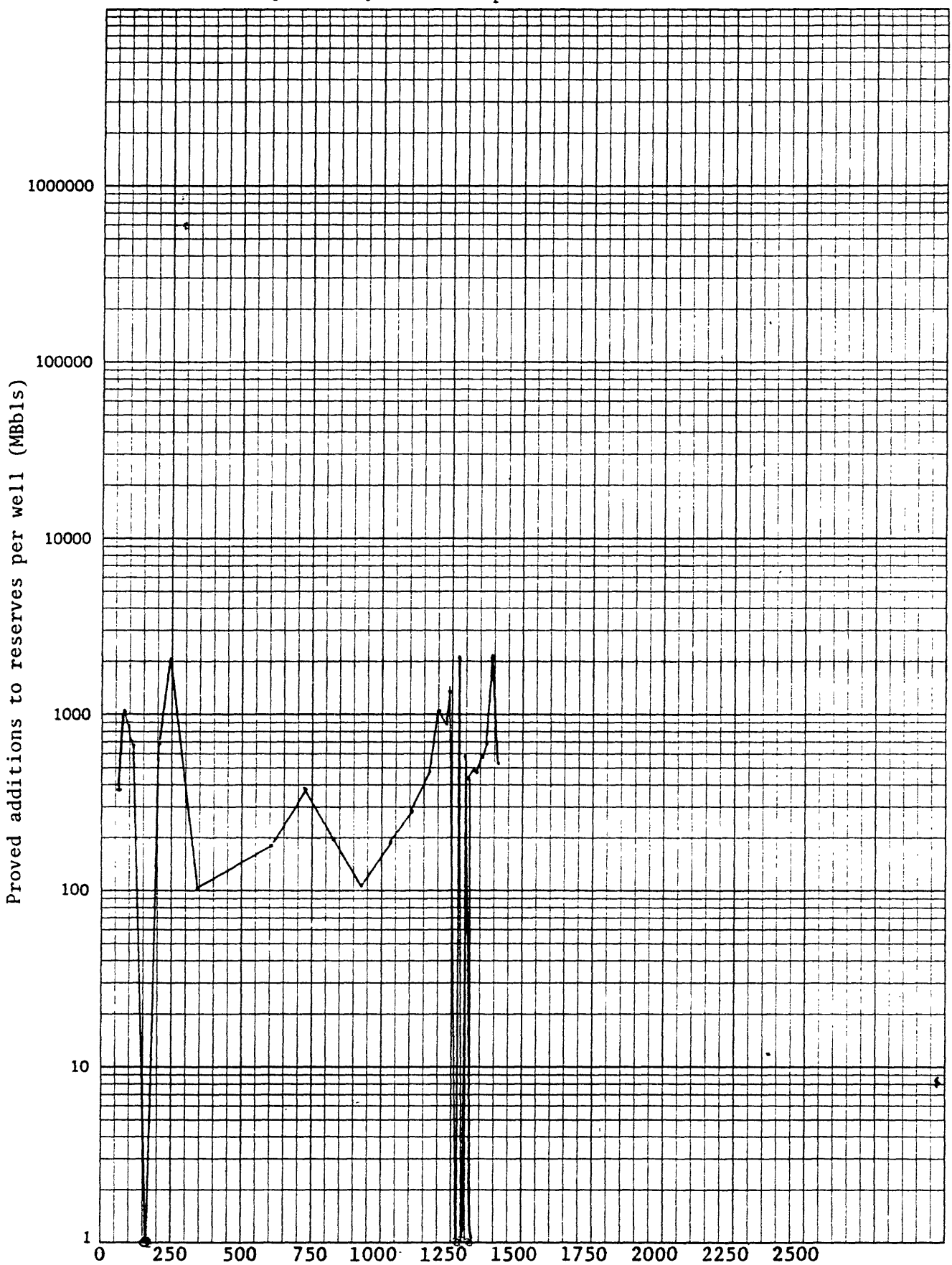
SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

Year (y)	Exploratory wells completed (W_y) (AAPG)	Cumulative exploratory wells completed (CW_y)	Reserves - MMBbls (R_y) (D/M)	Crude production MBbls (P_y) (D/M, WO)	Ultimate recovery rounded MMBbls ($CP_y + R_{y+1}$)	Cumulative production rounded MMBbls (CP_y)	Change in reserves ($R_{y+1} - R_y$) = ΔR_y MBbls	Proved additions to reserves MBbls ($D_y = \Delta R_y + P_y$)	Proved additions to reserves per well MBbls (D_y/W_y)
1918				363					
1919				334	1	1			
1920				356	1	1			
1921				389	1	1			
1922				496	2	2			
1923				494	2	2			
1924				497	3	3			
1925				459	3	3			
1926				478	4	4			
1927				504	4	4			
1928				512	5	5			
1929				535	5	5			
1930				523	6	6			
1931				527	6	6			
1932				530	7	7			
1933				562	8	8			
1934				557	8	8			
1935				541	9	9			
1936				503	9	9			
1937				502	10	10			
1938				513	10	10			
1939				500	11	11			
1940				496	11	11			
1941				414	12	12			
1942				463	12	12			
1943				356	23	12	11,000	11,356	
1944			11	300		13			
1945				202	23	13	-1,000	-728	
1946			10	368	22	13	-1,000	-632	
1947			9	356	24	14	1,000	1,356	
1948	36	36	10	369	18	14	-6,000	-5,631	-156
1949			4	411	18	14	250	661	
1950	31	67	4	909	29	15	10,150	11,059	357
1951	17	84	14	2,036	47	17	15,600	17,636	1,037
1952	34	118	30	2,377	70	20	20,000	22,377	658
1953	42	160	50	2,555	57	22	-15,000	-12,445	-296
1954	42	202	35	3,616	86	26	25,000	28,616	681
1955		202	60	6,224	107	32	15,000	21,224	
1956	42	244	75	9,100	191	41	75,000	84,100	2,002
1957	98	342	150	10,157	201	51	0	10,157	104
1958	138	480	150	9,983		61			
1959	132	612		11,594	233	73	10,000	21,594	164
1960	111	723	160	14,233	272	87	25,000	39,233	353
1961	104	827	185	15,578	293	103	5,000	20,578	198
1962	102	929	190	17,071	305	120	-5,000	12,071	118
1963	105	1,034	185	18,117	323	138	0	18,117	173
1964	78	1,112	185	20,428	343	158	0	20,428	262
1965	58	1,170	185	21,774	370	180	5,000	26,774	462
1966	30	1,200	190	21,365	402	202	10,000	31,365	1,046
1967	23	1,223	200	20,593	422	222	0	20,593	895
1968	15	1,238	200	19,528	442	242	0	19,528	1,302
1969	23	1,261	200	18,207	368	260	-92,300	-74,093	-3,221
1970	14	1,275	108	16,825	397	277	12,300	29,125	2,080
1971	7	1,282	120	13,651	389	290	-21,110	-7,449	-1,064
1972	11	1,293	99	10,811	395	301	-4,600	6,211	565
1973	11	1,304	94	9,152	401	311	-4,330	4,822	438
1974	9	1,313	90	7,863	376	318	-32,393	-24,530	-2,726
1975	11	1,324	58	7,460	381	326	-2,186	5,274	479
1976	15	1,339	55	7,710	388	333	-728	6,982	465
1977	14	1,353	55	7,557	396	341	728	8,285	592
1978	17	1,370	55	7,300	408	348	4,372	11,672	687
1979	24	1,394	60	10,308	459	358	40,807	51,115	2,130
1980	24	1,418	101	10,305	472	369	2,187	12,492	521
1981			103						

Ultimate crude oil recovery (MMBbls) vs cumulative exploratory wells completed



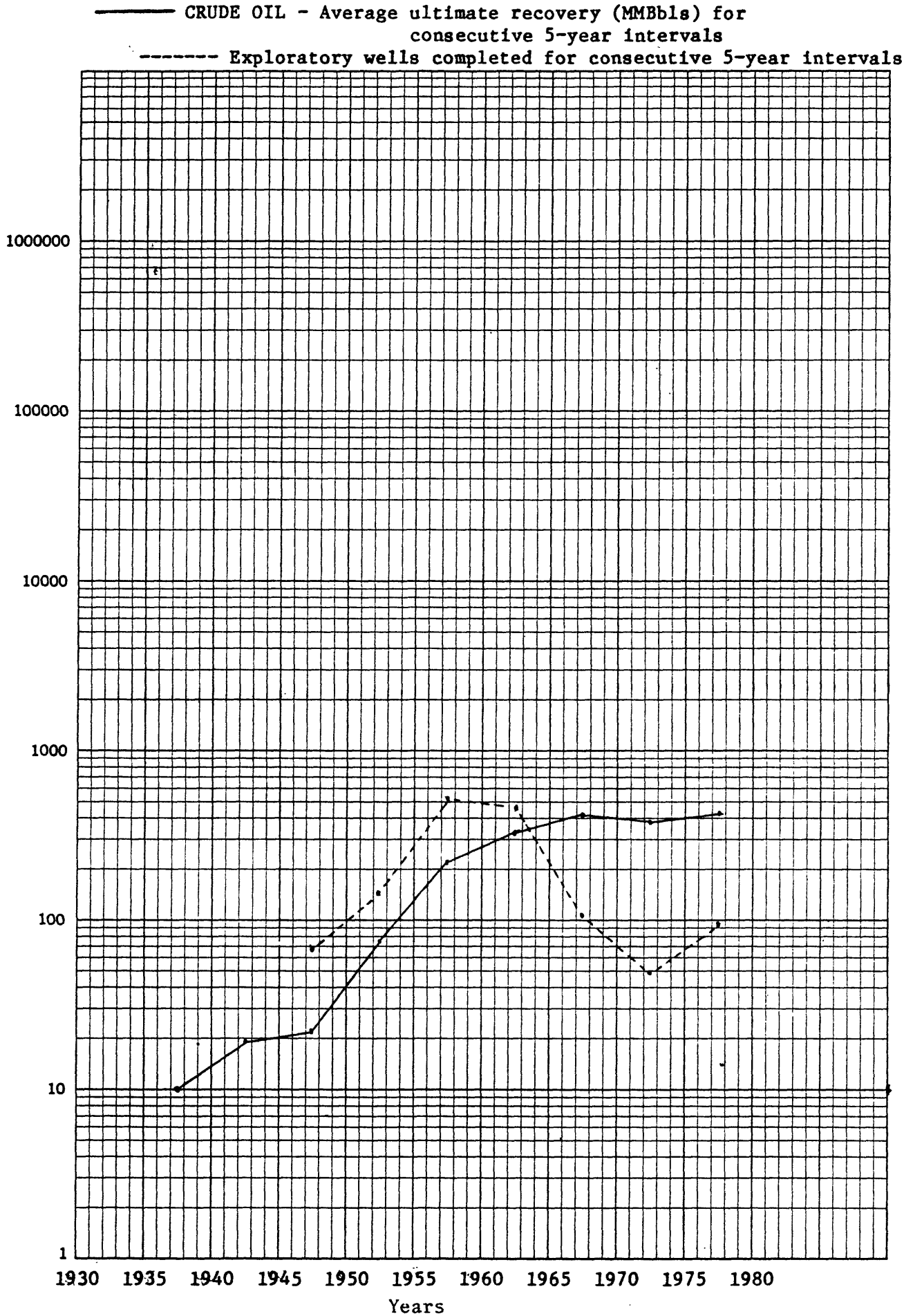
Proved additions to crude oil reserves per exploratory well completed (MBbls) vs cumulative exploratory wells completed



FRANCE

5 year period	Number of exploratory wells completed	Change in reserves (MMBbls)	Avg ultimate recovery (MMBbls)	Proved additions to reserves (MMBbls)	Proved additions to reserves by well (MMBbls)
1936-1940			10		
1941-1945		10	18	10	
1946-1950	67	4	22	6	.1
1951-1955	135	61	73	78	.6
1956-1960	521	110	224	155	.3
1961-1965	447	5	327	98	.2
1966-1970	105	-70	406	27	.3
1971-1975	49	-64	388	-16	-.3
1976-1980	94	47	425	90	.9

FRANCE



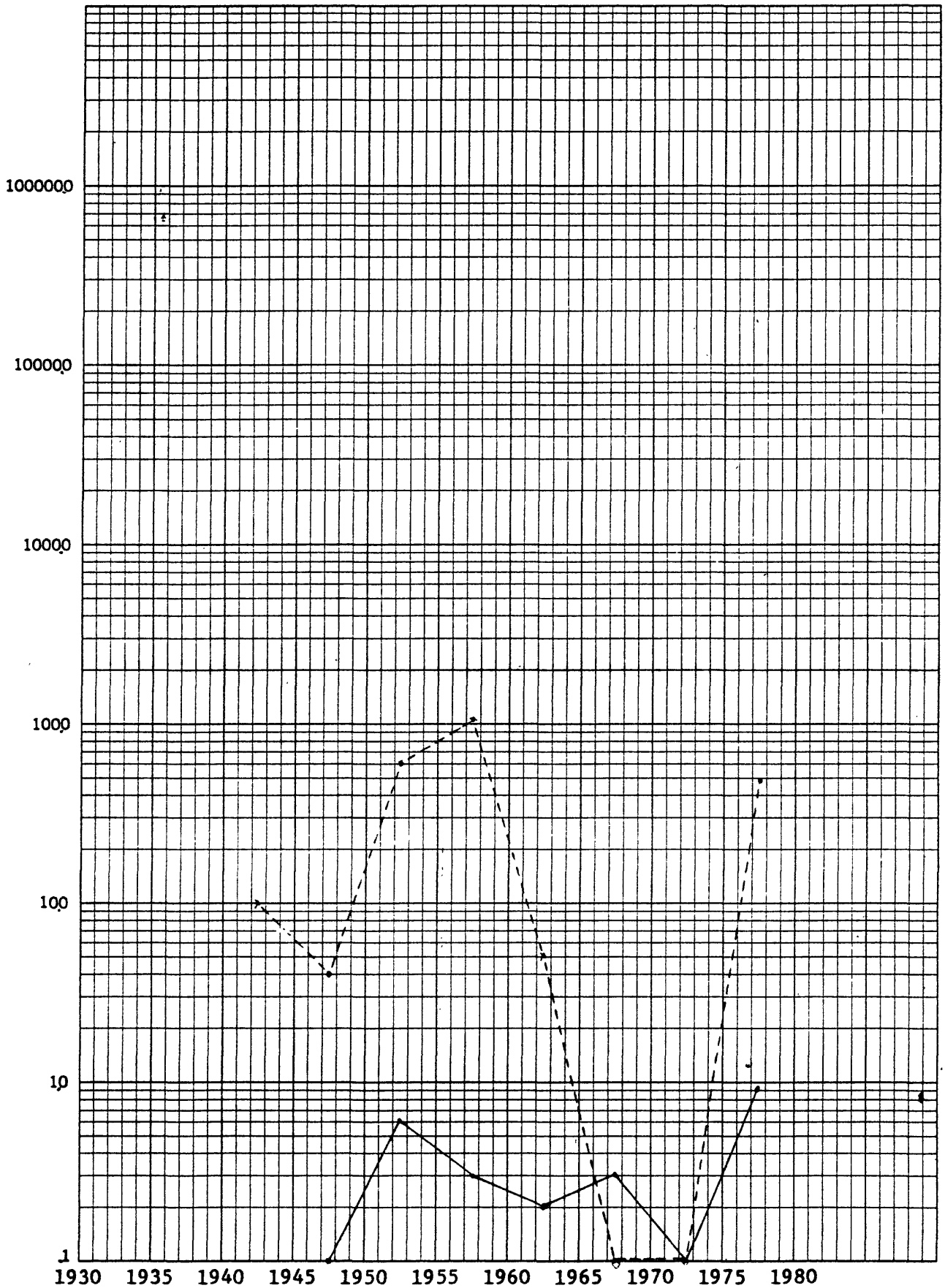
46 6463

K•E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS KEUFFEL & ESSER CO. MADE IN U.S.A.

FRANCE

——— Proved additions to crude oil reserves per well over consecutive 5-year intervals

------- Change in crude oil reserves over consecutive 5-year intervals



46 6463

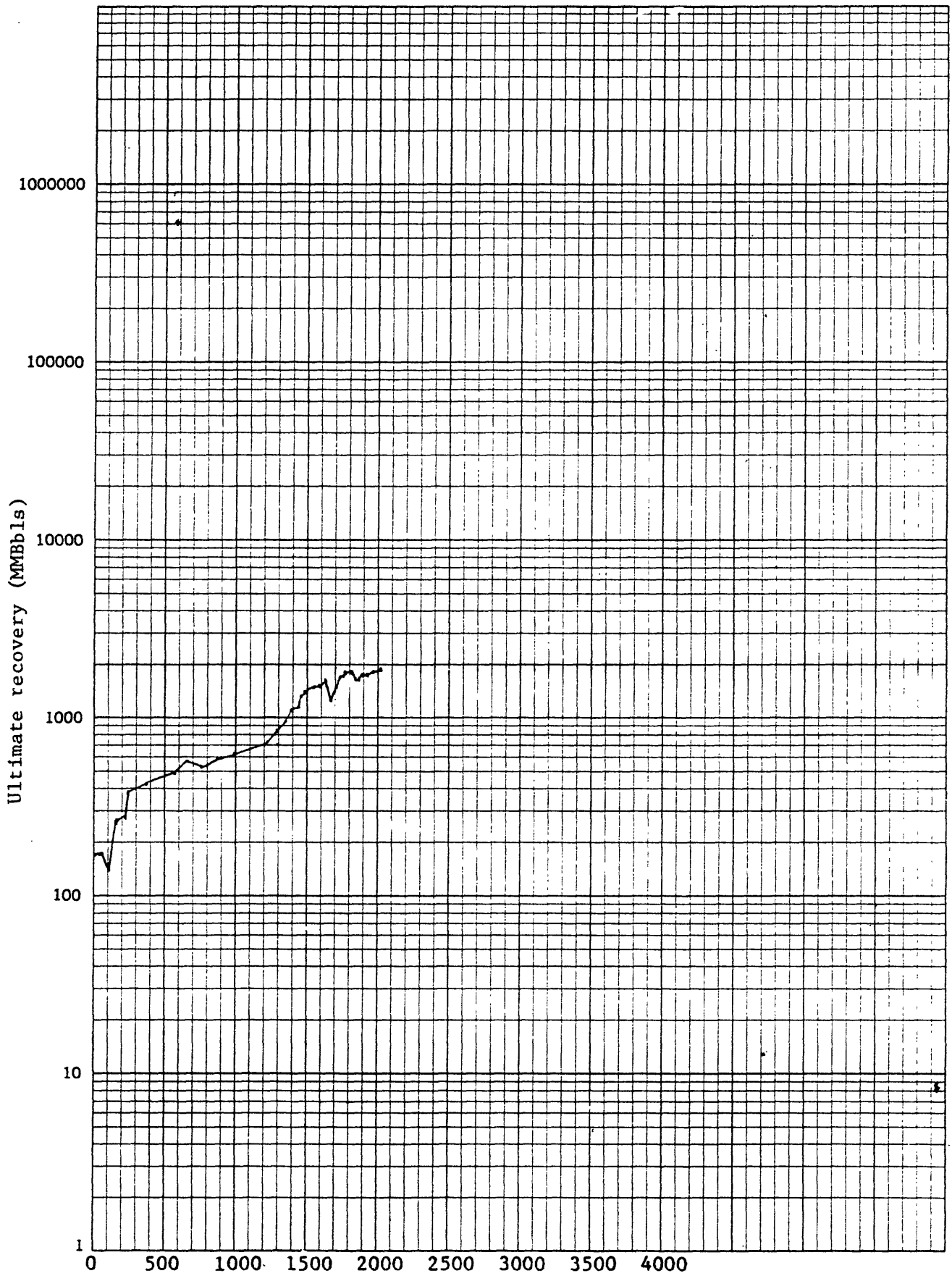
K•E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

WEST GERMANY

Year (y)	Exploratory wells completed (W_y) (AAPG)	Cumulative exploratory wells completed (CW_y)	Reserves - MMBbls (R_y) (D/H)	Crude production MMbls (P_y) (D/H, WO)	Ultimate recovery rounded MMBbls ($CP_y + R_{y+1}$)	Cumulative production rounded MMBbls (CP_y)	Change in reserves ($R_{y+1} - R_y$) = ΔR_y MBbls	Proved additions to reserves MBbls ($D_y = \Delta R_y + P_y$)	Proved additions to reserves per well MBbls (D_y/W_y)
1880				9					
1881				29					
1882				58					
1883				27					
1884				46					
1885				41					
1886				74					
1887				74					
1888				85					
1889				68	1	1			
1890				108	1	1			
1891				109	1	1			
1892				101	1	1			
1893				109	1	1			
1894				123	1	1			
1895				121	1	1			
1896				145	1	1			
1897				166	1	1			
1898				184	2	2			
1899				192	2	2			
1900				358	2	2			
1901				314	2	2			
1902				354	3	3			
1903				446	3	3			
1904				637	4	4			
1905				561	5	5			
1906				579	5	5			
1907				757	6	6			
1908				1,009	7	7			
1909				1,019	8	8			
1910				1,032	9	9			
1911				1,017	10	10			
1912				1,031	11	11			
1913				857	12	12			
1914				781	13	13			
1915				703	13	13			
1916				656	14	14			
1917				642	15	15			
1918				270	15	15			
1919				265	15	15			
1920				246	15	15			
1921				274	16	16			
1922				319	16	16			
1923				346	16	16			
1924				406	17	17			
1925				541	17	17			
1926				653	18	18			
1927				563	19	19			
1928				630	19	19			
1929				704	20	20			
1930				1,182	21	21			
1931				1,606	23	23			
1932				1,608	24	24			
1933				1,965	26	26			
1934				2,187	28	28			
1935				2,996	31	31			
1936				3,115	34	34			
1937				3,176	37	37			
1938				3,861	41	41			
1939				4,487	46	46			
1940				7,371	53	53			
1941				6,303	60	60			
1942				5,191	65	65			
1943				4,973	139	70	68,700	73,673	
1944			69	6,154		76			
1945	15	15		3,935	165	80	15,300	20,235	1,349
1946	20	35	85	4,539	166	84	-1,000	1,533	77
1947	31	66	82	4,032	168	88	-2,000	2,032	66
1948	42	108	80	4,489	138	93	-35,000	-30,511	-726
1949	50	158	45	5,947	249	99	115,000	120,947	2,419
1950	63	221	150	8,107	267	107	10,000	18,107	287
1951	125	346	160	9,681	367	117	90,000	99,681	797
1952	140	486	250	12,435	429	129	50,000	62,435	446
1953	80	566	300	15,505	494	144	50,000	65,505	819
1954	103	669	350	19,008	563	163	50,000	69,008	670
1955	107	776	400	22,435	523	186	-43,000	-40,565	-379
1956	113	889	337	25,408	578	211	30,000	55,408	490
1957	107	996	367	28,698	619	240	12,000	40,698	380
1958	123	1,119	379	32,119		272		32,119	261
1959	99	1,218		36,981	720	309	32,010	68,991	697
1960	76	1,294	411	40,076	839	349	78,790	118,866	1,564
1961	53	1,347	490	44,968	944	394	60,200	105,168	1,984
1962	49	1,396	550	48,943	1,093	443	100,000	148,943	3,040
1963	46	1,442	650	53,325	1,146	496	0	53,325	1,159
1964	16	1,458	650	55,415	1,252	532	50,000	105,415	6,588
1965	36	1,494	700	56,945	1,309	609	0	56,945	1,582
1966	57	1,551	700	57,100	1,366	666	0	57,100	1,002
1967	40	1,591	700	57,258	1,423	723	0	57,258	1,431
1968	42	1,633	700	57,652	1,511	781	30,000	87,652	2,087
1969	45	1,678	730	56,886	1,284	838	-304,305	-247,419	-5,498
1970	24	1,702	426	54,427	1,437	892	118,805	173,232	7,218
1971	27	1,729	545	53,547	1,506	946	15,500	69,097	2,559
1972	26	1,755	560	51,271	1,542	997	-15,000	36,271	1,395
1973	22	1,777	545	47,844	1,587	1,045	-3,000	44,944	2,043
1974	30	1,807	542	44,718	1,626	1,090	-6,415	38,303	1,277
1975	26	1,833	536	41,470	1,492	1,131	-174,917	-133,447	-5,132
1976	29	1,862	361	39,902	1,492	1,171	-39,902	0	
1977	37	1,899	321	39,012	1,519	1,210	-11,557	27,455	742
1978	27	1,926	309	37,230	1,552	1,247	-4,196	33,034	1,223
1979	49	1,975	305	34,670	1,608	1,282	20,925	55,595	1,134
1980	37	2,012	326	32,830	1,746	1,315	104,962	137,792	3,724
1981			431						

WEST GERMANY

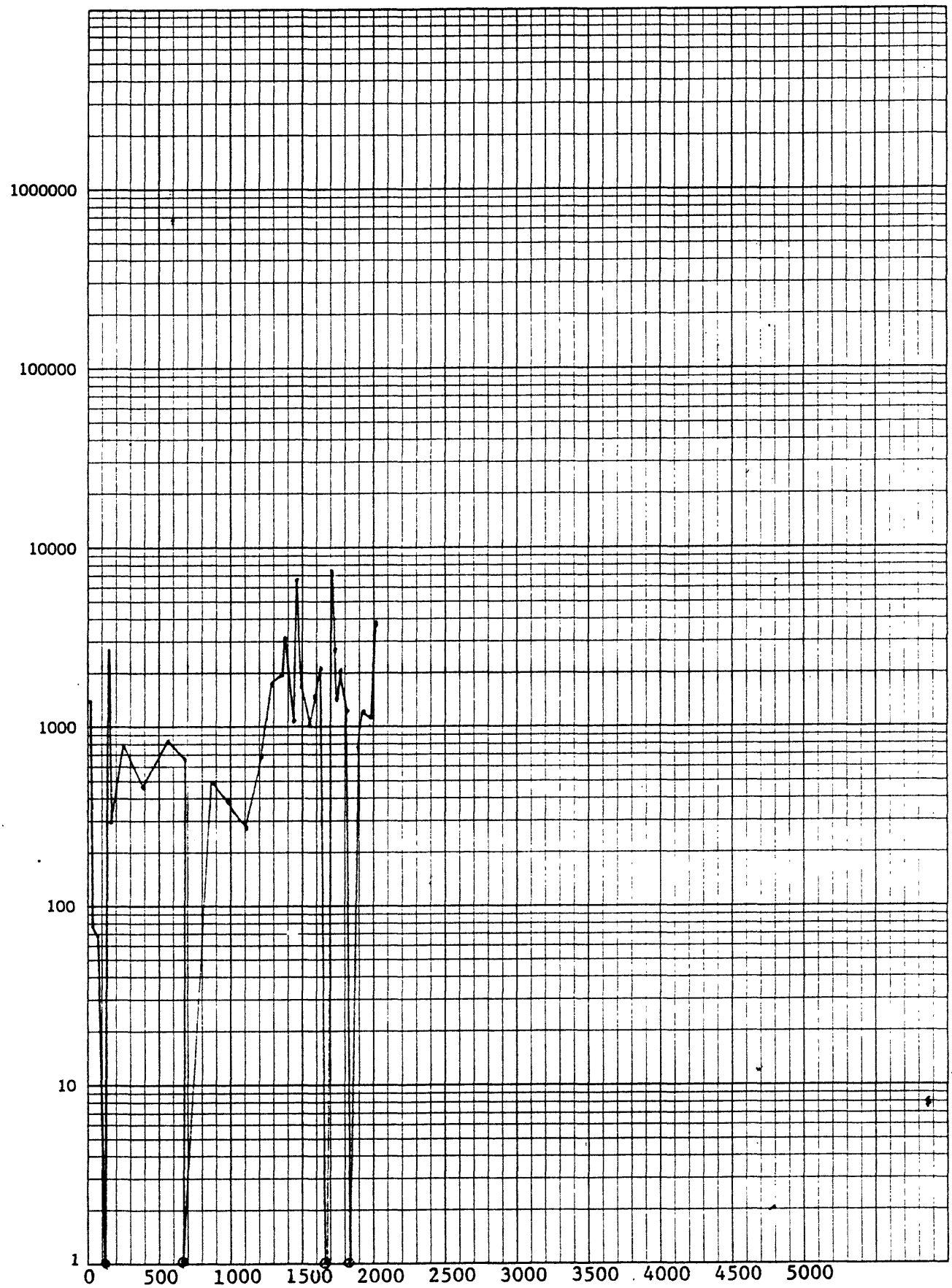
Ultimate crude oil recovery (MMBbls) vs cumulative exploratory wells completed



46 6463

K+E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

Proved additions to crude oil reserves per exploratory well completed (MBbls)
vs cumulative exploratory wells completed



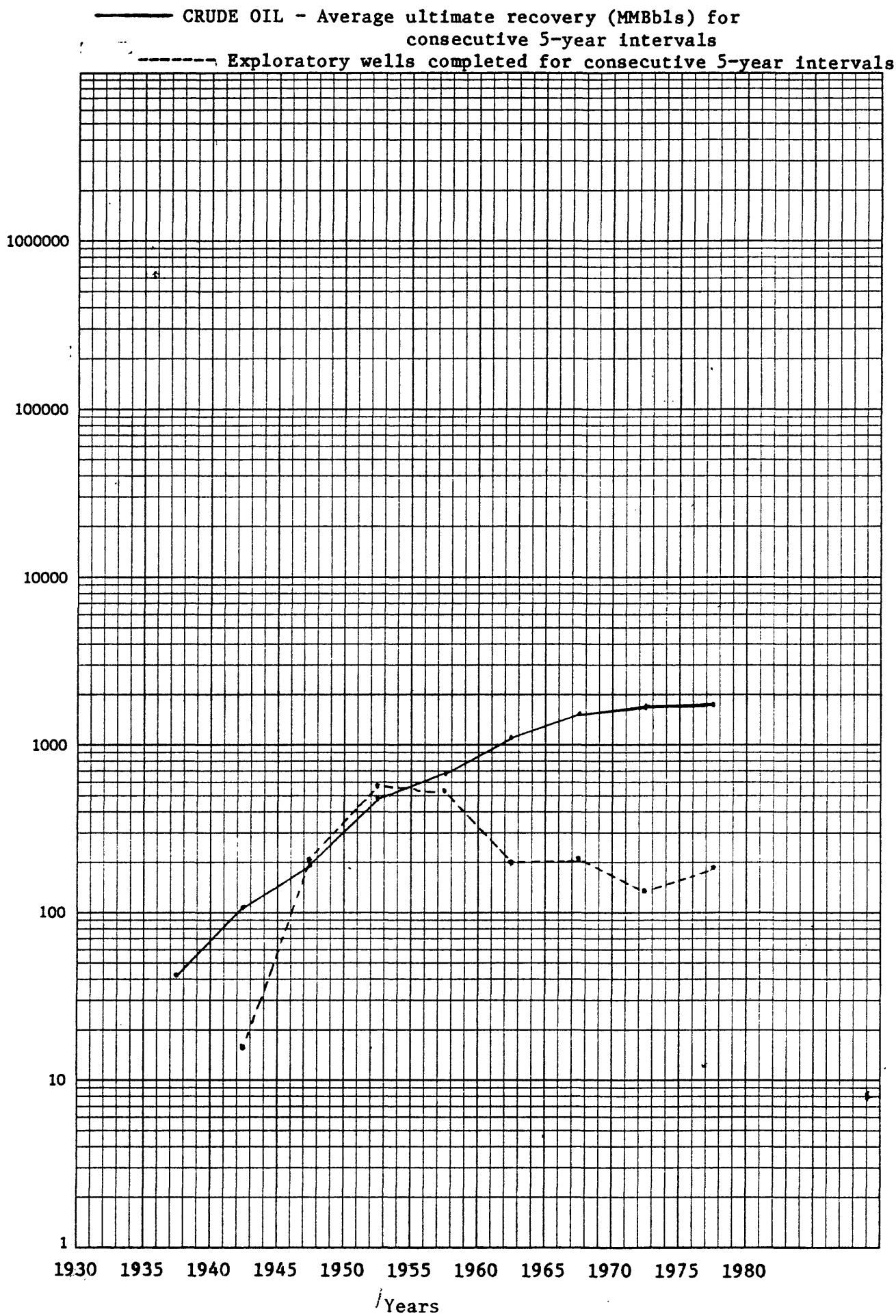
46 6463

SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

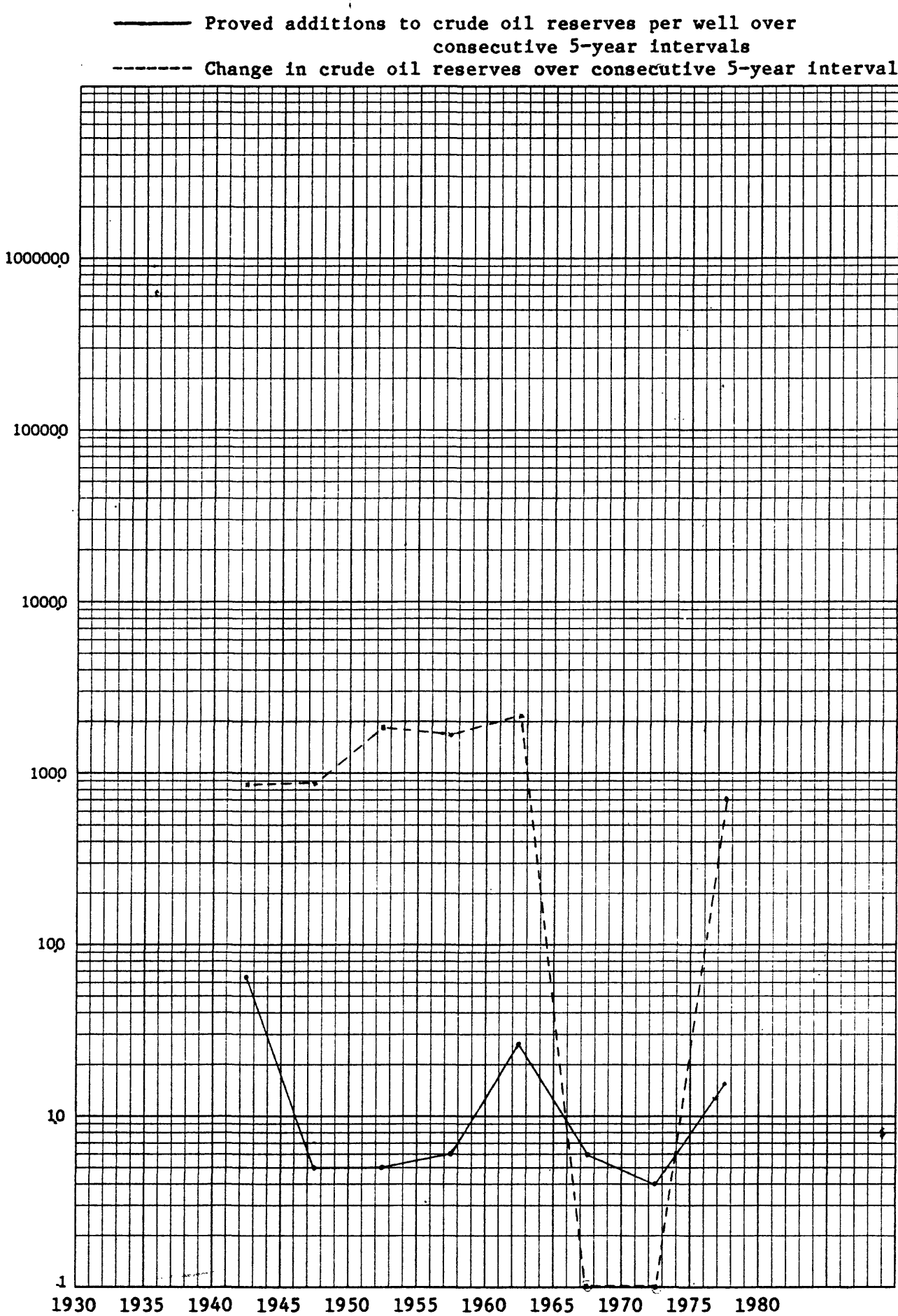
WEST GERMANY

5 year period	Number of exploratory wells completed	Change in reserves (MMBbls)	Avg ultimate recovery (MMBbls)	Proved additions to reserves (MMBbls)	Proved additions to reserves by well (MMBbls)
1936-1940			42		
1941-1945	15	85	107	94	6.3
1946-1950	206	85	198	112	.5
1951-1955	555	177	475	256	.5
1956-1960	518	153	689	316	.6
1961-1965	200	210	1,149	469	2.4
1966-1970	208	-155	1,400	128	.6
1971-1975	131	-183	1,551	55	.4
1976-1980	179	70	1,583	254	1.4

WEST GERMANY



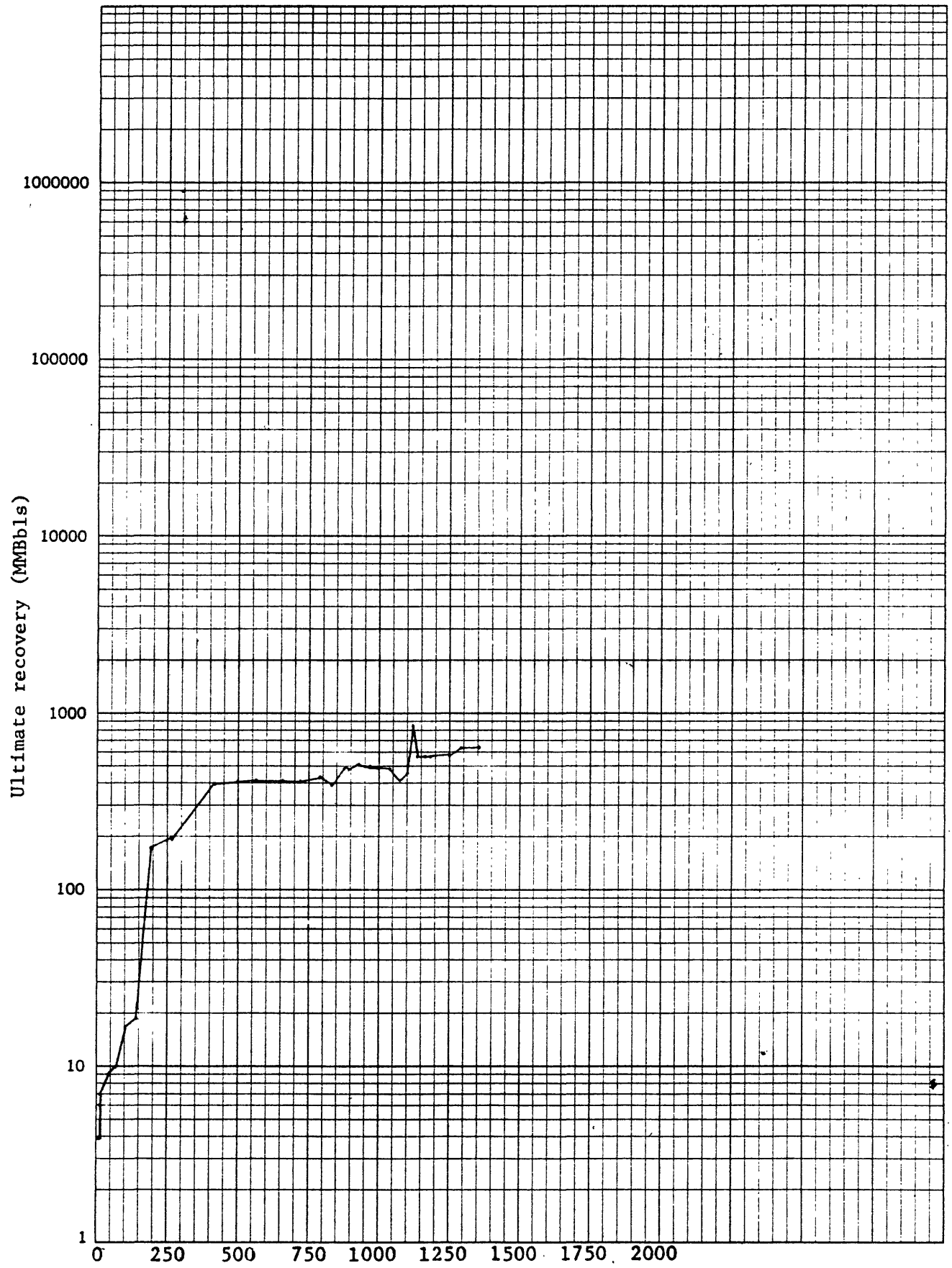
WEST GERMANY



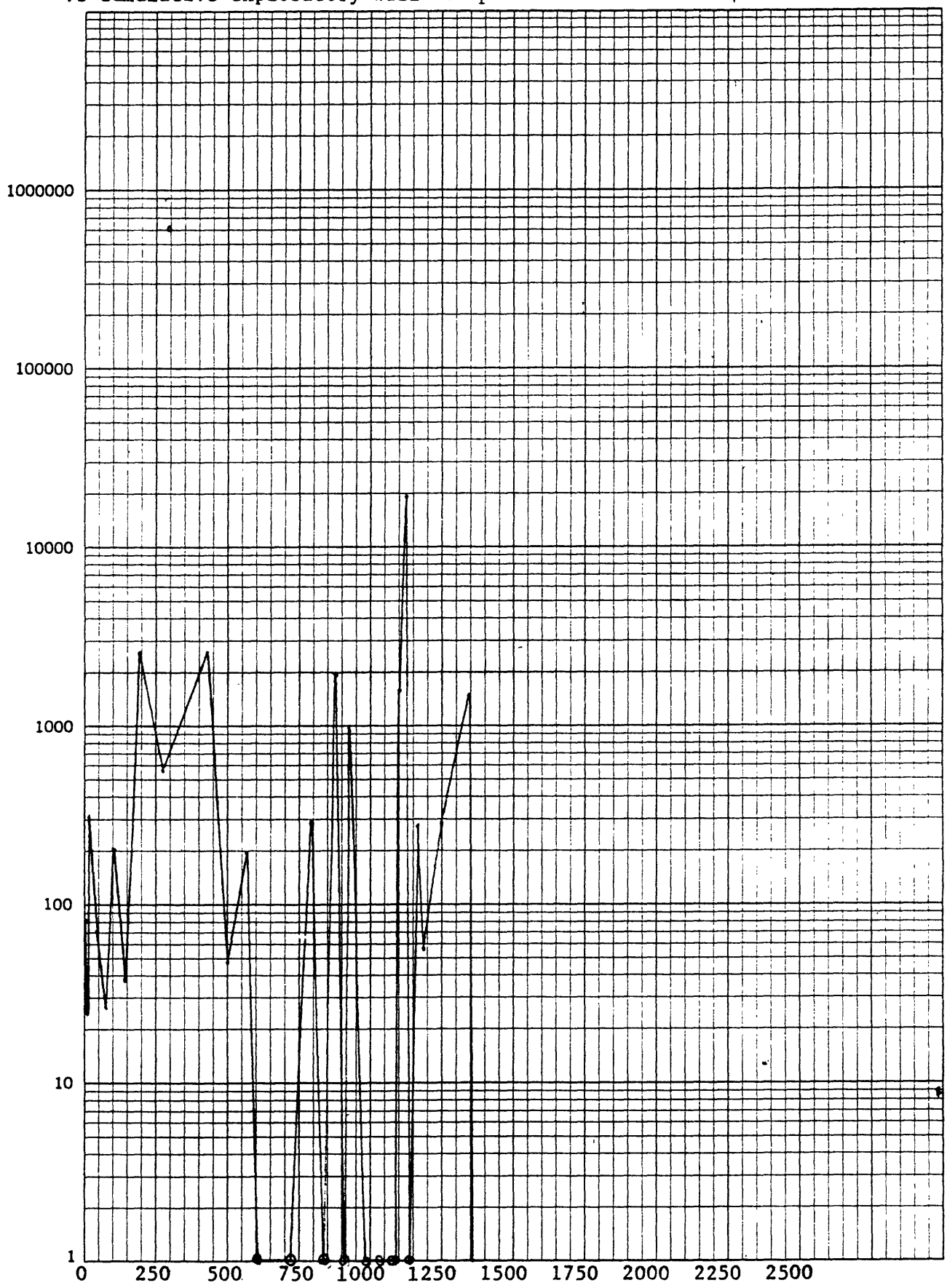
Year (y)	Exploratory wells completed (W_y) (AAPG)	Cumulative exploratory wells completed (CW_y)	Reserves - MMBbls (R_y) (D/M)	Crude production MBbls (P_y) (D/M, WO)	Ultimate recovery rounded MMBbls ($CP_y + R_{y+1}$)	Cumulative production rounded MMBbls (CP_y)	Change in reserves ($R_{y+1} - R_y$) = ΔR_y MBbls	Proved additions to reserves MBbls ($D_y = \Delta R_y + P_y$)	Proved additions to reserves per well MBbls (D_y/W_y)
1865				2					
1866				1					
1867				1					
1868									
1869									
1870									
1871									
1872									
1873									
1874				1					
1875				1					
1876				3					
1877				3					
1878				4					
1879				3					
1880				2					
1881				1					
1882				2					
1883				2					
1884				3					
1885				2					
1886				2					
1887				1					
1888				1					
1889				1					
1890				3					
1891				8					
1892				18					
1893				19					
1894				21					
1895				26					
1896				18					
1897				14					
1898				15					
1899				16					
1900				12					
1901				16					
1902				19					
1903				18					
1904				26					
1905				44					
1906				54					
1907				60					
1908				51					
1909				42					
1910				51					
1911				75					
1912				54	1	1			
1913				47	1	1			
1914				40	1	1			
1915				44	1	1			
1916				51	1	1			
1917				41	1	1			
1918				35	1	1			
1919				35	1	1			
1920				35	1	1			
1921				32	1	1			
1922				31	1	1			
1923				34	1	1			
1924				39	1	1			
1925				61	1	1			
1926				41	1	1			
1927				47	1	1			
1928				46	1	1			
1929				45	1	1			
1930				59	1	1			
1931				124	2	2			
1932				208	2	2			
1933				204	2	2			
1934				151	2	2			
1935				119	2	2			
1936				123	2	2			
1937				110	3	3			
1938				101	3	3			
1939				91	3	3			
1940				85	3	3			
1941				95	3	3			
1942				101	3	3			
1943				86	4	3	1,000	1,086	
1944			1	55		3			
1945				53	5	3	500	553	
1946			2	83	4	3	-500	-417	
1947	1	1	1	81	4	3	0	81	81
1948	3	4	1	71	4	3	0	71	24
1949			1	71	5	3	1,000	1,071	
1950	6	10	2	63	6	4	200	263	44
1951	3	13	2	135	7	4	800	935	312
1952	35	48	3	487	9	4	2,000	2,487	71
1953	26*	74	5	655	10	5	0	655	25
1954	27*	101	5	535	15	5	5,000	5,535	205
1955	41	142	10	1,519	17	7	0	1,519	37
1956	56	198	10	4,209	156	11	135,000	139,209	2,486
1957	72	270	145	8,593	195	20	30,000	38,593	536
1958	72	342	175	10,531		30			
1959	80	422		11,551	398	42	181,000	192,551	2,407
1960	78	500	356	13,613	401	55	-10,000	3,613	46
1961	68	568	346	13,434	415	69	-500	12,934	190
1962	83	651	346	12,303	407	81	-20,000	-7,697	-93
1963	69	720	326	12,155	403	93	-15,500	-3,345	-48
1964	70	790	310	18,184	421	111	0	18,184	260
1965	37	827	310	15,055	387	127	-50,000	-34,945	-944
1966	46	873	260	12,836	474	139	75,000	87,836	1,909
1967	24	897	335	12,006	471	151	-15,000	-2,994	-125
1968	31	928	320	10,260	502	162	20,000	30,260	976
1969	38	966	340	9,309	499	171	-12,000	-2,691	-71
1970	27	993	328	9,575	485	180	-23,000	-13,425	-497
1971	40	1,033	305	8,952	460	189	-33,900	-24,948	-624
1972	43	1,076	271	7,850	410	197	-58,400	-50,550	-1,176
1973	24	1,100	213	7,082	445	204	28,200	35,282	1,470
1974	20	1,120	241	6,956	843	211	391,574	398,530	19,926
1975	24	1,144	632	6,743	546	218	-304,284	-297,541	-12,398
1976	25	1,169	328	7,553	553	226	-1,166	6,387	255
1977	20	1,189	327	7,889	554	234	-6,813	1,076	54
1978	61	1,250	320	9,902	570	243	6,813	16,715	274
1979	43	1,293	327	11,581	630	255	48,416	59,997	1,396
1980	60	1,353	375	13,626	631	269	-13,542	84	1
1981			362						

*incomplete

Ultimate crude oil recovery (MMBbls) vs cumulative exploratory wells completed



Proved additions to crude oil reserves per exploratory well completed (MBbls) vs cumulative exploratory wells completed

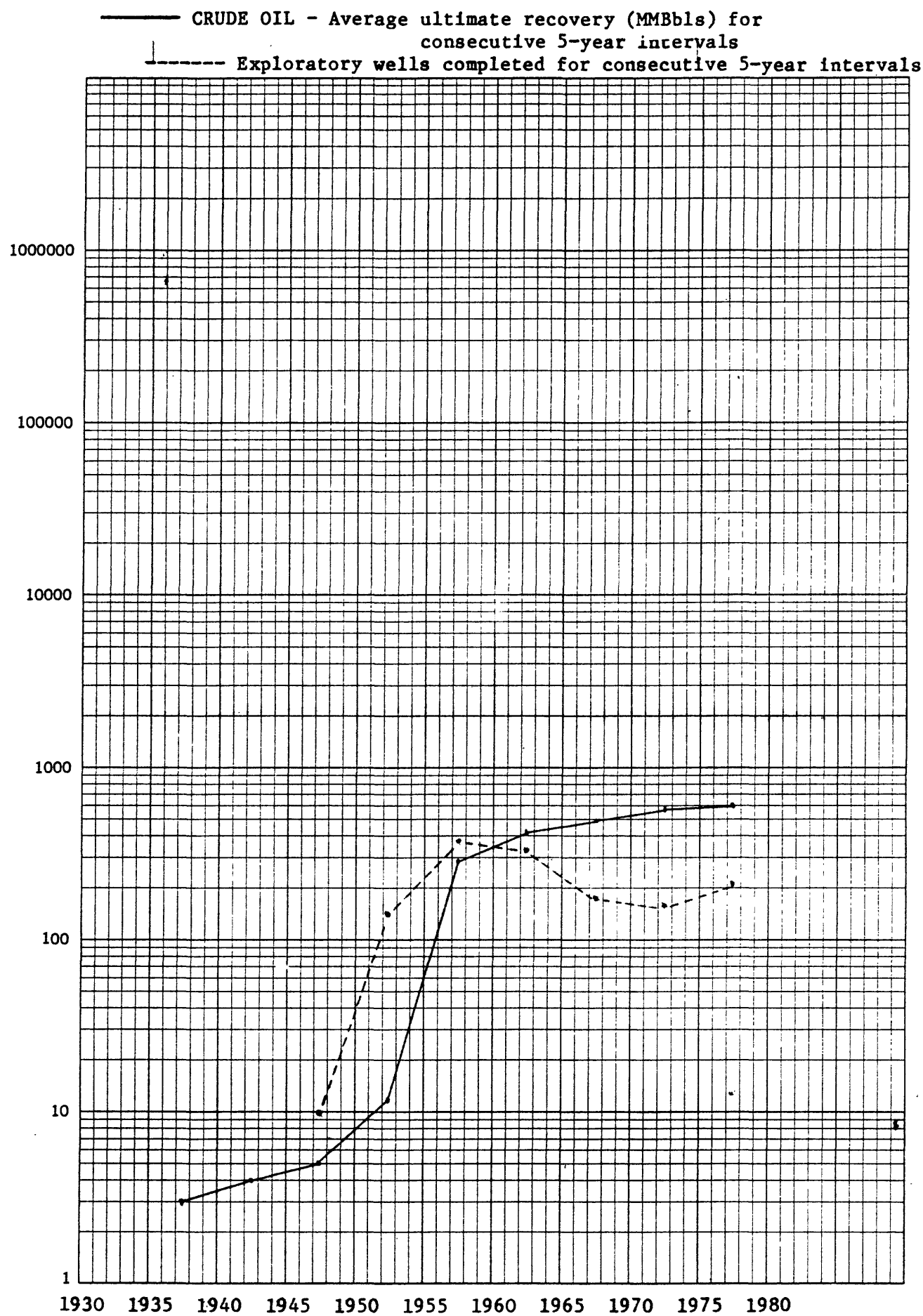


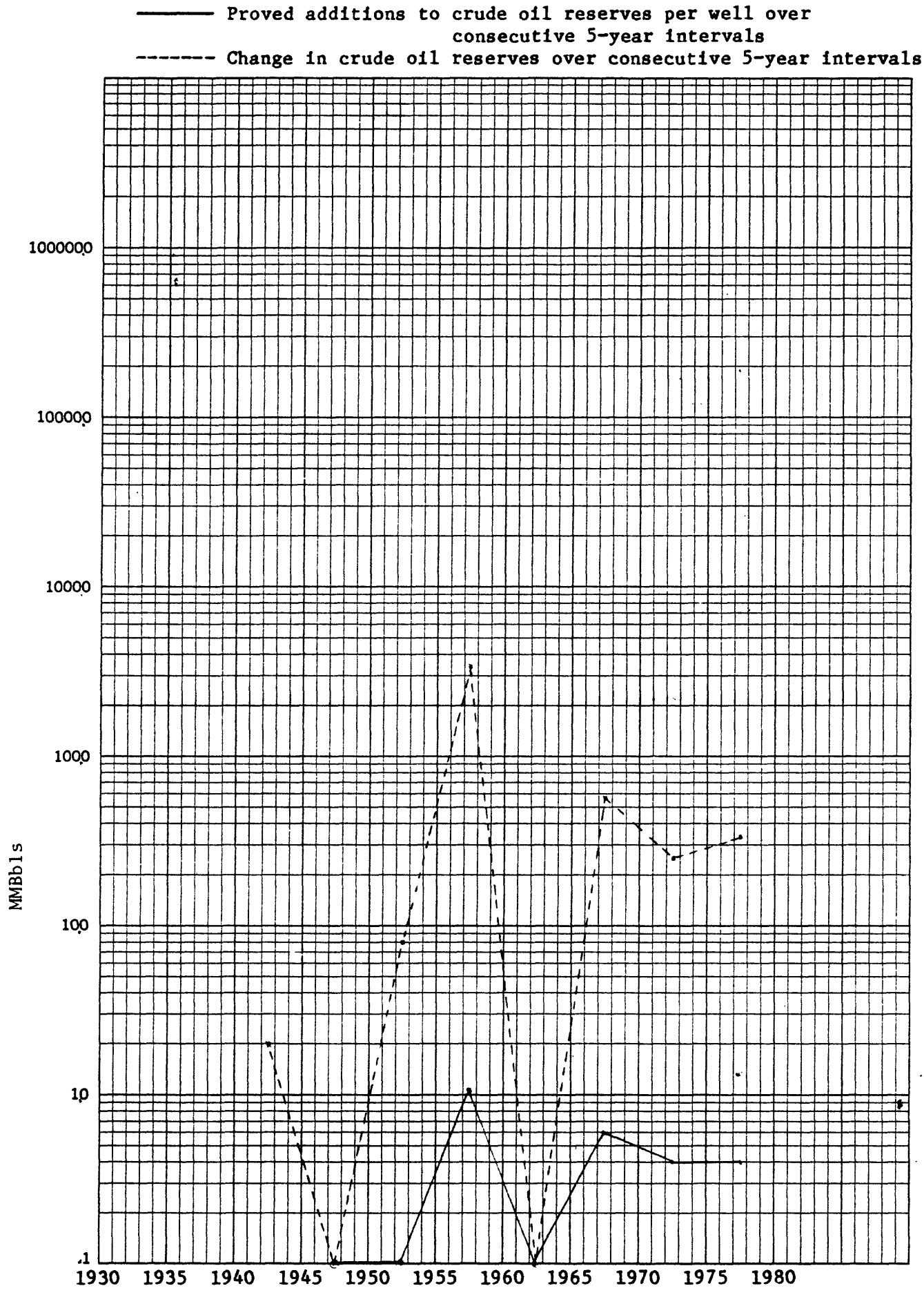
46 6463

K+E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS KEUFFEL & ESSER CO. MADE IN U.S.A.

ITALY

5 year period	Number of exploratory wells completed	Change in reserves (MMBbls)	Avg ultimate recovery (MMBbls)	Proved additions to reserves (MMBbls)	Proved additions to reserves by well (MMBbls)
1936-1940			3		
1941-1945		2	4	2	
1946-1950	10	0	5	1	.1
1951-1955	132	8	12	12	.1
1956-1960	358	336	288	375	1.1
1961-1965	327	-87	407	-15	-.1
1966-1970	166	45	486	99	.6
1971-1975	151	24	541	60	.4
1976-1980	209	33	588	84	.4

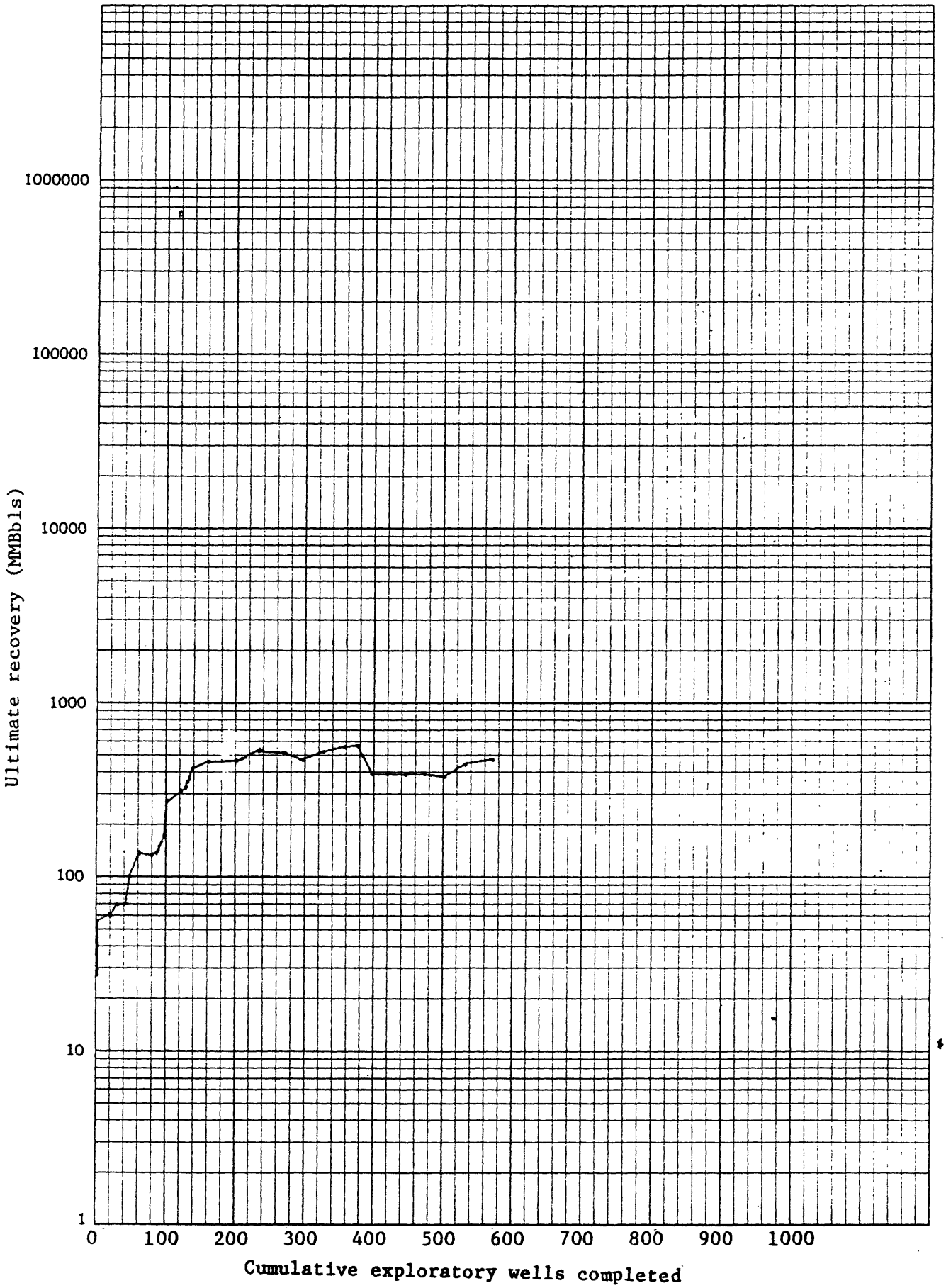




Year (y)	Exploratory wells completed (W_y) (AAPG)	Cumulative exploratory wells completed (CW_y)	Reserves - MMBbls (R_y) (D/M)	Crude production MBbls (P_y) (D/M, WO)	Ultimate recovery rounded MMBbls ($CP_y + R_{y+1}$)	Cumulative production roundad MMBbls (CP_y)	Change in reserves ($R_{y+1} - R_y$) = ΔR_y MBbls	Proved Additions to Reserves MBbls ($D_y = \Delta R_y + P_y$	Proved Additions to reserves per well MBbls (D_y/W_y)
1940									
1941									
1942									
1943				1					
1944				12					
1945				41					
1946	0	0		435					
1947	3	3		1,478	27	2	25,000	26,478	8,826
1948	3	6	25	3,443	55	5	25,000	28,443	9,481
1949	14	20	50	4,314	60	10	0	4,314	308
1950	11	31	50	4,897	68	15	3,000	7,897	718
1951	11	42	53	4,942	70	20	-3,000	1,942	177
1952	7	49	50	4,975	100	25	25,000	29,975	4,282
1953	17	66	75	5,701	130	30	25,000	30,701	1,806
1954	14	80	100	6,535	127	37	-10,000	-3,465	-248
1955	9	89	90	7,126	134	44	0	7,126	792
1956	7	96	90	7,652	162	52	20,000	27,652	3,950
1957	8	104	110	10,623	262	62	90,000	100,623	12,578
1958	8	112	200	11,306		73			
1959	11	123		12,367	311	86	25,000	37,367	3,397
1960	4	127	225	13,378	324	99	0	13,378	3,344
1961	4	131	225	14,271	338	113	0	14,271	3,568
1962	4	135	225	14,974	353	128	0	14,974	3,744
1963	4	139	225	15,377	419	144	50,000	65,377	16,344
1964	23	162	275	15,758	440	160	5,000	20,758	903
1965	40	202	280	16,630	456	176	0	16,630	416
1966	10	212	280	16,127	472	192	0	16,127	1,613
1967	4	216	280	15,438	488	208	0	15,438	3,860
1968	19	235	280	14,645	522	222	20,000	34,645	1,823
1969	35	270	300	13,792	511	236	-25,000	-11,208	-320
1970	27	297	275	13,080	479	249	-45,000	-31,920	-1,182
1971	29	326	230	11,727	522	261	31,212	42,939	1,481
1972	33	359	261	10,885	541	272	7,788	18,673	566
1973	18	377	269	10,169	550	282	-1,000	9,169	509
1974	19	396	268	10,227	392	292	-168,486	-158,259	-8,329
1975	24	420	100	9,676	393	302	-8,387	1,289	54
1976	26	446	91	10,538	393	313	-11,039	-501	19
1977	28	474	80	9,420	393	322	-9,270	150	5
1978	28	502	71	10,950	377	333	-26,514	-15,564	-556
1979	31	533	44	9,112	431	342	44,304	53,416	1,723
1980	37	570	89	8,756	474	351	34,656	43,412	1,173
1981			123						

NETHERLANDS

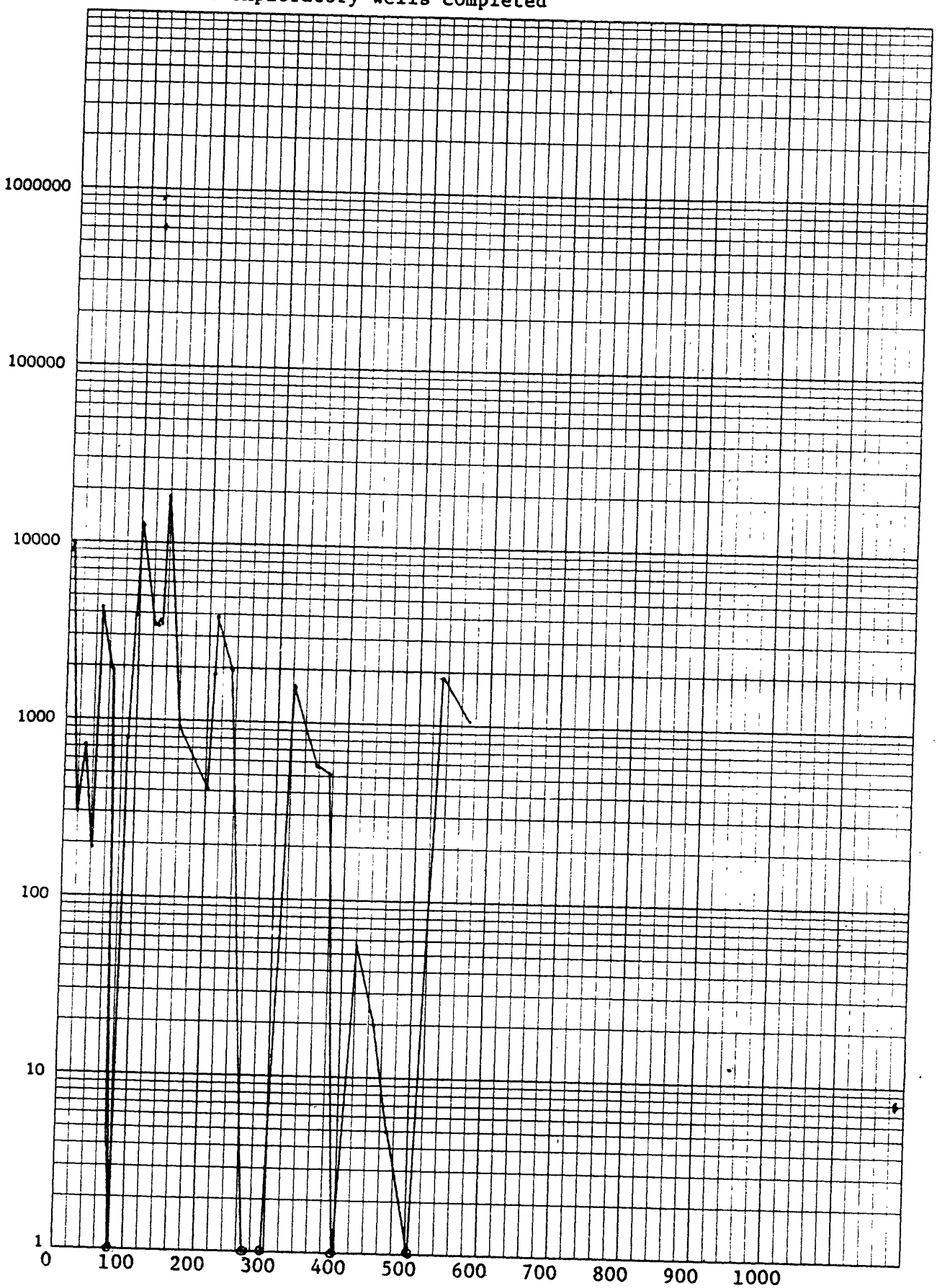
Ultimate crude oil recovery (MMBbls) vs cumulative exploratory wells completed



46 6463

K&E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS KEUFFEL & ESSER CO. MADE IN U.S.A.

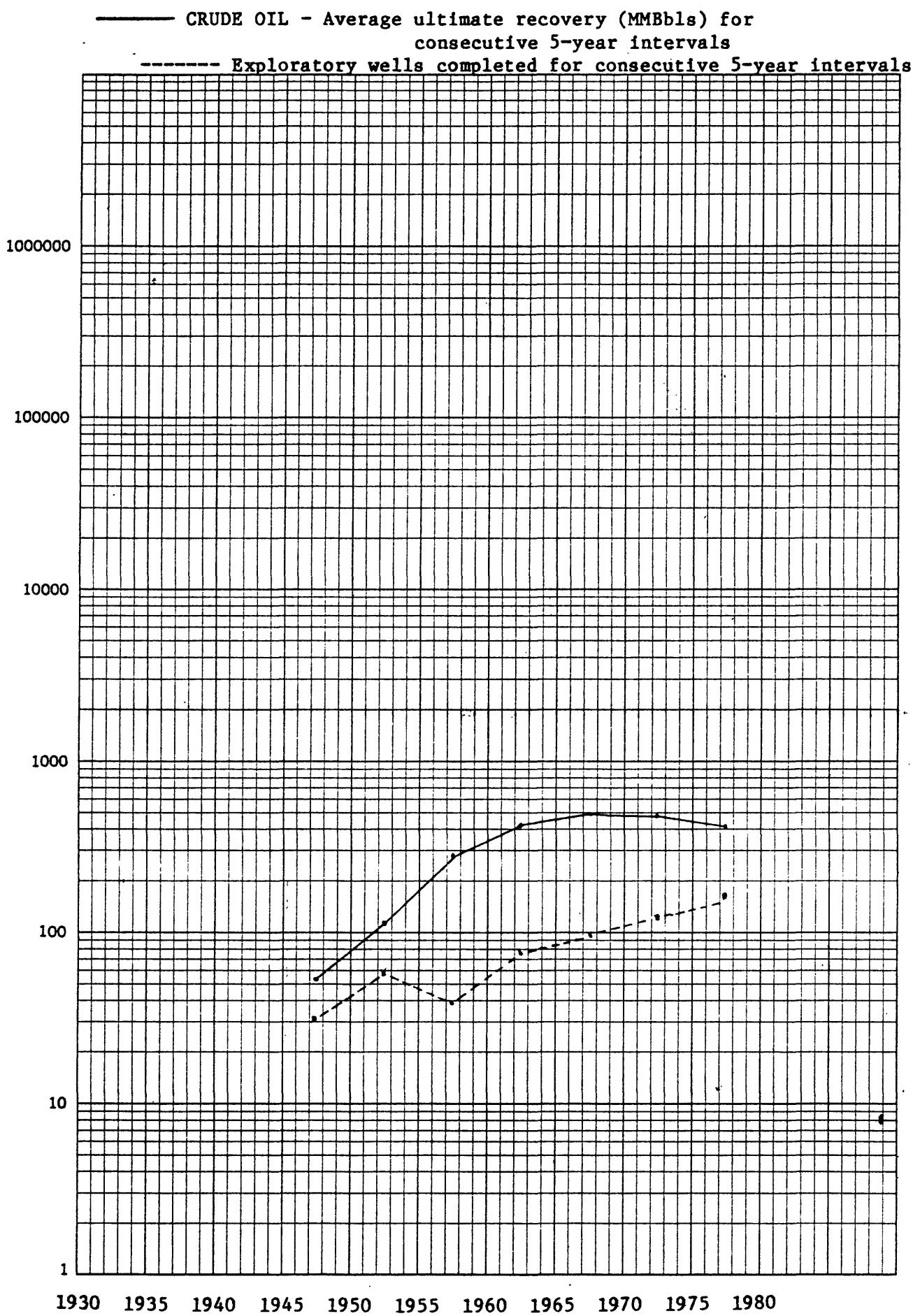
Proved additions to crude oil reserves per exploratory well completed (MBbls) vs cumulative exploratory wells completed



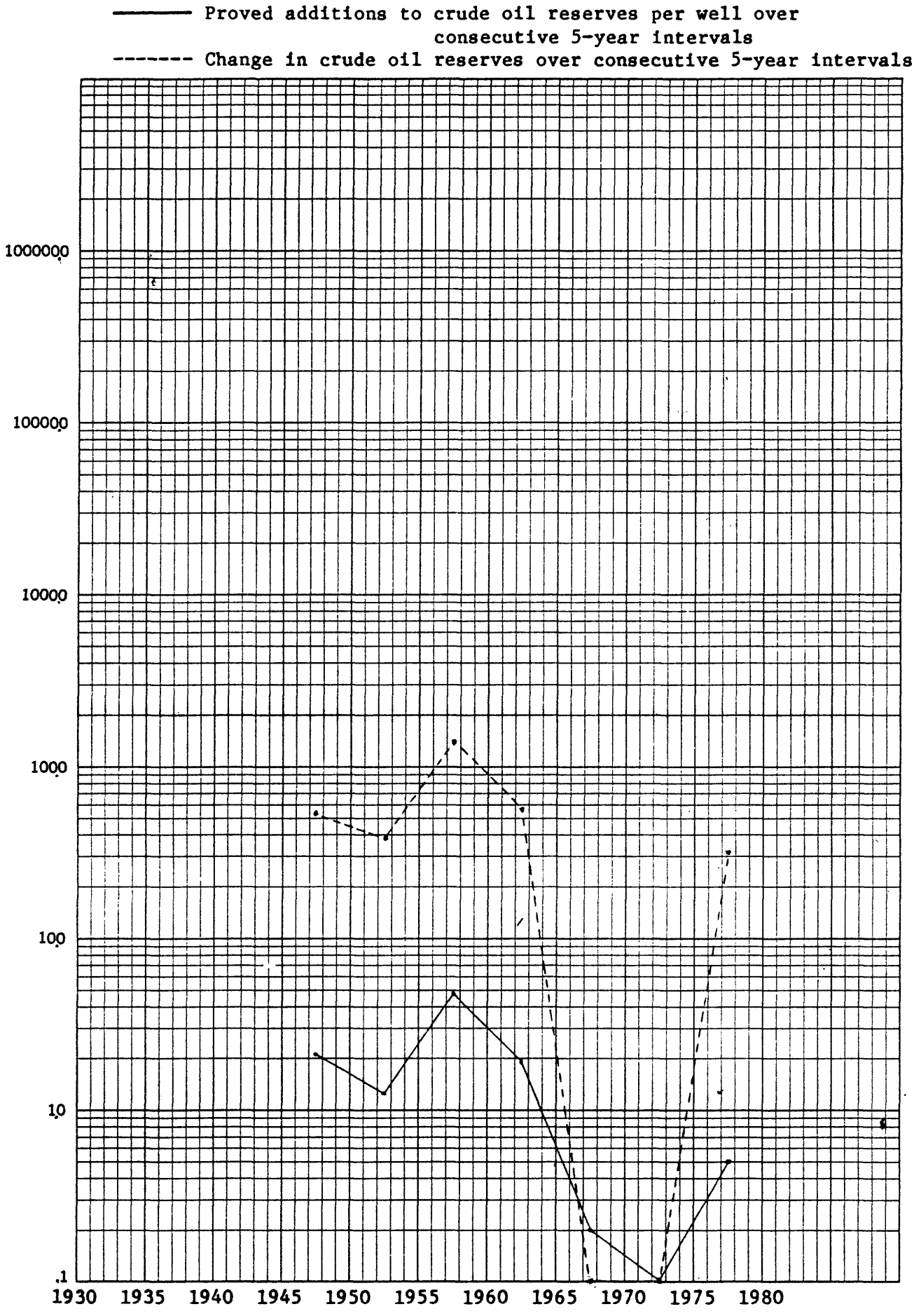
NETHERLANDS

5 year period	Number of exploratory wells completed	Change in reserves (MMBbls)	Avg ultimate recovery (MMBbls)	Proved additions to reserves (MMBbls)	Proved additions to reserves by well (MMBbls)
1936-1940					
1941-1945					
1946-1950	31	53	53	66	2.1
1951-1955	58	37	112	67	1.2
1956-1960	38	135	265	179	4.7
1961-1965	75	55	401	132	1.8
1966-1970	95	-50	494	23	.2
1971-1975	123	-138	480	-86	-.7
1976-1980	150	32	414	79	.5

NETHERLANDS



NETHERLANDS



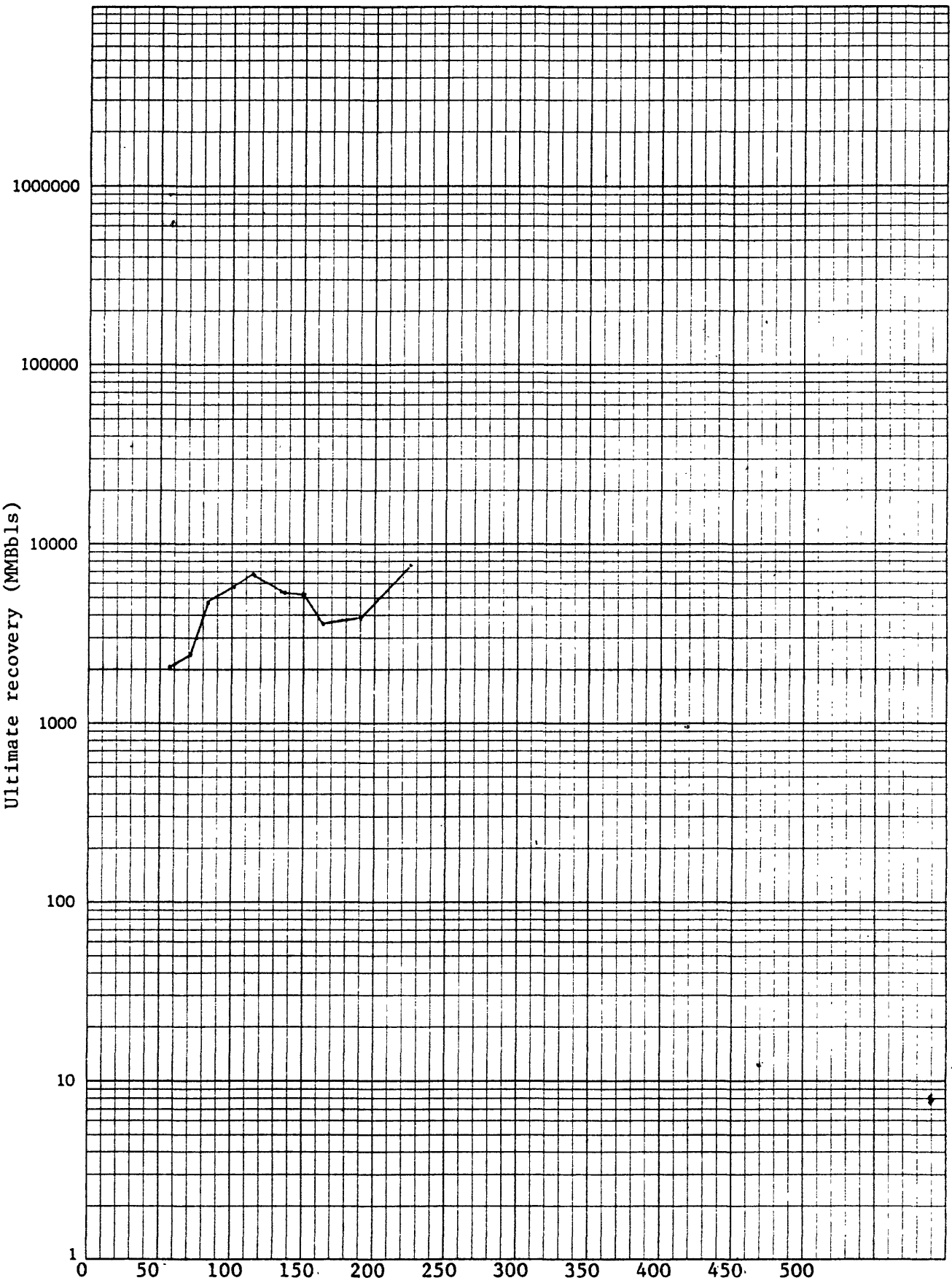
46 6463

K&E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

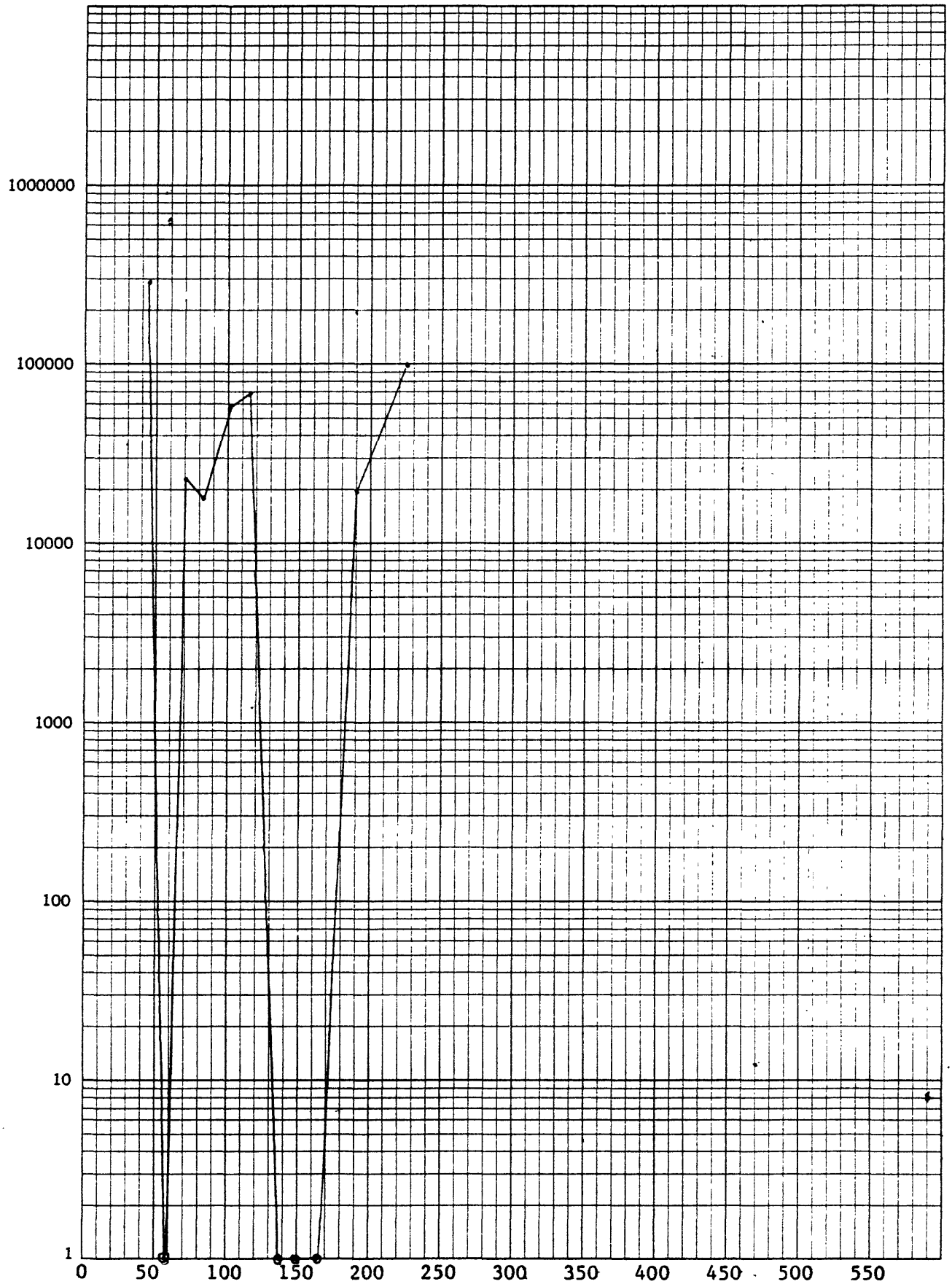
NORWAY

Year (y)	Exploratory wells completed (W_y) (AAPG)	Cumulative exploratory wells completed (CW_y)	Reserves - MMBbls (R_y) (D/M)	Crude production MBbls (P_y) (D/M, WO)	Ultimate recovery rounded MMBbls ($CP_y + R_{y+1}$)	Cumulative production rounded MMBbls (CP_y)	Change in reserves ($R_{y+1} - R_y$) = ΔR_y MBbls	Proved additions to Reserves MBbls ($D_y = \Delta R_y + P_y$)	Proved additions to reserves per well MBbls (D_y/W_y)
1965	0	0							
1966	1	1							
1967	5	6							
1968	11	17							
1969	14	31							
1970	13	44			3,500		3,500,000	3,500,000	269,231
1971	13	57	3,500	2,081	2,003	3	-1,500,000	-1,497,199	-115,169
1972	14	71	2,000	12,126	2,315	15	300,000	312,126	22,295
1973	13	84	2,300	11,166	4,526	26	2,200,000	2,211,168	17,031
1974	18	102	4,500	12,707	5,539	39	1,000,000	1,012,707	56,261
1975	14	116	5,500	68,900	6,510	108	901,840	970,740	69,339
1976	21	137	6,402	101,900	5,197	210	-1,414,360	-1,312,460	-62,498
1977	13	150	4,987	101,887	5,075	311	- 223,320	-121,433	-9,341
1978	14	164	4,764	129,940	3,414	441	-1,791,600	-1,661,660	-118,690
1979	26	190	2,973	139,928	3,928	581	374,490	514,418	19,785
1980	35	225	3,347	203,793	7,405	785	3,272,950	3,476,743	99,336
1981			6,620						

Ultimate crude oil recovery (MMBbls) vs cumulative exploratory wells completed

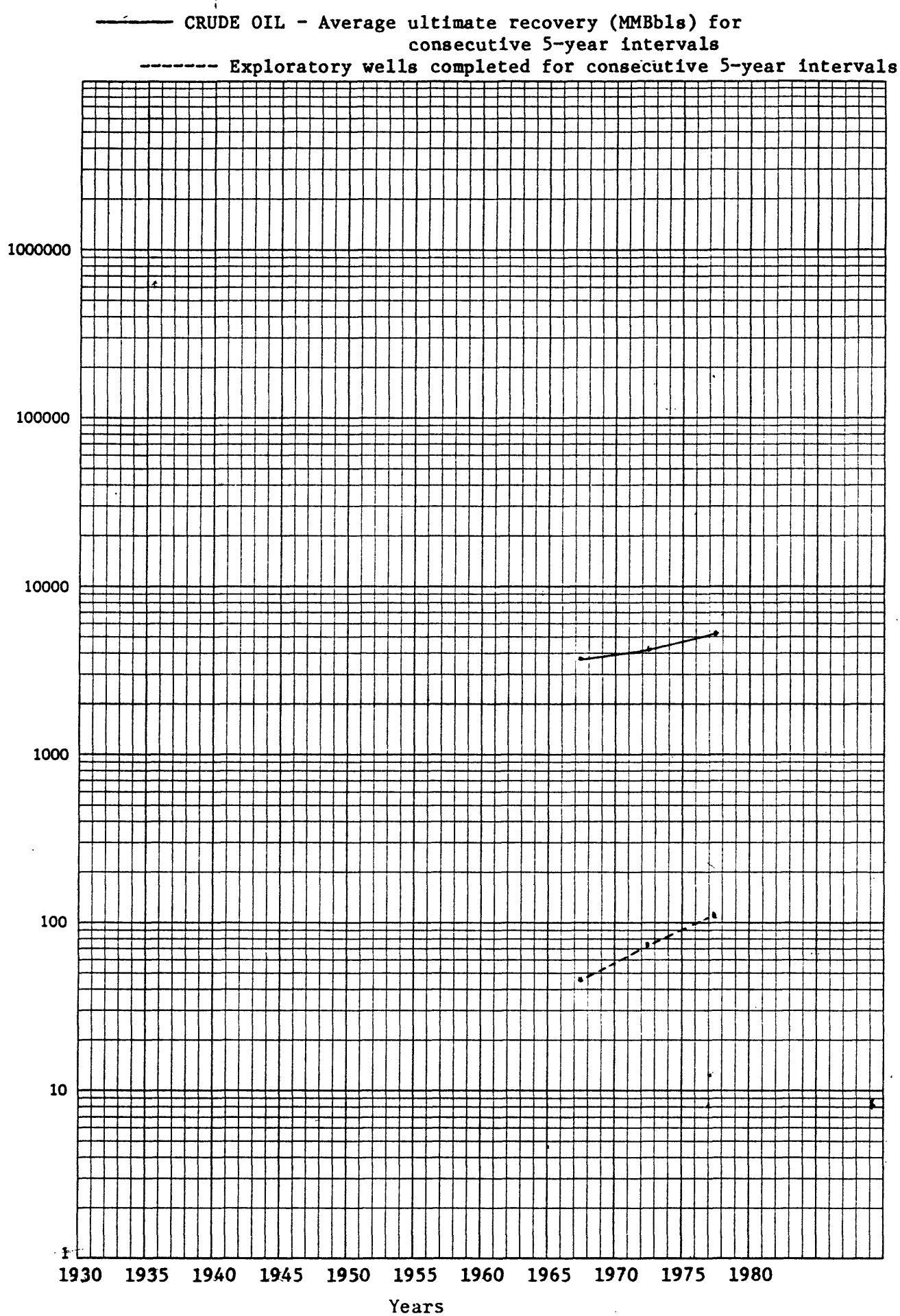


Proved additions to crude oil reserves per exploratory well completed (MBbls) vs cumulative exploratory wells completed

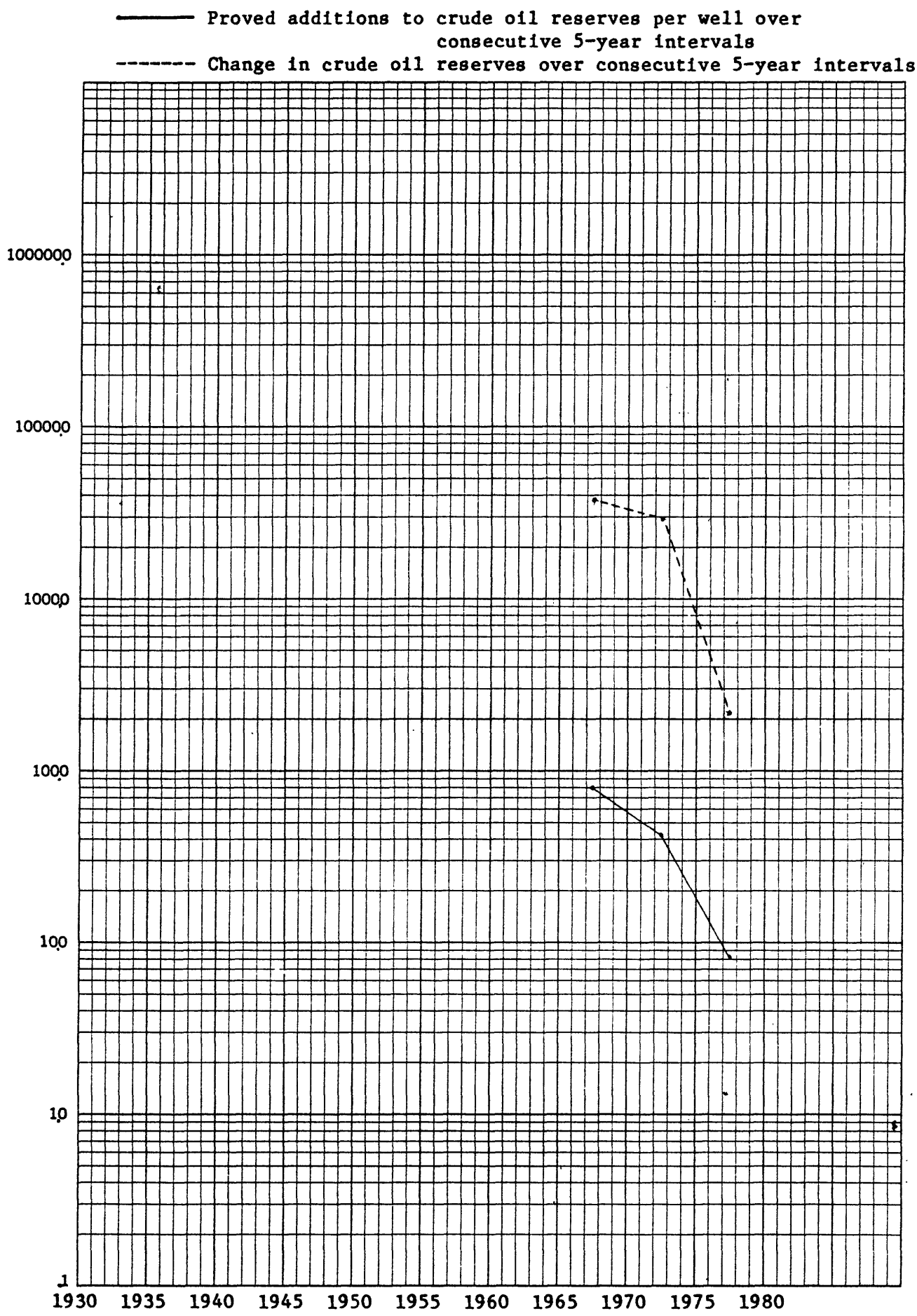


NORWAY

5 year period	Number of exploratory wells completed	Change in reserves (MMBbls)	Avg ultimate recovery (MMBbls)	Proved additions to reserves (MMBbls)	Proved additions to reserves by well (MMBbls)
1936-1940					
1941-1945					
1946-1950					
1951-1955					
1956-1960					
1961-1965					
1966-1970	44	3,500	3,500	3,500	79.6
1971-1975	72	2,902	4,179	3,010	41.8
1976-1980	109	218	5,004	896	8.2



NORWAY



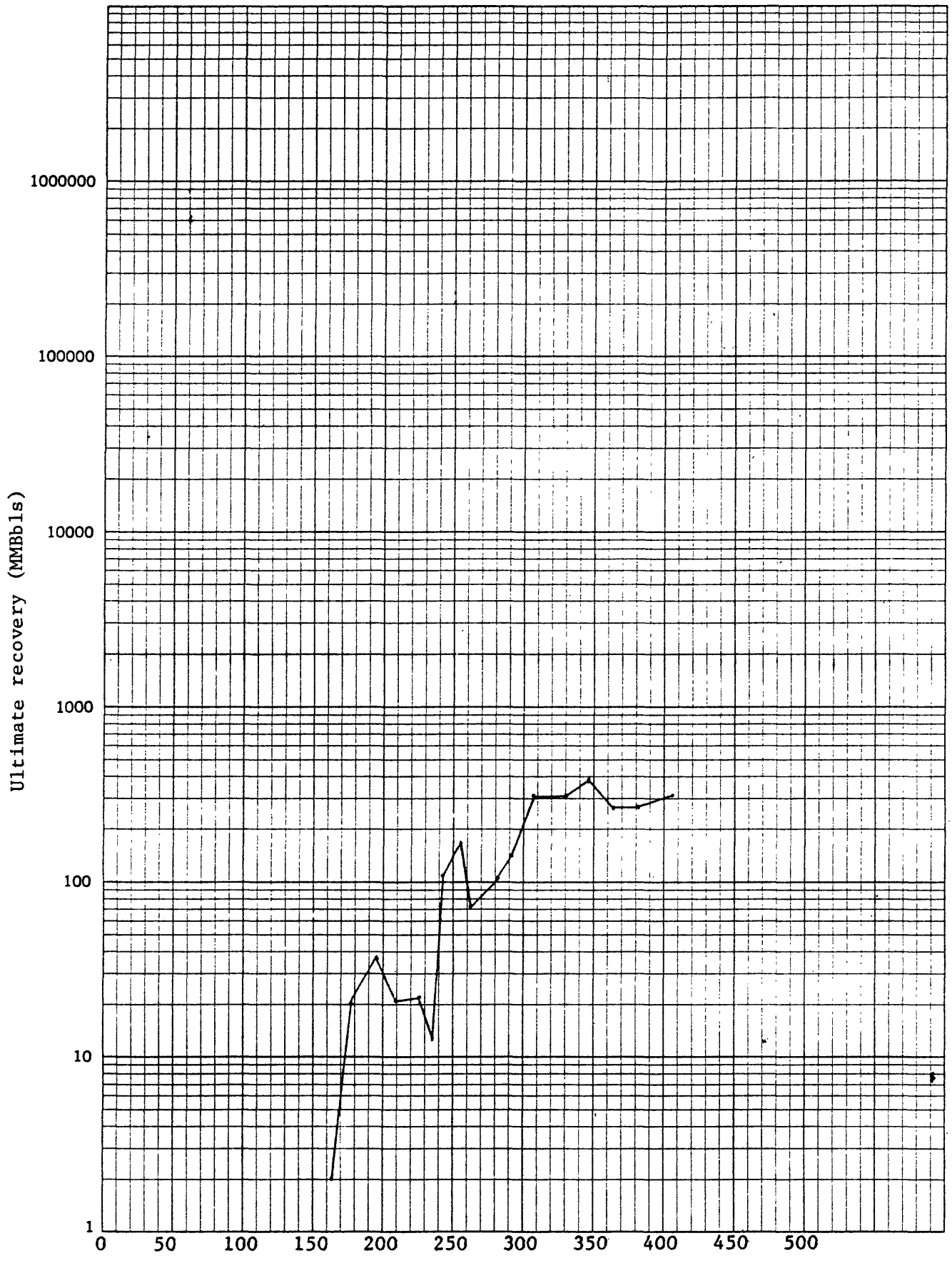
46 6463

K+E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS KEUFFEL & ESSER CO. MADE IN U.S.A.

Year (y)	Exploratory Wells completed (W_y) (AAPG)	Cumulative exploratory wells completed (CW_y)	Reserves - MMBbls (R_y) (D/M)	Crude production MBbls (P_y) (D/M, WO)	Ultimate recovery rounded MMBbls ($CP_y + R_{y+1}$)	Cumulative production rounded MMBbls (CP_y)	Change in reserves ($R_{y+1} - R_y$) = ΔR_y MBbls	Proved additions to reserves MBbls ($D_y = \Delta R_y + P_y$)	Proved additions to reserves per well MBbls (D_y/W_y)
1946	0	0							
1947	1	1							
1948									
1949	0	1							
1950	2	3							
1951	3	6							
1952	3	9							
1953	2	11							
1954	4	15							
1955	12	27							
1956	15	42							
1957	17	59							
1958	15	74							
1959	13	87							
1960	9	96							
1961	14	110							
1962	19	129							
1963	23	152							
1964	11	163			2				
1965	15	178	2		20		2,000	2,000	182
1966	17	195	20	236	35		18,000	18,000	1,200
1967	14	209	35	612	21		15,000	15,236	896
1968	17	226	20	925	22	1	-15,000	-14,388	-1,027
1969	9	235	20	1,386	13	2	0	925	55
1970	7	242	10	1,457	105	3	-10,000	-8,614	-957
1971	13	255	100	874	167	5	90,000	91,457	13,065
1972	7	262	162	1,020	72	5	61,937	62,811	4,832
1973	19	281	65	5,932	102	7	-96,937	-95,917	-13,702
1974	10	291	90	14,334	136	12	25,000	30,932	1,628
1975	16	307	109	14,882	304	27	19,305	33,639	3,364
1976	23	330	262	11,552	304	42	153,027	167,909	10,494
1977	16	346	251	6,898	363	53	-11,781	-229	-10
1978	18	364	303	6,570	257	60	52,833	59,731	3,733
1979	18	382	190	7,116	256	67	-113,573	-107,003	-5,945
1980	24	406	182	10,456	306	74	-8,097	-981	-55
1981			222			84	40,540	50,996	2,125

SPAIN

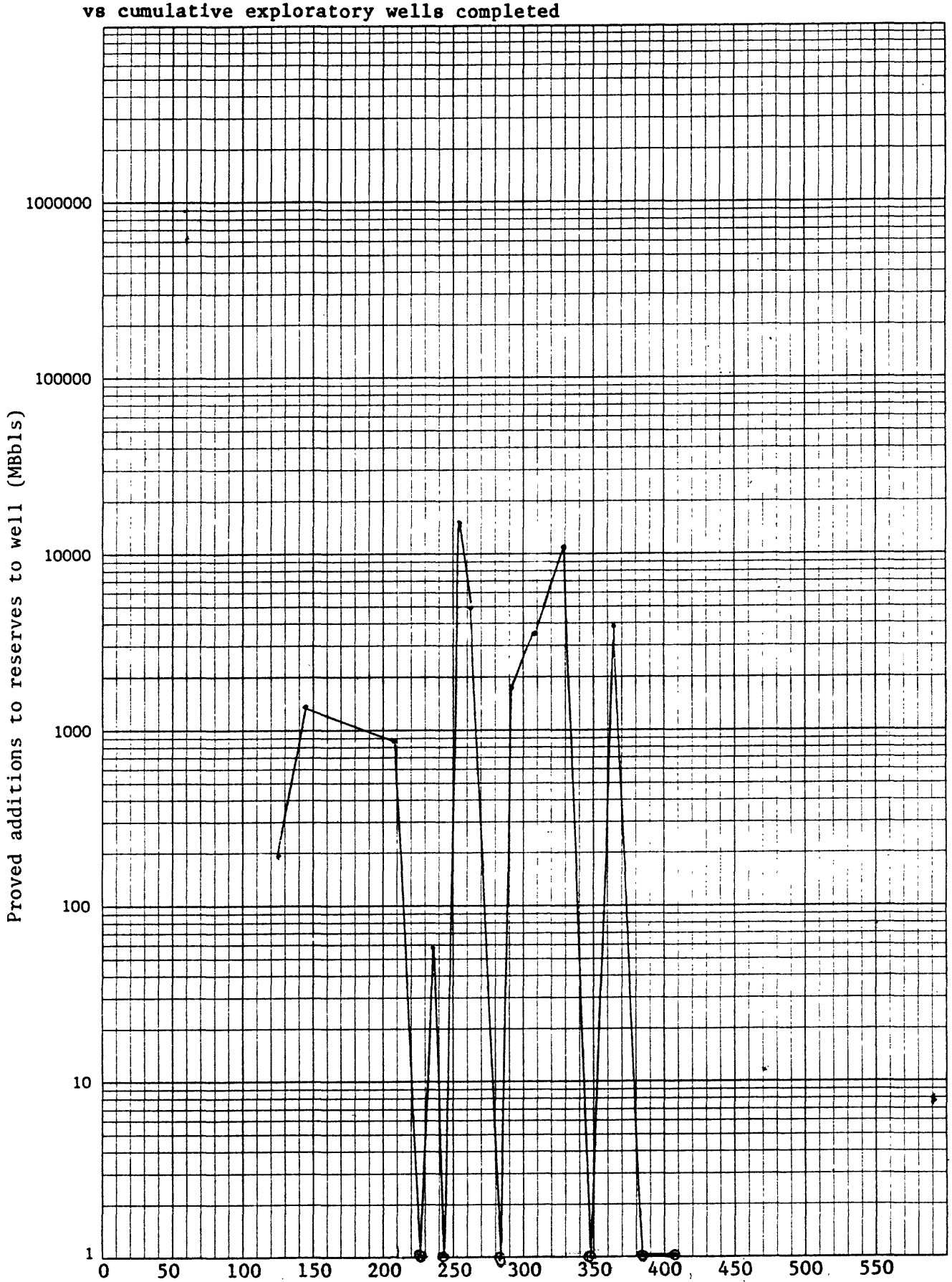
Ultimate crude oil recovery (MMBbls) vs cumulative exploratory wells completed



46 6463

K+E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

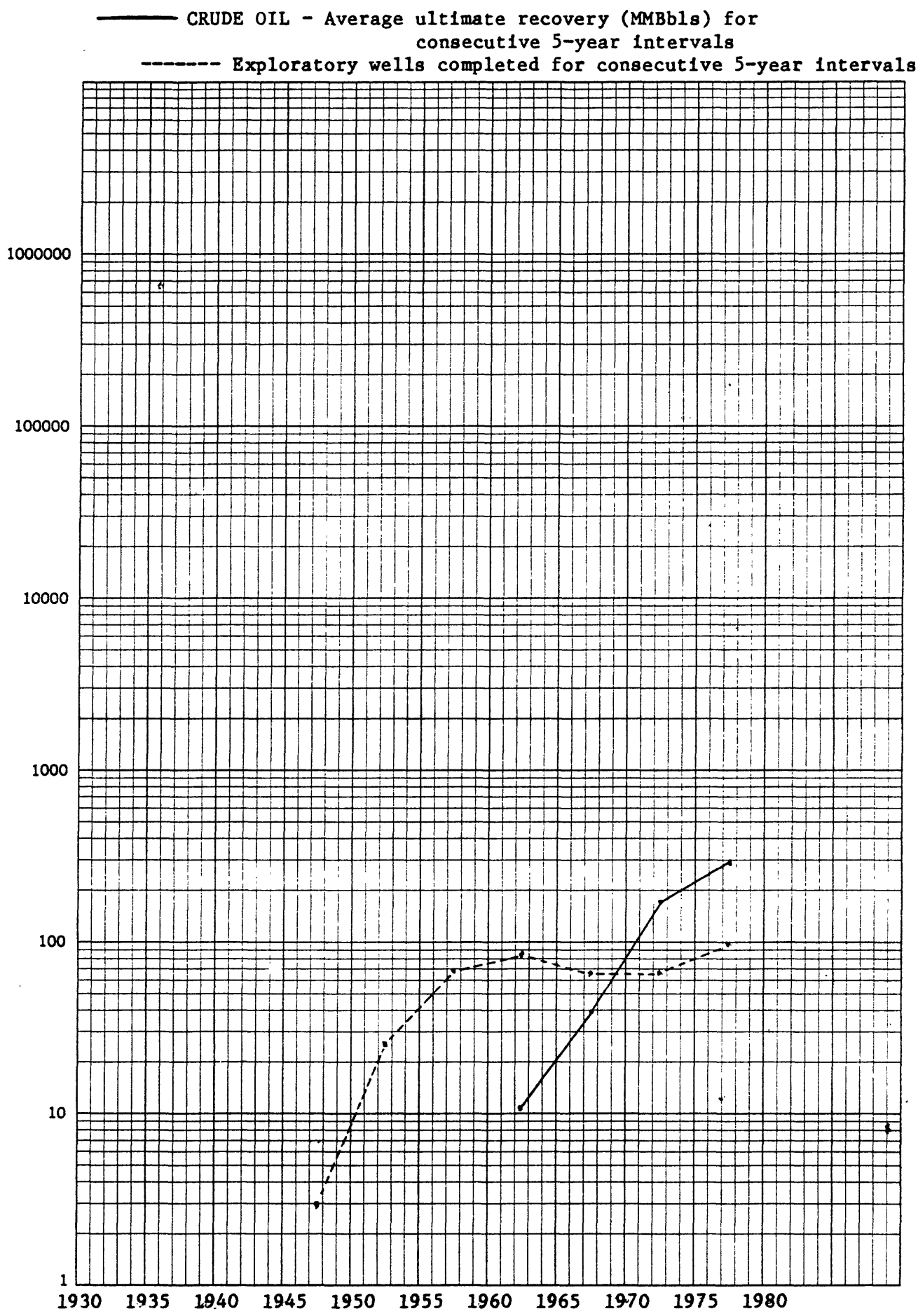
Proved additions to crude oil reserves per exploratory well completed (MBbls) vs cumulative exploratory wells completed



SPAIN

5 year period	Number of exploratory wells completed	Change in reserves (MMBbls)	Avg ultimate recovery (MMBbls)	Proved additions to reserves (MMBbls)	Proved additions to reserves by well (MMBbls)
1936-1940					
1941-1945					
1946-1950	3				
1951-1955	24				
1956-1960	69				
1961-1965	82	20	11	20	.2
1966-1970	64	80	39	84	1.3
1971-1975	65	162	156	200	3.1
1976-1980	99	-40	297	3	.0

SPAIN



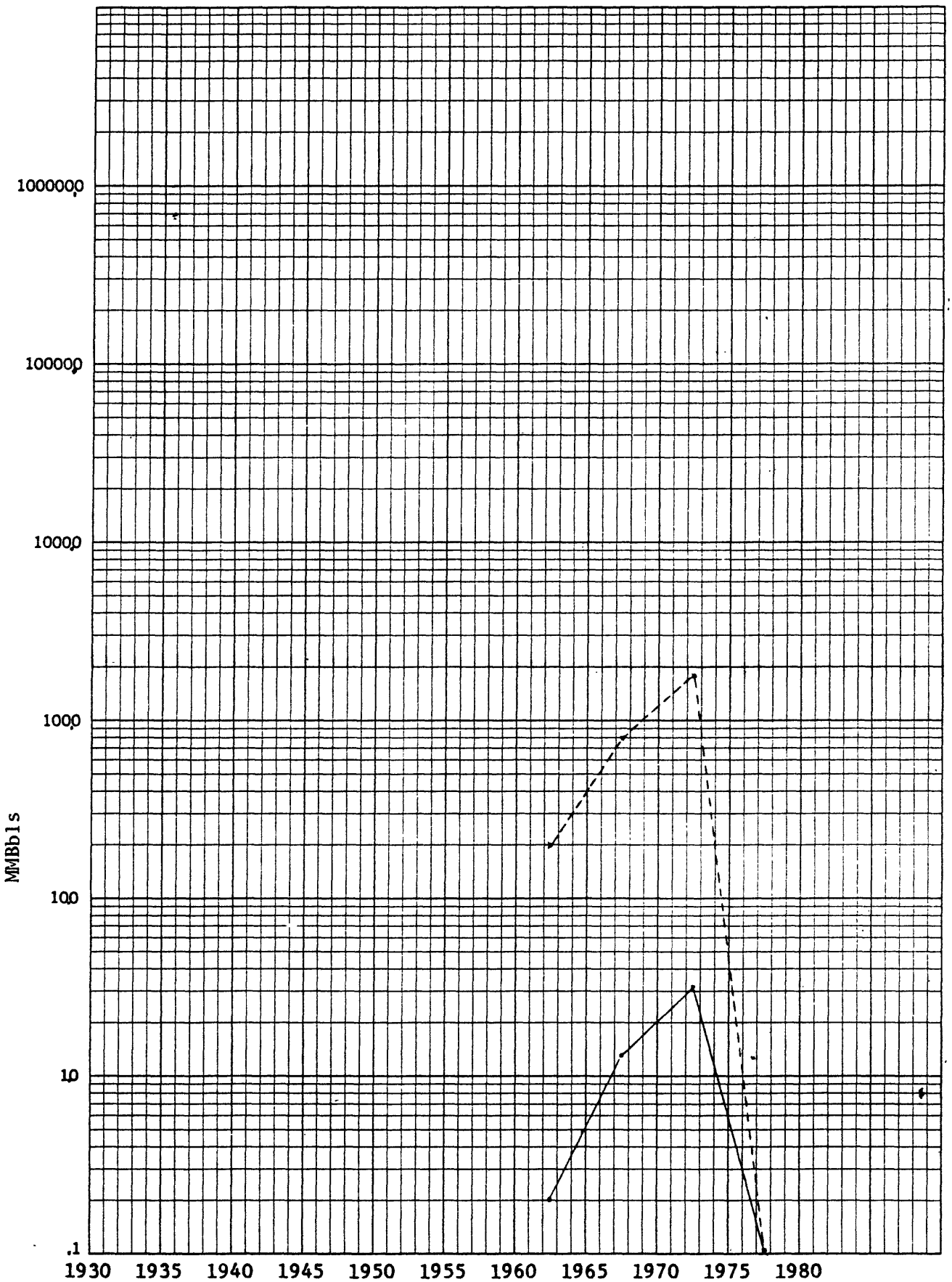
46 6463

K+E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS KEUFFEL & ESSER CO. MADE IN U.S.A.

SPAIN

——— Proved additions to crude oil reserves per well over consecutive 5-year intervals

------- Change in crude oil reserves over consecutive 5-year intervals



46 6463

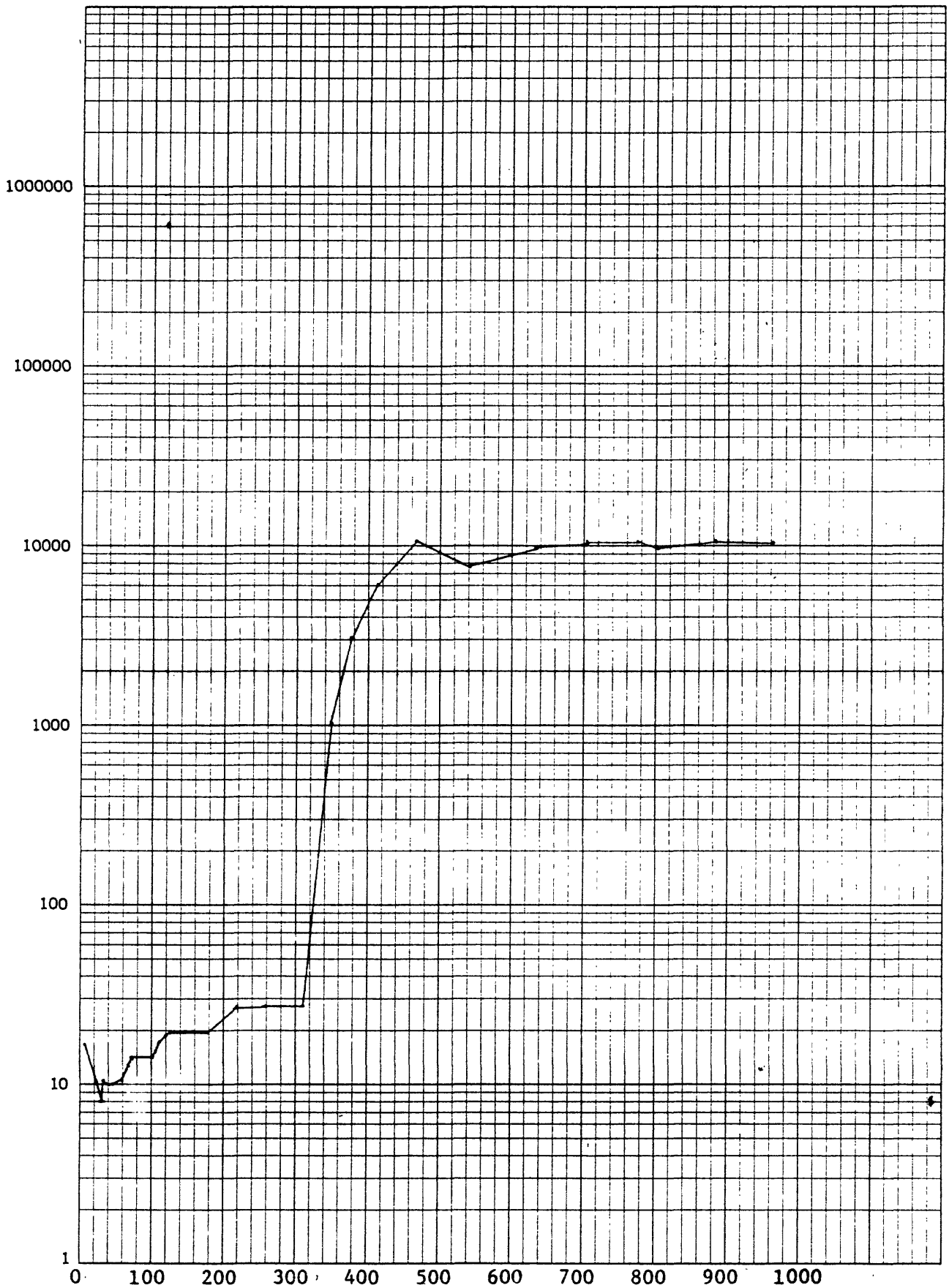
K+E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS KEUFFEL & ESSER CO. MADE IN U.S.A.

UNITED KINGDOM

Year (y)	Exploratory wells completed (W_y) (AAPG)	Cumulative exploratory wells completed (CW_y)	Reserves - MMBbls (R_y) (D/M)	Crude production MBbls (P_y) (D/M, WO)	Ultimate recovery rounded MMBbls ($CP_y + R_{y+1}$)	Cumulative production rounded MMBbls (CP_y)	Change in reserves ($R_{y+1} - R_y$) = ΔR_y MBbls	Proved additions to reserves MBbls ($D_y = \Delta R_y + P_y$	Proved additions to reserves per well MBbls (D_y/W_y)
1918									
1919				2					
1920				3					
1921				3					
1922				1					
1923				1					
1924				2					
1925				3					
1926				2					
1927				2					
1928				1					
1929									
1930									
1931									
1932									
1933									
1934									
1935									
1936									
1937									
1938									
1939									
1940				124					
1941				223					
1942				605	1	1			
1943				839	32	2	30,000	30,839	
1944			30	703		3		703	
1945				532	18	3	-15,000	-14,468	
1946	6	6	15	412	15	3	-3,000	-2,588	-431
1947	15	21	12	351	11	4	-4,800	-4,449	-297
1948	8	29	7	323	8	4	-3,200	-2,877	-370
1949	1	30	4	338	8	4	-300	38	38
1950	2	32	4	340	8	5	-300	40	20
1951	1	33	3	335	8	5	-100	235	235
1952	1	34	3	407	11	6	1,700	2,107	2,107
1953	4	38	5	410	10	6	-1,000	-590	-148
1954	7	45	4	450	10	6	0	450	64
1955	15	60	4	408	11	7	0	408	27
1956	10	70	4	489	13	7	1,500	1,989	199
1957	6	76	6	606	14	8	0	606	101
1958	17	93	6	591		9		591	35
1959	9	102		621	14	9	-500	121	13
1960	8	110	5	649	15	10	0	649	81
1961	4	114	5	810	16	11	0	810	203
1962		114	5	820	16	11	0	820	
1963	6	120	5	910	17	12	0	910	152
1964	5	125	5	939	18	13	0	939	188
1965	21	146	5	606	19	14	0	606	29
1966	33	179	5	569	19	14	0	569	17
1967	39	218	5	648	25	15	5,000	5,648	145
1968	39	257	10	591	25	16	-1,000	-409	-10
1969	55	312	9	562	25	16	0	562	10
1970	34	346	9	607	1,017	17	991,000	991,607	29,164
1971	32	378	1,000	1,499	3,018	18	2,000,000	2,001,499	62,547
1972	34	412	3,000	2,628	6,021	21	3,000,000	3,002,628	88,313
1973	55	467	6,000	2,946	10,924	24	4,900,000	4,902,946	89,114
1974	74	541	10,900	3,289	7,752	27	-3,175,000	3,171,711	-42,860
1975	93	634	7,725	8,000	9,852	35	2,101,700	2,109,700	22,684
1976	70	704	9,827	89,006	10,020	124	69,000	158,006	2,257
1977	72	776	9,896	271,653	10,456	396	174,700	446,353	6,199
1978	45	821	10,070	394,930	9,526	791	-1,335,500	-940,570	-20,902
1979	60	881	8,735	575,420	10,305	1,366	204,400	779,820	12,997
1980	81	962	8,939	577,225	10,152	1,943	-700	576,525	7,118
1981			8,209						

UNITED KINGDOM

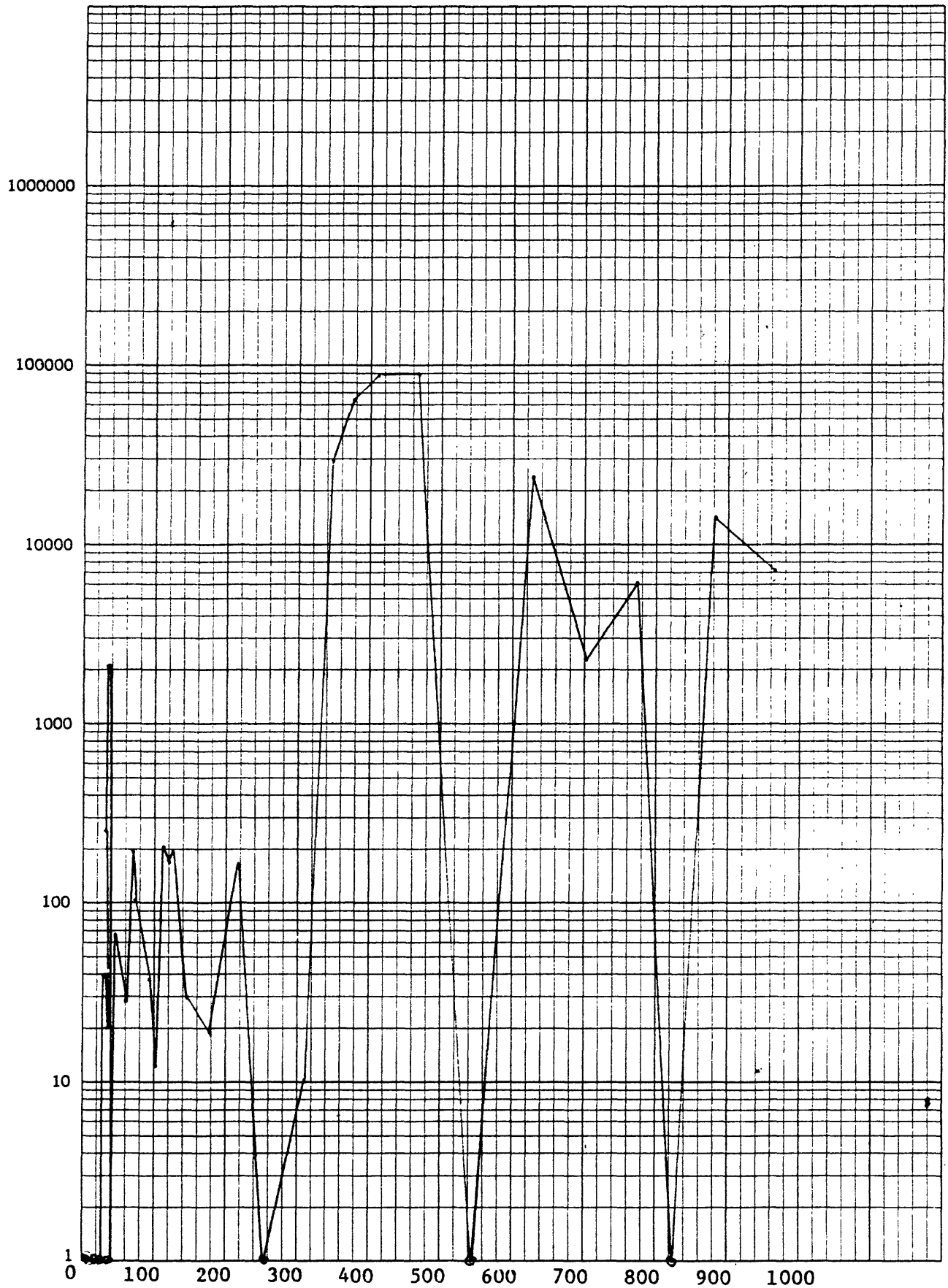
Ultimate crude oil recovery (MMBbls) vs cumulative exploratory wells completed



46 6463

SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

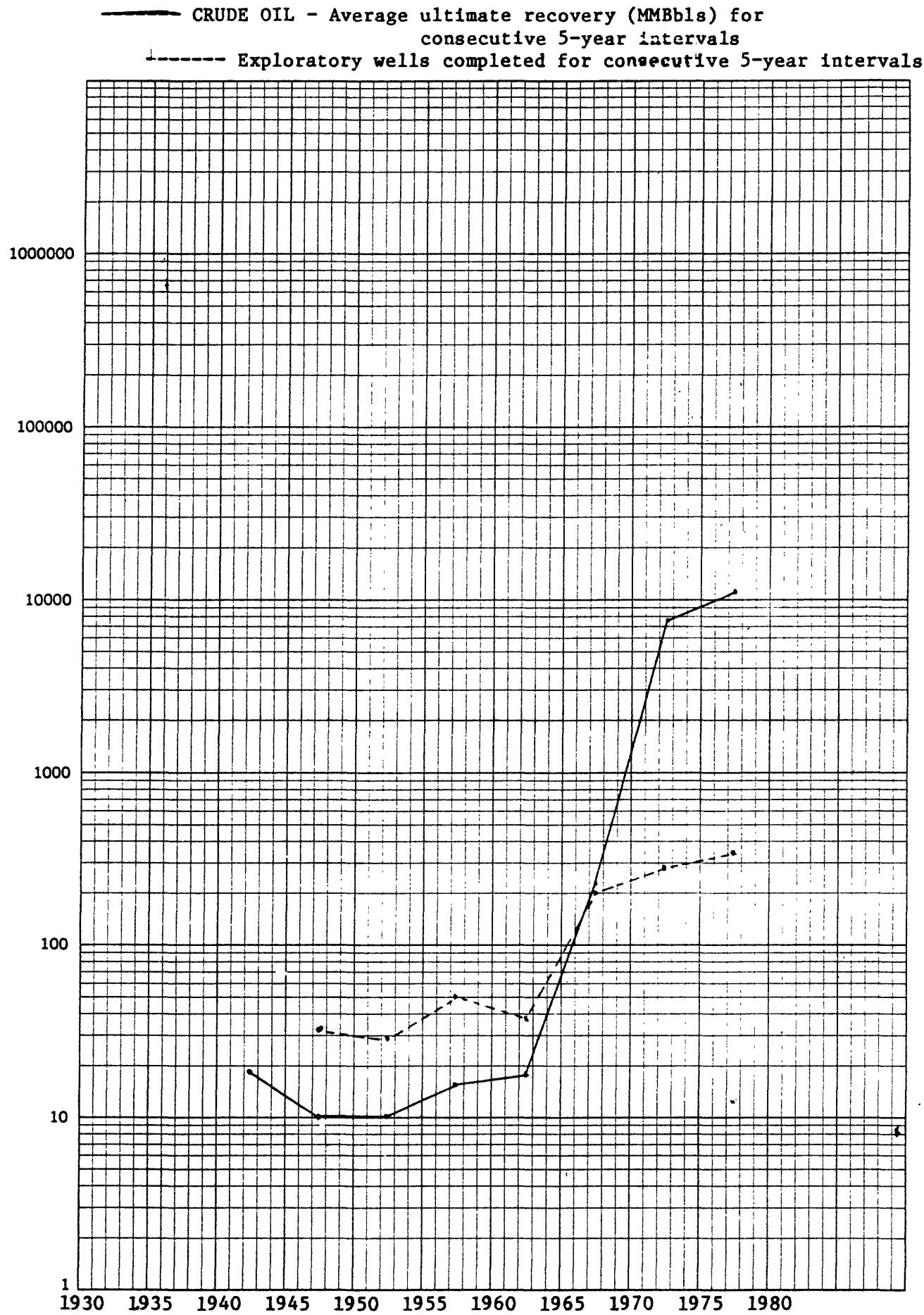
Proved additions to crude oil reserves per exploratory well completed (MBbls)
vs cumulative exploratory wells completed



UNITED KINGDOM

5 year period	Number of exploratory wells completed	Change in reserves (MMBbls)	Avg ultimate recovery (MMBbls)	Proved additions to reserves (MMBbls)	Proved additions to reserves by well (MMBbls)
1936-1940					
1941-1945		15	17	18	
1946-1950	32	-11	10	-10	-.3
1951-1955	28	1	10	1	
1956-1960	50	1	14	5	.1
1961-1965	36	0	17	5	.2
1966-1970	200	995	222	1,000	5.0
1971-1975	288	8,827	7,515	8,845	30.7
1976-1980	328	-889	10,094	1,020	3.1

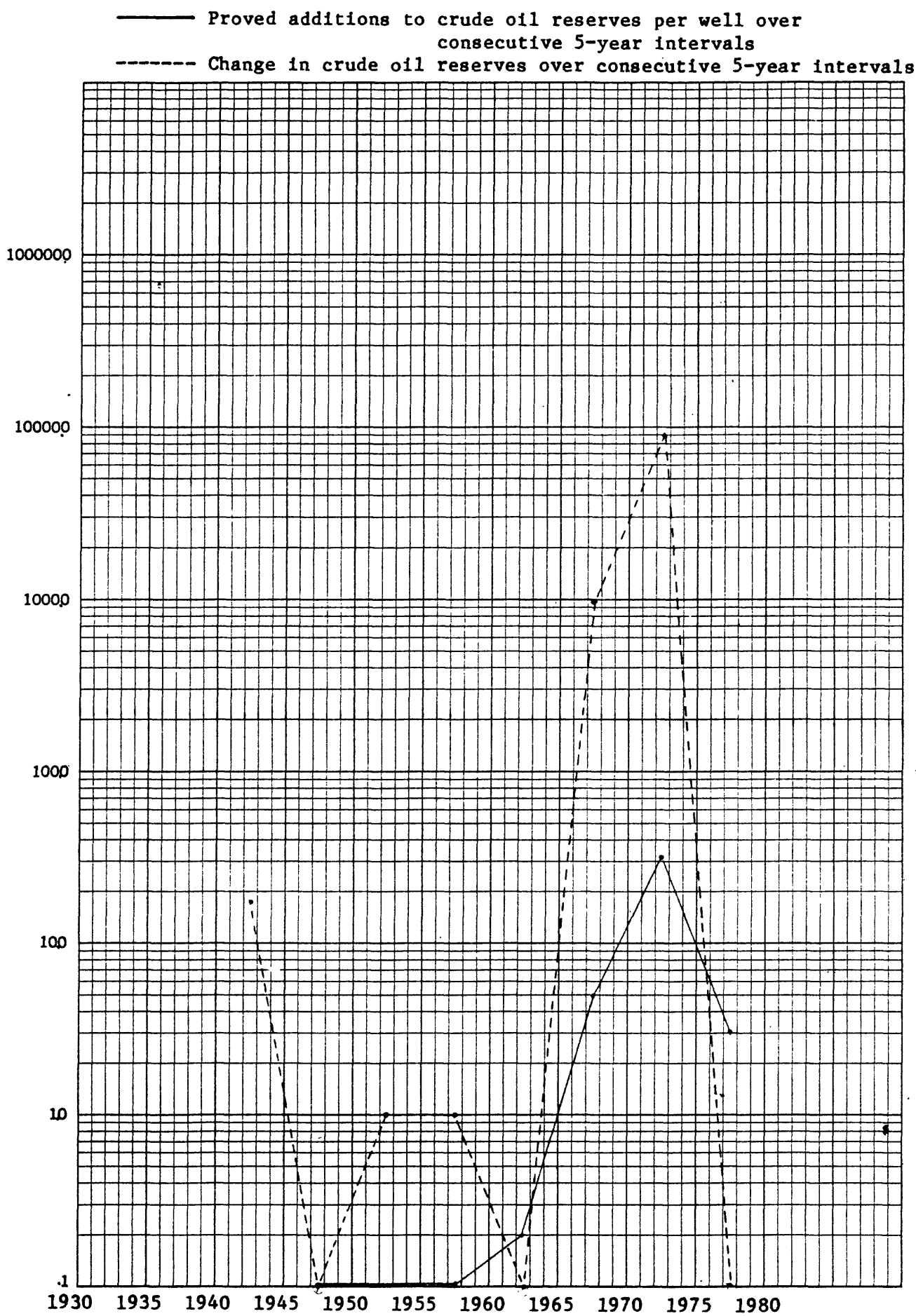
UNITED KINGDOM



46 6463

K+E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS KEUFFEL & ESSER CO. MADE IN U.S.A.

UNITED KINGDOM



46 6463

K+E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS KEUFFEL & ESSER CO. MADE IN U.S.A.

SOUTH AMERICA AND MEXICO

Argentina

Bolivia

Brazil

Chile

Colombia

Ecuador

Peru

Trinidad & Tobago

Venezuela

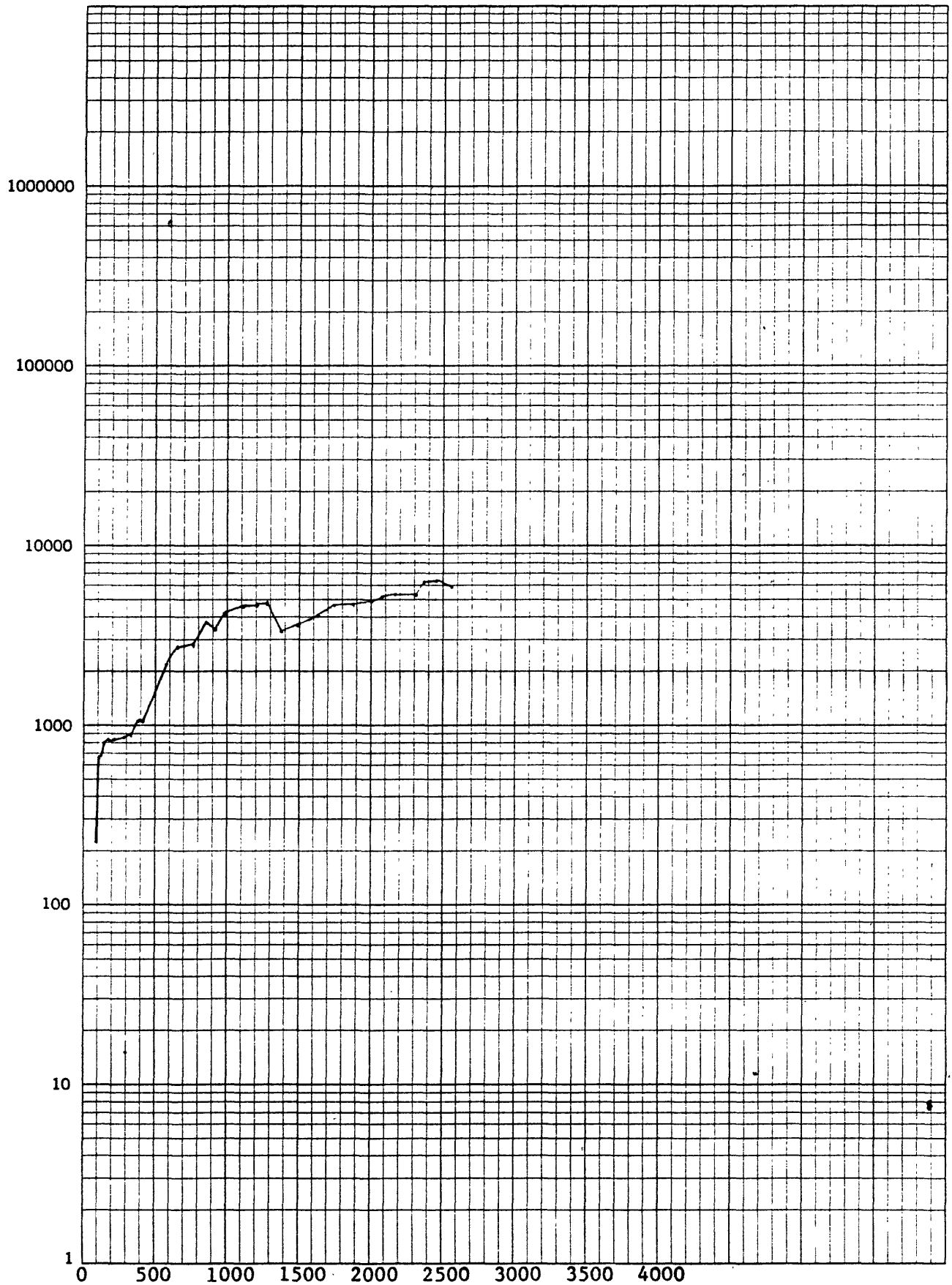
Mexico

ARGENTINA

Year (y)	Exploratory wells completed (W_y) (AAPG)	Cumulative exploratory wells completed (CW_y)	Reserves - MMBbls (R_y) (D/M)	Crude production MBbls (P_y) (D/M, WO)	Ultimate recovery rounded MMBbls ($CP_y + R_{y+1}$)	Cumulative production rounded MMBbls (CP_y)	Change in reserves ($R_{y+1} - R_y$) = ΔR_y MBbls	Proved additions to reserves MBbls ($D_y = \Delta R_y + P_y$)	Proved additions to reserves per well MBbls (D_y/W_y)
1917				3,115	3	3			
1918				1,353	4	4			
1919				1,331	6	6			
1920				1,651	7	7			
1921				2,036	9	9			
1922				2,866	12	12			
1923				3,400	16	16			
1924				4,639	20	20			
1925				6,336	27	27			
1926				7,851	35	35			
1927				8,630	43	43			
1928				9,070	52	52			
1929				9,391	62	62			
1930				9,002	71	71			
1931				11,709	82	82			
1932				13,139	96	96			
1933				13,691	109	109			
1934				14,024	123	123			
1935				14,297	138	138			
1936				15,458	153	153			
1937				16,355	169	169			
1938				17,076	186	186			
1939				18,613	205	205			
1940	90	90		20,609	226	226			
1941				21,873	248	248			
1942				23,704	271	271			
1943				27,714	467	299	168,000	195,714	
1944			168	24,230		323		24,230	
1945	17	107		22,881	646	346	132,000	154,881	9,110
1946	12	119	300	20,604	667	367	0	20,604	1,717
1947			300	21,846	663	388	-25,000	-3,154	
1948			275	23,734	662	412	-25,000	-1,266	
1949			250	22,589	685	435	0	22,589	
1950			250	23,353	728	458	20,000	43,353	
1951	23	142	270	24,465	783	483	30,000	54,465	2,368
1952	47	189	300	24,588	807	507	0	24,588	523
1953	40	229	300	28,501	811	536	-25,000	3,501	88
1954	54	283	275	29,573	865	565	25,000	54,573	1,011
1955	48	331	300	30,501	896	596	0	30,501	635
1956	51	382	300	31,013	1,077	627	150,000	181,013	3,549
1957	38	420	450	33,952	1,061	661	50,000	83,952	2,209
1958	33	453	500	35,829		697			
1959				44,710	2,141	741	900,000	944,710	
1960	121	574	1,400	64,232	2,356	806	150,000	214,232	1,770
1961	84	658	1,550	84,418	2,590	890	150,000	234,418	2,791
1962	130	788	1,700	98,154	2,638	988	-50,000	48,154	370
1963	76	864	1,650	97,221	3,585	1,085	850,000	947,221	12,463
1964	55	919	2,500	100,370	3,386	1,186	-300,000	-199,630	-3,629
1965	78	997	2,200	98,262	4,184	1,284	700,000	798,262	10,234
1966	116	1,113	2,900	104,757	4,434	1,389	145,000	249,757	2,153
1967	92	1,205	3,045	114,739	4,453	1,503	-95,000	19,739	215
1968	85	1,290	2,950	125,492	4,679	1,629	100,000	325,492	3,829
1969	86	1,376	3,050	130,036	3,332	1,759	-1,477,000	-1,346,964	-15,662
1970	113	1,489	1,573	143,399	3,475	1,902	0	143,399	1,269
1971	145	1,634	1,573	154,514	4,057	2,057	427,000	581,514	4,010
1972	110	1,744	2,000	158,464	4,681	2,215	466,000	624,464	5,677
1973	139	1,883	2,466	153,539	4,681	2,369	-154,000	-461	-3
1974	117	2,000	2,312	151,110	4,979	2,520	147,000	298,110	2,548
1975	78	2,078	2,459	144,364	5,164	2,664	41,000	185,364	2,376
1976	82	2,160	2,500	145,561	5,325	2,810	15,000	160,561	1,958
1977	143	2,303	2,515	157,248	5,284	2,967	-198,000	-40,752	-285
1978	81	2,384	2,317	165,195	6,032	3,132	-583,000	-417,805	-5,158
1979	71	2,455	2,900	169,000	6,201	3,301	0	169,000	2,380
1980	110	2,565	2,900	177,163	5,936	3,479	-443,000	-265,837	-2,417
1981			2,457						

ARGENTINA

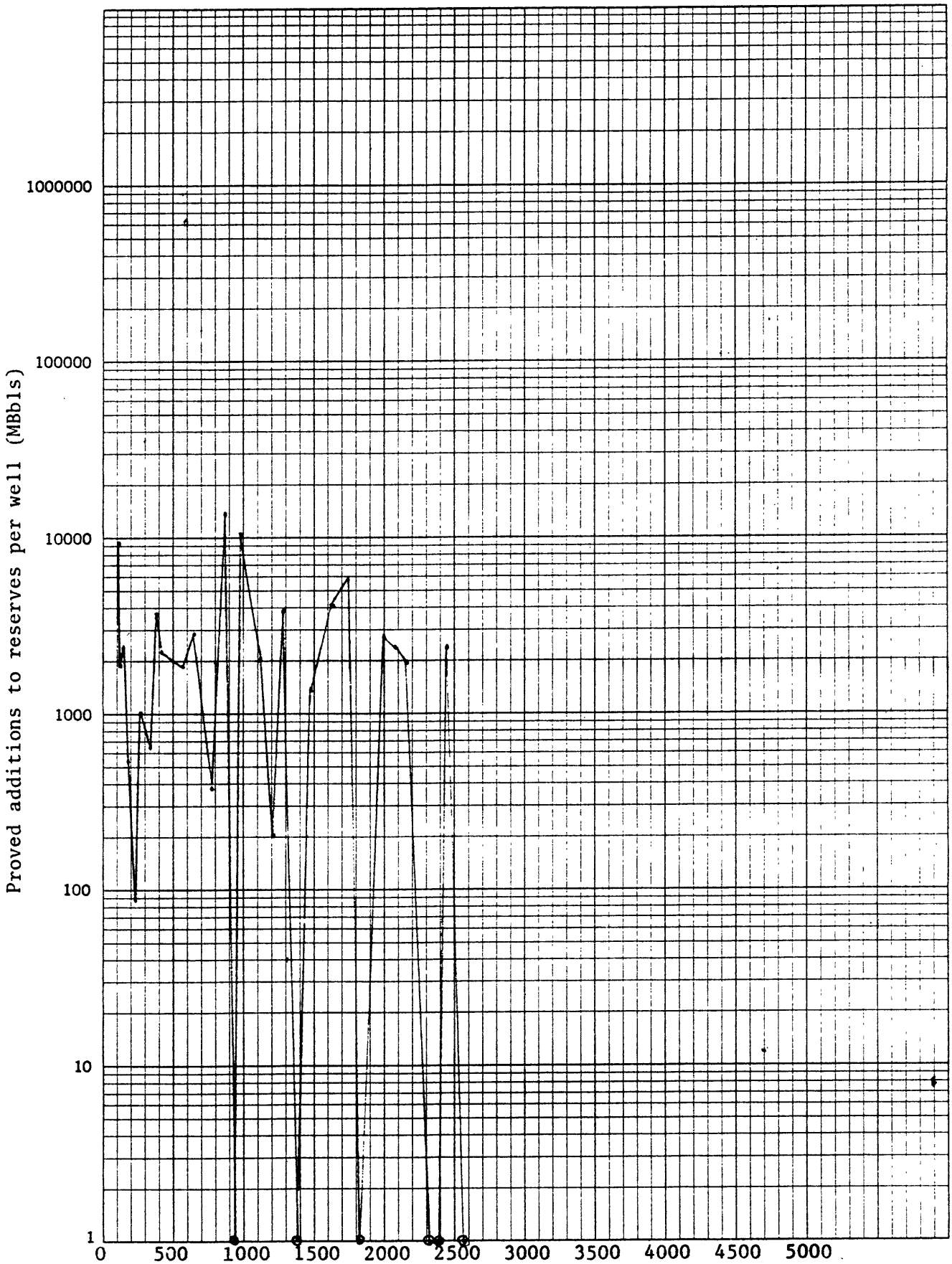
Ultimate crude oil recovery (MMBbls) vs cumulative exploratory wells completed



46 6463

K•E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

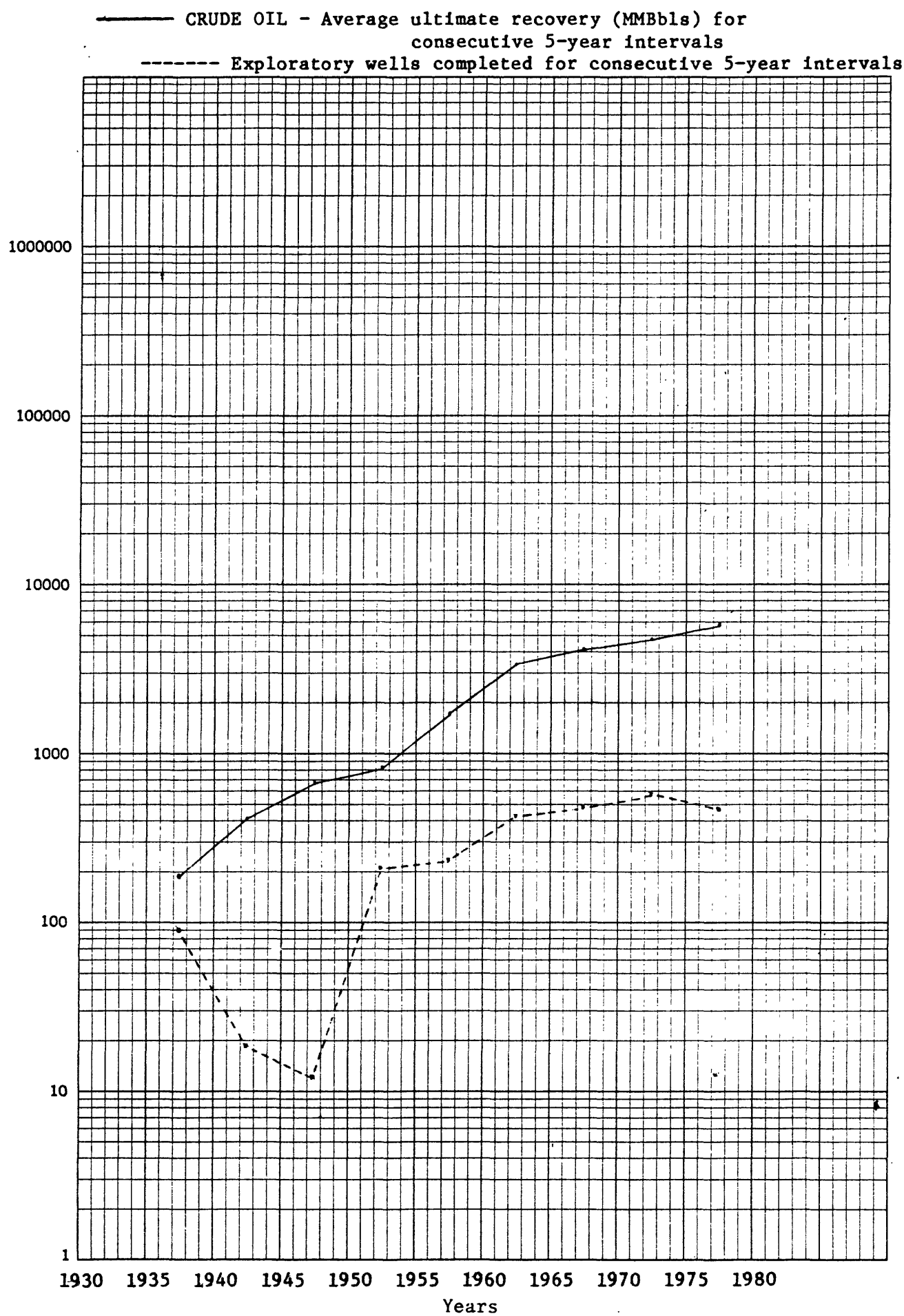
Proved additions to crude oil reserves per exploratory well completed (MBbls) vs cumulative exploratory wells completed



ARGENTINA

5 year period	Number of exploratory wells completed	Change in reserves (MMBbls)	Avg ultimate recovery (MMBbls)	Proved additions to reserves (MMBbls)	Proved additions to reserves by well (MMBbls)
1936-1940	90		188		
1941-1945	17	300	408	375	22.1
1946-1950	12	-30	681	83	6.9
1951-1955	212	30	832	169	.8
1956-1960	243	1,250	1,659	1,424	5.9
1961-1965	423	1,350	3,277	1,827	4.3
1966-1970	492	-1,327	4,075	-609	-1.2
1971-1975	589	927	4,712	1,689	2.9
1976-1980	487	-1,209	5,755	-395	-.8

ARGENTINA



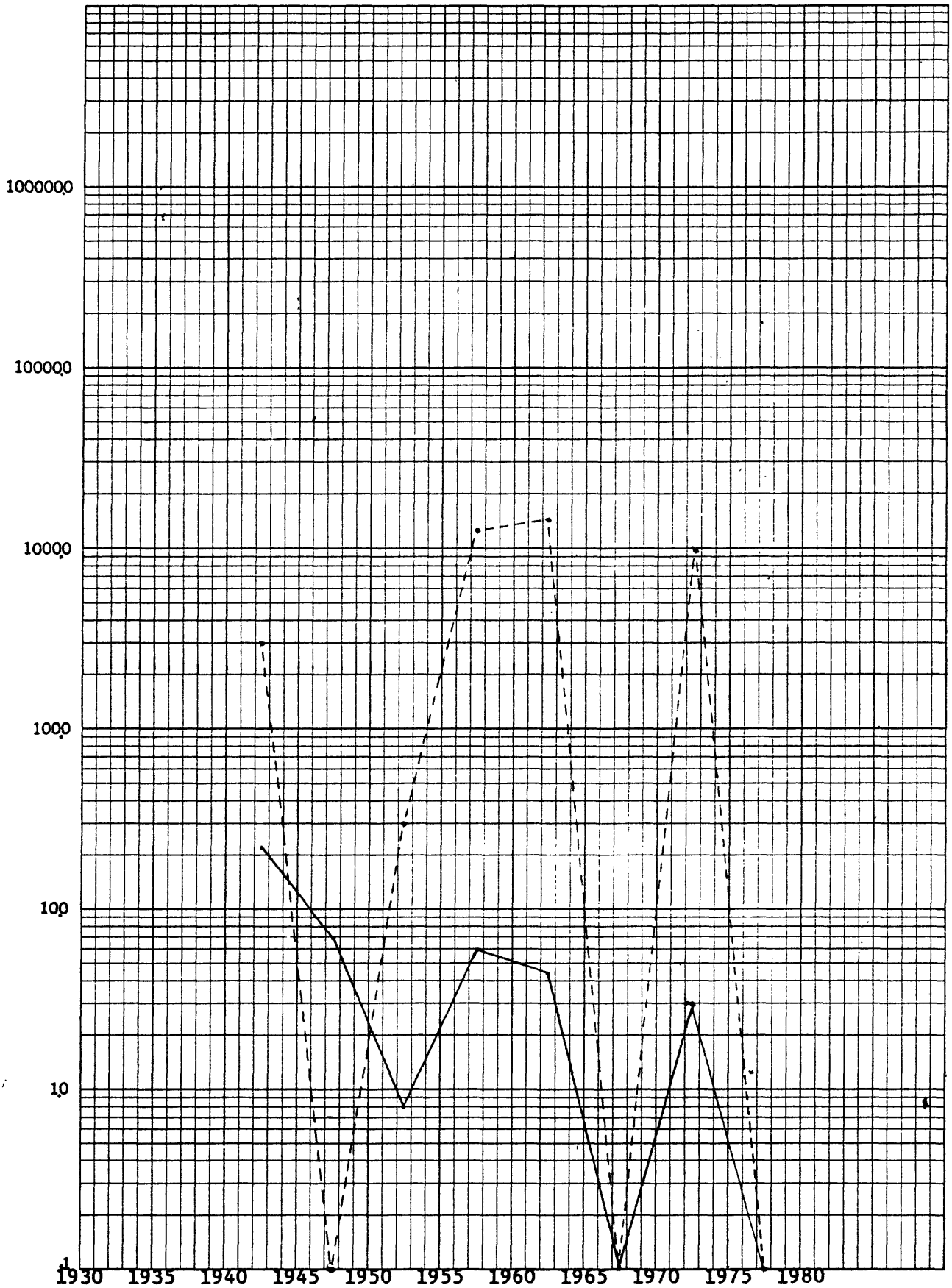
46 6463

K+E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

ARGENTINA

——— Proved additions to crude oil reserves per well over consecutive 5-year intervals

------- Change in crude oil reserves over consecutive 5-year intervals



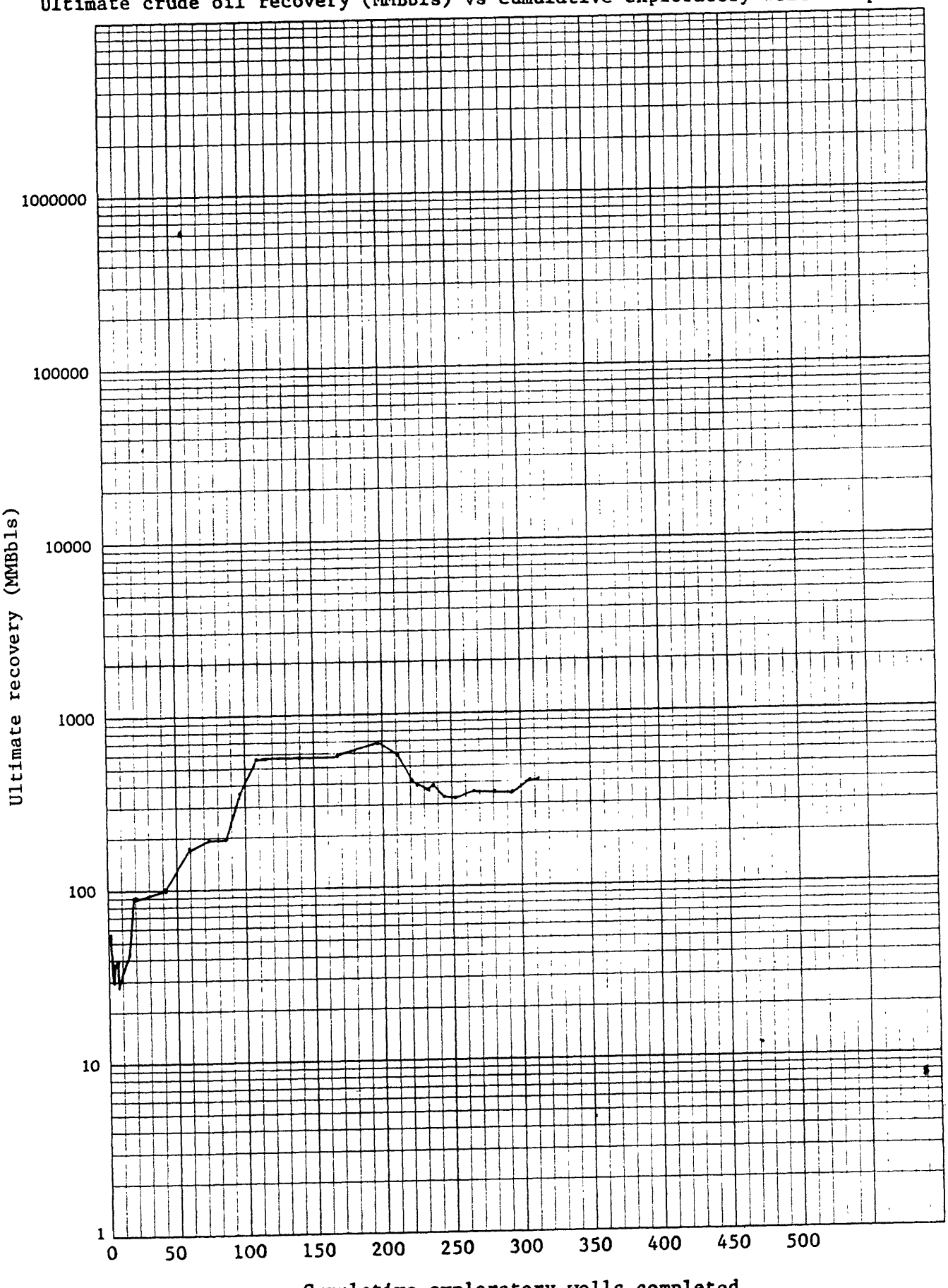
46 6463

K+E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

BOLIVIA

Year (y)	Exploratory wells completed (W_y) (AAPG)	Cumulative exploratory wells completed (CW_y)	Reserves - MMBbls (R_y) (D/M)	Crude production MBbls(P_y) (D/M, WO)	Ultimate recovery rounded MMBbls ($CP_y + R_{y+1}$)	Cumulative production rounded MMBbls (CP_y)	Change in reserves ($R_{y+1} - R_y$)= ΔR_y MBbls	Proved additions to reserves MBbls ($D_y = \Delta R_y + P_y$)	Proved additions to reserves per well MBbls (D_y/W_y)
1930				56					
1931				25					
1932				44					
1933				112					
1934				159					
1935				164	1	1			
1936				105	1	1			
1937				122	1	1			
1938				226	1	1			
1939				215	1	1			
1940				288	2	2			
1941				235	2	2			
1942				308	2	2			
1943				334	47	2	45,400	45,734	
1944			45	314		3			
1945				382	53	3	4,600	4,982	
1946	0		50	363	53	3	0	363	
1947	1	1	50	377	54	4	0	377	377
1948	2	3	50	464	19	4	-35,000	-34,536	-17,268
1949	1	4	15	678	25	5	5,000	5,678	5,678
1950	2	6	20	616	29	6	3,000	3,616	1,808
1951	1	7	23	523	16	6	-13,000	-12,477	-12,477
1952			10	526	17	7	0	526	
1953			10	601	17	7	0	601	
1954	6	13	10	1,695	39	9	20,000	21,695	3,616
1955	2	15	30	2,693	42	12	0	2,693	1,346
1956	5	20	30	3,196	90	15	45,000	48,196	9,639
1957			75	3,575	93	18	0	3,575	
1958	9	29	75	3,435		22		3,435	382
1959	12	41		3,170	100	25	0	3,170	264
1960	18	59	75	3,574	154	29	50,000	53,574	2,976
1961	14	73	125	2,989	182	32	25,000	27,989	1,999
1962	13	86	150	2,911	184	34	0	2,911	224
1963	10	96	150	3,401	338	38	150,000	153,401	15,340
1964	13	109	300	3,195	541	41	200,000	203,195	15,630
1965	16	125	500	3,357	544	44	0	3,357	210
1966	15	140	500	6,085	550	50	0	6,085	406
1967	28	168	500	14,527	565	65	0	14,527	519
1968	28	196	500	14,974	660	80	80,000	94,974	3,392
1969	15	211	580	14,759	595	95	-80,000	-65,241	-4,349
1970	10	221	500	8,820	404	104	-200,000	-191,180	-19,118
1971	4	225	300	13,206	379	117	-38,000	-24,794	-6,199
1972	8	233	262	15,967	353	133	-42,000	-26,033	-3,254
1973	4	237	220	17,266	373	150	3,000	20,266	5,067
1974	7	244	223	16,603	326	167	-64,000	-47,397	-6,771
1975	7	251	159	14,732	319	181	-21,000	-6,268	-895
1976	16	267	138	14,856	358	196	24,000	38,856	2,429
1977	14	281	162	12,676	339	209	-32,000	-19,324	-1,380
1978	13	294	130	12,775	340	222	-12,000	775	60
1979	12	306	118	11,228	407	233	56,000	67,228	5,602
1980	6	312	174	8,704	410	242	-6,000	2,704	450
1981			168						

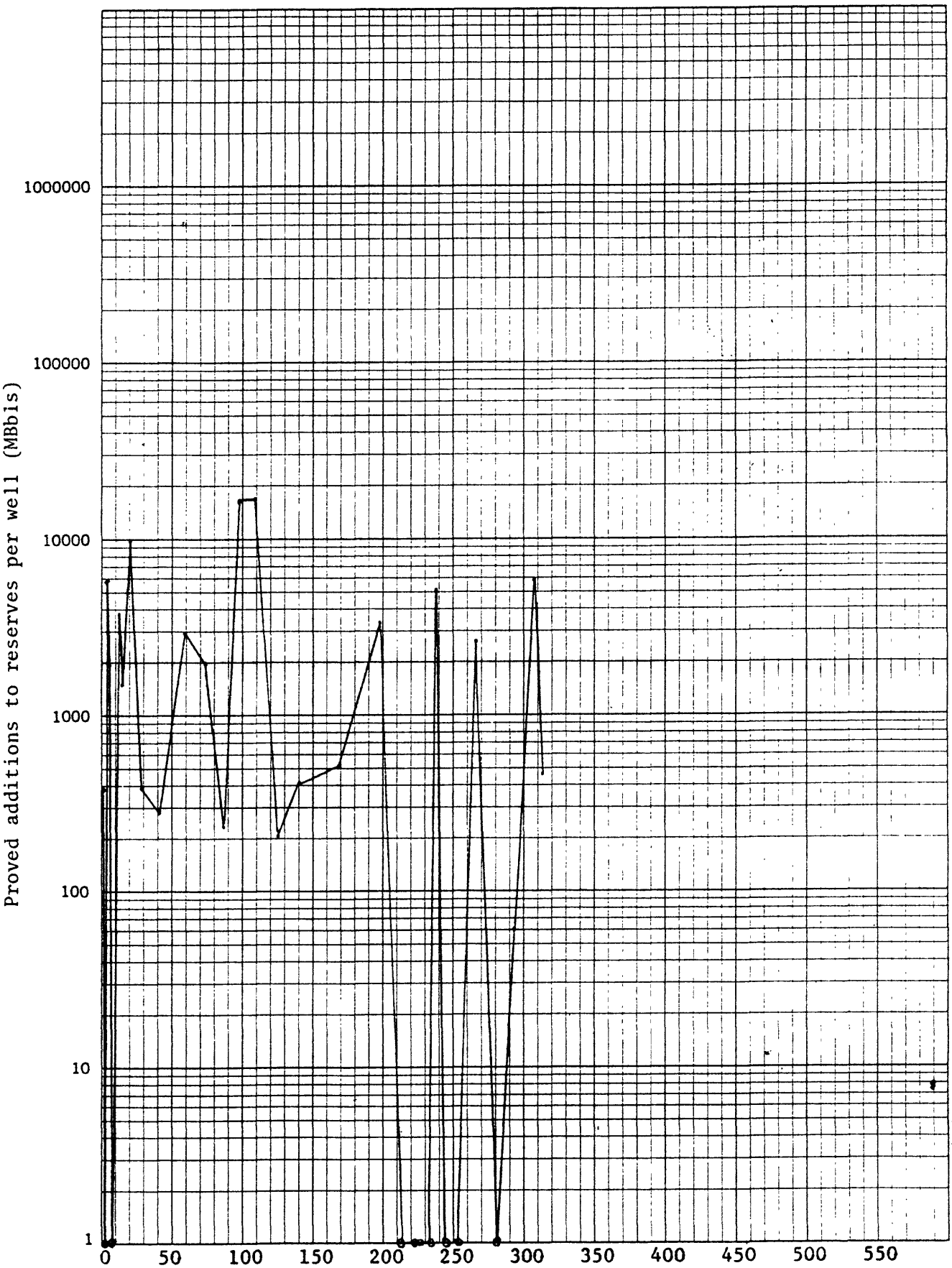
Ultimate crude oil recovery (MMBbls) vs cumulative exploratory wells completed



46 6463

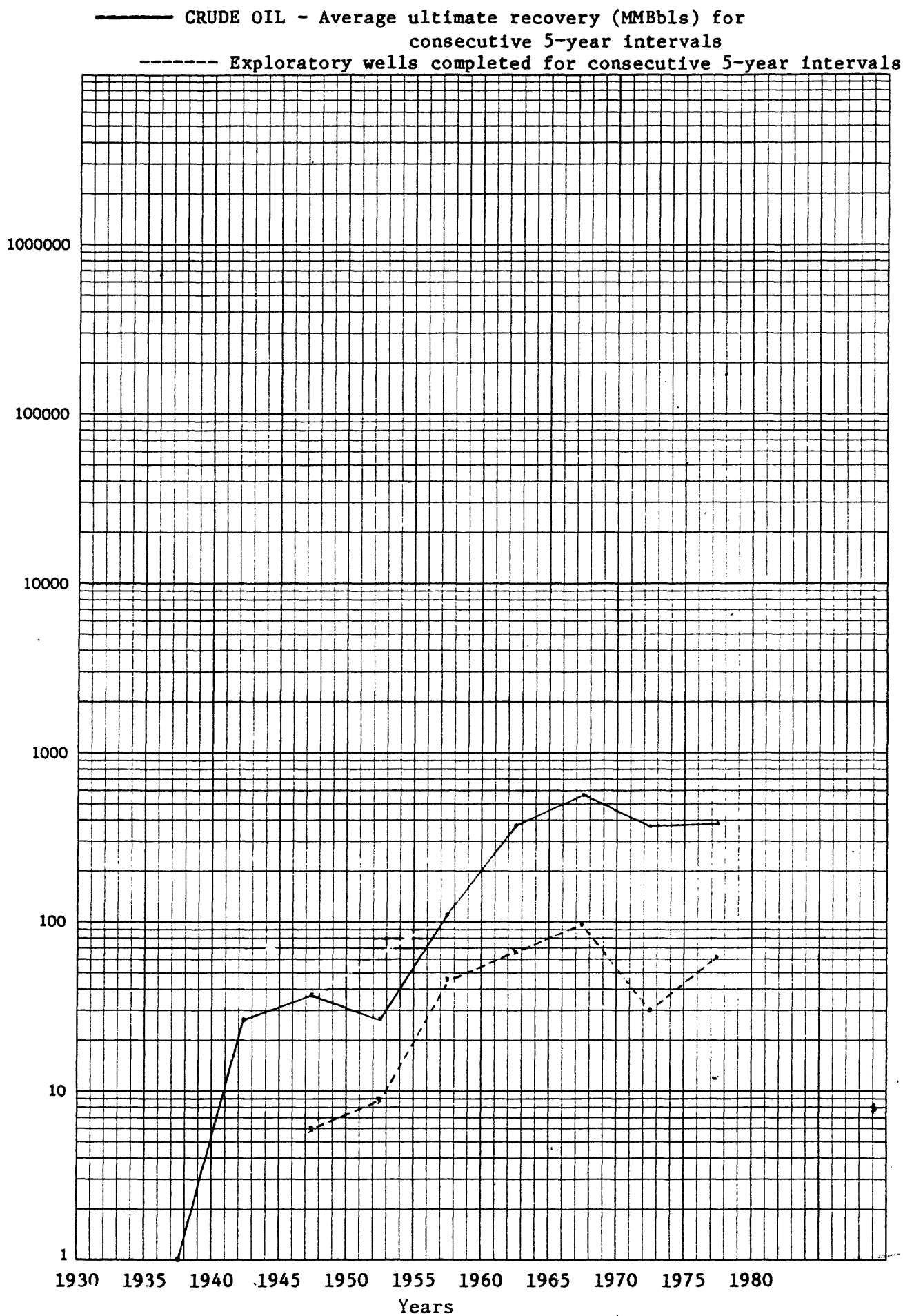
K+E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS KEUFFEL & ESSER CO. MADE IN U.S.A.

Proved additions to crude oil reserves per exploratory well completed (MBbls) vs cumulative exploratory wells completed

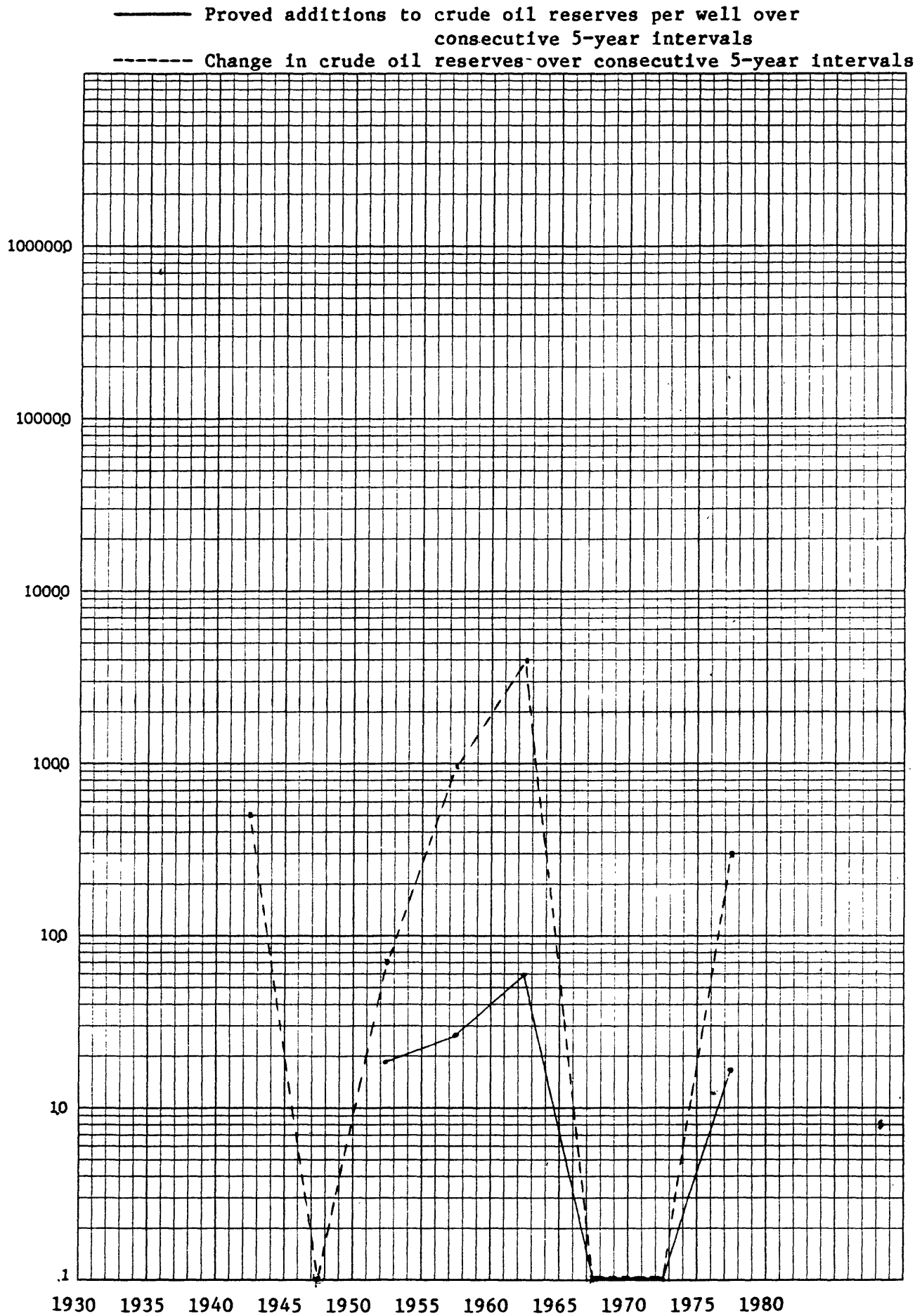


BOLIVIA

5 year period	Number of exploratory wells completed	Change in reserves (MMBbls)	Avg ultimate recovery (MMBbls)	Proved additions to reserves (MMBbls)	Proved additions to reserves by well (MMBbls)
1936-1940			1		
1941-1945		50	26	51	
1946-1950	6	-27	36	-25	-4.2
1951-1955	9	7	26	15	1.7
1956-1960	44	95	109	112	2.5
1961-1965	66	375	358	390	5.9
1966-1970	96	-200	555	-140	-1.5
1971-1975	30	-162	350	-84	-2.8
1976-1980	61	30	371	91	1.5



BOLIVIA



46 6463

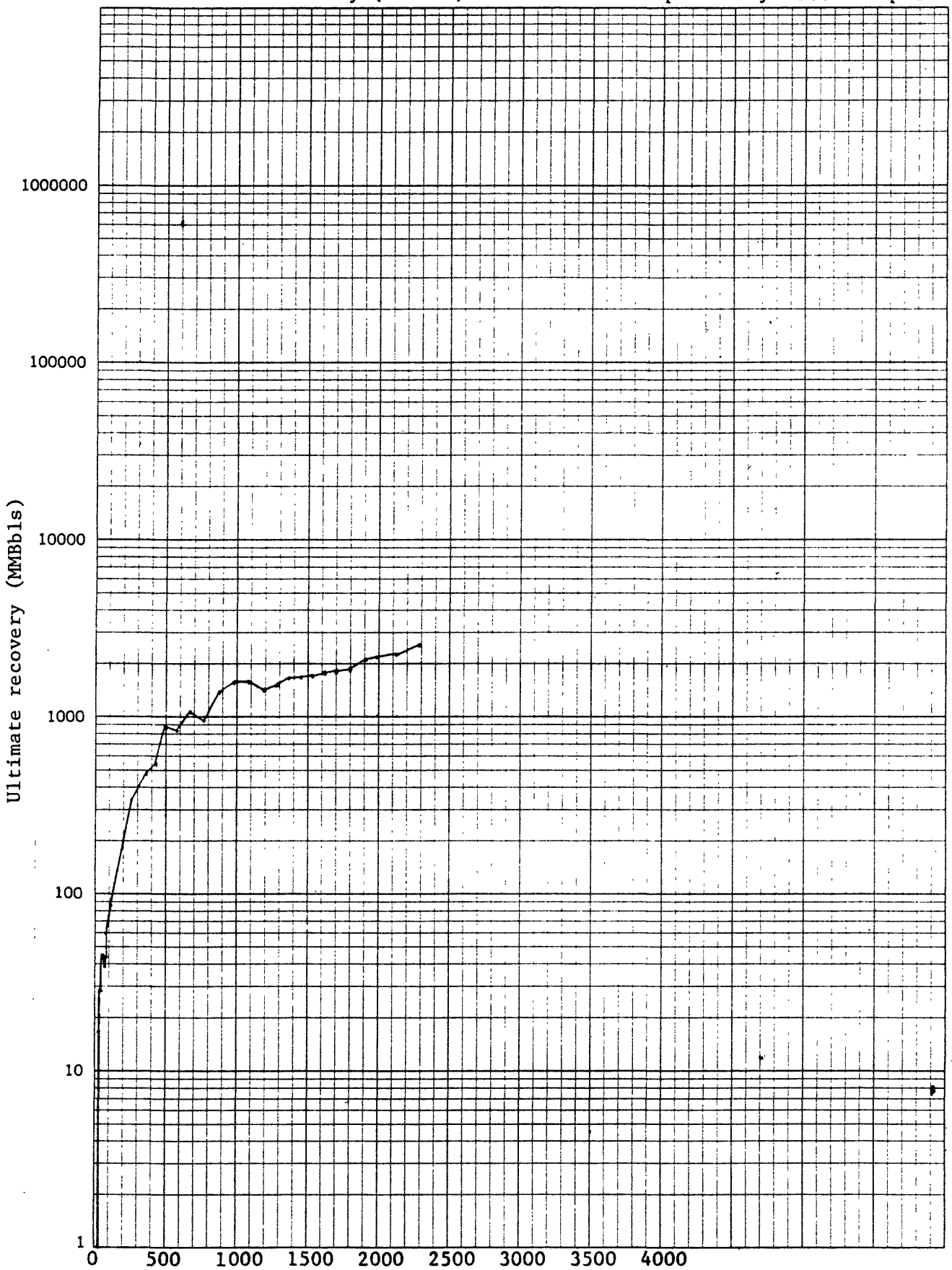
K+E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

BRAZIL

Year (y)	Exploratory wells completed (W_y) (AAPG)	Cumulative exploratory wells completed (CW_y)	Reserves - MMBbls (R_y) (D/M)	Crude production MBbls (P_y) (D/M, WO)	Ultimate recovery rounded MMBbls ($CP_y + R_{y+1}$)	Cumulative production rounded MMBbls (CP_y)	Change in reserves (R_{y+1}) - R_y) = ΔR_y MBbls	Proved additions to reserves MBbls ($D_y = \Delta R_y + P_y$)	Proved additions to reserves per well MBbls (D_y/W_y)
1940				2					
1941				3					
1942				33					
1943				48	1		1,000	1,048	
1944			1	58					
1945				79	1		0	79	
1946			1	67	1		0	67	
1947	18	18	1	97	1		0	97	5
1948	3	21	1	144	16	1	14,000	14,144	4,715
1949	8	29	15	109	21	1	5,000	5,109	639
1950	6	35	20	339	27	1	6,000	6,339	1,057
1951	4	39	26	691	27	2	-1,000	-309	-77
1952	4	43	25	750	42	2	15,000	15,750	3,938
1953	6	49	40	916	43	3	0	916	153
1954	6	55	40	993	39	4	-5,000	-4,007	-667
1955	10	65	35	2,022	41	6	0	2,022	202
1956	8	73	35	4,059	60	10	15,000	19,059	2,382
1957	38	111	50	10,106	843	21	772,000	782,106	20,582
1958	56	167	822	18,919		39			
1959	92	259		23,590	323	63	-562,000	-538,410	-5,852
1960	95	354	260	29,613	468	93	115,000	144,613	1,522
1961	76	430	375	34,815	527	127	25,000	59,815	787
1962	70	500	400	33,401	871	161	310,000	343,401	4,906
1963	89	589	710	35,710	824	197	-83,000	-47,290	-531
1964	86	675	627	33,313	1,030	230	173,000	206,313	2,399
1965	98	773	800	34,342	936	264	-128,000	-93,658	-956
1966	98	871	672	42,451	1,307	307	328,000	370,451	3,780
1967	110	981	1,000	53,515	1,460	360	100,000	153,515	1,396
1968	115	1,096	1,100	58,785	1,419	419	-100,000	-41,215	-358
1969	86	1,182	1,000	63,969	1,335	483	-148,000	-84,031	-977
1970	100	1,282	852	60,923	1,401	544	5,000	65,923	659
1971	87	1,369	857	63,513	1,462	607	-2,000	61,513	707
1972	80	1,449	855	61,088	1,466	668	-57,000	4,088	51
1973	78	1,527	798	62,122	1,505	731	-24,000	38,122	489
1974	86	1,613	774	64,751	1,574	795	5,000	69,751	811
1975	87	1,700	779	62,766	1,641	858	4,000	66,766	767
1976	105	1,805	783	61,026	1,774	919	72,000	133,026	1,267
1977	100	1,905	855	58,686	2,072	978	239,000	297,686	2,977
1978	89	1,994	1,094	58,400	2,162	1,036	32,000	90,400	1,016
1979	134	2,128	1,126	61,358	2,346	1,098	122,000	183,358	1,368
1980	166	2,294	1,248	66,437	2,482	1,164	70,000	136,437	822
1981			1,318						

BRAZIL

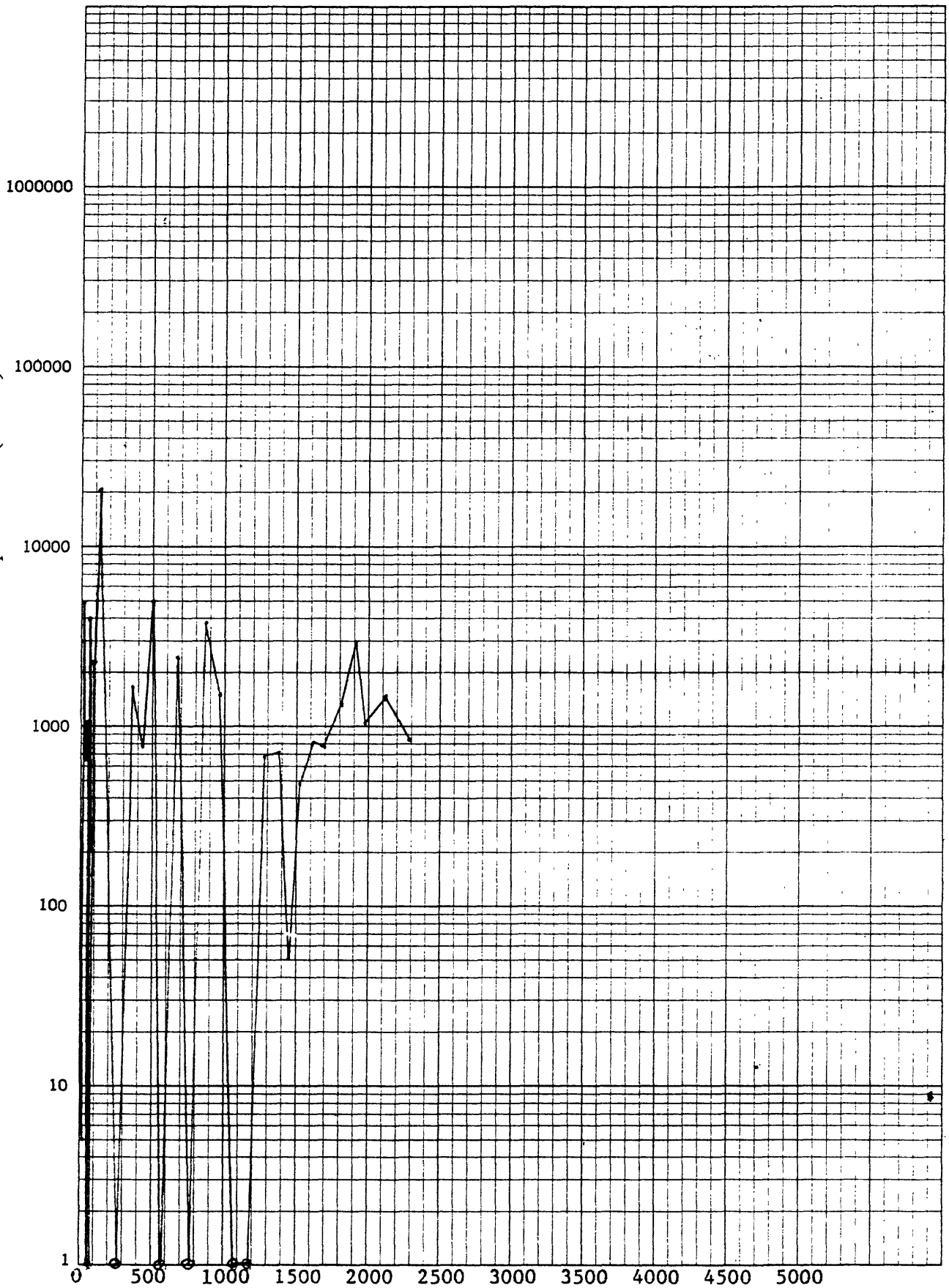
Ultimate crude oil recovery (MMBbls) vs cumulative exploratory wells completed



46 6463

SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

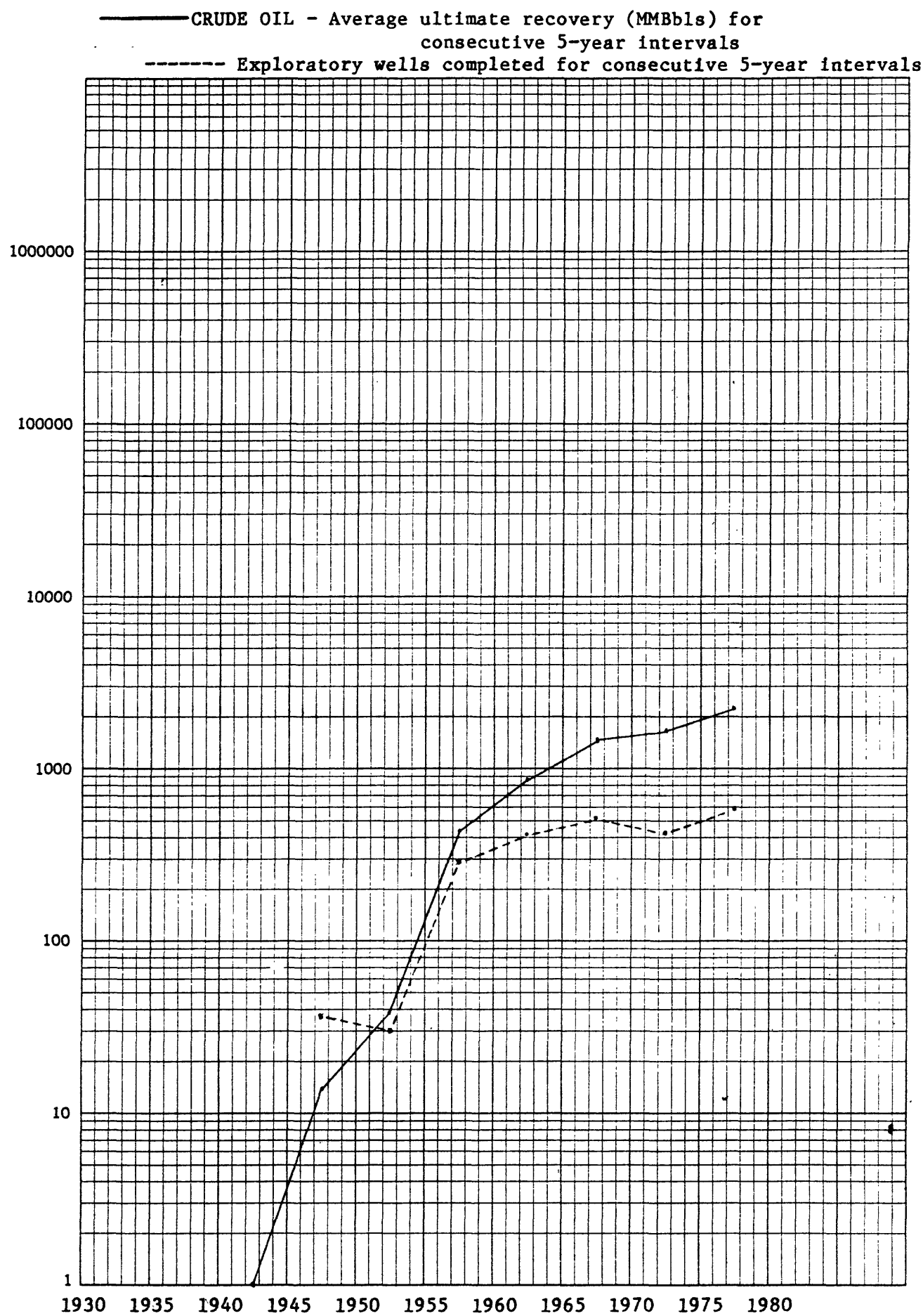
Proved additions to crude oil reserves per exploratory well completed (MBbls) vs cumulative exploratory wells completed



BRAZIL

5 year period	Number of exploratory wells completed	Change in reserves (MMBbls)	Avg ultimate recovery (MMBbls)	Proved additions to reserves (MMBbls)	Proved additions to reserves by well (MMBbls)
1936-1940					
1941-1945		1	1	1	
1946-1950	35	25	13	25	.7
1951-1955	30	9	38	15	.5
1956-1960	289	340	424	408	1.4
1961-1965	419	297	838	468	1.1
1966-1970	509	185	1,384	465	.9
1971-1975	418	-74	1,530	241	.6
1976-1980	594	535	2,167	840	1.4

BRAZIL

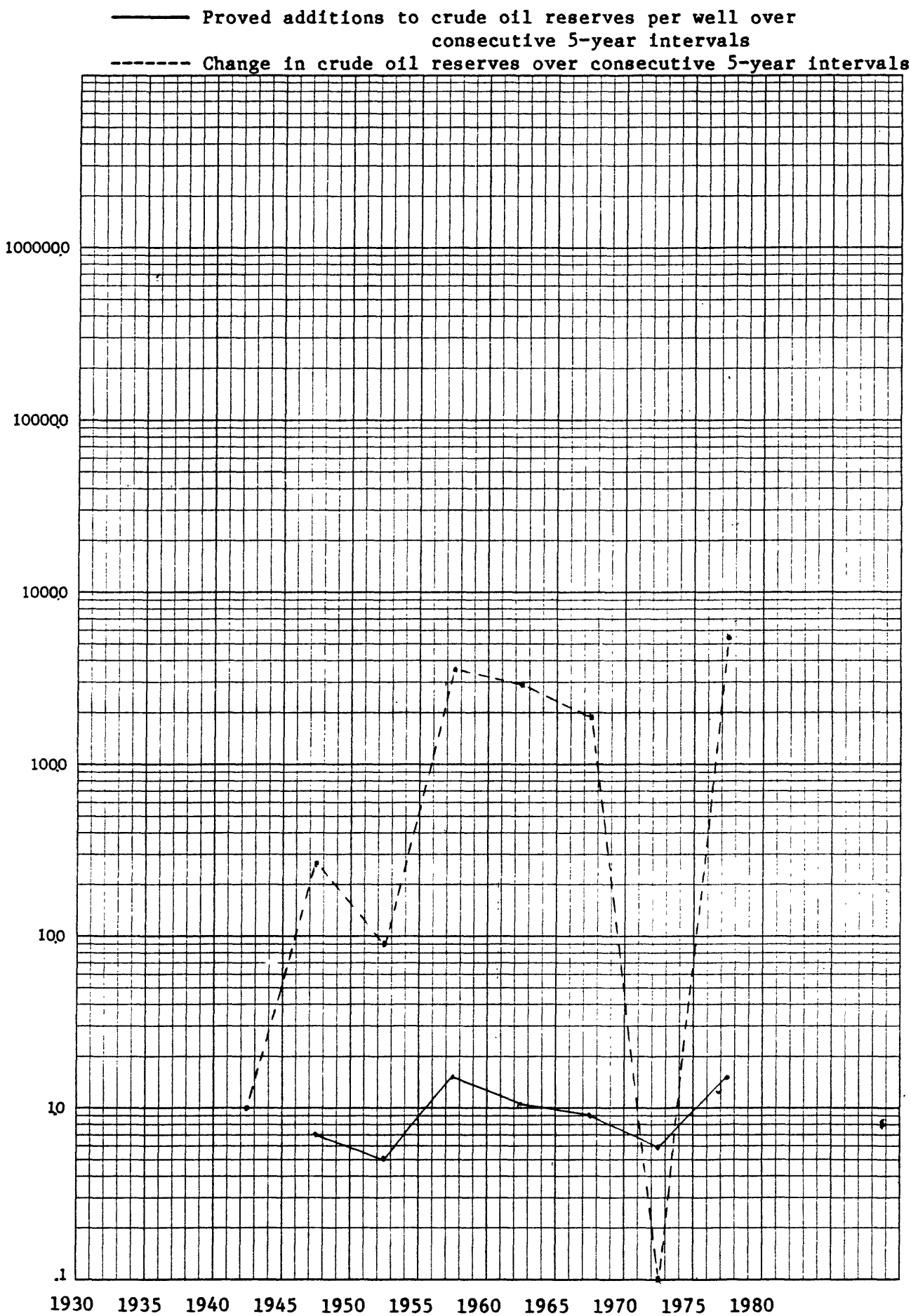


46 6463

SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

K·E

BRAZIL



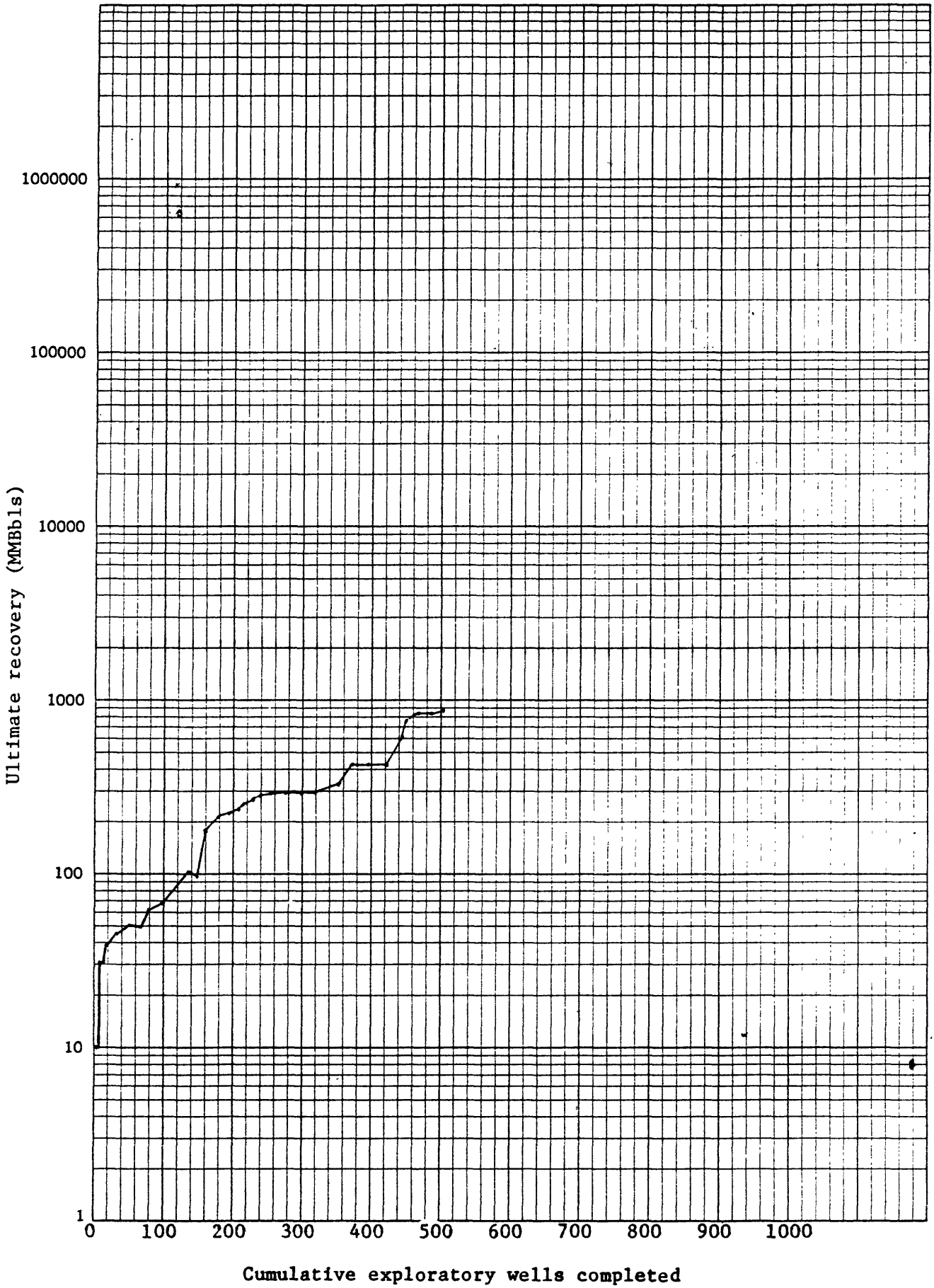
46 6463

K•E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

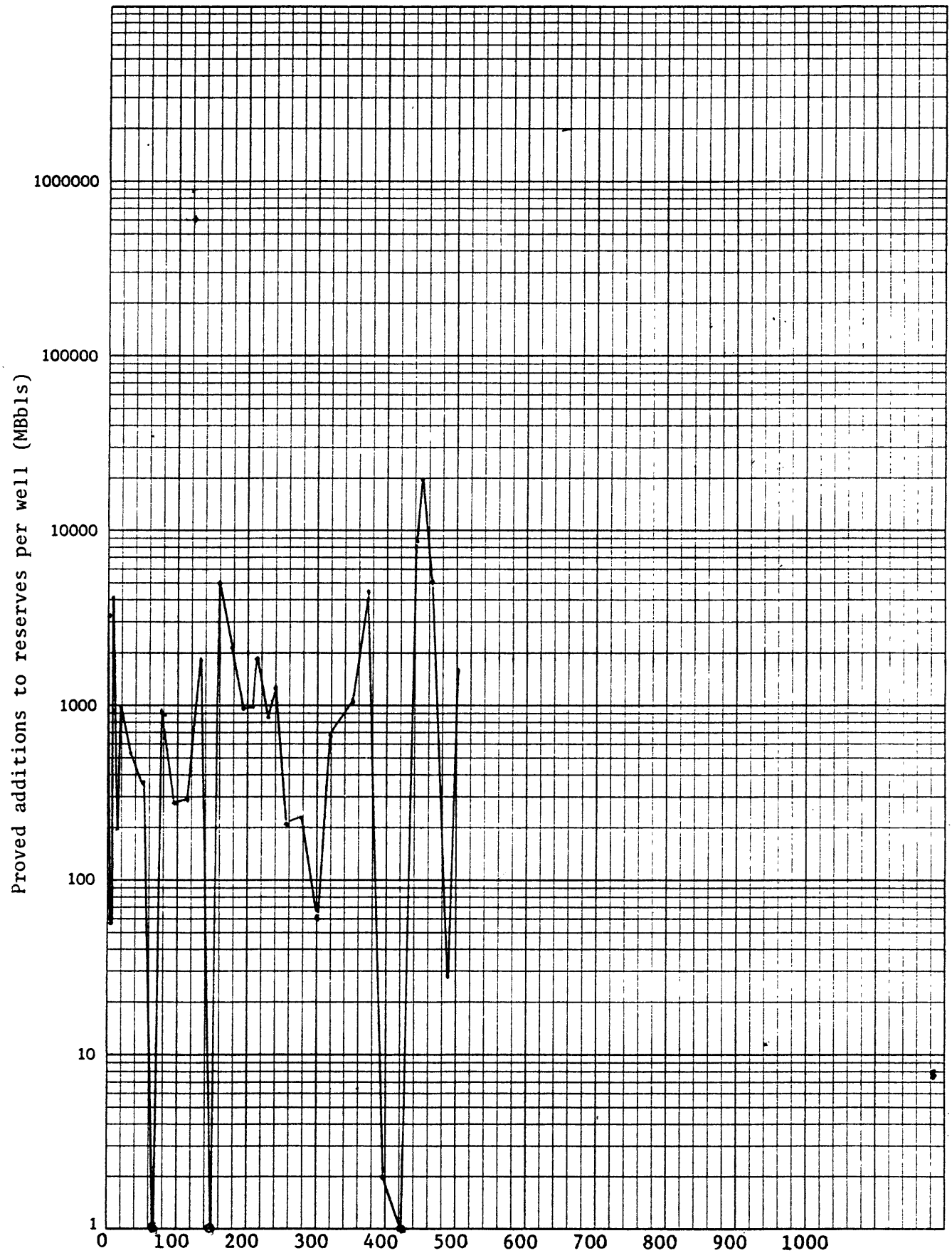
CHILE

Year (y)	Exploratory wells completed (W_y) (AAPG)	Cumulative exploratory wells completed (CW_y)	Reserves - MMBbls (R_y) (D/M)	Crude production MBbls (P_y) (D/M, WO)	Ultimate recovery rounded MMBbls ($CP_y + R_{y+1}$)	Cumulative production rounded MMBbls (CP_y)	Change in reserves ($R_{y+1} - R_y$) = ΔR_y MBbls	Proved additions to reserves MBbls ($D_y = \Delta R_y + P_y$)	Proved additions to reserves per well MBbls (D_y/W_y)
1941									
1942									
1943									
1944									
1945									
1946									
1947	0	0					400	400	
1948	3	3			10		9,600	9,600	3,200
1949	1	4	10	55	10		0	55	55
1950	5	9	10	629	31	1	20,000	20,629	4,126
1951	4	13	30	760	31	1	0	760	190
1952	6	19	30	910	37	2	5,000	5,910	985
1953	12	31	35	1,258	44	4	5,000	6,258	522
1954	20	51	40	1,736	50	5	5,000	6,736	337
1955	13	64	45	2,577	48	8	-5,000	-2,423	-186
1956	15	79	40	3,542	61	11	10,000	13,542	903
1957	17	96	50	4,337	66	16	0	4,337	255
1958	20	116	50	5,568		21		5,568	278
1959	19	135		6,428	103	28	25,000	31,428	1,654
1960	11	146	75	7,231	95	35	-15,000	-7,769	-706
1961	14	160	60	9,263	164	44	60,000	69,263	4,947
1962	19	179	120	11,689	206	56	30,000	41,689	2,194
1963	14	193	150	13,206	219	69	0	13,206	943
1964	14	207	150	13,687	233	83	0	13,687	978
1965	8	215	150	12,704	246	96	0	12,704	1,588
1966	15	230	150	12,429	258	108	0	12,429	829
1967	10	240	150	12,369	270	120	0	12,369	1,237
1968	17	257	150	13,696	274	134	-10,000	3,696	217
1969	19	276	140	13,350	279	147	-9,000	4,350	229
1970	24	300	131	12,432	280	160	-11,000	1,432	60
1971	20	320	120	12,883	293	173	0	12,883	644
1972	33	353	120	12,527	329	185	24,000	36,527	1,107
1973	20	373	144	11,429	417	197	76,000	87,429	4,371
1974	25	398	220	10,055	417	207	-10,000	55	2
1975	23	421	210	8,946	417	216	-9,000	-54	-2
1976	22	443	201	8,372	612	224	187,000	195,372	8,880
1977	7	450	388	8,030	747	232	127,000	135,030	19,290
1978	14	464	515	7,284	817	239	63,000	70,284	5,020
1979	22	486	578	8,582	817	247	-8,000	582	26
1980	16	502	570	12,821	841	261	10,000	22,821	1,426
1981			580						

Ultimate crude oil recovery (MMBbls) vs cumulative exploratory wells completed



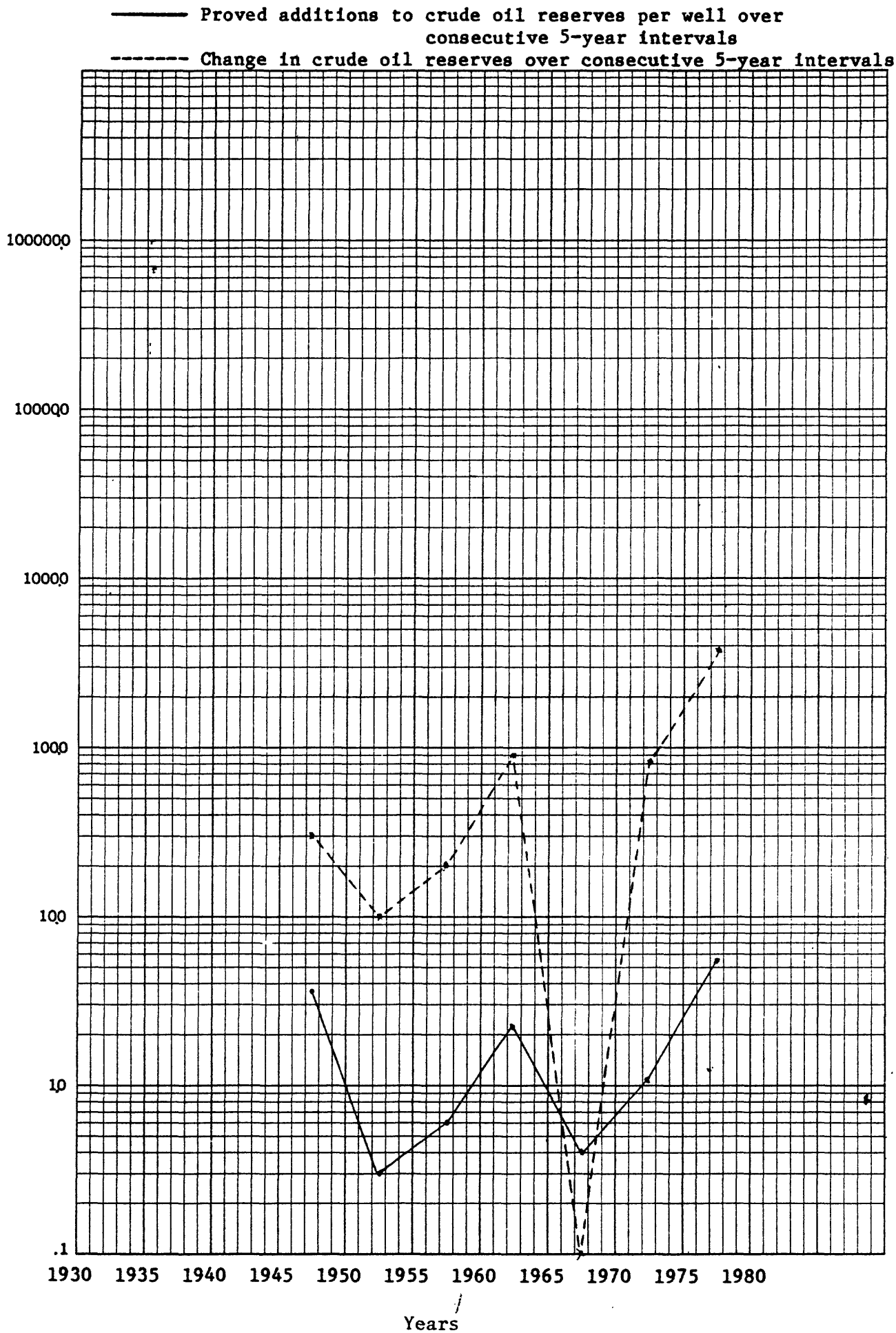
Proved additions to crude oil reserves per exploratory well completed (MBbls) vs cumulative exploratory wells completed



CHILE

5 year period	Number of exploratory wells completed	Change in reserves (MMBbls)	Avg ultimate recovery (MMBbls)	Proved additions to reserves (MMBbls)	Proved additions to reserves by well (MMBbls)
1936-1940					
1941-1945					
1946-1950	9	30	17	31	3.4
1951-1955	55	10	42	18	.3
1956-1960	82	20	81	47	.6
1961-1965	69	90	214	151	2.2
1966-1970	85	-30	272	33	.4
1971-1975	121	81	375	137	1.1
1976-1980	81	379	767	424	5.2

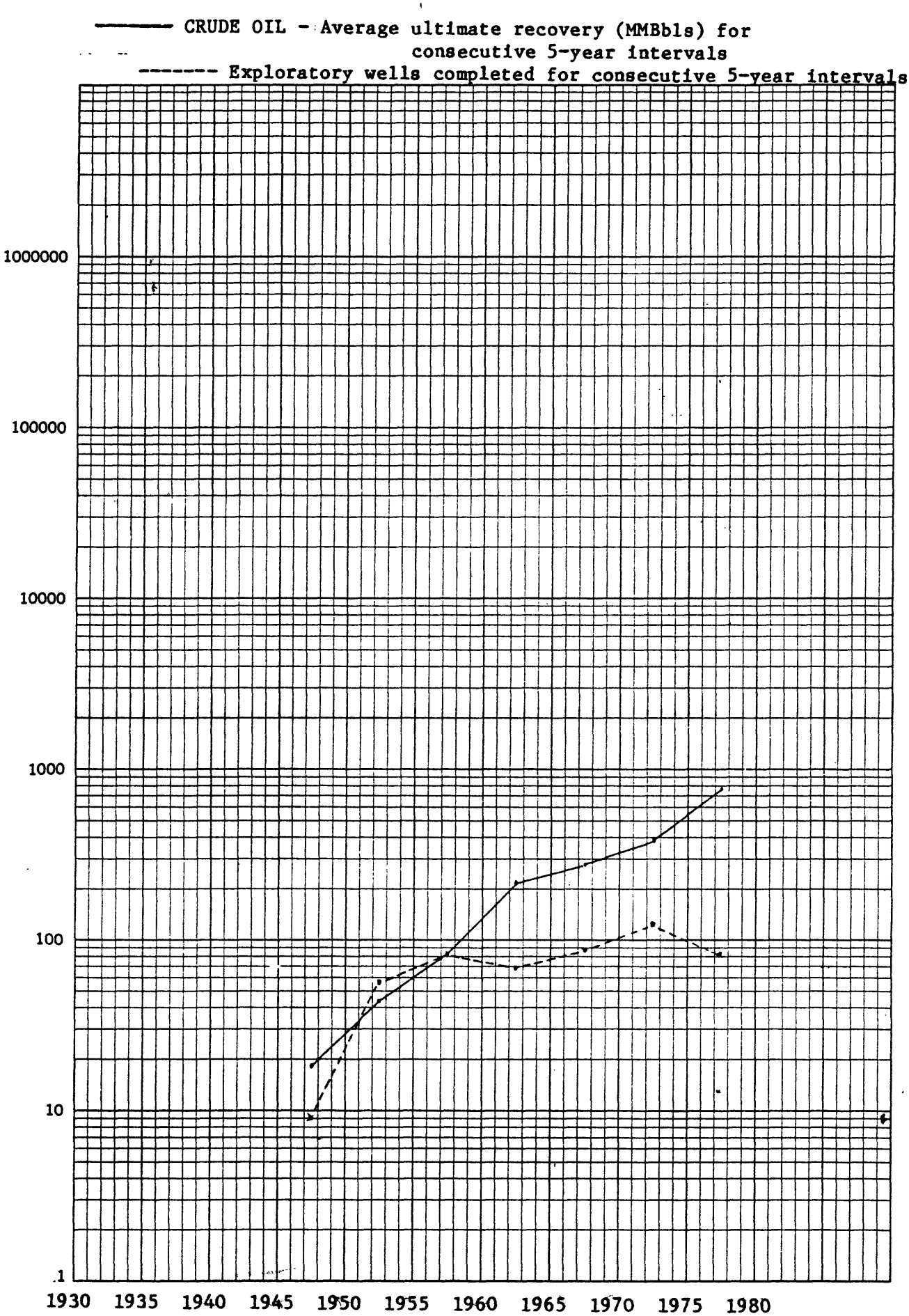
CHILE



46 6463

K•E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS KEUFFEL & ESSER CO. MADE IN U.S.A.

CHILE



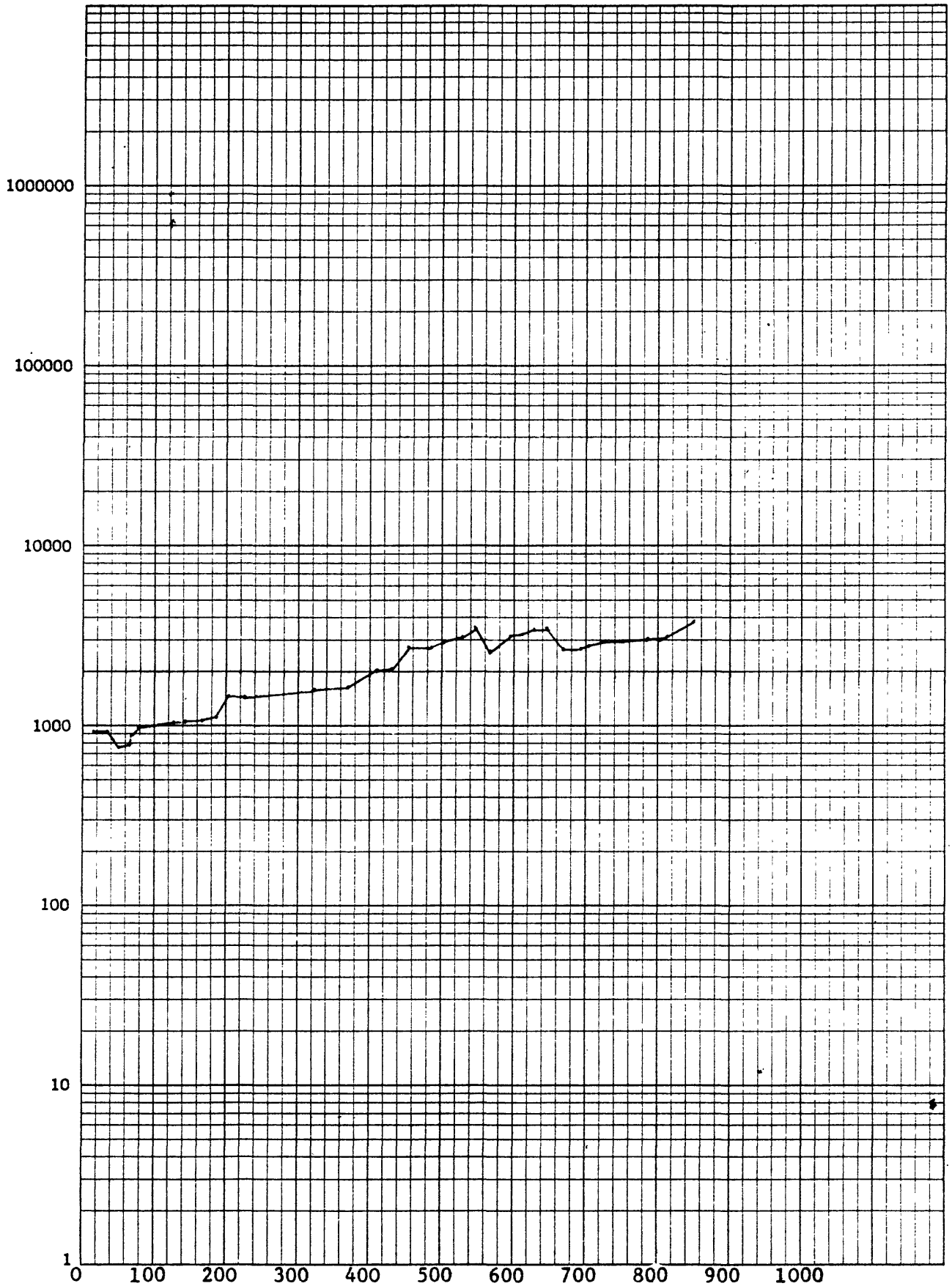
46 6463

K•E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS KEUFFEL & ESSER CO. MADE IN U.S.A.

Year (y)	Exploratory wells completed (W_y) (AAPG)	Cumulative exploratory wells completed (CW_y)	Reserves = MMBbls (R_y) (D/M)	Crude production MMbls (P_y) (D/M, WO)	Ultimate recovery rounded MMBbls ($CP_y + R_{y+1}$)	Cumulative production rounded MMBbls (CP_y)	Change in reserves ($R_{y+1} - R_y$) = ΔR_y MBbls	Proved additions to reserves MBbls ($D_y = \Delta R_y + P_y$)	Proved additions to reserves per well MBbls (D_y/W_y)
1921				67					
1922				323					
1923				425	1	1			
1924				445	1	1			
1925				1,007	2	2			
1926				6,444	9	9			
1927				15,014	24	24			
1928				19,897	44	44			
1929				20,385	64	64			
1930				20,346	84	84			
1931				18,237	103	103			
1932				16,414	119	119			
1933				13,158	132	132			
1934				17,341	150	150			
1935				17,598	167	167			
1936				18,756	186	186			
1937				20,599	206	206			
1938				21,582	228	228			
1939				23,857	252	252			
1940				25,593	277	277			
1941				24,553	302	302			
1942				10,487	313	313			
1943				13,261	826	326	500,000	513,261	
1944			500	22,291		348		22,291	
1945				22,449	871	371	0	22,449	
1946	16	16	500	22,118	918	393	25,000	47,118	2,945
1947	19	35	525	24,794	917	417	-25,000	-206	11
1948	15	50	500	23,792	741	441	-200,000	-176,208	-11,747
1949	15	65	300	29,722	771	471	0	29,722	1,981
1950	4	69	300	34,060	880	505	75,000	109,060	27,265
1951	8	77	375	38,398	943	543	25,000	63,398	7,925
1952	50	127	400	38,638	1,057	582	75,000	113,638	2,273
1953	14	141	475	39,431	1,021	621	-75,000	-35,569	-2,541
1954	24	165	400	39,981	1,111	661	50,000	89,981	3,749
1955	20	185	450	39,711	1,226	701	75,000	114,711	5,735
1956	18	203	525	44,968	1,496	746	225,000	269,968	14,998
1957	26	229	750	45,744	1,492	792	-50,000	-4,256	-164
1958	32	261	700	46,901		839			
1959	60	321		53,576	1,542	892	-50,000	3,576	60
1960	50	371	650	55,770	1,573	948	-25,000	30,770	615
1961	39	410	625	53,247	2,001	1,001	375,000	428,247	10,981
1962	20	430	1,000	51,918	2,053	1,053	0	51,918	2,596
1963	22	452	1,000	60,343	2,614	1,114	500,000	560,343	25,470
1964	30	482	1,500	62,596	2,676	1,176	0	62,596	2,087
1965	20	502	1,500	72,670	2,949	1,249	200,000	272,670	13,634
1966	24	526	1,700	71,431	3,120	1,320	100,000	171,431	7,143
1967	18	544	1,800	68,877	3,389	1,389	200,000	268,877	14,938
1968	21	565	2,000	63,673	2,483	1,453	-970,000	-906,327	-43,158
1969	30	595	1,030	76,776	3,130	1,530	570,000	646,776	21,559
1970	16	611	1,600	80,050	3,190	1,610	-20,000	60,050	3,753
1971	17	628	1,580	78,101	3,314	1,689	46,000	124,101	7,300
1972	20	648	1,626	71,674	3,357	1,759	-28,000	43,674	2,184
1973	20	668	1,598	66,844	2,514	1,826	-910,000	-843,156	-42,158
1974	24	692	688	60,867	2,514	1,887	-61,000	-133	-6
1975	14	706	627	57,685	2,575	1,945	3,000	60,685	4,335
1976	21	727	630	53,376	2,929	1,998	301,000	354,376	16,875
1977	27	754	931	50,735	2,828	2,049	-152,000	-101,265	-3,751
1978	29	783	779	47,450	3,009	2,096	125,000	172,450	5,947
1979	30	813	904	45,851	3,101	2,142	55,000	100,851	3,362
1980	34	847	959	45,516	2,704	2,188	-443,000	-397,484	-11,691
1981			516						

COLOMBIA

Ultimate crude oil recovery (MMBbls) vs cumulative exploratory wells completed

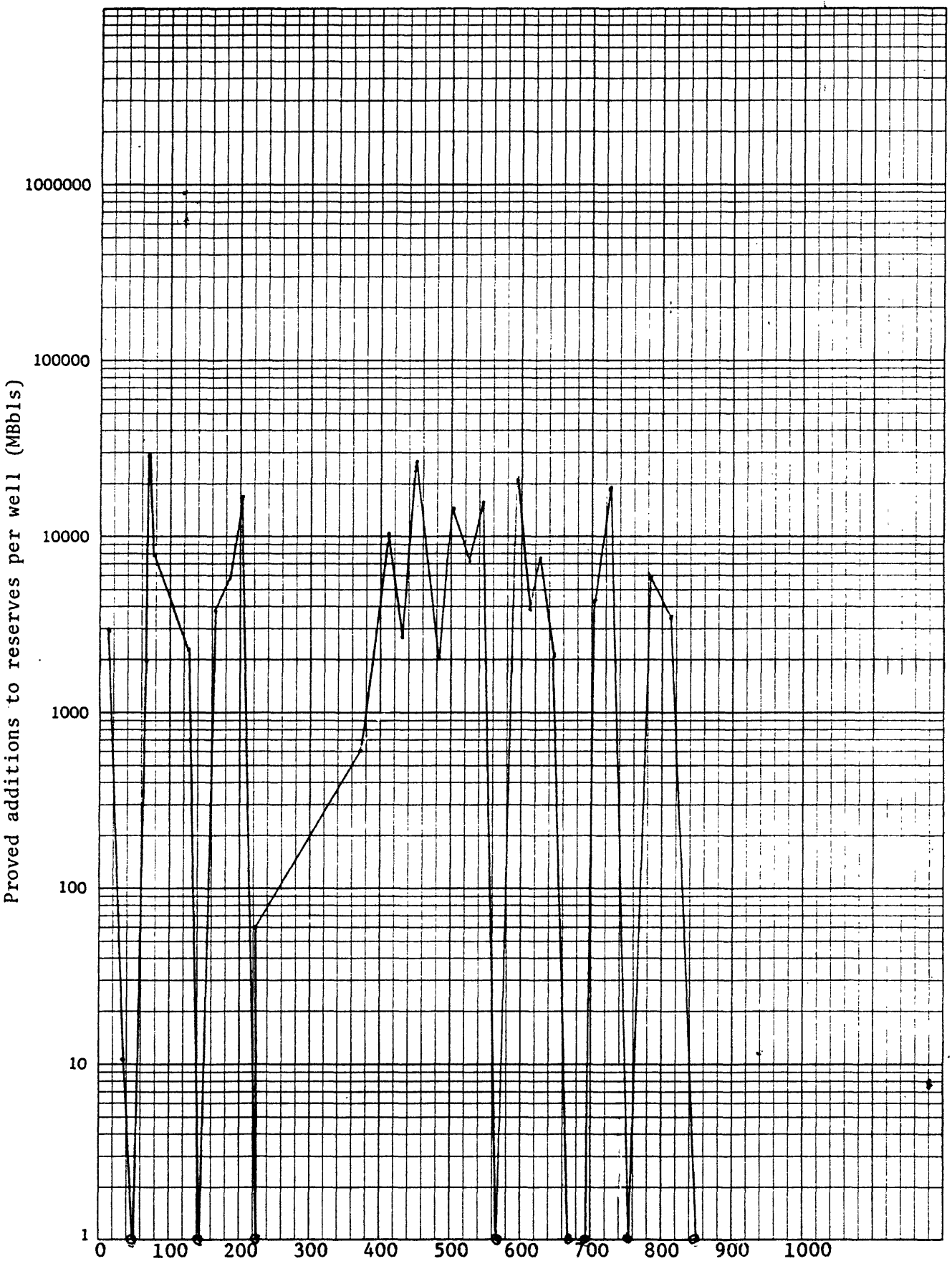


46 6463

K+E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS KEUFFEL & ESSER CO. MADE IN U.S.A.

COLOMBIA

Proved additions to crude oil reserves per exploratory well completed (MBbls) vs cumulative exploratory wells completed



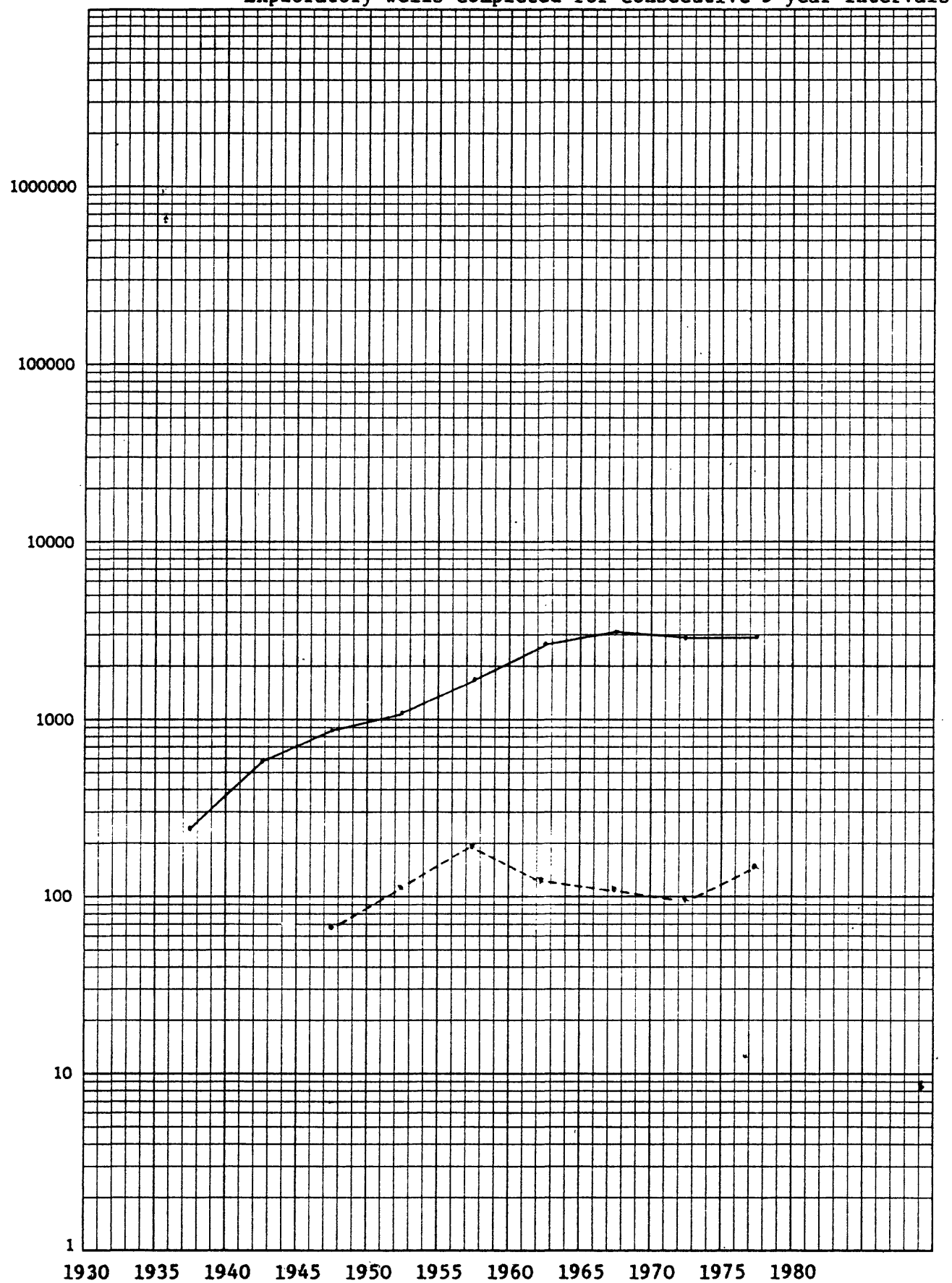
46 6463

SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

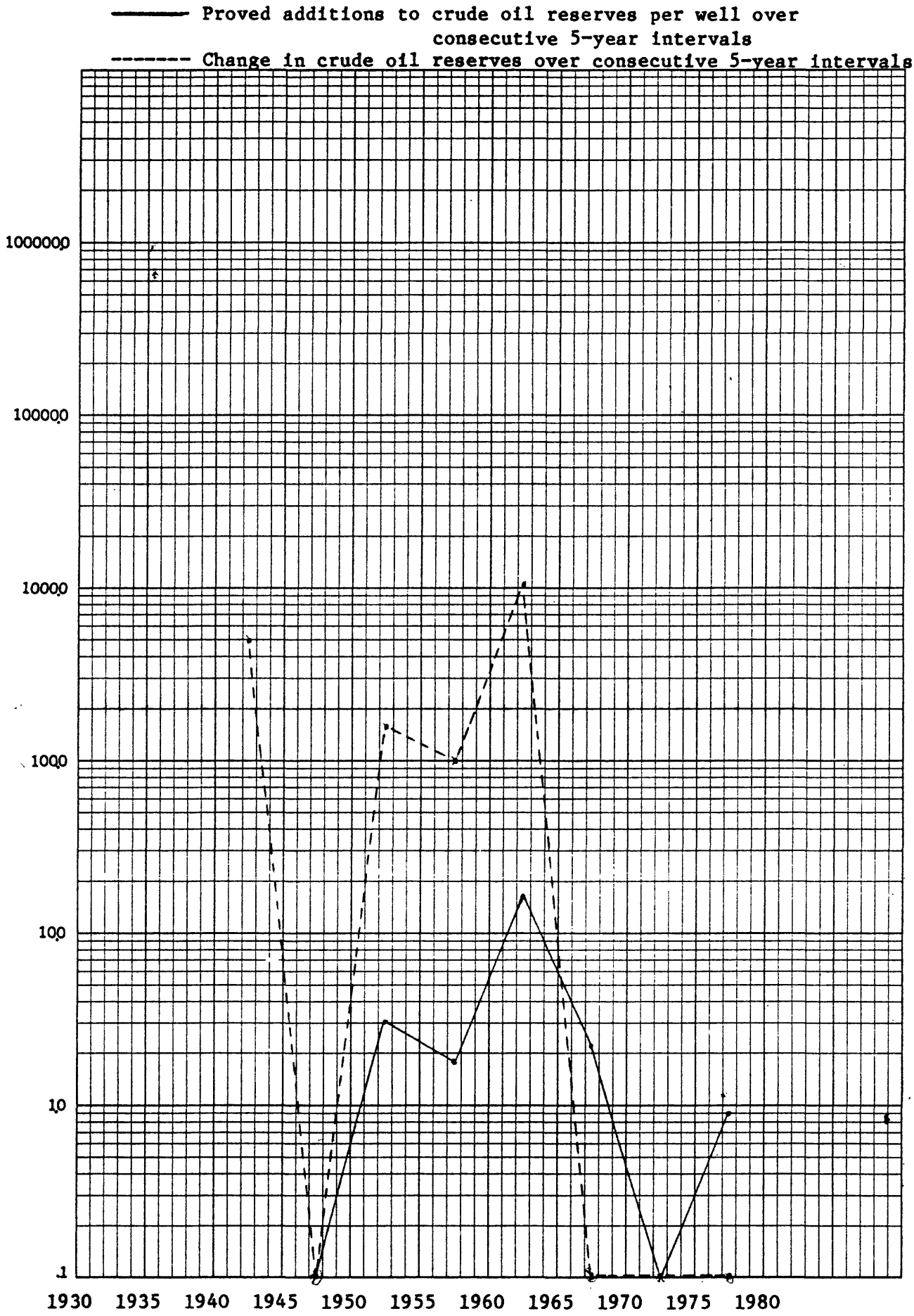
COLOMBIA

5 year period	Number of exploratory wells completed	Change in reserves (MMBbls)	Avg ultimate recovery (MMBbls)	Proved additions to reserves (MMBbls)	Proved additions to reserves by well (MMBbls)
1936-1940			230		
1941-1945		500	578	557	
1946-1950	69	-125	845	10	.1
1951-1955	116	150	1,072	346	3.0
1956-1960	186	100	1,526	301	1.6
1961-1965	131	1,075	2,459	1,376	10.5
1966-1970	109	-120	3,062	241	2.2
1971-1975	95	-950	2,855	-614	-6.5
1976-1980	141	-114	2,912	129	.9

COLOMBIA


CRUDE OIL - Average ultimate recovery (MMBbls) for consecutive 5-year intervals
Exploratory wells completed for consecutive 5-year intervals
1000000
100000
10000
1000
100
10
1
1930
1935
1940
1945
1950
1955
1960
1965
1970
1975
1980
Years
46 6463
SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.
K•E

COLOMBIA



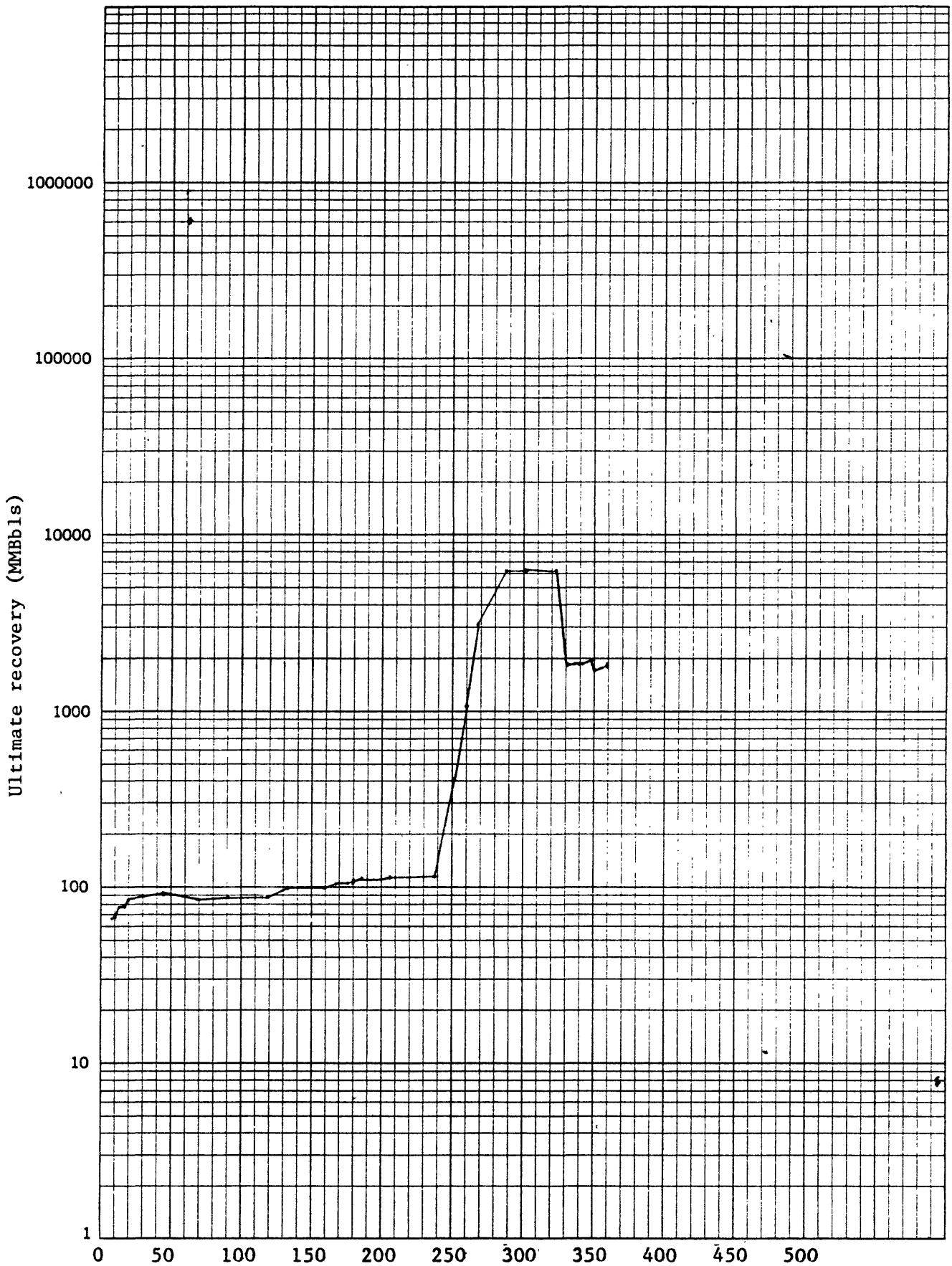
46 6463

K•E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS KEUFFEL & ESSER CO. MADE IN U.S.A.

Year (y)	Exploratory wells completed (W_y) (AAPG)	Cumulative exploratory wells completed (CW_y)	Reserves - MMBbls (R_y) (D/M)	Crude production MBbls (P_y) (D/M, WO)	Ultimate recovery rounded MMBbls ($CP_y + R_{y+1}$)	Cumulative production rounded MMBbls (CP_y)	Change in reserves ($R_{y+1} - R_y$) = ΔR_y MBbls	Proved additions to reserves MBbls ($D_y = \Delta R_y + P_y$)	Proved additions to reserves per well MBbls (D_y/W_y)
1917				57					
1918				60					
1919				60					
1920				60					
1921				60					
1922				60					
1923				87					
1924				100	1	1			
1925				160	1	1			
1926				214	1	1			
1927				537	1	1			
1928				1,084	3	3			
1929				1,381	4	4			
1930				1,553	5	5			
1931				1,762	7	7			
1932				1,597	9	9			
1933				1,620	10	10			
1934				1,637	12	12			
1935				1,732	14	14			
1936				1,942	16	16			
1937				2,161	18	18			
1938				2,246	20	20			
1939				2,313	22	22			
1940				2,349	25	25			
1941				1,557	26	26			
1942				2,278	29	29			
1943				2,315	76	31	45,000	47,315	
1944			45	2,967		34		2,967	
1945				2,664	62	37	-20,000	17,336	
1946	7	7	25	2,323	64	39	0	2,323	332
1947	3	10	25	2,282	66	41	0	2,282	761
1948	3	13	25	2,563	74	44	5,000	7,563	2,521
1949	1	14	30	2,617	74	46	-3,000	-383	-383
1950	2	16	28	2,632	75	49	-2,000	632	316
1951	4	20	26	2,708	82	52	4,000	6,708	1,677
1952	25	45	30	2,839	90	55	5,000	7,839	314
1953	24	69	35	3,040	84	58	-9,000	-5,960	-248
1954	23	92	26	3,146	87	61	0	3,146	137
1955	26	118	26	3,599	88	64	-2,000	1,599	62
1956	16	134	24	3,420	98	68	6,000	9,420	589
1957	25	159	30	3,191	96	71	-5,000	-1,809	72
1958	3	162	25	3,108		74		3,108	1,036
1959	6	168		2,759	102	77	0	2,759	460
1960	8	176	25	2,730	105	80	0	2,730	341
1961	4	180	25	2,926	107	82	0	2,926	732
1962	0	180	25	2,573	105	85	-5,000	-2,427	
1963	0	180	20	2,465	108	88	0	2,465	
1964	6	186	20	2,796	115	90	5,000	7,796	1,299
1965	21	207	25	2,849	118	93	0	2,849	136
1966	31	238	25	2,660	121	96	0	2,660	86
1967	14	252	25	2,183	408	98	6,000	8,183	584
1968	8	260	310	1,815	1,100	100	969,000	970,815	121,351
1969	8	268	1,000	1,567	3,101	101	2,000,000	2,001,567	250,195
1970	20	288	3,000	1,444	6,103	103	3,000,000	3,001,444	150,072
1971	15	303	6,000	1,354	6,175	104	71,000	72,354	4,824
1972	20	323	6,071	28,579	6,097	133	-107,000	-78,421	3,921
1973	8	331	5,964	76,221	1,709	209	-4,464	71,757	8,970
1974	5	336	1,500	63,678	1,718	273	-55	63,623	12,724
1975	3	339	1,445	58,753	1,718	331	-58	58,695	19,565
1976	3	342	1,387	68,362	1,719	400	-68	68,294	22,765
1977	5	347	1,319	66,954	1,967				
1978	3	350	1,500	74,825	1,653	467	181	67,135	13,427
1979	9	359	1,111	78,375	1,713	542	-389	74,436	24,812
1980			1,093	78,825	1,749	620	-18	78,357	8,706
1981			1,050			699	-43	78,782	

ECUADOR

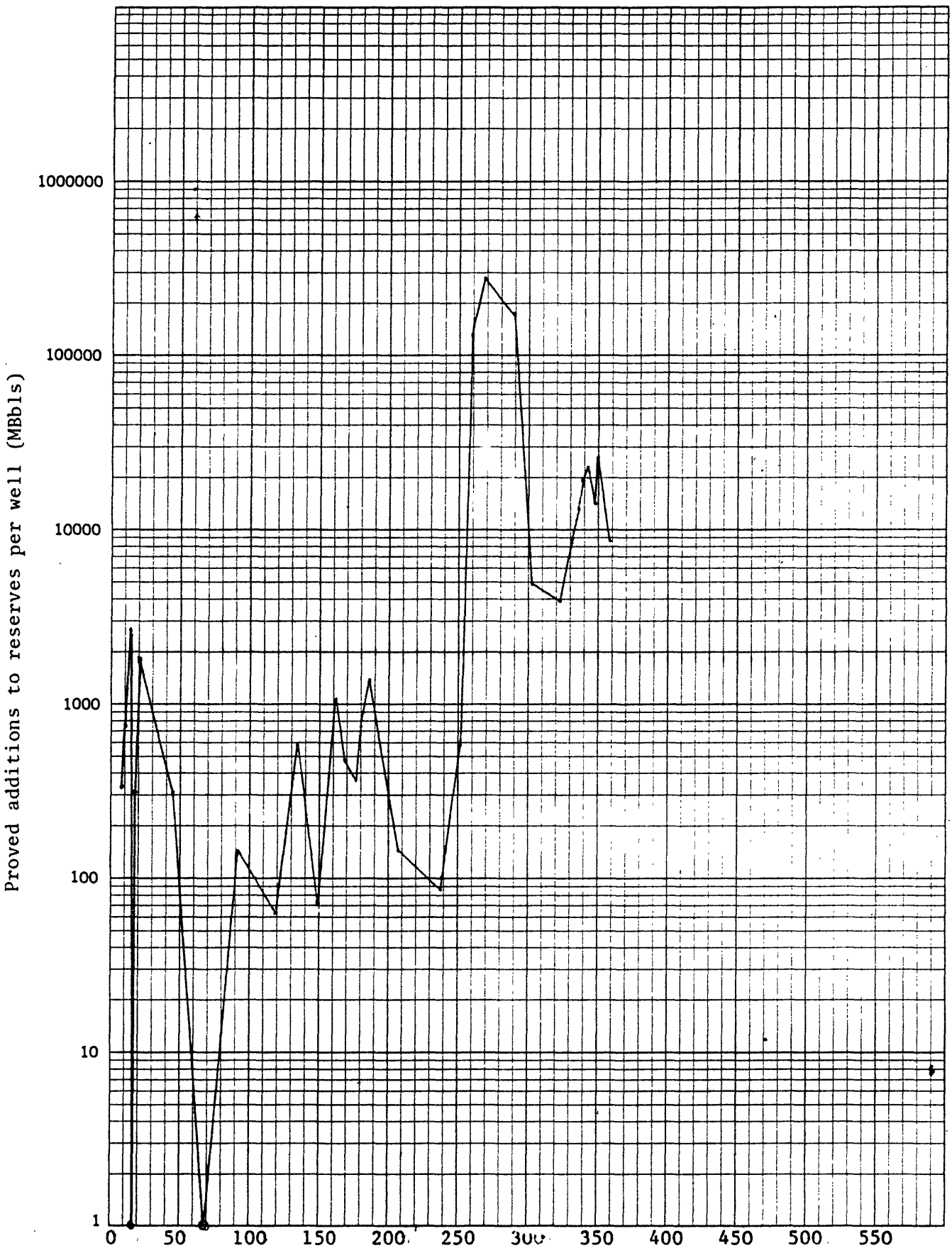
Ultimate crude oil recovery (MMBbls) vs cumulative exploratory wells completed



46 6463

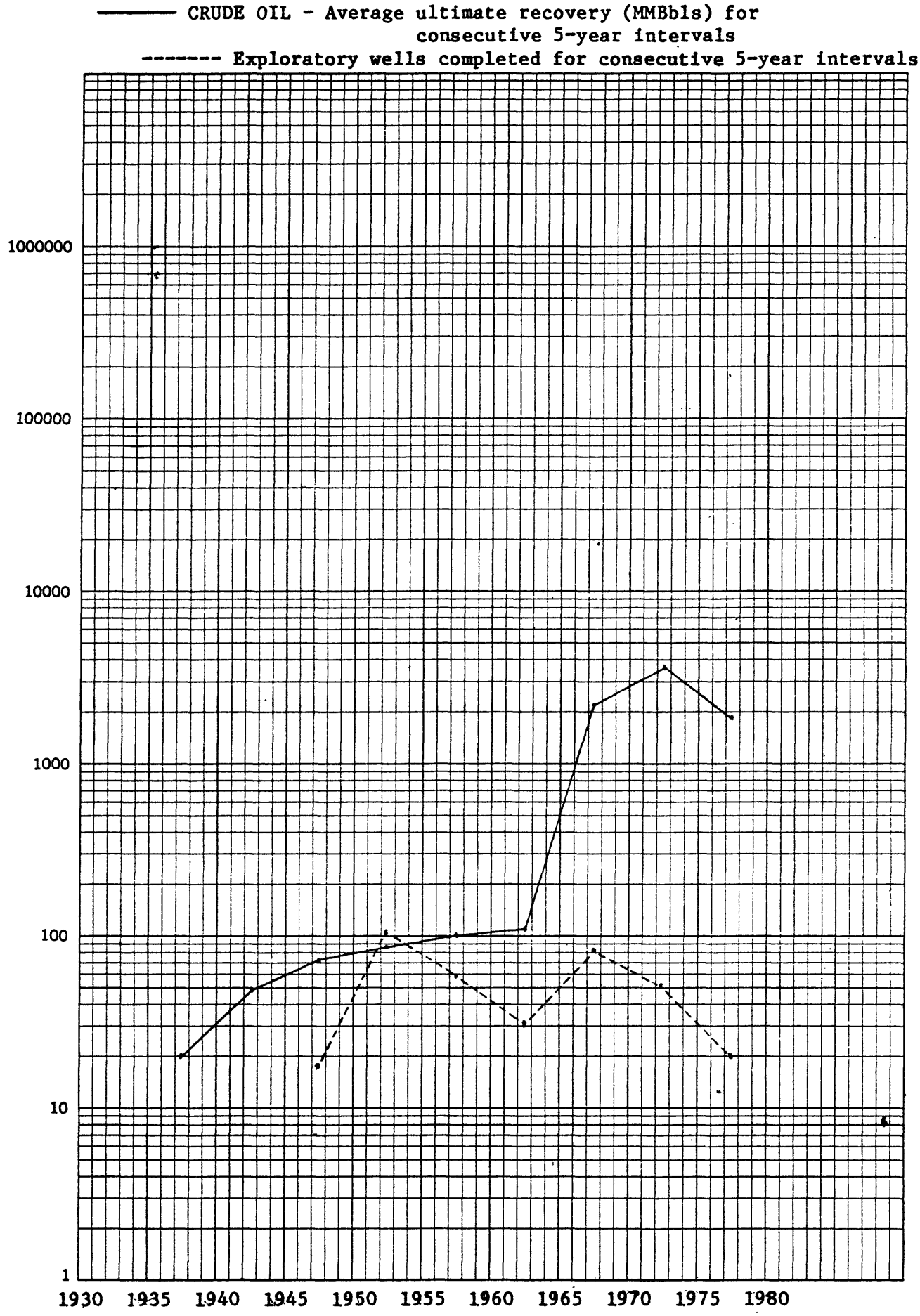
K+E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

Proved additions to crude oil reserves per exploratory well completed (MBbls)
vs cumulative exploratory wells completed

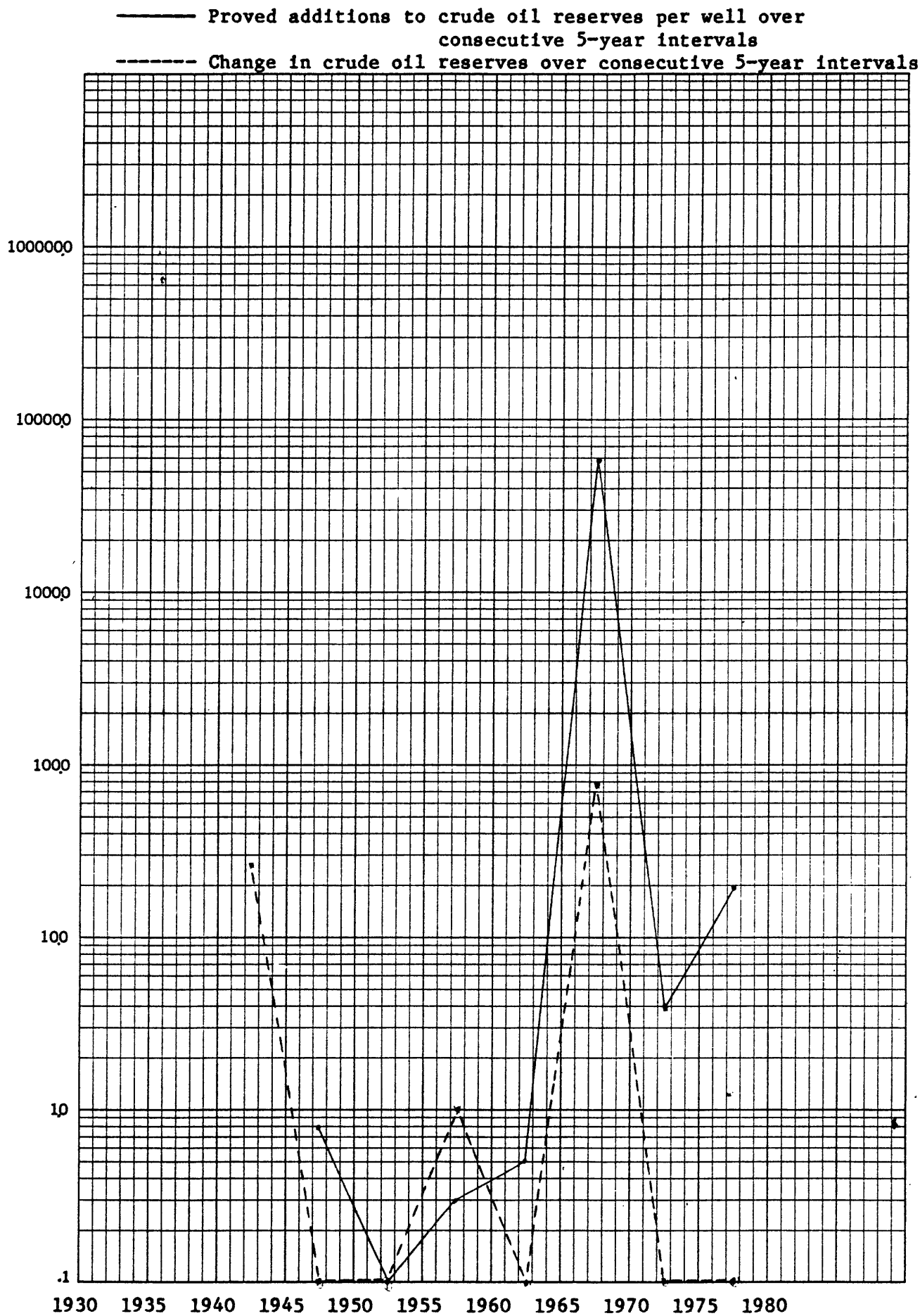


ECUADOR

5 year period	Number of exploratory wells completed	Change in reserves (MMBbls)	Avg ultimate recovery (MMBbls)	Proved additions to reserves (MMBbls)	Proved additions to reserves by well (MMBbls)
1936-1940			20		
1941-1945		25	48	33	
1946-1950	16	0	71	13	.8
1951-1955	102	-2	86	14	.1
1956-1960	58	1	100	16	.3
1961-1965	31	0	111	14	.5
1966-1970	81	5,975	2,167	5,985	73.8
1971-1975	51	-40	3,483	189	3.7
1976-1980	20	0	1,760	366	18.3


——— CRUDE OIL - Average ultimate recovery (MMBbls) for consecutive 5-year intervals
------- Exploratory wells completed for consecutive 5-year intervals
1000000
100000
10000
1000
100
10
1
1930
1935
1940
1945
1950
1955
1960
1965
1970
1975
1980
Years
46 6463
SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

ECUADOR

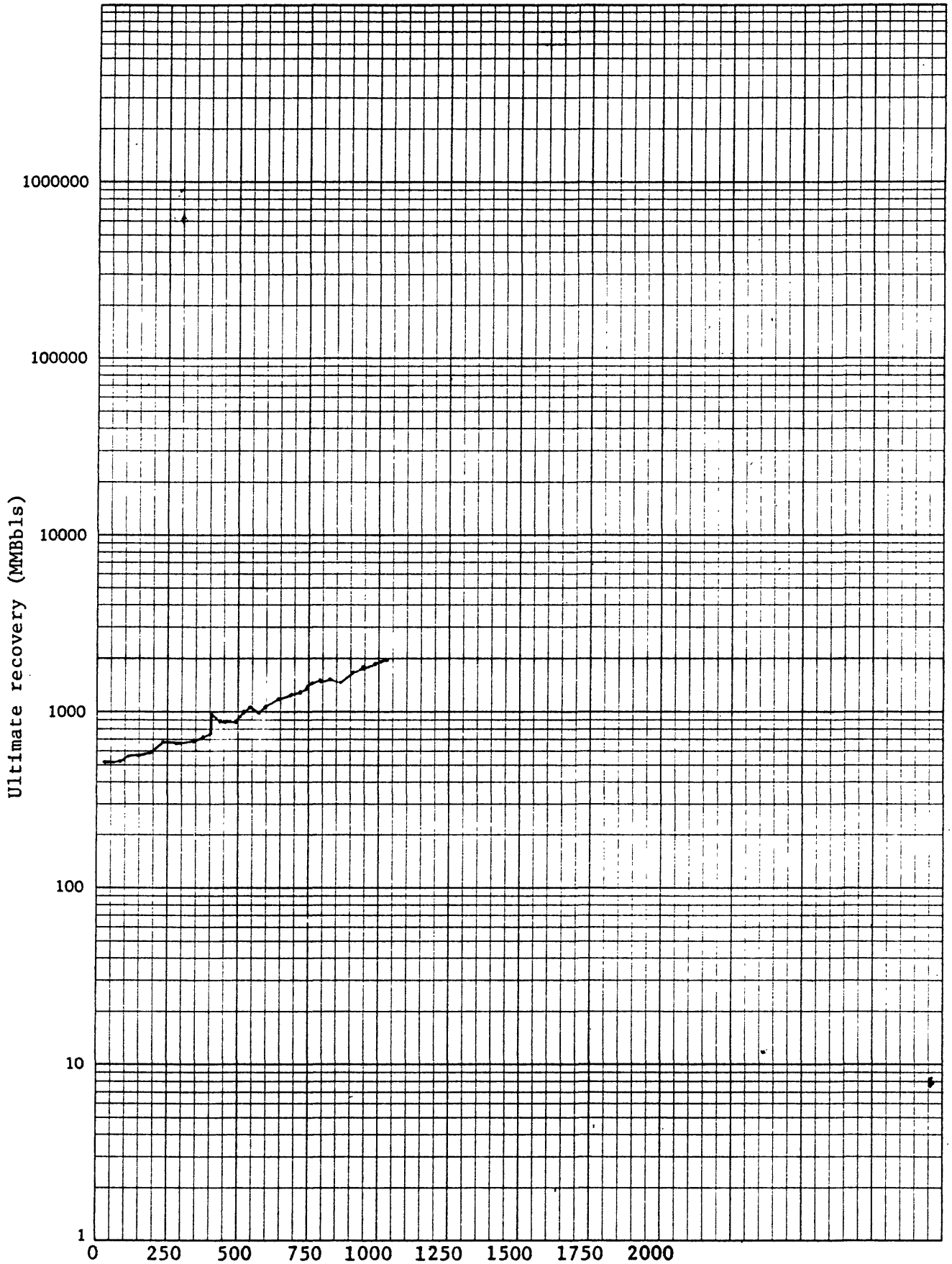


46 6463

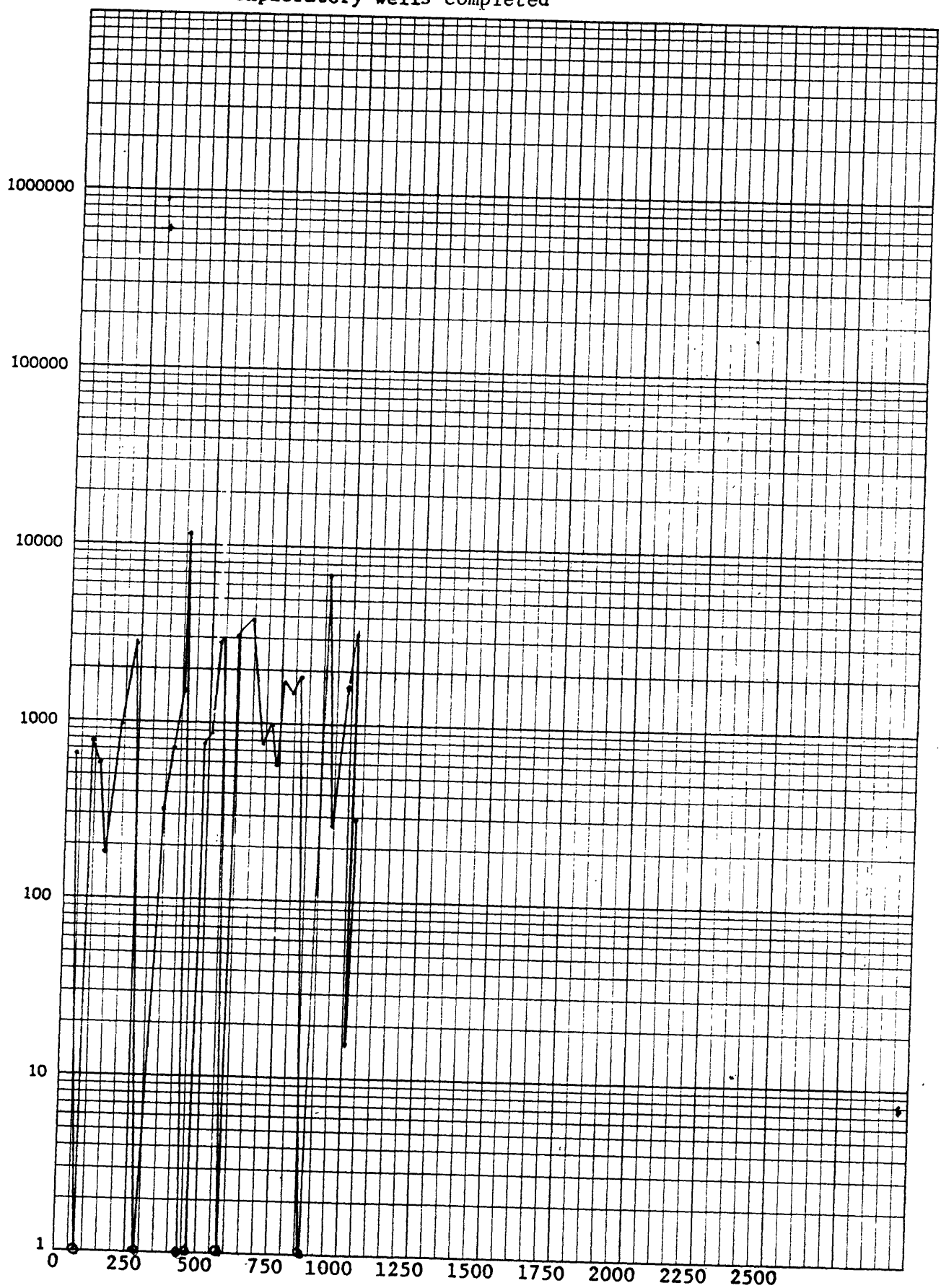
K•E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

(y)	completed (W_y) (AAPG)	wells completed (CW_y)	MMbbls (R_y) (O/M)	MMbbls (P_y) (O/M, WO)	rounded MMbbls ($CP_y + R_{y+1}$)	rounded MMbbls (CP_y)	($R_{y+1} - R_y$) = ΔR_y MMbbls	reserves MMbls ($U_y = \Delta R_y + P_y$)	in reserves per well MMbls (U_y/W_y)
1896				47					
1897				71					
1898				71					
1899				89					
1900				274	1	1			
1901				275	1	1			
1902				287	1	1			
1903				278	1	1			
1904				290	2	2			
1905				373	2	2			
1906				531	3	3			
1907				751	3	3			
1908				945	4	4			
1909				1,411	6	6			
1910				1,238	7	7			
1911				1,465	8	8			
1912				1,752	10	10			
1913				2,071	12	12			
1914				1,837	14	14			
1915				2,579	17	17			
1916				2,593	19	19			
1917				2,377	22	22			
1918				2,527	24	24			
1919				2,628	27	27			
1920				2,817	30	30			
1921				3,699	33	33			
1922				5,314	39	39			
1923				5,699	45	45			
1924				8,379	53	53			
1925				9,232	62	62			
1926				10,762	73	73			
1927				10,127	83	83			
1928				12,006	95	95			
1929				13,422	108	108			
1930				12,449	121	121			
1931				10,089	131	131			
1932				9,899	141	141			
1933				13,257	154	154			
1934				16,314	170	170			
1935				17,067	188	188			
1936				17,593	205	205			
1937				17,457	223	223			
1938				15,839	238	238			
1939				23,506	252	252			
1940				12,126	264	264			
1941				11,935	276	276			
1942				13,629	290	290			
1943				14,654	439	304	135,000	149,654	
1944			135	14,389		319			
1945				13,744	492	332	25,000	38,744	
1946	29	29	160	12,468	511	345	6,000	18,468	637
1947	30	59	166	12,764	508	358	-16,000	-3,236	-108
1948	32	91	150	14,069	532	372	10,000	24,069	752
1949	26	117	160	14,796	546	386	0	14,796	569
1950	32	149	160	15,012	551	401	-10,000	5,012	157
1951	43	192	150	16,110	593	418	25,000	41,110	956
1952	38	230	175	16,403	684	434	75,000	91,403	2,405
1953	62	292	250	15,999	675	450	-25,000	-9,001	-145
1954	55	347	225	17,162	692	467	0	17,162	312
1955	24	371	225	17,242	709	484	0	17,242	718
1956	31	402	225	18,383	753	503	25,000	43,383	1,399
1957	16	418	250	19,222	936	522	164,000	183,222	11,451
1958	14	432	414	18,732		541			
1959	3	435		17,733	893	558	-79,000	-61,267	-20,422
1960	21	456	335	19,255	878	578	-35,000	-15,745	-750
1961	26	482	300	19,371	897	597	0	19,371	745
1962	25	507	300	21,134	918	618	0	21,134	845
1963	26	533	300	21,468	990	640	50,000	71,468	2,749
1964	8	541	350	23,119	1,013	663	0	23,119	2,890
1965	30	571	350	23,068	986	686	-50,000	-26,932	-898
1966	24	595	300	23,027	1,059	709	50,000	73,027	3,043
1967	50	645	350	25,857	1,235	735	150,000	175,857	3,517
1968	36	681	500	27,056	1,262	762	0	27,056	752
1969	38	719	500	26,330	1,298	788	10,000	36,330	956
1970	28	747	510	26,269	1,314	814	-10,000	16,269	581
1971	21	768	500	22,588	1,347	837	10,000	32,588	1,552
1972	25	793	510	23,635	1,381	861	10,000	33,635	1,345
1973	31	824	520	25,767	1,430	886	24,000	49,767	1,605
1974	43	867	544	28,069	1,396	914	-62,000	-33,931	-789
1975	43	910	482	26,384	1,648	941	265,000	291,384	6,776
1976	36	946	747	27,936	1,697	969	-19,000	8,936	248
1977	37	983	728	33,276	1,752	1,002	22,000	55,276	1,494
1978	25	1,008	750	55,191	1,831	1,057	24,000	79,191	3,168
1979	3	1,011	774	74,042	1,831	1,131	-74,000	042	14
1980	13	1,024	700	75,762	1,835	1,207	-72,000	3,762	289
1981			628						

Ultimate crude oil recovery (MMBbls) vs cumulative exploratory wells completed



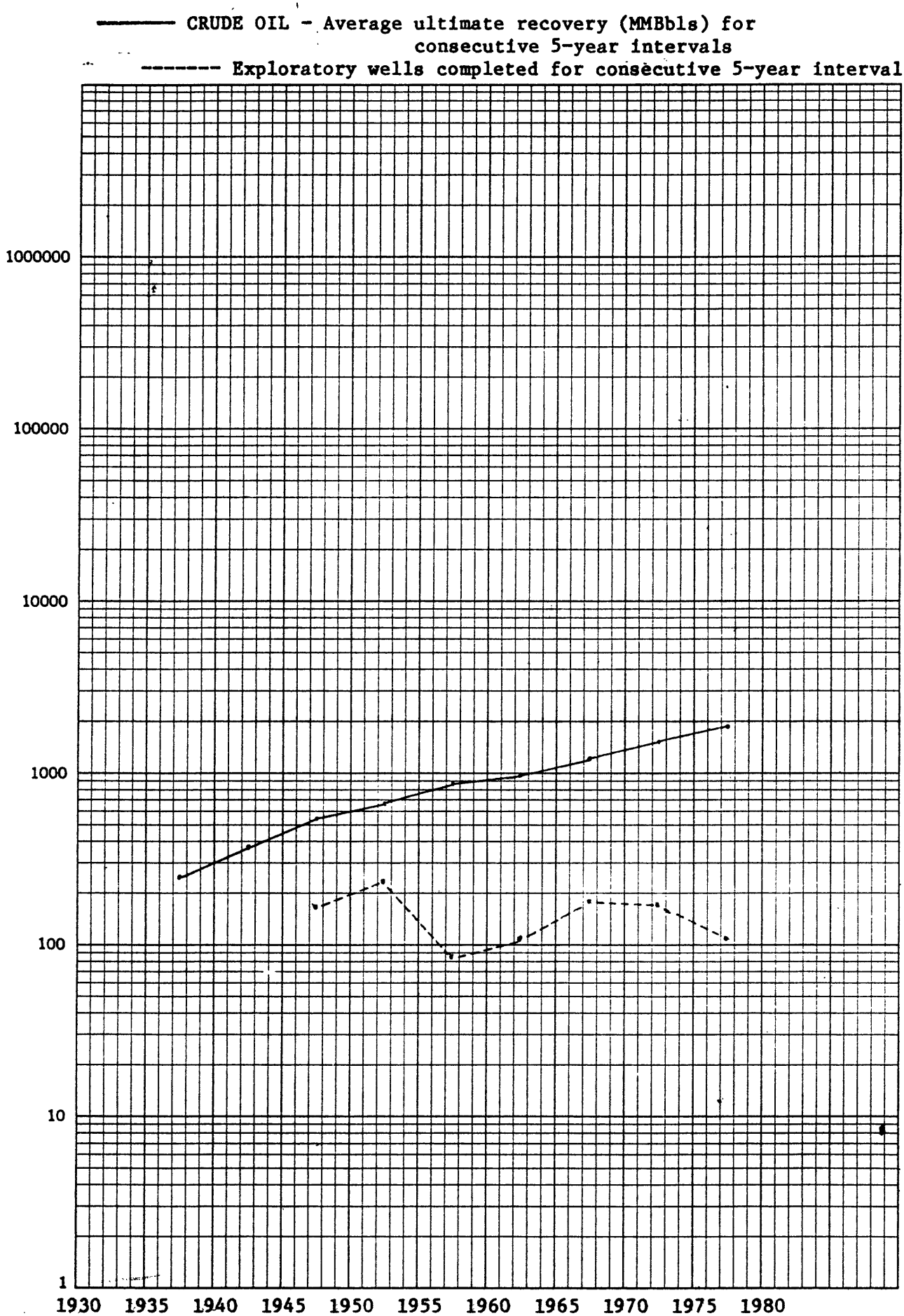
Proved additions to crude oil reserves per exploratory well completed (MBbls) vs cumulative exploratory wells completed



PERU

5 year period	Number of exploratory wells completed	Change in reserves (MMBbls)	Avg ultimate recovery (MMBbls)	Proved additions to reserves (MMBbls)	Proved additions to reserves by well (MMBbls)
1936-1940			236		
1941-1945		160	374	189	
1946-1950	149	-10	530	59	.4
1951-1955	222	75	671	157	.7
1956-1960	85	75	865	149	1.8
1961-1965	115	0	961	107	.9
1966-1970	176	200	1,234	328	1.9
1971-1975	163	247	1,448	374	2.3
1976-1980	114	-119	1,789	147	1.3

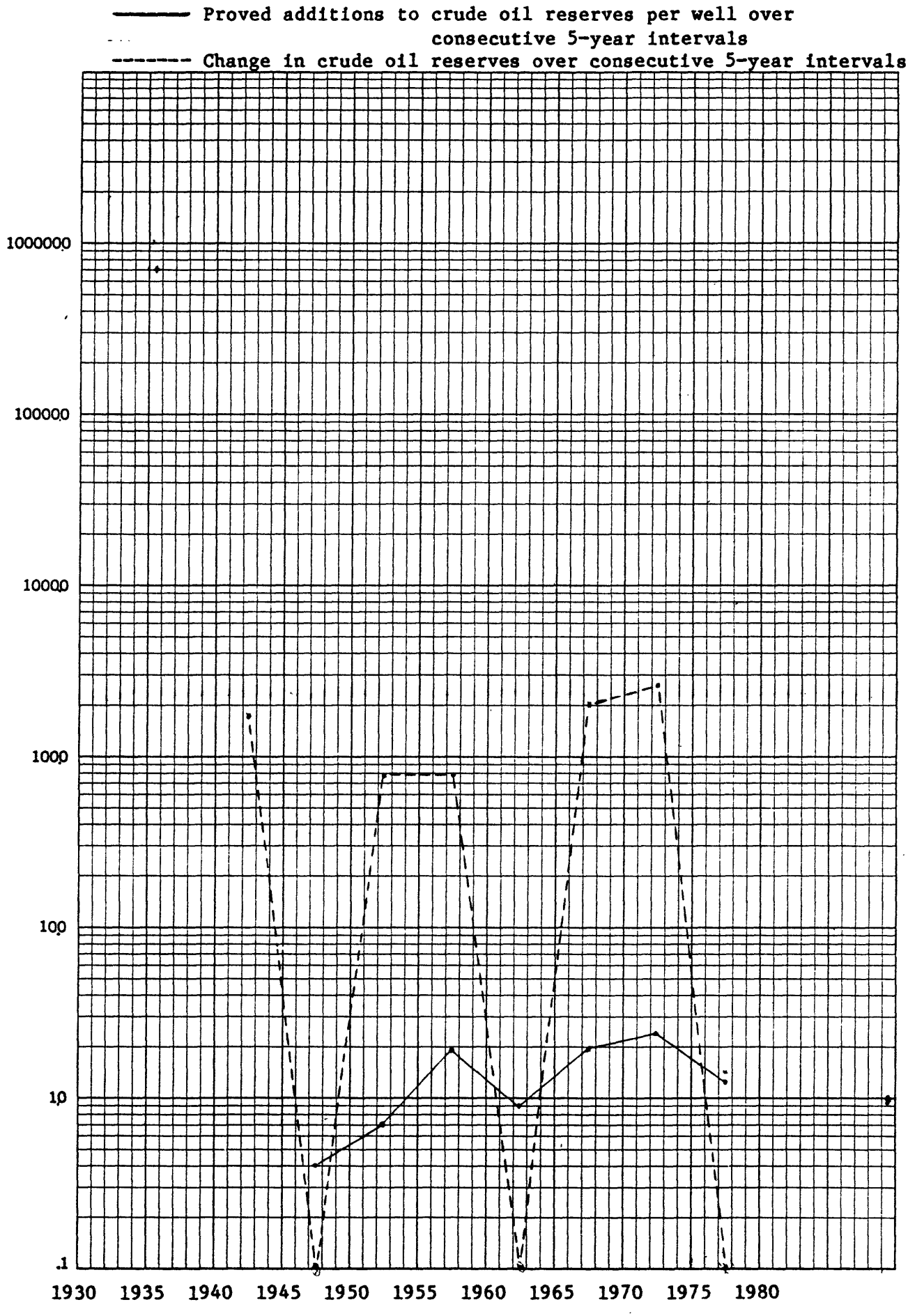
PERU



46 6463

SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

PERU



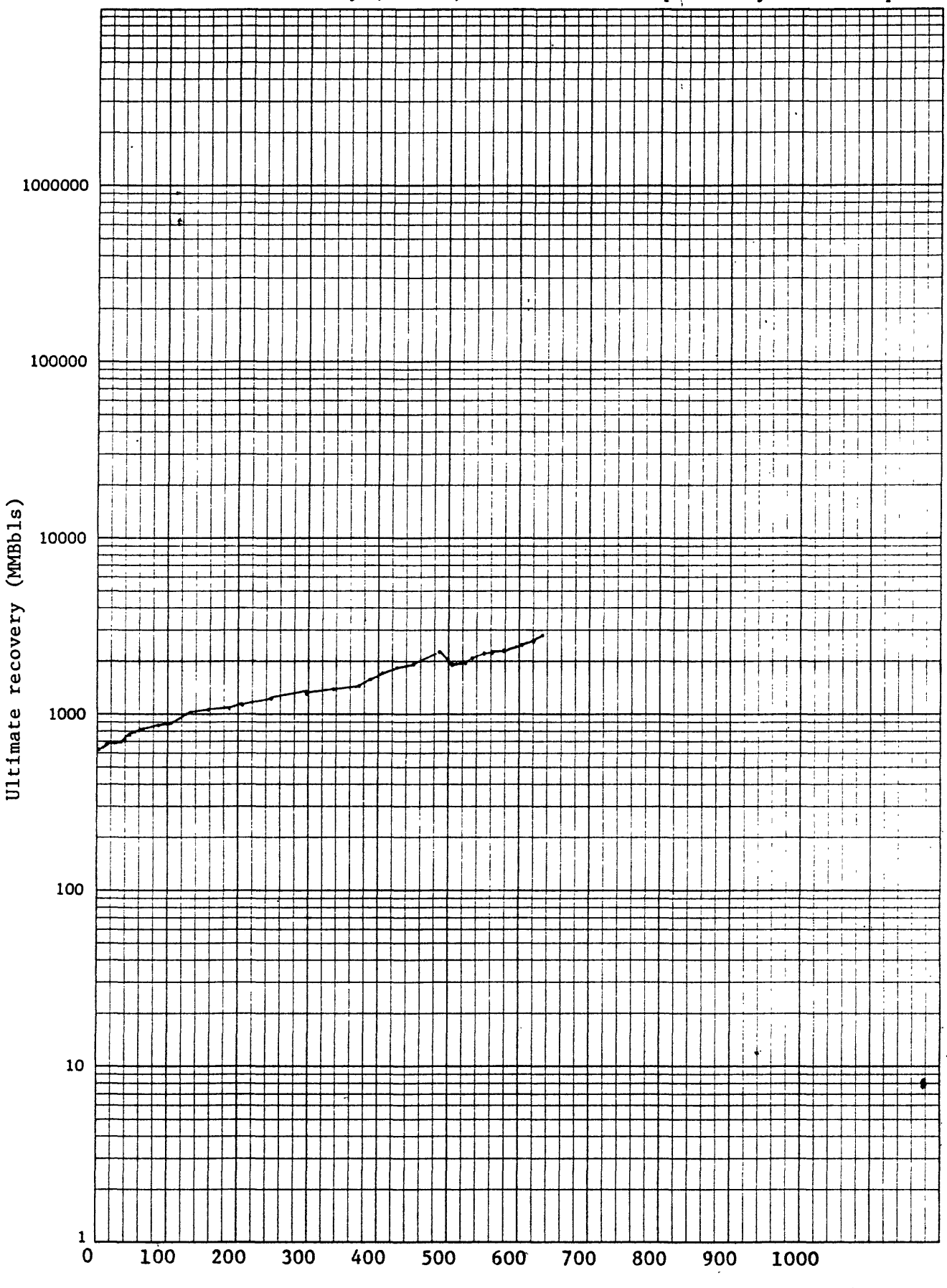
46 6463

K+E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS KEUFFEL & ESSER CO. MADE IN U.S.A.

Year (y)	Exploratory wells completed (W_y) (AAPG)	Cumulative exploratory wells completed (CW_y)	Reserves - MMBbls (R_y) (D/M)	Crude production MBbls (P_y) (D/M, WO)	Ultimate recovery rounded MMBbls ($CP_y + R_{y+1}$)	Cumulative production rounded MMBbls (CP_y)	Change in reserves ($R_{y+1} - R_y$) = ΔR_y MBbls	Proved additions to reserves MBbls ($D_y = \Delta R_y + P_y$)	Proved additions to reserves per well MBbls (D_y/W_y)
1909				57					
1910				143					
1911				285					
1912				437	1	1			
1913				504	1	1			
1914				644	2	2			
1915				750	3	3			
1916				929	4	4			
1917				1,602	5	5			
1918				2,082	7	7			
1919				1,841	9	9			
1920				2,083	11	11			
1921				2,354	14	14			
1922				2,445	16	16			
1923				3,051	19	19			
1924				4,057	23	23			
1925				4,387	28	28			
1926				4,971	33	33			
1927				5,380	38	38			
1928				7,684	46	46			
1929				8,716	54	54			
1930				9,419	64	64			
1931				9,744	74	74			
1932				10,126	84	84			
1933				9,561	93	93			
1934				10,894	104	104			
1935				11,671	116	116			
1936				13,237	129	129			
1937				15,503	145	145			
1938				17,737	162	162			
1939				19,270	182	182			
1940				22,227	204	204			
1941				20,506	224	224			
1942				22,069	246	246			
1943				21,385	504	268	236,000	257,385	
1944			236	22,139		290			
1945				21,093	611	311	64,000	85,093	
1946	0	0	300	20,233	616	331	-15,000	5,233	
1947	2	2	285	20,521	652	352	15,000	35,521	17,761
1948		2	300	20,111	622	372	-50,000	-29,889	
1949	13	15	250	20,617	652	392	10,000	30,617	2,355
1950	9	24	260	20,632	663	413	-10,000	10,632	1,181
1951	9	33	250	20,843	684	434	0	20,843	2,316
1952	7	40	250	21,258	705	455	0	21,258	3,037
1953	5	45	250	22,346	758	478	30,000	52,346	10,469
1954	9	54	280	23,629	781	501	0	23,629	2,625
1955	10	64	280	24,896	806	526	0	24,896	2,490
1956	22	86	280	28,929	845	555	10,000	38,929	1,770
1957	19	105	290	34,064	889	589	10,000	44,064	2,319
1958	12	117	300	37,355		626			
1959	17	134		40,919	1,017	667	50,000	90,919	5,348
1960	24	158	350	42,357	1,100	710	40,000	82,357	3,432
1961	31	189	390	45,768	1,180	755	35,000	80,768	2,605
1962	20	209	425	48,876	1,229	804	0	48,876	2,444
1963	37	246	425	48,678	1,278	853	0	48,678	1,316
1964	53	299	425	47,731	1,326	901	0	47,731	901
1965	37	336	425	48,859	1,375	950	0	48,859	1,321
1966	36	372	425	55,603	1,455	1,005	25,000	80,603	2,239
1967	14	386	450	64,990	1,595	1,070	75,000	139,990	9,999
1968	23	409	525	66,904	1,662	1,137	0	66,904	2,909
1969	20	429	525	57,429	1,785	1,195	65,000	122,429	6,121
1970	21	450	590	51,047	1,851	1,246	15,000	66,047	3,145
1971	35	485	605	47,148	2,346	1,293	448,000	495,148	14,147
1972	23	508	1,053	51,719	1,844	1,344	-553,000	-501,281	-21,795
1973	15	523	500	60,666	1,905	1,405	0	60,666	4,044
1974	13	536	500	68,131	2,124	1,473	151,000	219,131	16,856
1975	14	550	651	78,613	2,203	1,552	0	78,613	5,615
1976	12	562	651	77,673	2,280	1,630	-1,000	76,673	6,389
1977	17	579	650	83,950	2,363	1,713	0	83,950	4,938
1978	28	607	650	83,777	2,447	1,797	0	83,777	2,992
1979	13	620	650	78,764	2,531	1,876	5,000	83,764	6,443
1980	13	633	655	77,613	2,604	1,954	-5,000	72,613	5,586
1981			650						

TRINIDAD AND TOBAGO

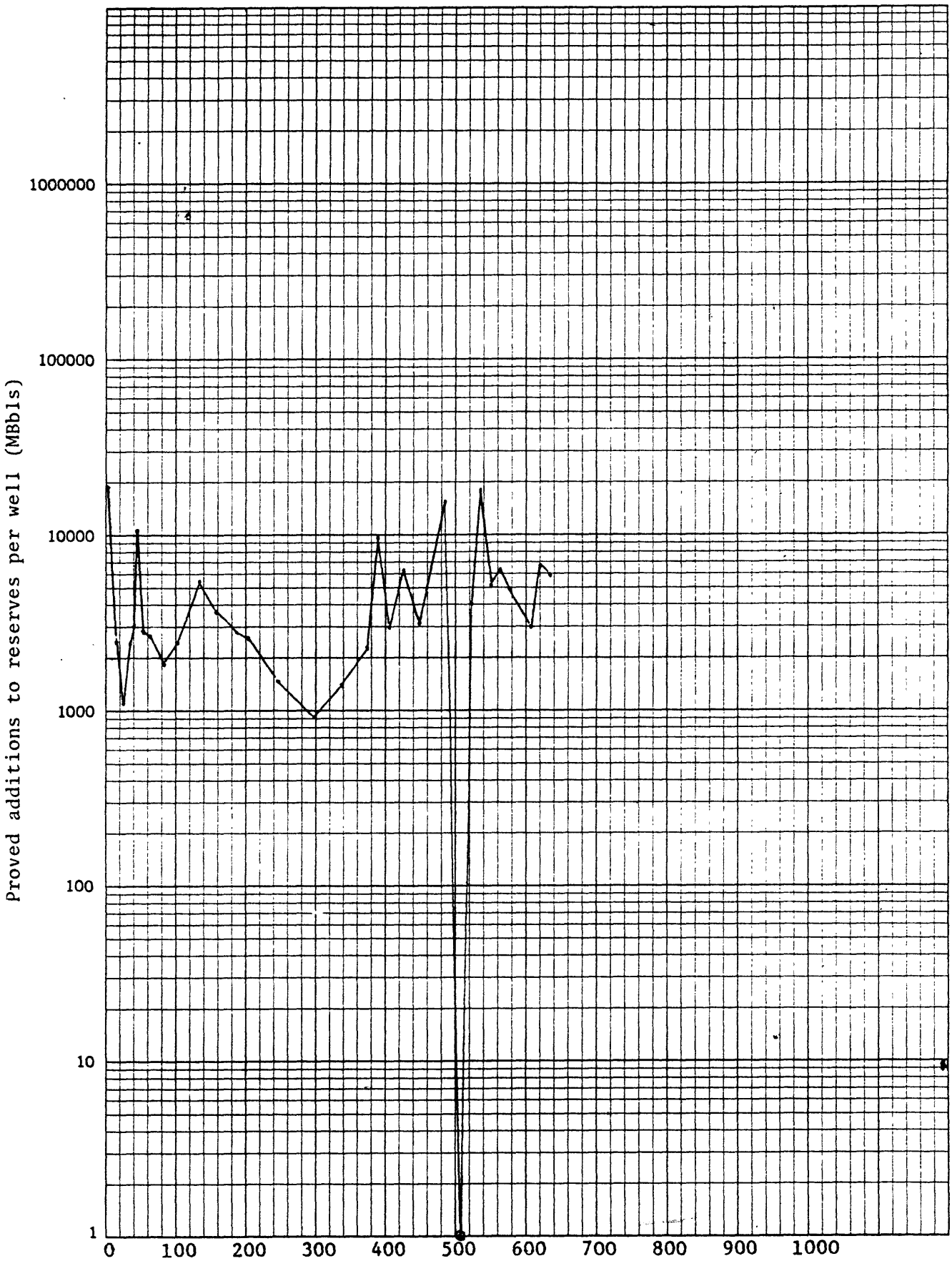
Ultimate crude oil recovery (MMBbls) vs cumulative exploratory wells completed



46 6463

K+E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

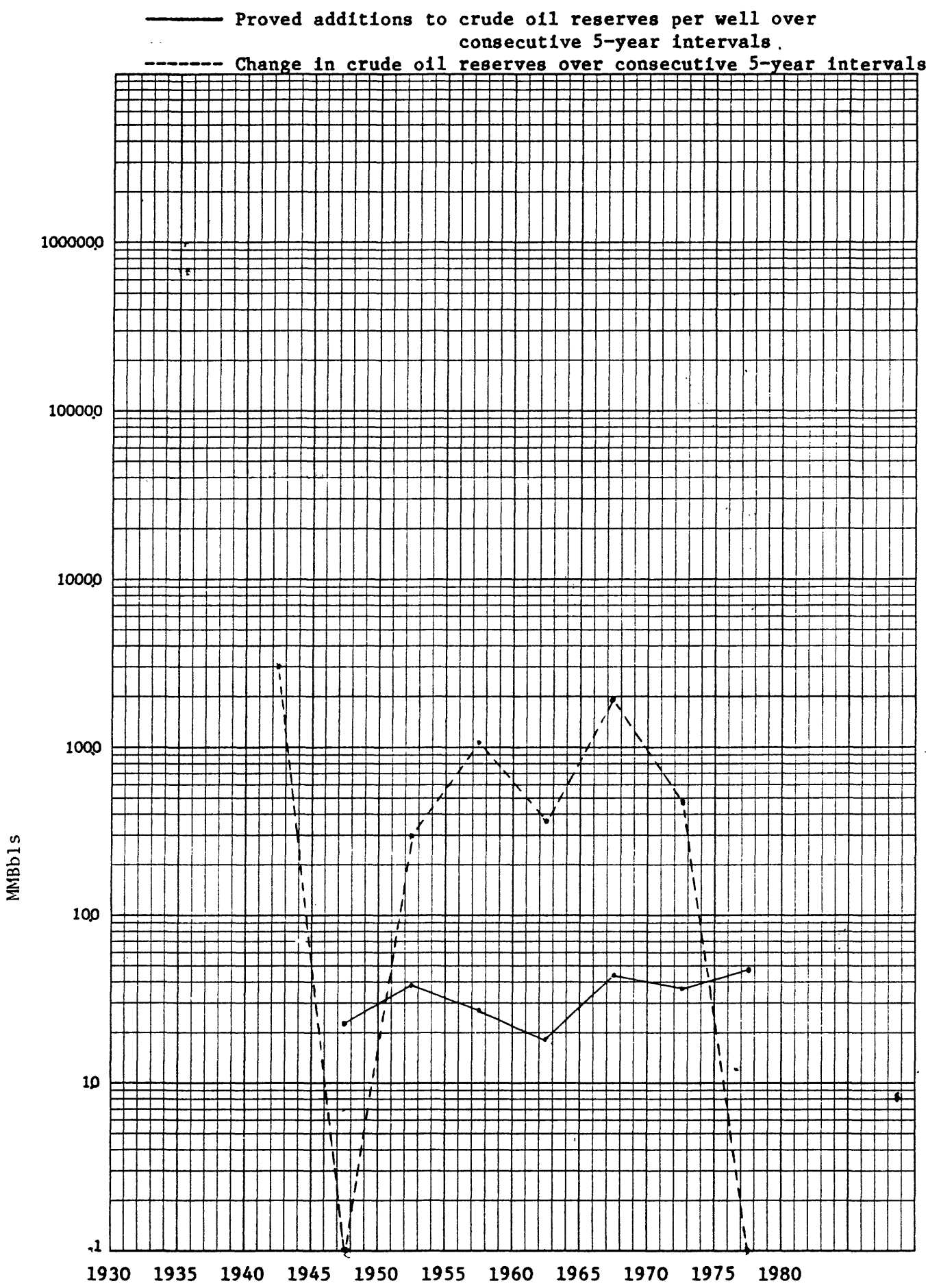
Proved additions to crude oil reserves per exploratory well completed (MBbls) vs cumulative exploratory wells completed



TRINIDAD & TOBAGO

5 year period	Number of exploratory wells completed	Change in reserves (MMBbls)	Avg ultimate recovery (MMBbls)	Proved additions to reserves (MMBbls)	Proved additions to reserves by well (MMBbls)
1936-1940			164		
1941-1945		300	396	342	
1946-1950	24	-50	641	53	2.2
1951-1955	40	30	747	143	3.6
1956-1960	94	110	963	256	2.7
1961-1965	178	35	1,278	276	1.6
1966-1970	114	180	1,670	476	4.2
1971-1975	100	46	2,084	353	3.5
1976-1980	83	-1	2,445	402	4.8

TRINIDAD AND TOBAGO



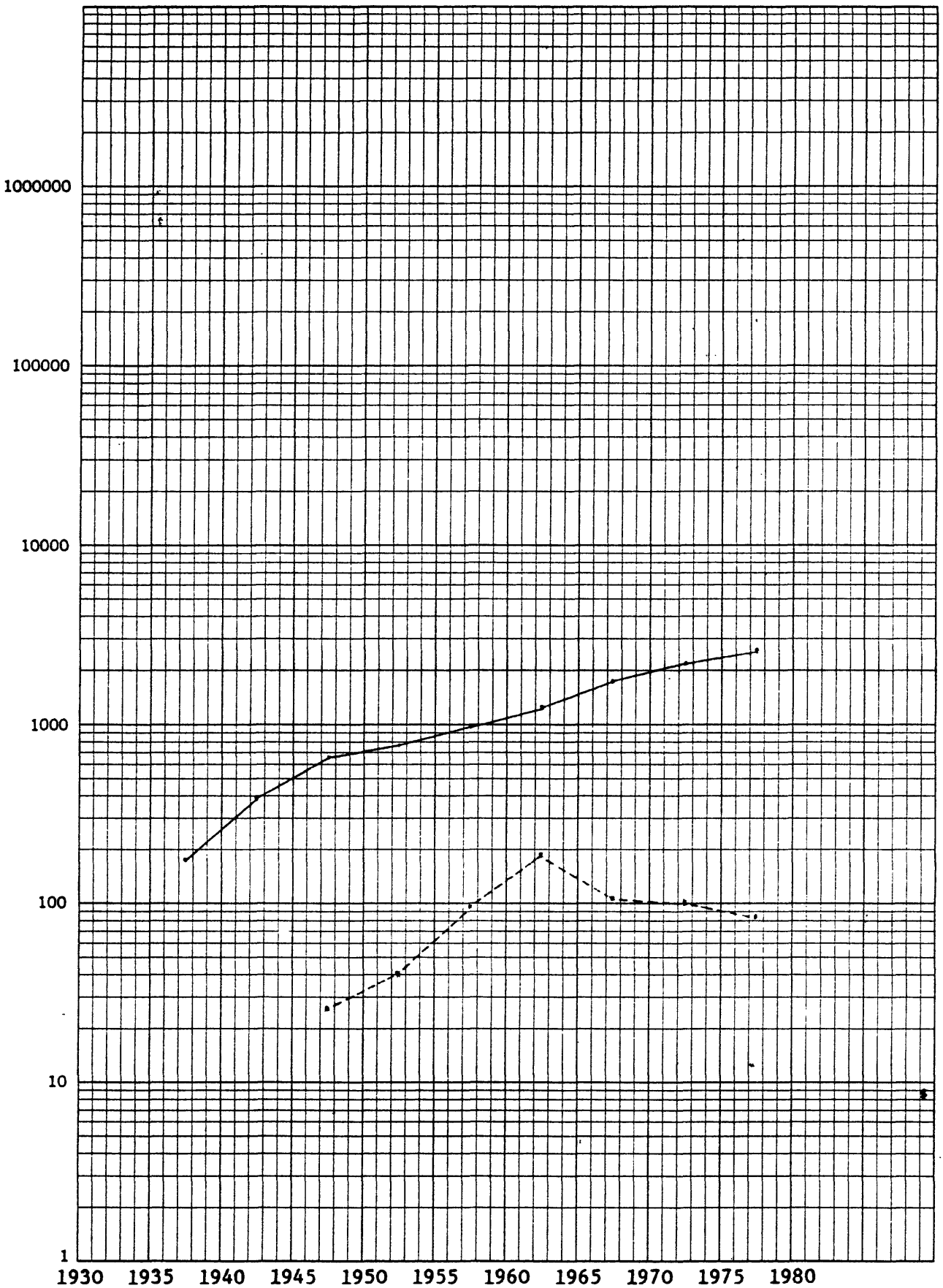
46 6463

K•E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

TRINIDAD AND TOBAGO

——— CRUDE OIL - Average ultimate recovery (MMBbls) for consecutive 5-year intervals

------- Exploratory wells completed for consecutive 5-year intervals



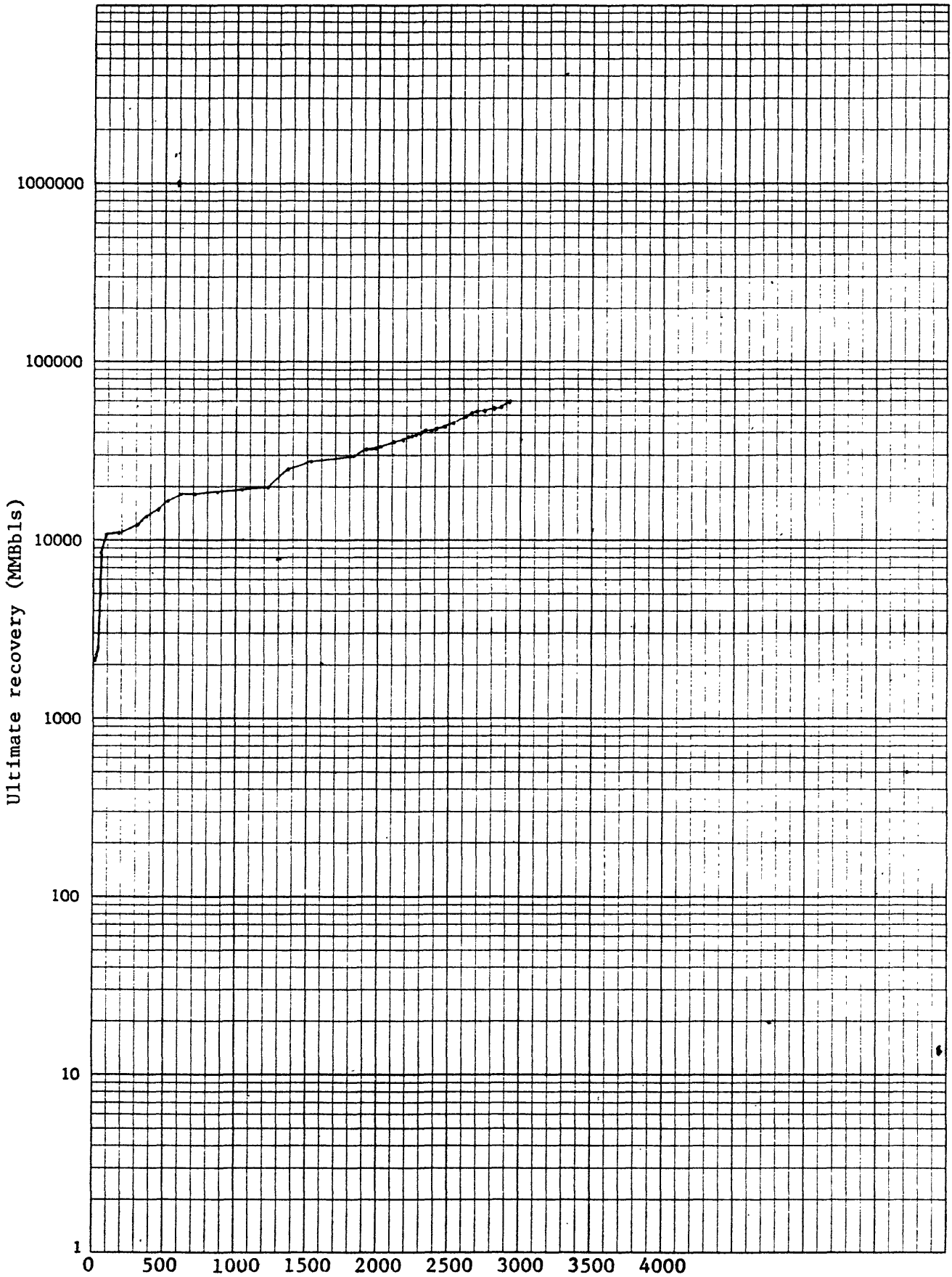
46 6463

K+E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS KEUFFEL & ESSER CO. MADE IN U.S.A.

Year (y)	Exploratory wells completed (W_y) (AAPG)	Cumulative exploratory wells completed (CW_y)	Reserves - MMBbls (R_y) (D/M)	Crude production MBbls (P_y) (D/M, WO)	Ultimate recovery rounded MMBbls ($CP_y + R_{y+1}$)	Cumulative production rounded MMBbls (CP_y)	Change in reserves ($R_{y+1} - R_y$) = ΔR_y MBbls	Proved additions to reserves MBbls ($D_y = \Delta R_y + P_y$)	Proved additions to reserves per well MBbls (D_y/W_y)
1917				120					
1918				333					
1919				425	1	1			
1920				457	1	1			
1921				1,433	3	3			
1922				2,201	5	5			
1923				4,201	9	9			
1924				9,042	18	18			
1925				19,687	38	38			
1926				36,911	75	75			
1927				63,134	138	138			
1928				105,749	244	244			
1929				137,472	381	381			
1930				136,669	518	518			
1931				116,613	634	634			
1932				116,541	751	751			
1933				117,720	869	869			
1934				136,103	1,005	1,005			
1935				148,254	1,153	1,153			
1936				154,794	1,308	1,308			
1937				186,230	1,494	1,494			
1938				188,174	1,682	1,682			
1939				206,470	1,889	1,889			
1940	18	18		185,570	2,074	2,074			
1941	6	24		228,430	2,303	2,303			
1942	10	34		147,675	2,450	2,450			
1943	18	52		177,631	8,228	2,628	5,600,000	5,777,631	320,979
1944	10	62	5,600	257,046		2,885			
1945	30	92		323,156	10,208	3,208	1,400,000	1,723,156	57,439
1946	78	170	7,000	388,486	11,097	3,597	500,000	888,486	11,846
1947	155	325	7,500	434,905	12,382	4,032	850,000	1,284,905	8,290
1948	59	384	8,350	490,015	13,522	4,522	650,000	1,140,015	19,322
1949	67	451	9,000	482,316	14,504	5,004	500,000	982,316	14,661
1950	66	517	9,500	546,783	15,051	5,551	0	546,783	8,285
1951	99	616	9,500	622,216	16,173	6,173	500,000	1,122,216	11,336
1952	111	727	10,000	660,254	16,433	6,833	-400,000	260,254	2,345
1953	151	878	9,600	644,243	17,377	7,477	300,000	944,243	6,253
1954	178	1,056	9,900	691,810	18,869	8,169	800,000	1,491,810	8,381
1955	165	1,221	10,700	787,409	19,876	8,957	219,000	1,006,409	6,099
1956	140	1,361	10,919	899,212	23,856	9,856	3,081,000	3,980,212	28,430
1957	174	1,535	14,000	1,014,457	26,217	10,870	1,347,000	2,361,457	13,572
1958	193	1,728	15,347	950,796		11,821			
1959	110	1,838		1,011,452	29,709	12,833	1,439,000	2,450,452	22,277
1960	72	1,910	16,876	1,041,675	31,228	13,874	478,000	1,519,675	21,107
1961	80	1,990	17,354	1,065,757	31,822	14,940	-472,000	593,757	7,422
1962	64	2,054	16,882	1,167,916	32,913	16,108	-77,000	1,090,916	17,045
1963	51	2,105	16,805	1,185,511	34,304	17,293	206,000	1,391,511	27,285
1964	53	2,158	17,011	1,241,782	35,784	18,535	238,000	1,479,782	27,920
1965	56	2,214	17,249	1,267,602	37,169	19,803	117,000	1,384,602	24,725
1966	26	2,240	17,366	1,230,463	37,903	21,033	-496,000	734,463	28,249
1967	31	2,271	16,870	1,292,876	38,282	22,326	-914,000	378,876	12,222
1968	29	2,300	15,956	1,319,340	39,646	23,646	44,000	1,363,340	47,011
1969	33	2,333	16,000	1,311,832	40,962	24,957	5,000	1,316,832	39,904
1970	38	2,371	16,005	1,353,420	40,352	26,311	-1,964,000	-610,580	-16,068
1971	44	2,415	14,041	1,295,406	41,346	27,606	-301,000	994,406	22,600
1972	64	2,479	13,740	1,178,487	42,657	28,785	131,000	1,309,487	20,460
1973	63	2,542	13,872	1,228,594	43,825	30,013	-60,000	1,169,594	18,549
1974	76	2,618	13,812	1,086,332	49,667	31,100	4,755,000	5,841,332	76,860
1975	35	2,653	18,567	856,364	50,351	31,956	-172,000	684,364	19,553
1976	45	2,698	18,395	819,737	51,025	32,796	-166,000	673,737	14,972
1977	48	2,746	18,229	816,818	51,656	33,613	-186,000	630,818	13,142
1978	60	2,806	18,041	790,225	52,628	34,403	183,000	973,225	16,220
1979	58	2,864	18,226	855,925	53,976	35,259	491,000	1,346,925	23,223
1980	51	2,915	18,717	793,397	55,671	36,052	902,000	1,695,397	33,243
1981			19,619						

VENEZUELA

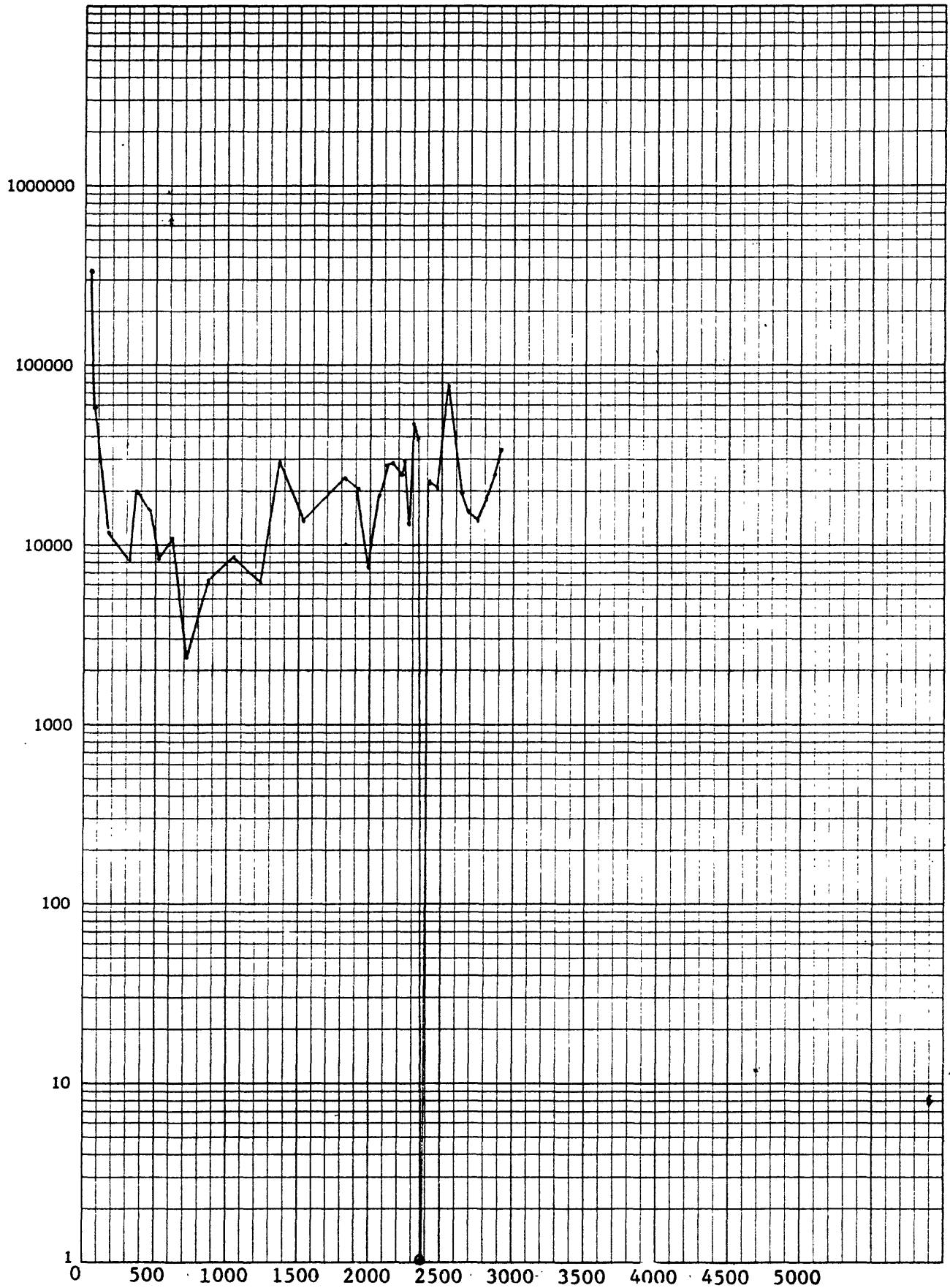
Ultimate crude oil recovery (MMBbls) vs cumulative exploratory wells completed



46 6463

K+E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

Proved additions to crude oil reserves per exploratory well completed (MBbls) vs cumulative exploratory wells completed



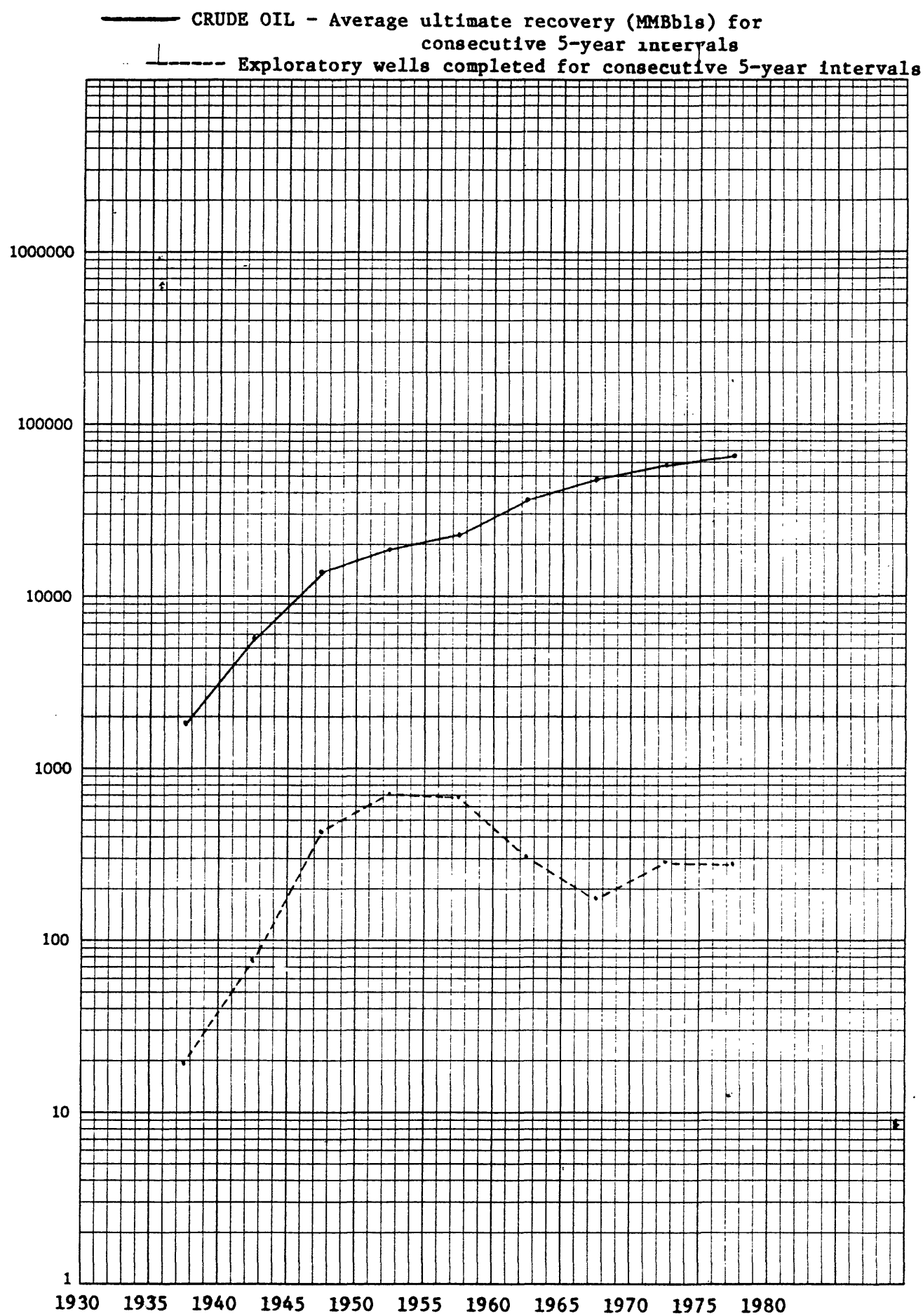
46 6463

K+E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS KEUFFEL & ESSER CO. MADE IN U.S.A.

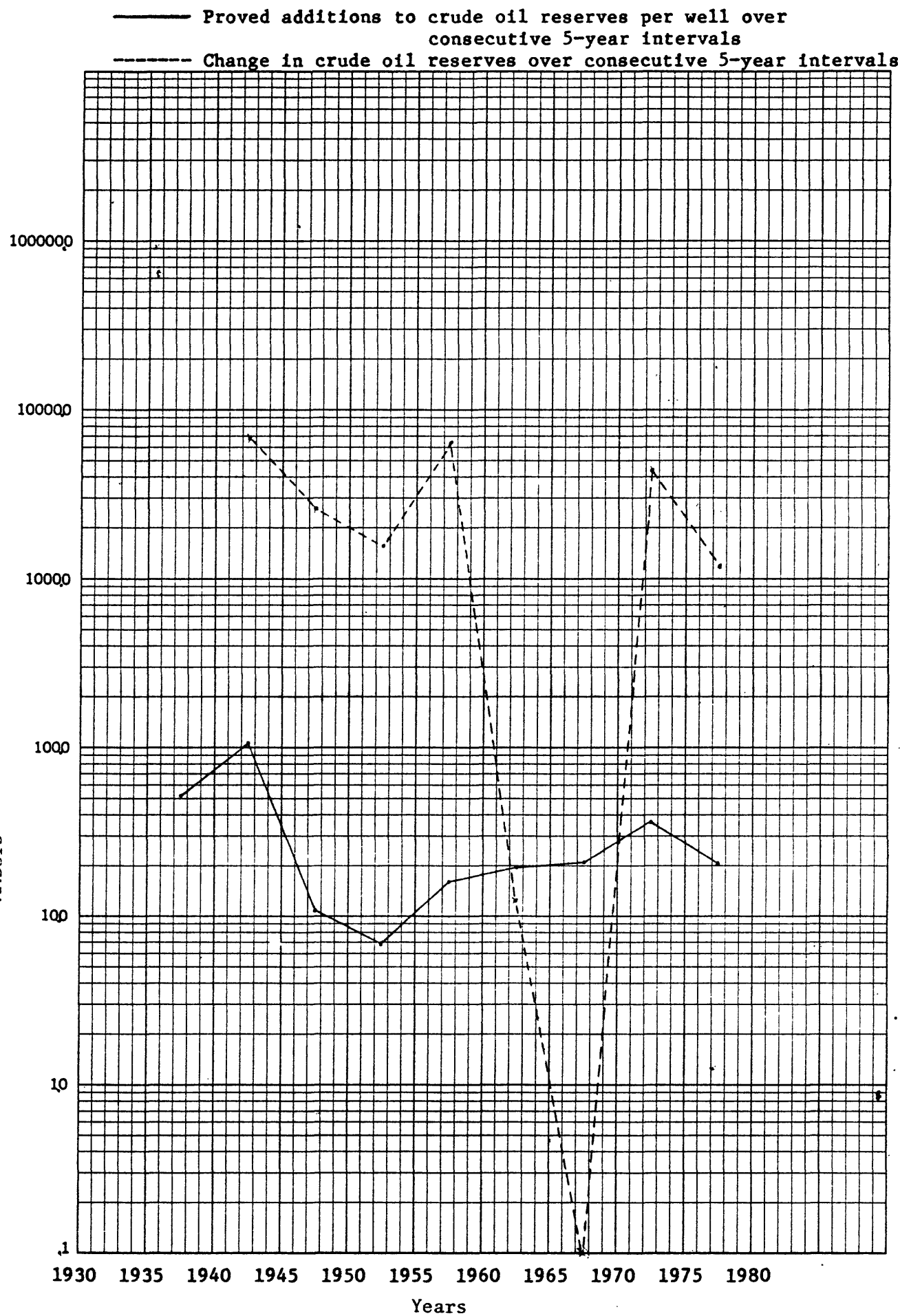
VENEZUELA

5 year period	Number of exploratory wells completed	Change in reserves (MMBbls)	Avg ultimate recovery (MMBbls)	Proved additions to reserves (MMBbls)	Proved additions to reserves by well (MMBbls)
1936-1940	18		1,689	921	51.2
1941-1945	74	7,000	5,797	7,501	101.3
1946-1950	425	2,500	13,311	4,842	11.4
1951-1955	704	1,419	17,746	4,824	6.9
1956-1960	689	6,345	22,202	10,311	15.0
1961-1965	304	12	34,398	5,942	19.5
1966-1970	157	-3,325	39,429	3,182	20.3
1971-1975	282	4,353	45,569	9,998	35.5
1976-1980	262	1,224	52,991	5,320	20.3

VENEZUELA



VENEZUELA



46 6463

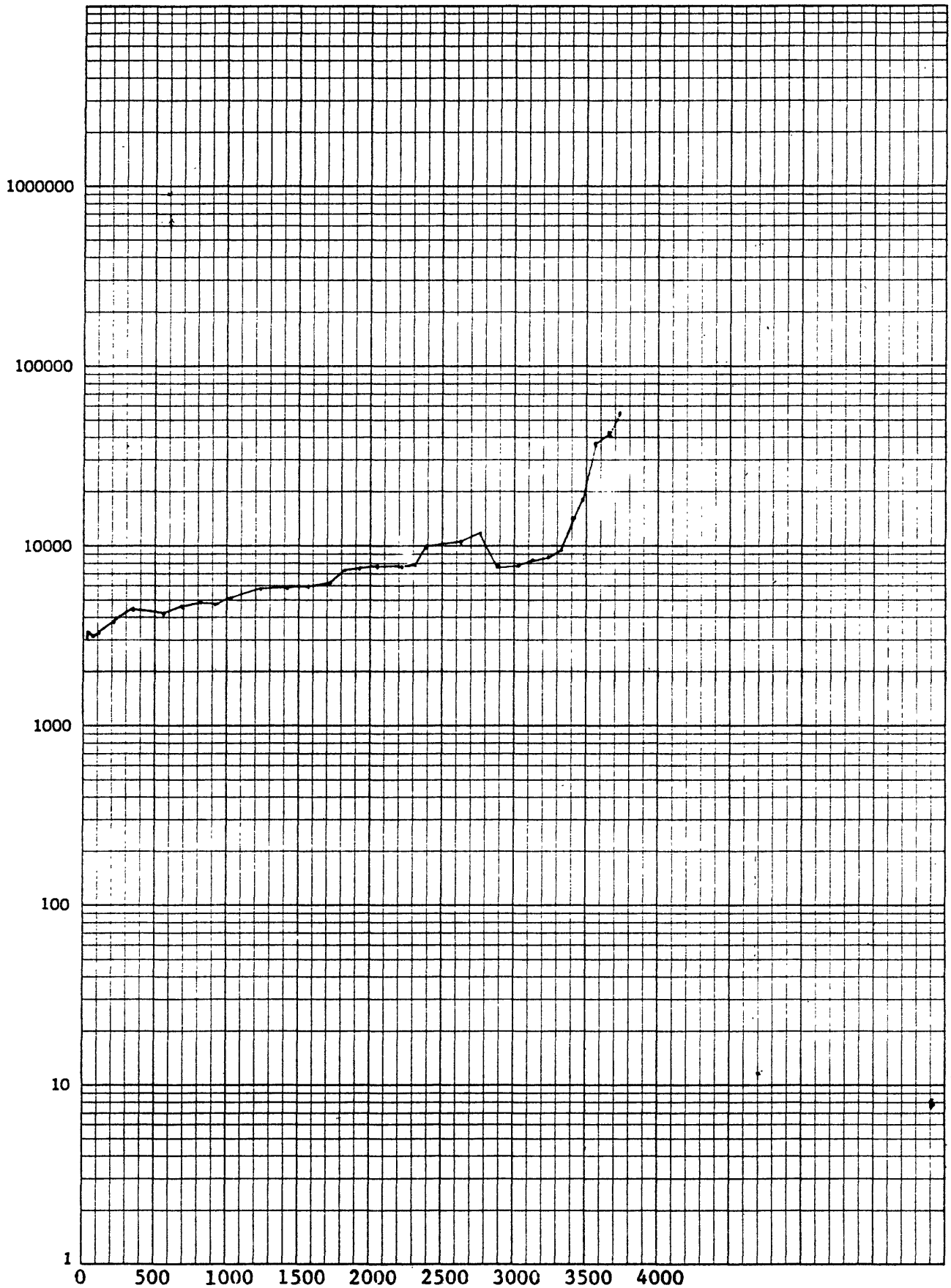
K•E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS KEUFFEL & ESSER CO. MADE IN U.S.A.

MEXICO

Year (y)	Exploratory wells completed (W_y) (AAPG)	Cumulative exploratory wells completed (CW_y)	Reserves - MMBbls (R_y) (D/M)	Crude production MBbls (P_y) (D/M, WO)	Ultimate recovery rounded MMBbls ($CP_y + R_{y+1}$)	Cumulative production rounded MMBbls (CP_y)	Change in reserves ($R_{y+1} - R_y$) = ΔR_y MBbls	Proved additions to reserves MBbls ($D_y = \Delta R_y + P_y$)	Proved additions to reserves per well MBbls (D_y/W_y)
1901				10					
1902				40					
1903				75					
1904				126					
1905				251	1	1			
1906				502	1	1			
1907				1,005	2	2			
1908				3,933	6	6			
1909				2,714	9	9			
1910				3,634	12	12			
1911				12,553	25	25			
1912				16,558	41	41			
1913				25,696	67	67			
1914				26,235	93	93			
1915				32,911	126	126			
1916				40,546	167	167			
1917				55,293	222	222			
1918				63,828	286	286			
1919				87,073	373	373			
1920				157,069	530	530			
1921				193,398	723	723			
1922				182,278	906	906			
1923				149,585	1,055	1,055			
1924				139,678	1,195	1,195			
1925				115,515	1,311	1,311			
1926				90,421	1,401	1,401			
1927				64,121	1,465	1,465			
1928				50,151	1,515	1,515			
1929				44,688	1,560	1,560			
1930				39,530	1,599	1,599			
1931				33,039	1,632	1,632			
1932				32,805	1,665	1,665			
1933				34,001	1,699	1,699			
1934				38,172	1,737	1,737			
1935				40,241	1,778	1,778			
1936				41,028	1,819	1,819			
1937				46,907	1,866	1,866			
1938				38,506	1,904	1,904			
1939				42,898	1,947	1,947			
1940				44,036	1,991	1,991			
1941				42,196	2,033	2,033			
1942				34,815	2,068	2,068			
1943				35,163	2,703	2,103	600,000	635,163	
1944			600	38,203	2,141	2,141			
1945				43,547	3,055	2,185	270,000	313,547	
1946	17	17	870	49,235	3,094	2,234	-10,000	39,235	2,308
1947	19	36	860	56,284	3,348	2,290	198,000	254,284	13,383
1948	24	60	1,058	58,508	3,199	2,349	-208,000	-149,492	-6,229
1949	50	110	850	60,910	3,260	2,410	0	60,910	1,218
1950	100	210	850	72,443	3,782	2,482	450,000	522,443	5,224
1951	129	339	1,300	77,312	3,938	2,560	78,000	155,312	1,204
1952	111	450	1,378	77,275	4,337	2,637	322,000	399,275	3,597
1953	128	578	1,700	72,440	4,109	2,709	-300,000	-227,560	-1,778
1954	121	699	1,400	83,653	4,443	2,793	250,000	333,653	2,757
1955	114	813	1,650	89,406	4,882	2,882	350,000	439,406	3,854
1956	113	926	2,000	90,660	4,723	2,973	-250,000	-159,340	-1,410
1957	108	1,034	1,750	88,266	5,127	3,061	316,000	404,266	3,743
1958	76	1,110	2,066	93,533		3,155			
1959	133	1,243		96,393	5,709	3,251	392,000	488,393	3,672
1960	176	1,419	2,458	99,049	5,808	3,350	0	99,049	563
1961	160	1,579	2,458	106,784	5,912	3,457	-3,000	103,784	649
1962	133	1,712	2,455	111,830	6,024	3,569	0	111,830	841
1963	99	1,811	2,455	114,867	6,288	3,684	149,000	263,867	2,665
1964	109	1,920	2,604	115,576	6,380	3,799	-23,000	92,576	849
1965	139	2,059	2,581	117,959	6,411	3,917	-87,000	30,959	223
1966	153	2,212	2,494	121,149	6,689	4,039	156,000	277,149	1,811
1967	135	2,347	2,650	133,042	6,880	4,172	58,000	191,042	1,415
1968	151	2,498	2,708	142,257	9,844	4,314	2,822,000	2,964,257	19,631
1969	134	2,632	5,530	168,379	10,052	4,482	40,000	208,379	1,555
1970	130	2,762	5,570	177,599	10,228	4,660	-2,000	175,599	1,351
1971	129	2,891	5,568	177,274	7,674	4,837	-2,731,000	-2,553,726	-19,796
1972	143	3,034	2,837	185,011	7,855	5,022	-4,000	181,011	1,266
1973	104	3,138	2,833	191,482	8,061	5,214	14,000	205,482	1,976
1974	98	3,236	2,847	238,271	8,539	5,452	240,000	478,271	4,880
1975	87	3,323	3,087	294,254	9,177	5,746	344,000	638,254	7,336
1976	79	3,402	3,431	327,285	13,352	6,073	3,848,000	4,175,285	52,852
1977	79	3,481	7,279	358,090	16,859	6,431	3,149,000	3,507,090	44,394
1978	83	3,564	10,428	443,475	35,282	6,875	17,979,000	18,422,475	221,958
1979	83	3,647	28,407	577,235	41,012	7,452	5,153,000	5,730,235	69,039
1980	85	3,732	33,560	708,454	52,322	8,161	10,601,000	11,309,454	133,052
1981			44,161						

MEXICO

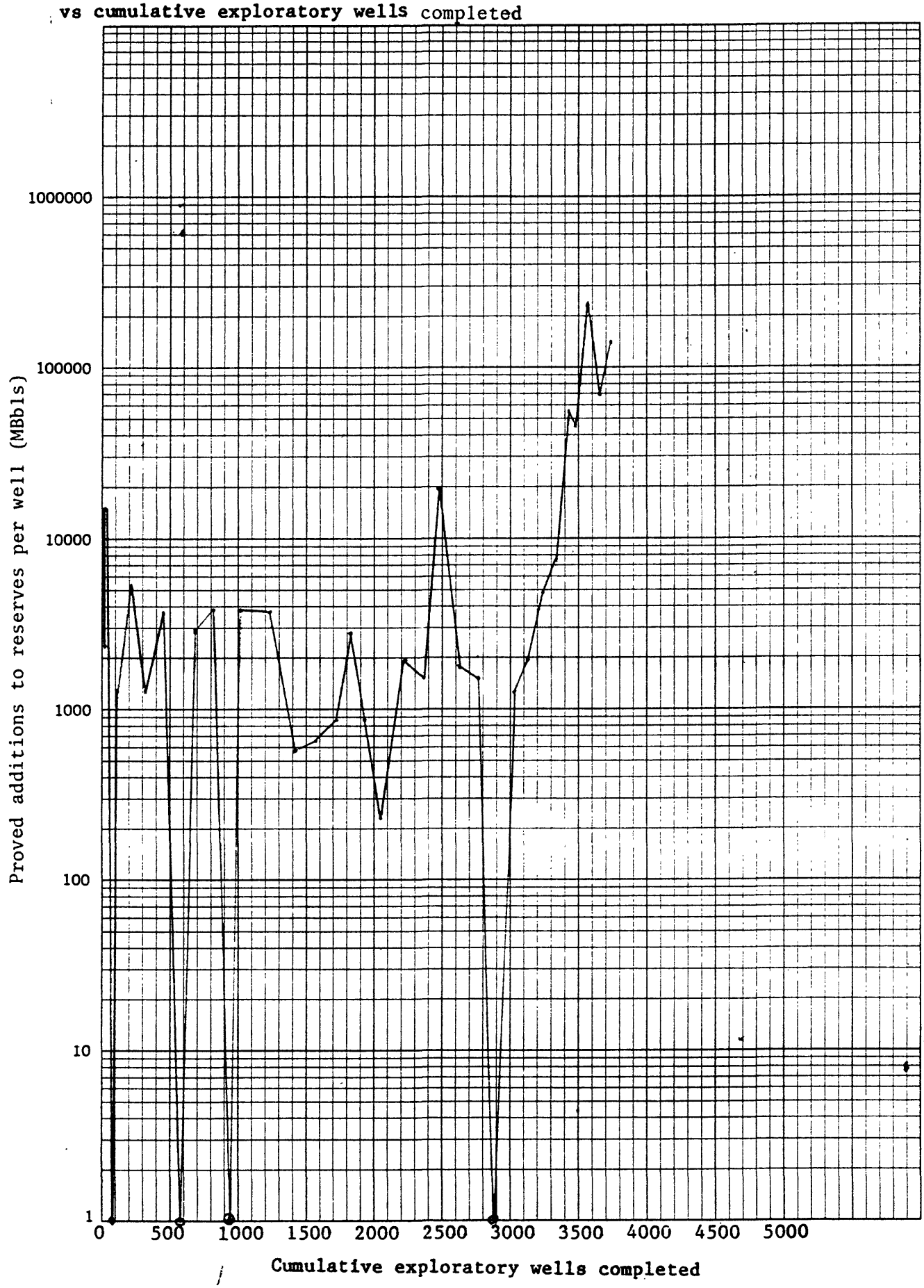
Ultimate crude oil recovery (MMBbls) vs cumulative exploratory wells completed



46 6463

SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

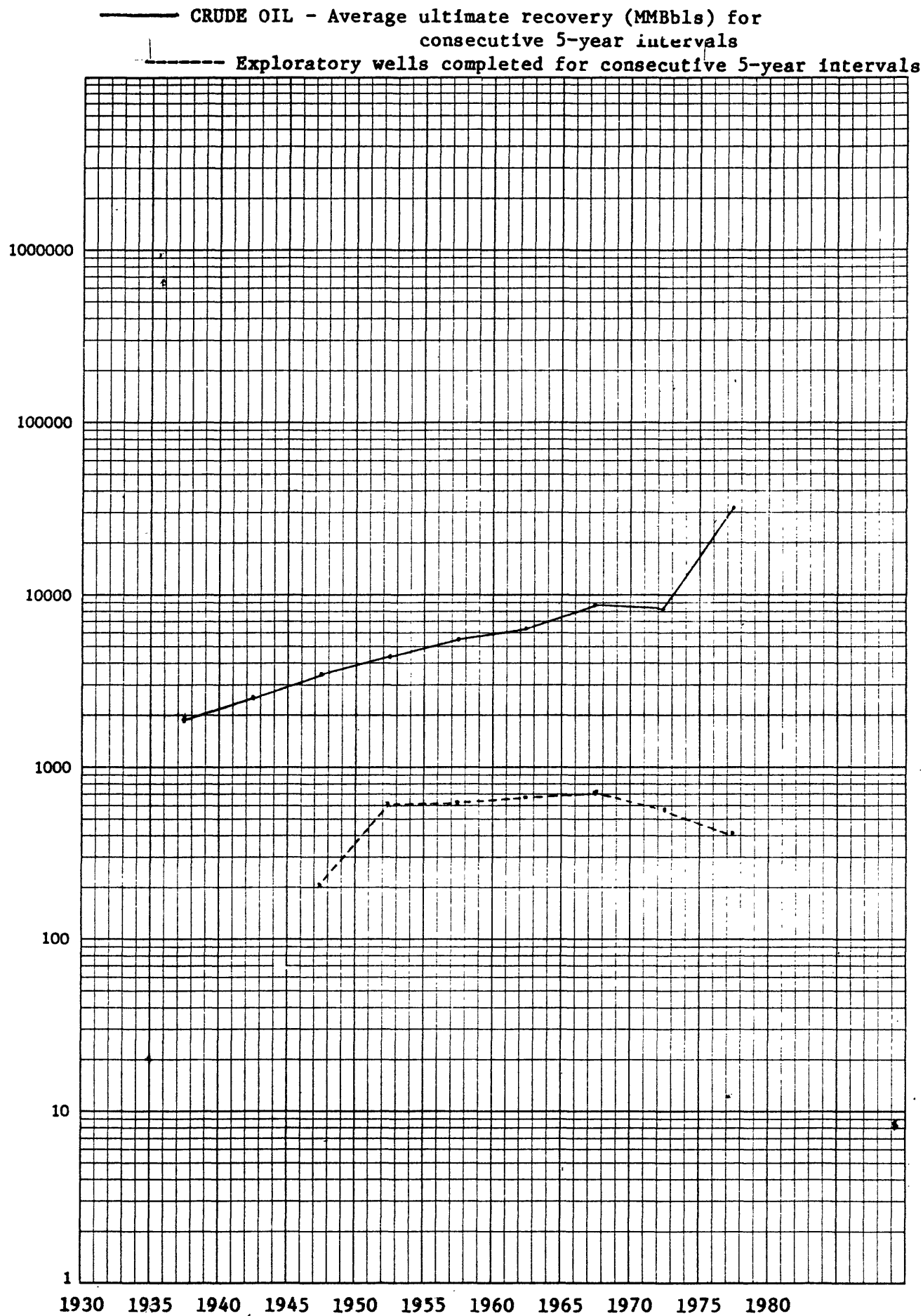
Proved additions to crude oil reserves per exploratory well completed (MBbls) vs cumulative exploratory wells completed



MEXICO

5 year period	Number of exploratory wells completed	Change in reserves (MMBbls)	Avg ultimate recovery (MMBbls)	Proved additions to reserves (MMBbls)	Proved additions to reserves by well (MMBbls)
1936-1940			1,905		
1941-1945		870	2,400	949	
1946-1950	210	430	3,337	727	3.5
1951-1955	603	700	4,342	1,100	1.8
1956-1960	606	458	5,341	832	1.4
1961-1965	640	36	6,203	604	.9
1966-1970	703	3,074	8,739	3,816	5.4
1971-1975	561	-2,137	8,261	-1,052	-1.9
1976-1980	409	40,730	31,765	43,143	105.5

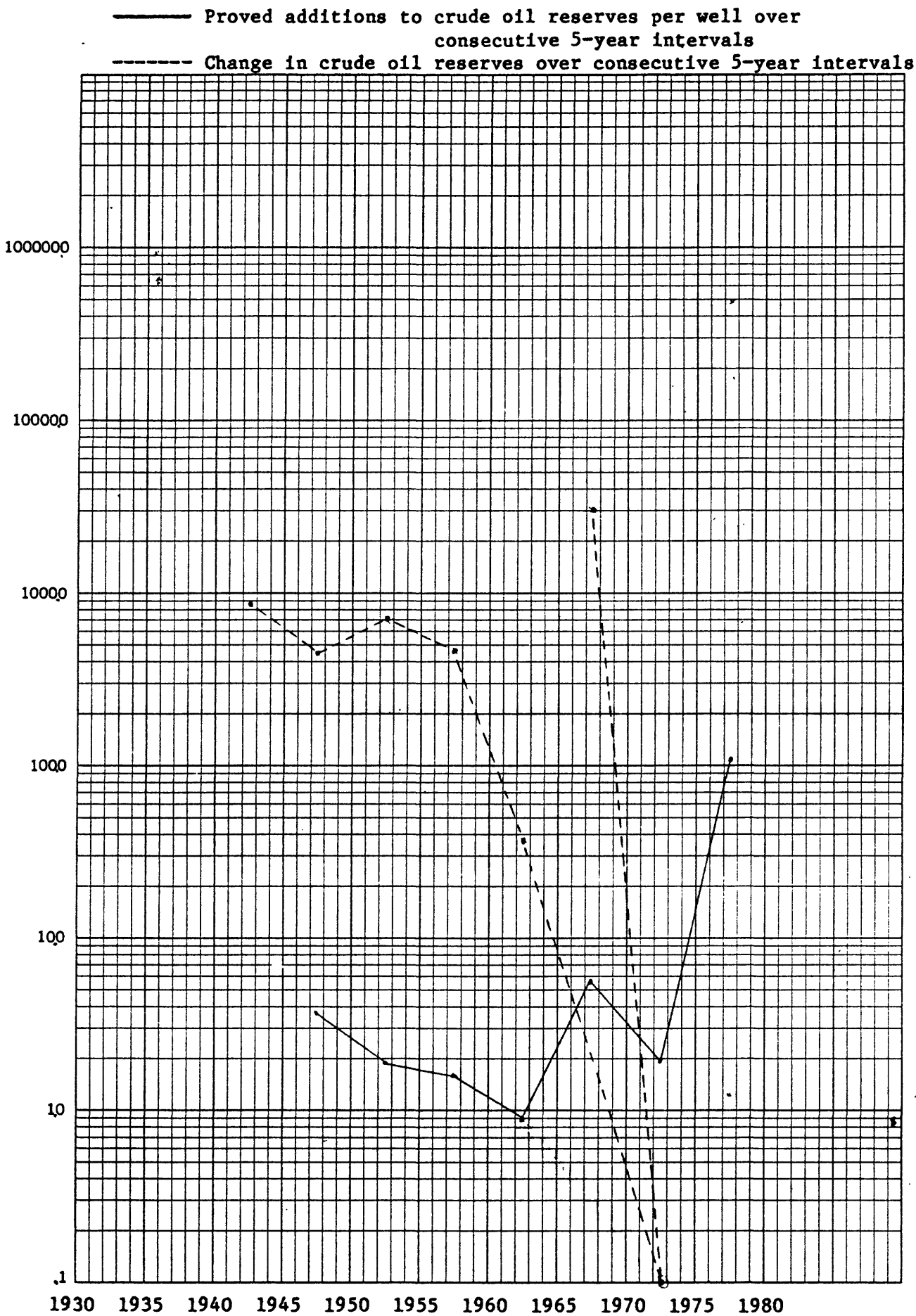
MEXICO



46 6463

K+E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS KEUFFEL & ESSER CO. MADE IN U.S.A.

MEXICO



46 6463

K+E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS KEUFFEL & ESSER CO. MADE IN U.S.A.

FAR EAST

Burma

China

India

Indonesia

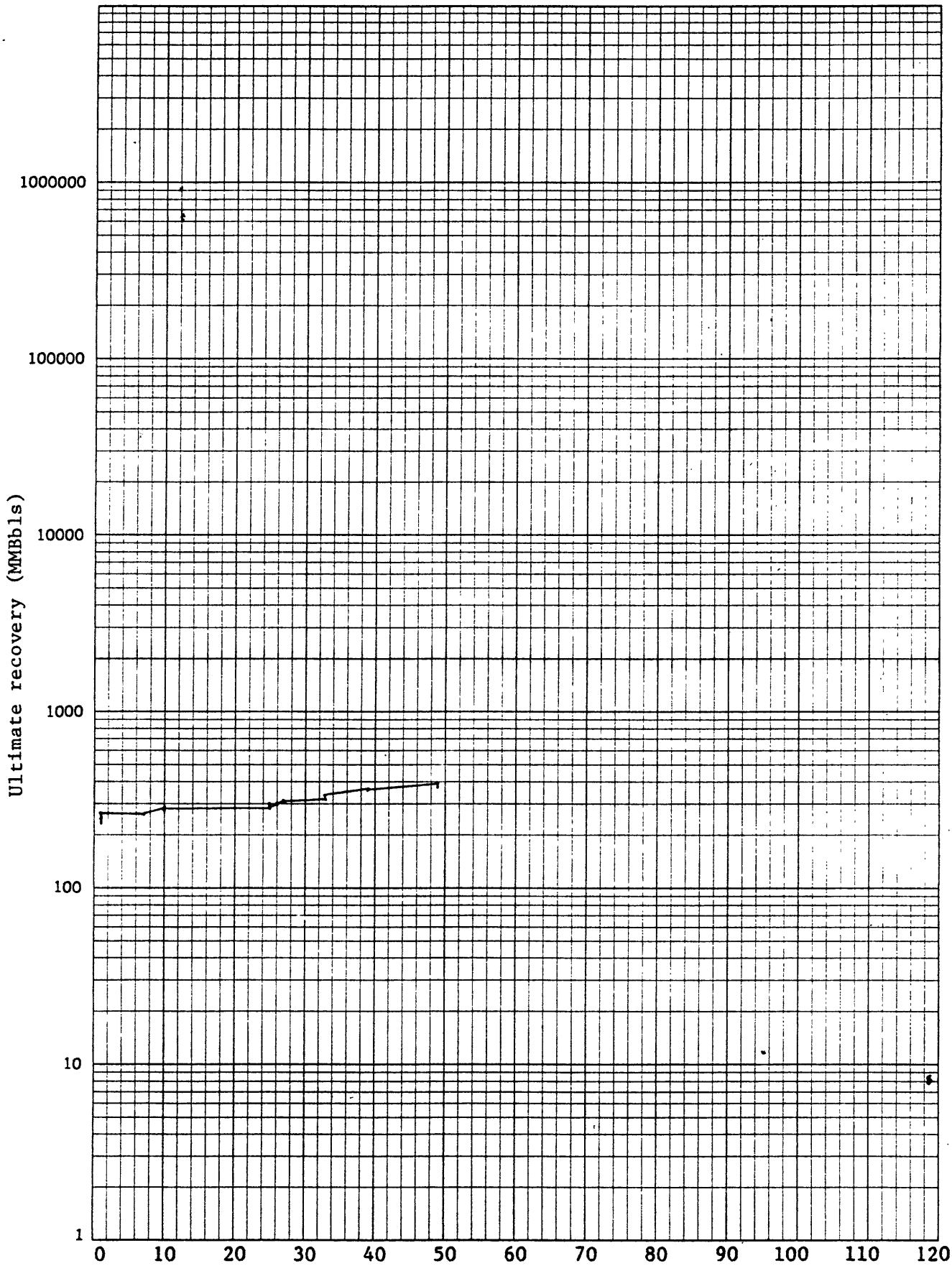
Japan

Malaysia/Brunei

Pakistan

Year (y)	Exploratory wells completed (W_y) (AAPG)	Cumulative exploratory wells completed (CW_y)	Reserves - MMBbls (R_y) (D/M)	Crude production MBbls (P_y) (D/M, WO)	Ultimate recovery rounded MMBbls ($CP_y + R_{y+1}$)	Cumulative production rounded MMBbls (CP_y)	Change in reserves ($R_{y+1} - R_y = \Delta R_y$) MBbls	Proved additions to reserves MBbls ($D_y = \Delta R_y + P_y$)	Proved additions to reserves per well MBbls (D_y/W_y)
1918				7,858	8	8			
1919				8,402	16	16			
1920				7,998	24	24			
1921				8,466	33	33			
1922				8,056	41	41			
1923				7,760	49	49			
1924				7,726	56	56			
1925				7,515	64	64			
1926				7,149	71	71			
1927				7,031	78	78			
1928				7,497	85	85			
1929				7,245	93	93			
1930				7,336	100	100			
1931				6,974	107	107			
1932				7,079	114	114			
1933				7,120	172	121			
1934				7,279	128	128			
1935				7,181	136	136			
1936				7,588	143	143			
1937				7,848	151	151			
1938				7,538	159	159			
1939				7,873	167	167			
1940				7,731	174	174			
1941				7,762	182	182			
1942				2,500	185	185			
1943				1,000	186	186			
1944				750	186	186			
1945				725	187	187			
1946				15	187	187			
1947	0	0		59	312	187	125,000	125,059	
1948	1	1	125	341	237	187	-75,000	-74,659	-74,059
1949	0	1	50	248	238	188	0	248	
1950	0	1	50	532	236	188	-2,000	-1,468	
1951	0	1	48	851	237	189	0	851	
1952	0	1	48	869	235	190	-3,000	-2,131	
1953	0	1	45	1,051	236	191	0	1,051	
1954	0	1	45	1,345	237	192	0	1,345	
1955		1	45	1,582	239	194	0	1,582	
1956	0	1	45	1,837	239	196	-2,000	-163	
1957	0	1	43	2,958	243	199	500	3,458	
1958	2	3	44	3,454		202			
1959	4	7		3,967	251	206	1,500	5,467	1,367
1960	3	10	45	4,078	260	210	5,000	9,078	3,026
1961		10	50	4,194	269	214	5,000	9,194	
1962	15	25	55	4,366	269	219	-5,000	-634	-42
1963	0	25	50	4,761	273	223	0	4,761	
1964		25	50	4,161	274	228	-4,000	161	
1965	0	25	46	4,065	292	232	14,000	18,065	
1966	*	25	60	4,252	296	236	0	4,252	
1967		25	60	4,442	300	240	0	4,442	
1968		25	60	5,634	286	246	-20,000	-14,366	
1969	1	26	40	6,050	300	252	8,000	14,050	14,050
1970	1	27	48	6,388	308	258	2,000	8,388	8,388
1971	*	27	50	6,652	304	265	-10,539	-3,887	
1972	6	33	39	7,466	313	273	539	8,005	1,334
1973	0	33	40	7,514	323	280	3,000	10,514	
1974	6	39	43	7,581	348	288	17,460	25,041	4,174
1975	10	49	60	6,700	361	294	6,716	13,416	1,342
1976	0	49	67	8,183	366	303	-4,176	4,007	
1977	0	49	63	10,400	381	313	4,921	15,321	
1978	0	49	68	8,990	380	322	-9,990	-1,000	
1979	0	49	58	10,527	380	333	-10,882	-355	
1980	0	49	47	10,980	379	343	-11,000	-20	
1981			36						

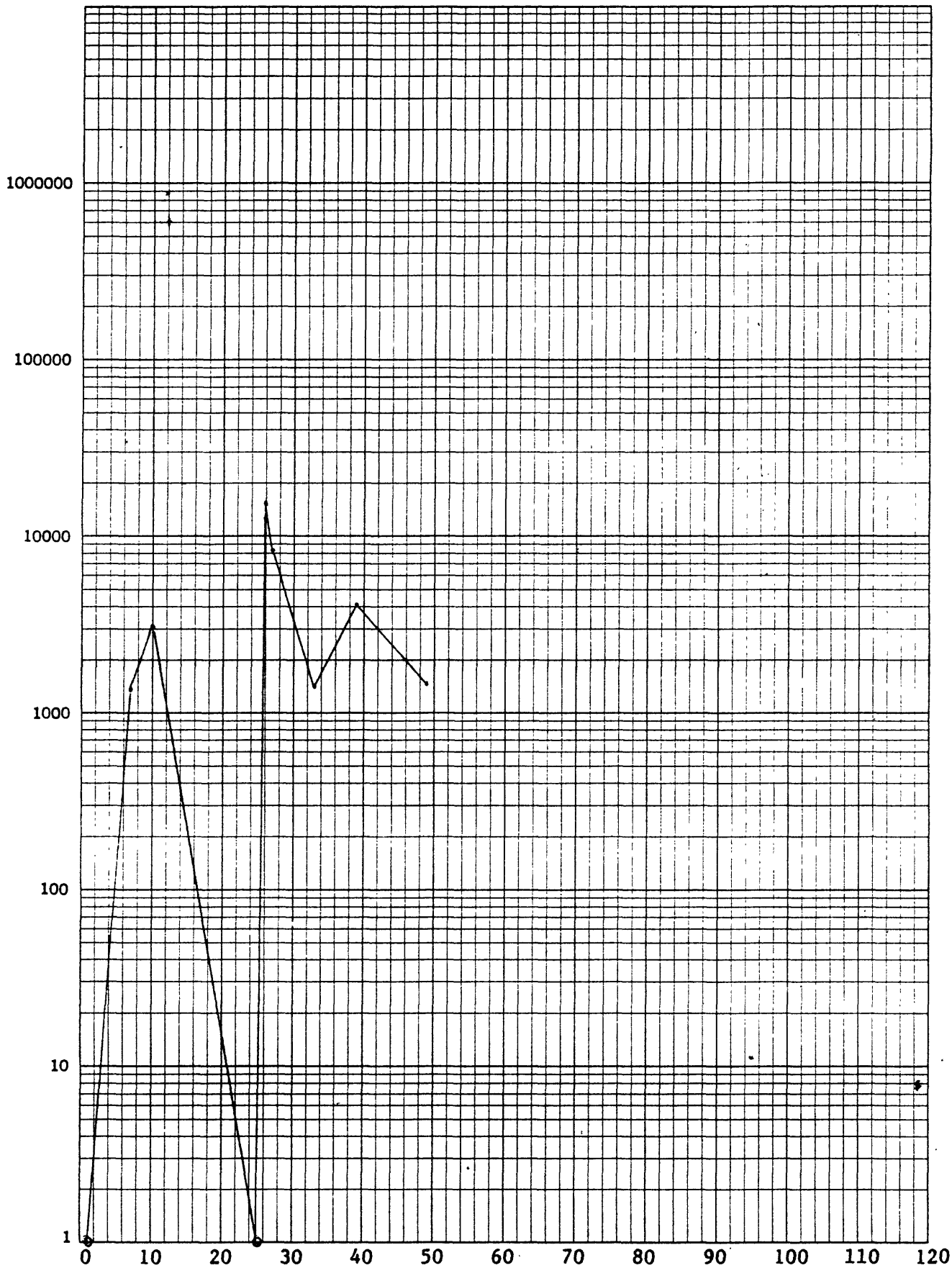
Ultimate crude oil recovery (MMBbls) vs cumulative exploratory wells completed



46 6463

K•E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS KEUFFEL & ESSER CO. MADE IN U.S.A.

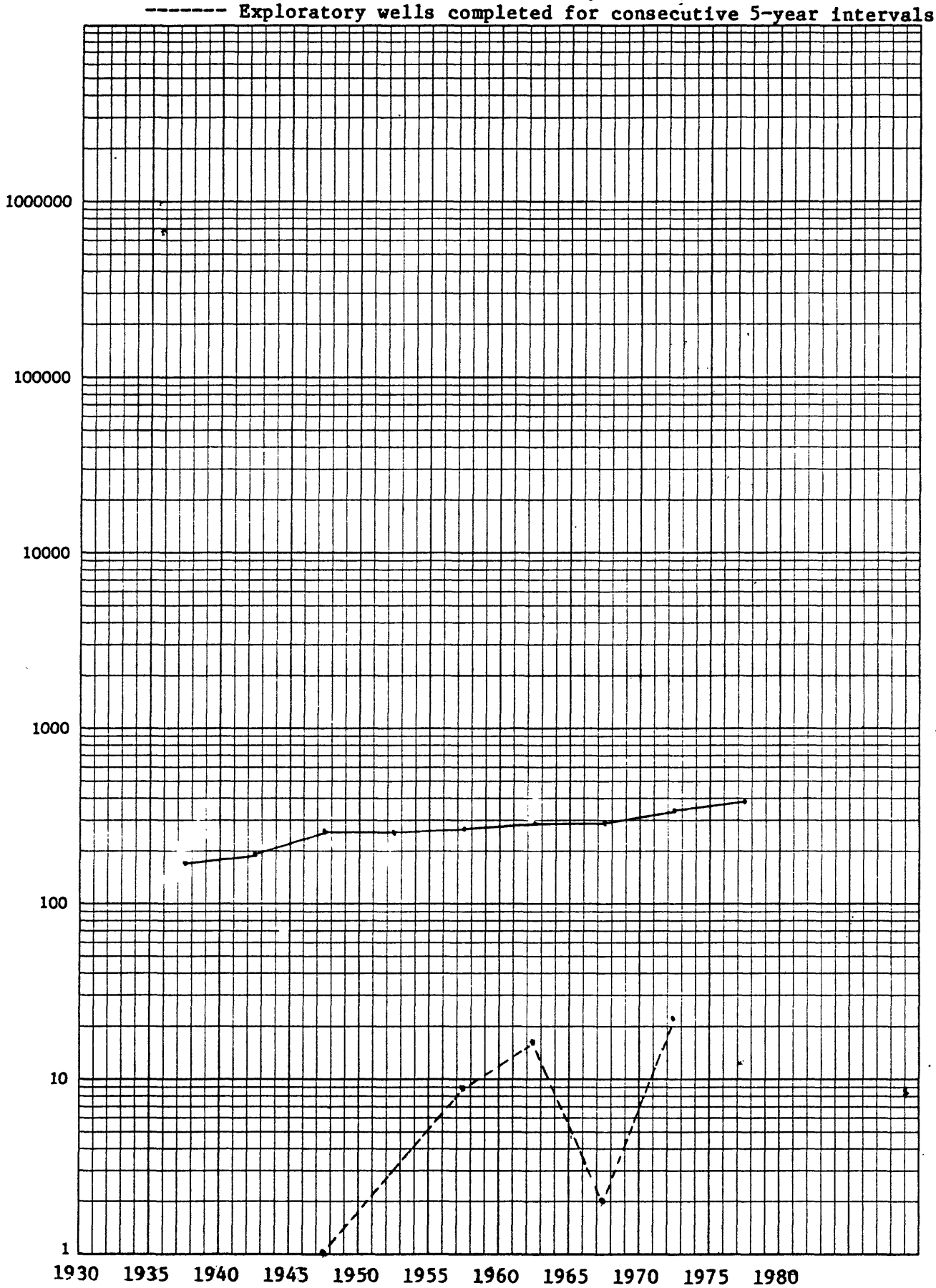
Proved additions to crude oil reserves per exploratory well completed (MBbls) vs cumulative exploratory wells completed



BURMA

5 year period	Number of exploratory wells completed	Change in reserves (MMBbls)	Avg ultimate recovery (MMBbls)	Proved additions to reserves (MMBbls)	Proved additions to reserves by well (MMBbls)
1936-1940			159		
1941-1945			185		
1946-1950	1	48	242	49	49.0
1951-1955	0	-3	237	3	0.0
1956-1960	9	6	248	17	1.9
1961-1965	15	10	275	31	2.1
1966-1970	2	-10	298	16	8.0
1971-1975	22	17	330	53	2.4
1976-1980	0	-31	377	18	0.0

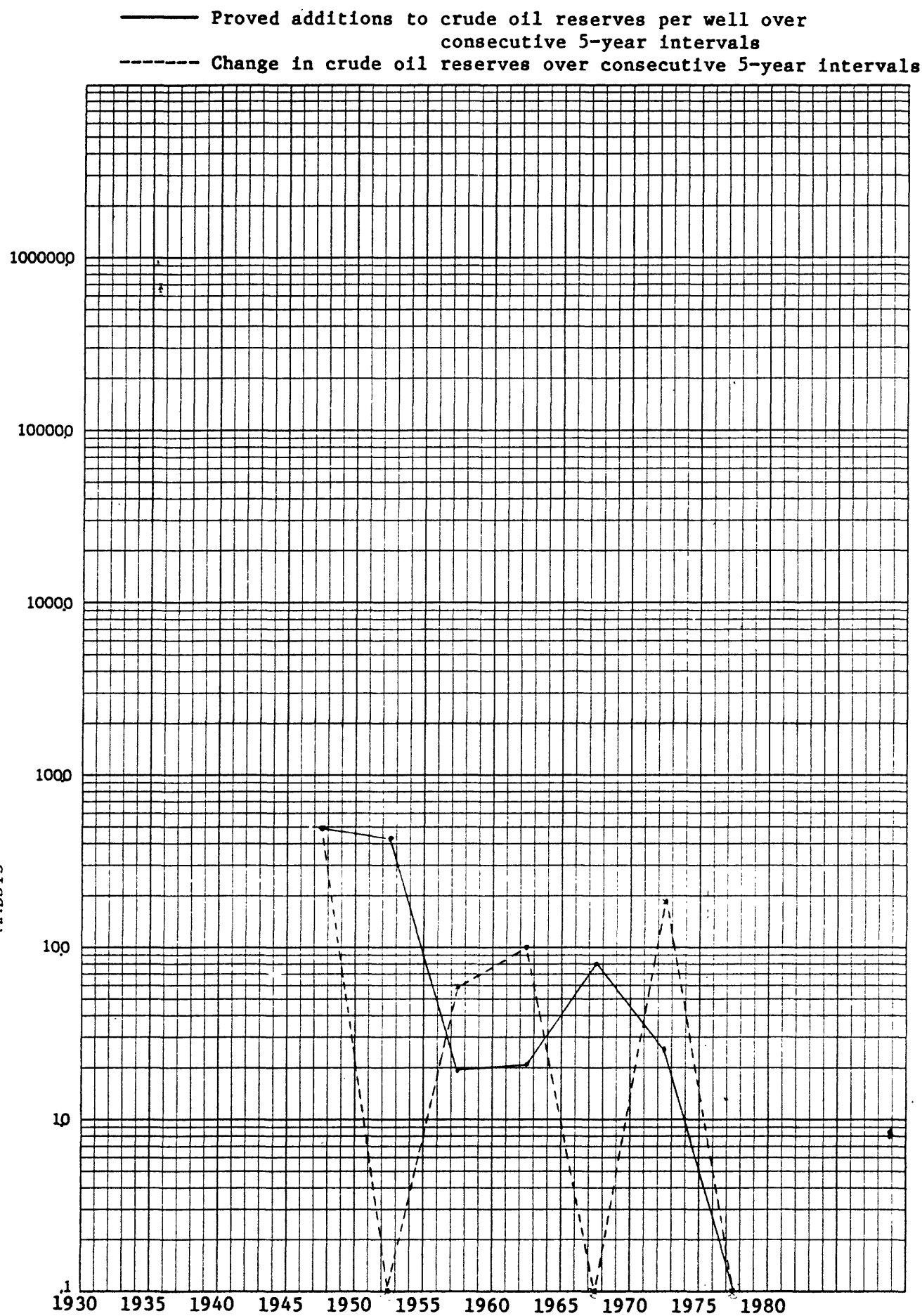
BURMA



46 6463

K+E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS KEUFFEL & ESSER CO. MADE IN U.S.A.

BURMA



46 6463

K•E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS KEUFFEL & ESSER CO. MADE IN U.S.A.

CHINA

Year (y)	Exploratory wells completed (W_y) (AAPG)	Cumulative exploratory wells completed (CW_y)	Reserves - MMBbls (R^y) (D/M)	Crude production MBbls (P_y) (D/M, WO)	Ultimate recovery rounded MMBbls ($CP_y + R_{y+1}$)	Cumulative production rounded MMBbls (CP_y)	Change in reserves ($R_{y+1} - R_y$) = ΔR_y MBbls	Proved additions to reserves MBbls ($D_y = \Delta R_y + P_y$)	Proved additions to reserves per well MBbls (D_y/W_y)
1938									
1939				4					
1940				10					
1941				87					
1942				340					
1943				447	1	1			
1944				505	1	1			
1945				484	17	2	15,000	15,484	
1946			15	513	28	2	11,000	11,513	
1947			26	374	18	3	-11,000	-10,626	
1948			15	533	23	3	5,000	5,533	
1949			20	730	24	4	0	730	
1950			20	730	16	5	-9,500	-8,770	
1951			11	730	16	5	0	730	
1952			11	1,000	22	6	5,000	6,000	
1953			16	1,500	34	8	10,000	11,500	
1954			26	3,000	42	11	5,000	8,000	
1955			31	3,500	44	14	-300	3,200	
1956			30	4,700	219	19	169,950	174,650	
1957			200	5,000	224	24	-25	4,975	
1958			200	6,000		30			
1959				15,330	446	46	199,875	215,205	
1960			400	22,776	568	68	100,000	122,776	
1961			500	27,667	696	96	100,000	127,667	
1962			600	31,609	728	128	0	31,609	
1963			600	35,113	763	163	0	35,113	
1964			600	37,595	1,000	200	200,000	237,595	
1965			800	49,085	1,249	249	200,000	249,085	
1966			1,000	74,970	1,324	324	0	74,970	
1967			1,000	61,421	1,386	386	0	61,421	
1968			1,000	75,575	1,461	461	0	75,575	
1969			1,000	75,000	6,205	536	4,669,000	4,744,000	
1970			5,669	146,000	6,351	682	0	146,000	
1971			5,669	167,900	13,350	850	6,831,000	6,998,900	
1972			12,500	216,080	13,566	1,066	0	216,080	
1973			12,500	365,000	16,231	1,431	2,300,000	2,665,000	
1974			14,800	474,500	16,706	1,906	0	474,500	
1975			14,800	571,590	19,719	2,477	2,442,000	3,013,590	
1976			17,242	645,897	21,123	3,123	758,000	1,403,897	
1977			18,000	653,350	21,803	3,777	26,000	679,350	
1978			18,026	731,825	24,533	4,508	1,999,000	2,730,825	
1979			20,025	790,041	24,549	5,299	-775,000	15,041	
1980			19,250	773,143	25,072	6,072	-250,000	523,143	
1981			19,000						

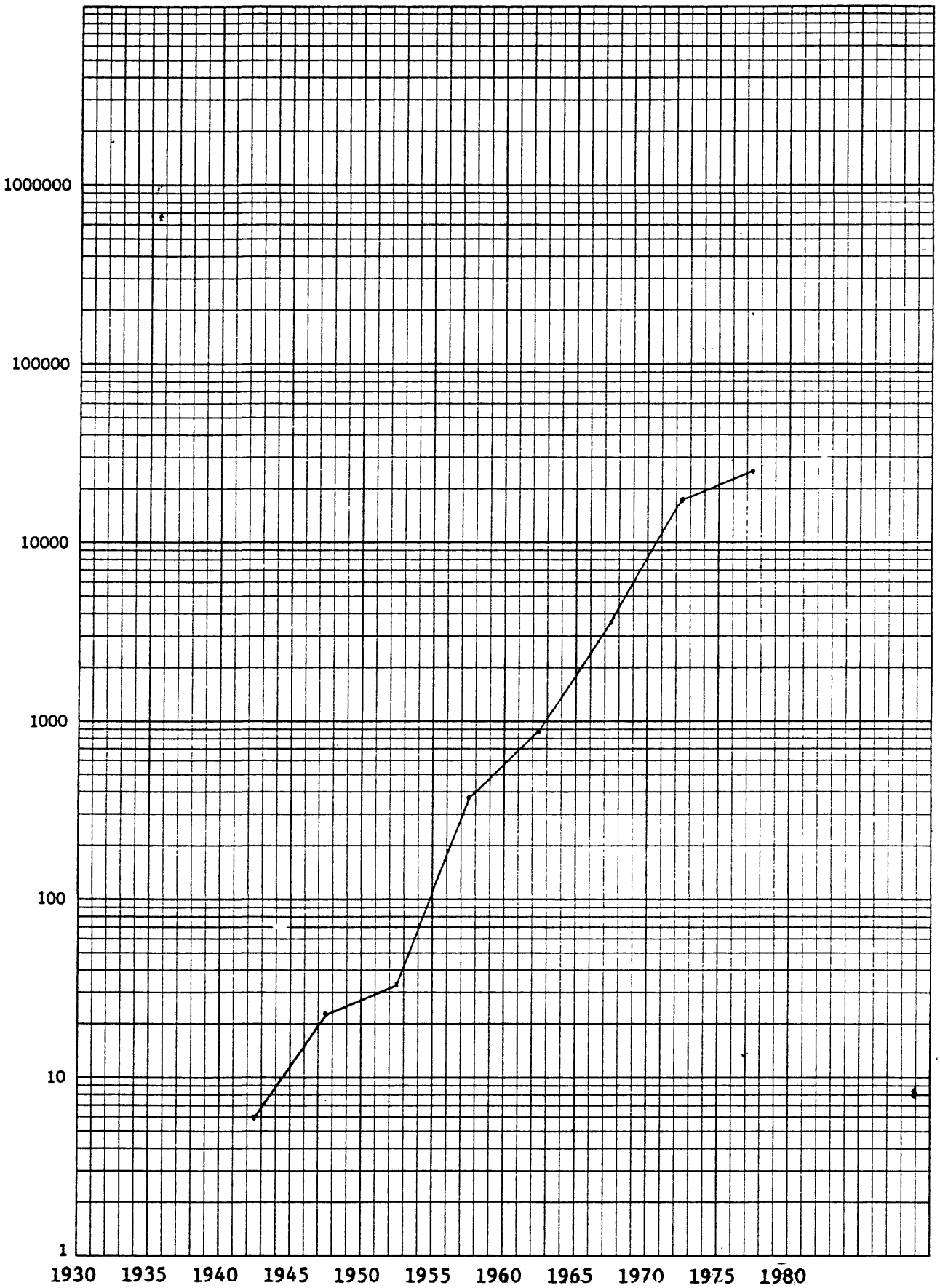
(1) Includes Formosa to 1958

CHINA

5 year period	Number of exploratory wells completed	Change in reserves (MMBbls)	Avg ultimate recovery (MMBbls)	Proved additions to reserves (MMBbls)	Proved additions to reserves by well (MMBbls)
1936-1940					
1941-1945		15	6	15	
1946-1950		-4	22	-1	
1951-1955		20	32	30	
1956-1960		470	364	518	
1961-1965		500	887	682	
1966-1970		4,669	3,345	5,102	
1971-1975		11,573	15,914	13,369	
1976-1980		1,758	23,416	5,352	

CHINA

——— CRUDE OIL - Average ultimate recovery (MMBbls) for consecutive 5-year intervals



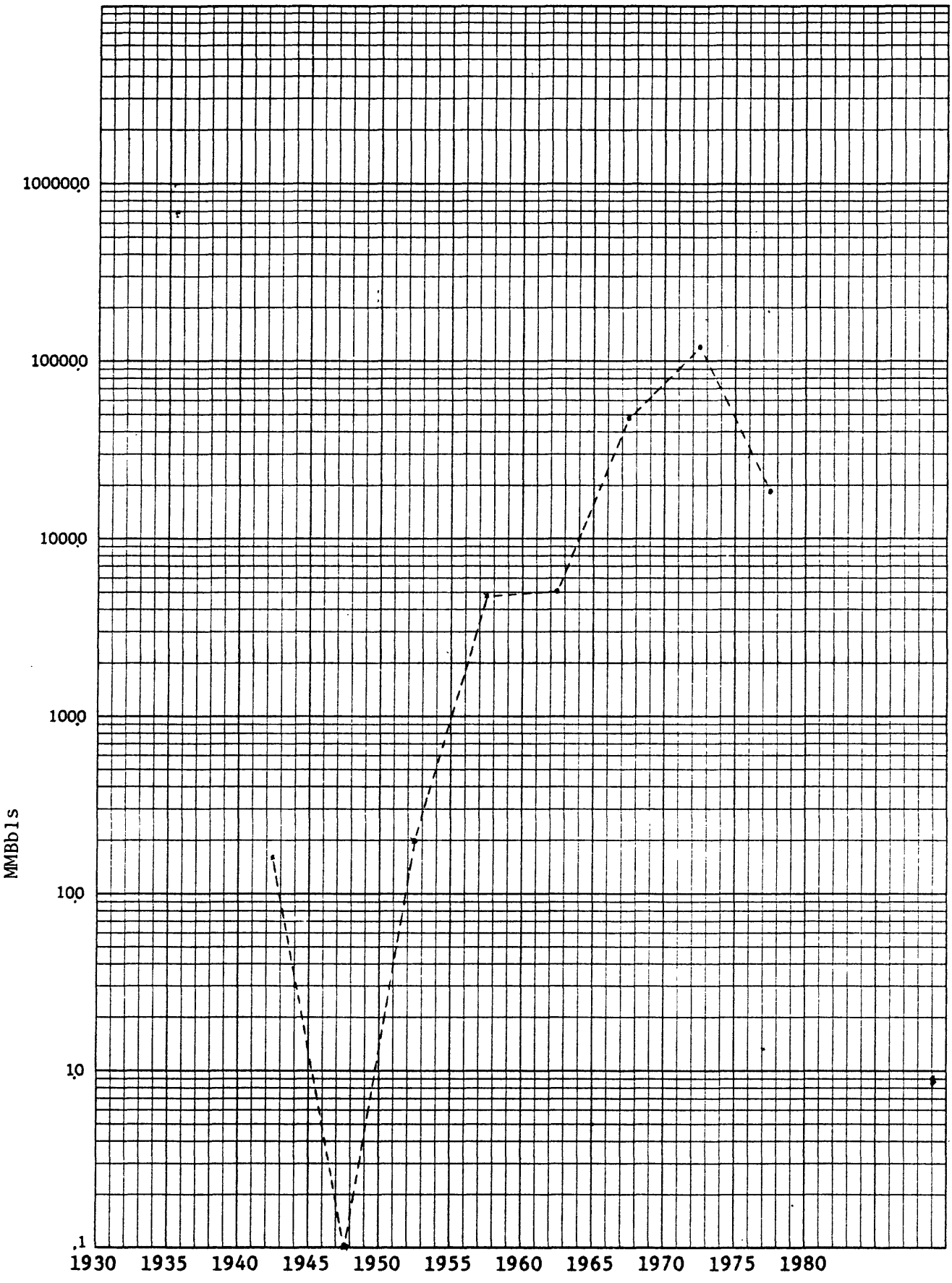
46 6463

K+E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS KEUFFEL & ESSER CO. MADE IN U.S.A.

CHINA

——— Proved additions to crude oil reserves per well over consecutive 5-year intervals

------- Change in crude oil reserves over consecutive 5-year intervals



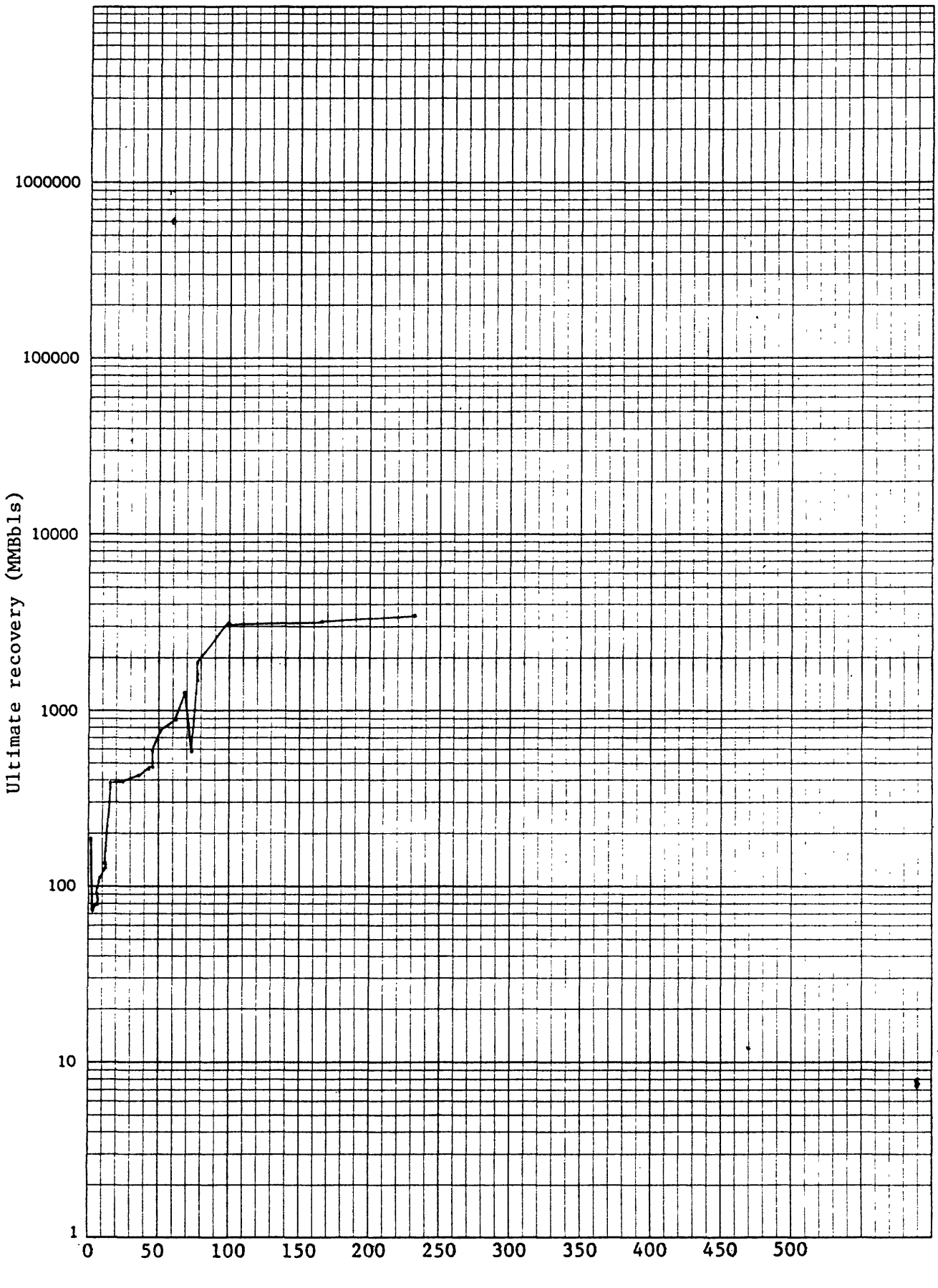
46 6463

K+E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS KEUFFEL & ESSER CO. MADE IN U.S.A.

Year (y)	Exploratory wells completed (W_y) (AAPG)	Cumulative exploratory wells completed (CW_y)	Reserves - MMBbls (R_y) (D/M)	Crude production MBbls (P_y) (D/M, WO)	Ultimate recovery rounded MMBbls ($CP_y + R_{y+1}$)	Cumulative production rounded MMBbls (CP_y)	Change in reserves ($R_{y+1} - R_y$) = ΔR_y MBbls	Proved additions to reserves MBbls ($D_y = \Delta R_y + P_y$)	Proved additions to reserves per well MBbls (D_y/W_y)
1918				330					
1919				334	1	1			
1920				377	1	1			
1921				268	1	1			
1922				252	2	2			
1923				308	2	2			
1924				361	2	2			
1925				529	3	3			
1926				683	3	3			
1927				696	4	4			
1928				894	5	5			
1929				953	6	6			
1930				1,332	7	7			
1931				1,582	9	9			
1932				1,571	10	10			
1933				1,497	12	12			
1934				1,822	14	14			
1935				1,927	16	16			
1936				1,850	18	18			
1937				1,871	19	19			
1938				1,874	21	21			
1939				1,460	23	23			
1940				1,425	24	24			
1941				1,886	26	26			
1942				1,889	28	28			
1943				2,055	197	30	167,400	169,455	
1944			167	2,314		32			
1945				1,991	169	34	-32,400	-30,409	
1946	2	2	135	1,852	176	36	5,000	6,852	3,426
1947	1	3	140	1,863	73	38	-105,000	-103,137	-103,137
1948	0	3	35	1,875	72	40	-3,000	-1,125	
1949	1	4	32	1,906	77	42	3,000	4,906	4,906
1950	2	6	35	1,867	79	44	0	1,867	934
1951	0	6	35	1,949	91	46	10,000	11,949	
1952	0	6	45	1,900	98	48	5,000	6,900	
1953	2	8	50	2,215	118	50	18,000	20,215	10,108
1954	4	12	68	2,235	120	52	0	2,235	559
1955	0	12	68	2,526	124	55	1,000	3,526	
1956	3	15	69	2,876	377	57	251,000	253,876	84,625
1957	10	25	320	3,241	380	61	-1,000	2,241	224
1958	5	30	319	3,258		64			
1959	6	36		3,377	417	67	31,000	34,377	5,729
1960	7	43	350	3,370	446	71	25,000	28,370	4,053
1961	3	46	375	3,356	474	74	25,000	28,356	9,452
1962		46	400	8,016	582	82	100,000	108,016	
1963	5	51	500	12,266	769	94	175,000	187,266	37,453
1964			675	16,965	886	111	100,000	116,965	
1965			775	22,494	1,134	134	225,000	247,494	
1966	e		1,000	35,624	1,169	169	0	35,624	
1967	e		1,000	43,400	1,248	213	35,000	78,400	
1968			1,035	43,552	1,306	256	15,000	58,552	
1969	10	61	1,050	51,724	569	308	-788,809	-737,085	-73,709
1970			261	52,596	1,104	361	481,509	534,105	
1971	e		743	52,091	1,153	413	-3,064	49,027	
1972	7	68	740	56,965	1,257	470	47,364	104,329	14,904
1973	10	78	787	55,388	1,416	525	104,000	159,388	15,939
1974	0	78	891	55,733	1,507	581	35,405	91,138	
1975	0	78	926	61,611	1,713	642	144,355	205,966	
1976			1,071	64,632	2,756	707	978,491	1,043,123	
1977	22	100	2,049	75,787	3,043	783	210,749	286,536	13,024
1978	66	166	2,260	82,125	3,175	865	50,000	132,125	2,002
1979	65	231	2,310	98,442	3,300	963	27,000	125,442	1,930
1980			2,337	69,906	3,442	1,033	72,000	141,906	
1981			2,409						

e = secret
(1) includes Pakistan to 1958

Ultimate crude oil recovery (MMBbls) vs cumulative exploratory wells completed

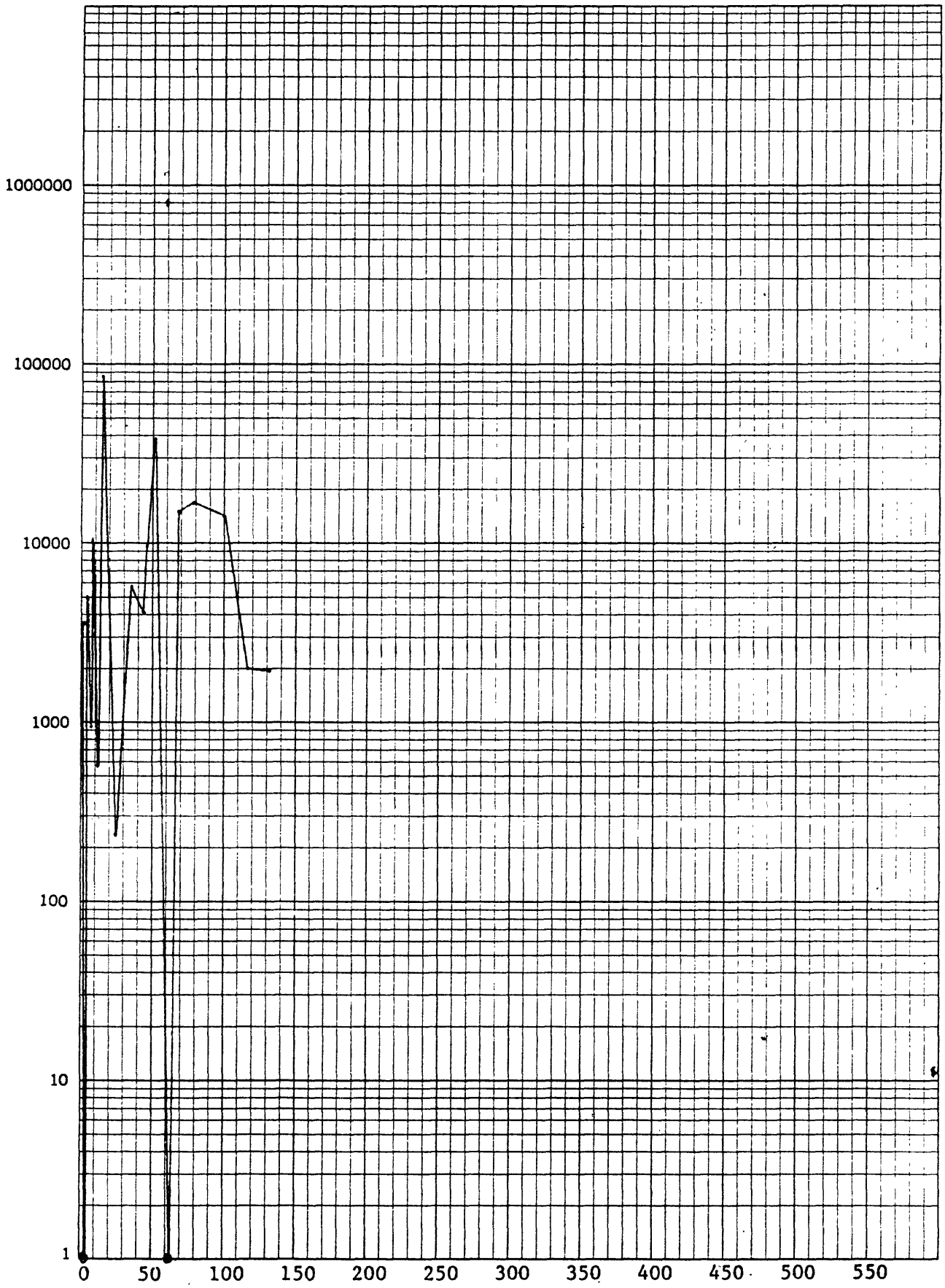


46 6463

K+E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

INDIA

Proved additions to crude oil reserves per exploratory well completed (MBbls)
vs cumulative exploratory wells completed



II-132

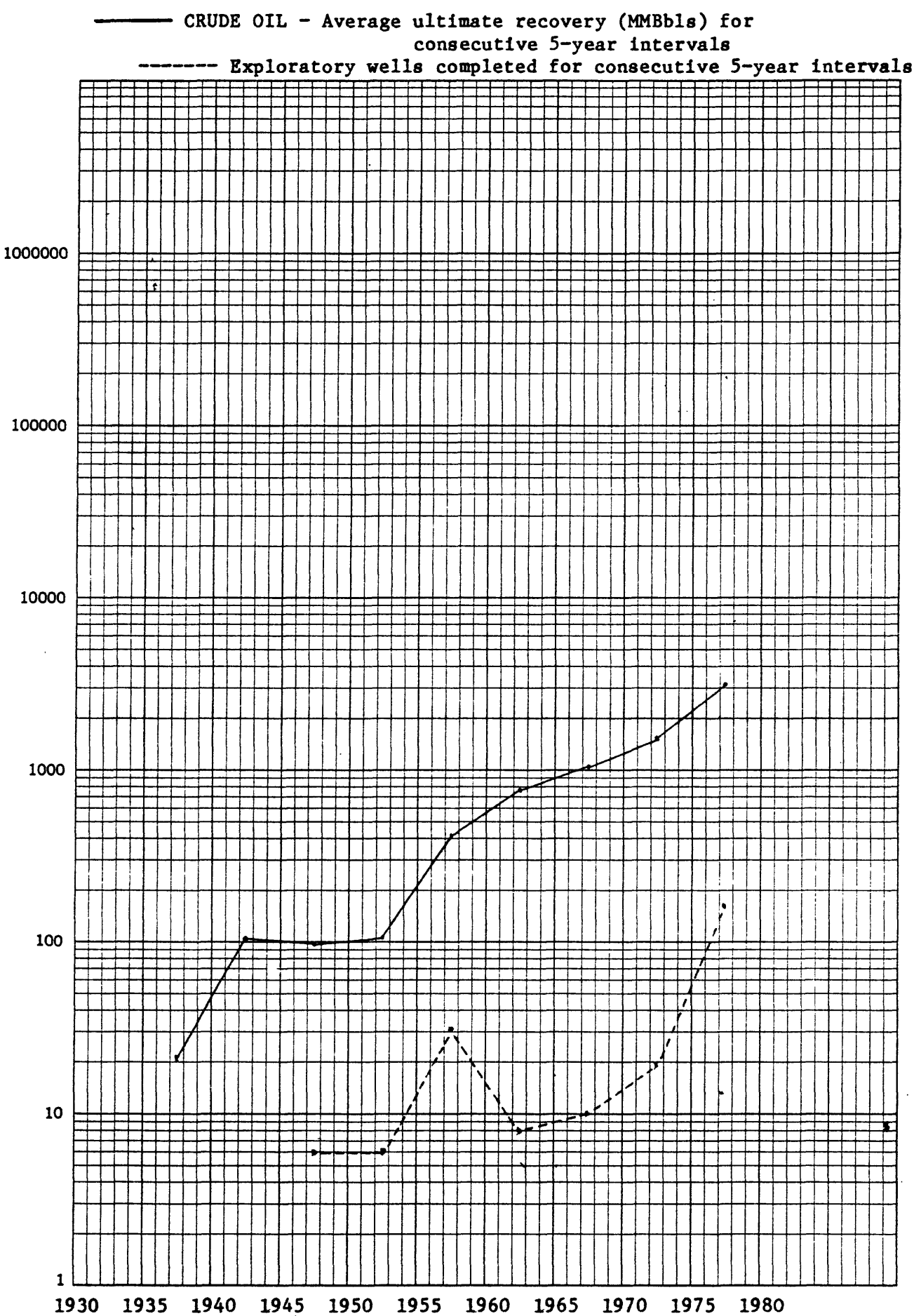
46 6463

K+E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS KEUFFEL & ESSER CO. MADE IN U.S.A.

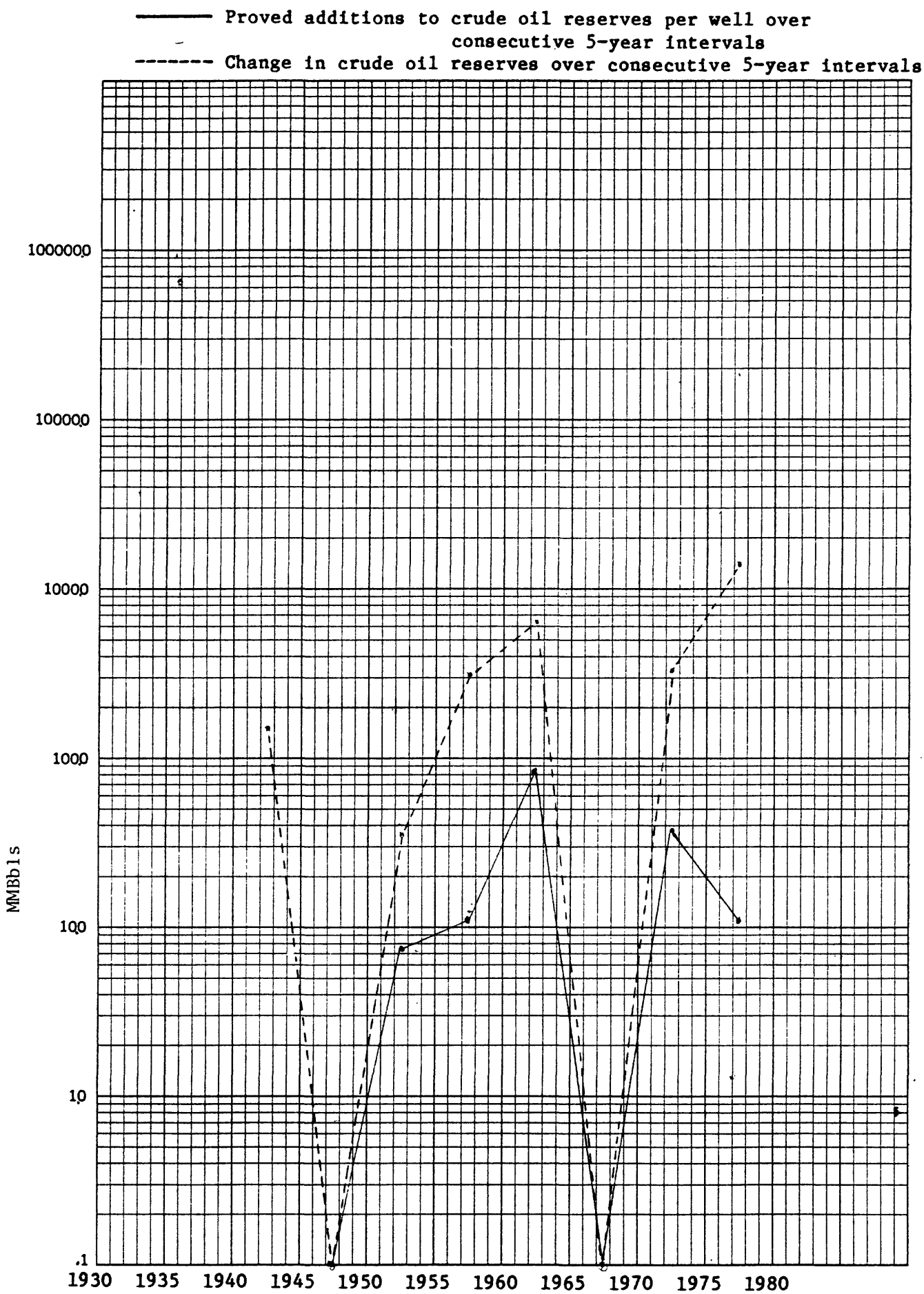
INDIA

5 year period	Number of exploratory wells completed	Change in reserves (MMBbls)	Avg ultimate recovery (MMBbls)	Proved additions to reserves (MMBbls)	Proved additions to reserves by well (MMBbls)
1936-1940			21		
1941-1945		135	105	139	
1946-1950	6	-100	95	-90	-15.0
1951-1955	6	34	110	45	7.5
1956-1960	31	306	405	318	10.3
1961-1965	8	625	769	687	85.9
1966-1970	10	-257	1,079	-30	-3.0
1971-1975	17	327	1,409	609	35.8
1976-1980	153	1,338	3,143	1,729	11.3

INDIA

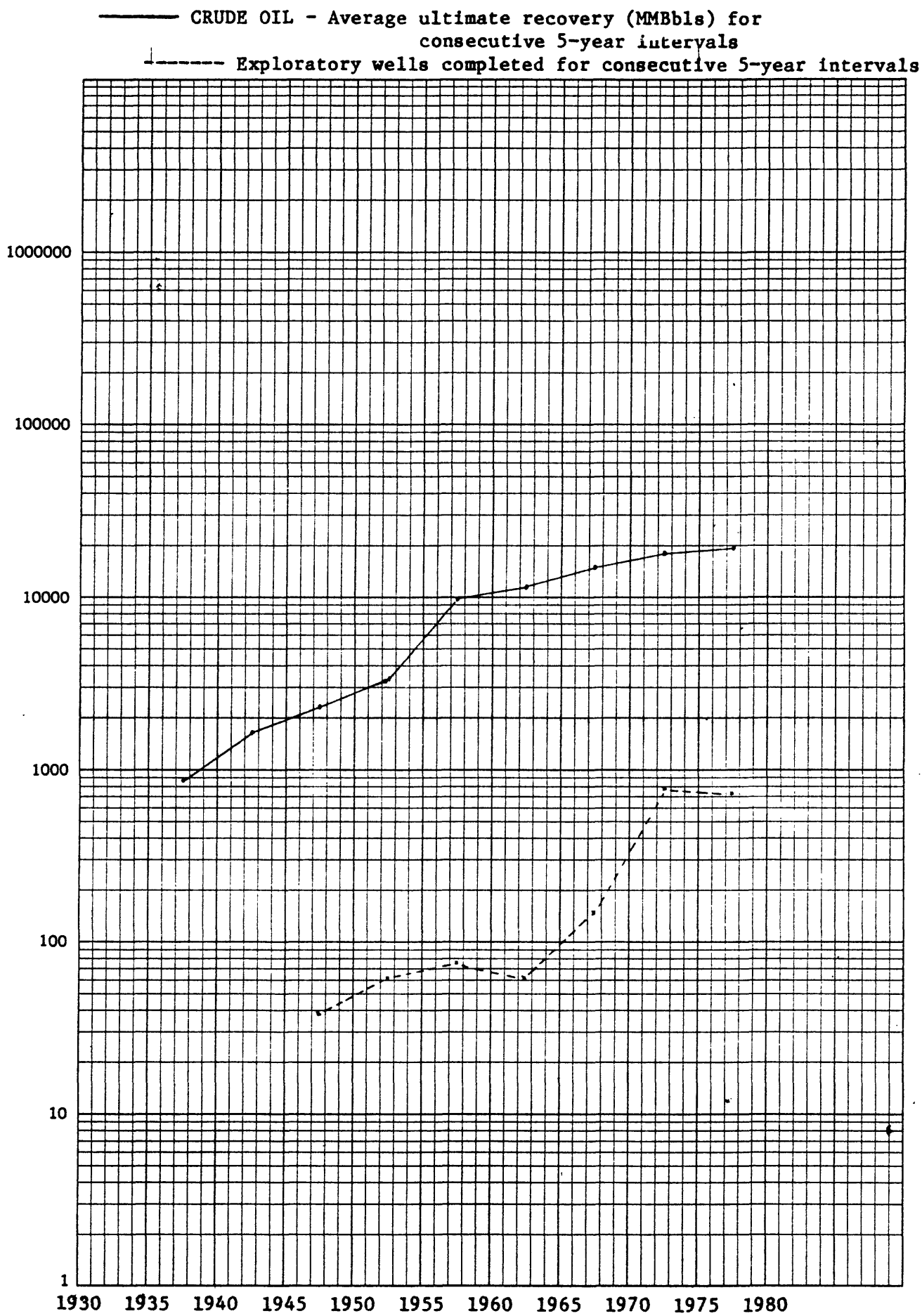


INDIA

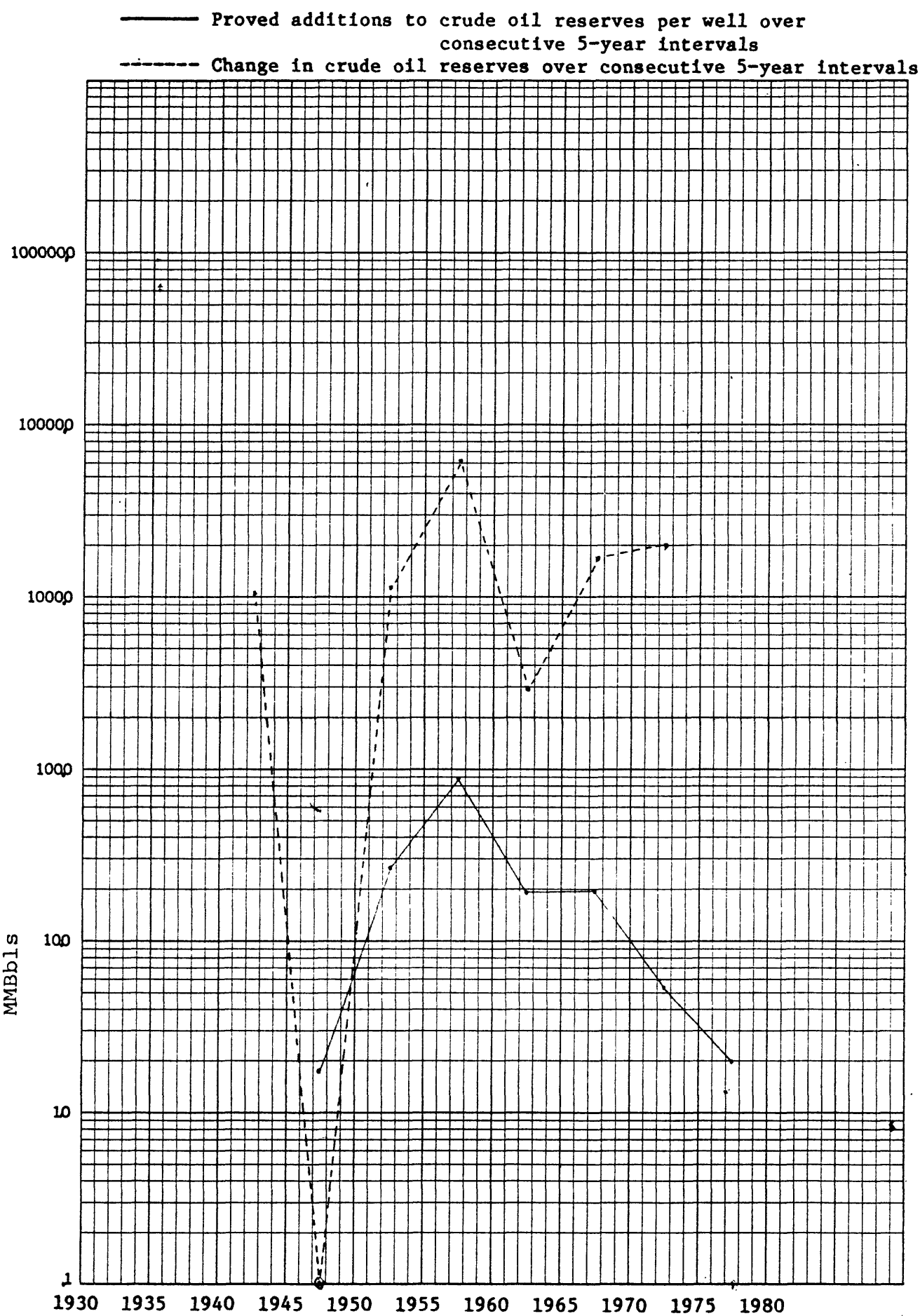


INDONESIA

Year (y)	Exploratory wells completed (W_y) (AAPG)	Cumulative exploratory wells completed (CW_y)	Reserves - MMBbls (R^y) (D/M)	Crude production MBbls (P_y) (D/M, WO)	Ultimate recovery rounded MMBbls ($CP_y + R_{y+1}$)	Cumulative production rounded MMBbls (CP_y)	Change in reserves ($R_{y+1} - R_y$) = ΔR_y MBbls	Proved additions to reserves MBbls ($D_y = \Delta R_y + P_y$)	Proved additions to reserves per well MBbls (D_y/W_y)
1893				600	1	1			
1894				688	2	2			
1895				1,216	3	3			
1896				1,427	4	4			
1897				2,552	6	6			
1898				2,944	9	9			
1899				1,796	11	11			
1900				2,253	13	13			
1901				4,014	18	18			
1902				4,014	22	22			
1903				5,770	27	27			
1904				6,508	34	34			
1905				7,850	42	42			
1906				8,181	50	50			
1907				9,983	60	60			
1908				10,283	70	70			
1909				11,042	81	81			
1910				11,031	92	92			
1911				12,173	104	104			
1912				10,346	115	115			
1913				11,172	126	126			
1914				11,422	135	135			
1915				11,920	150	150			
1916				12,547	162	162			
1917				13,180	175	175			
1918				12,778	188	188			
1919				15,508	204	204			
1920				17,529	221	221			
1921				16,958	238	238			
1922				17,066	255	255			
1923				19,870	275	275			
1924				20,473	296	296			
1925				21,422	317	317			
1926				21,243	338	338			
1927				27,433	366	366			
1928				32,118	398	398			
1929				39,279	437	437			
1930				41,728	479	479			
1931				35,539	514	514			
1932				39,001	553	553			
1933				42,567	596	596			
1934				46,529	643	643			
1935				47,171	690	690			
1936				50,335	740	740			
1937				56,724	797	797			
1938				57,318	854	854			
1939				62,087	916	916			
1940				62,011	978	978			
1941				53,704	1,032	1,032			
1942				24,000	1,056	1,056			
1943				48,294	2,054	1,104	950,700	998,294	
1944			350	22,250		1,126			
1945				7,500	2,209	1,134	125,000	132,600	
1946			1,075	2,100	2,236	1,136	-25,000	-22,900	
1947			1,050	8,020	1,394	1,144	-200,000	-191,980	
1948	6	6	850	31,765	2,226	1,176	200,000	231,765	57,941
1949	13	19	1,050	42,206	2,368	1,218	100,300	142,206	9,480
1950	19	38	1,150	48,400	2,266	1,266	-150,000	-101,600	-5,347
1951	24	62	1,000	55,453	2,422	1,322	100,000	155,453	6,477
1952	14	76	1,100	62,495	2,884	1,384	400,000	462,495	33,035
1953	9	85	1,500	75,626	3,360	1,460	300,000	375,626	63,958
1954	7	92	2,000	79,536	3,699	1,539	160,000	239,586	34,227
1955	7	99	2,160	87,083	3,757	1,627	0	87,083	12,440
1956	9	108	2,160	93,320	7,733	1,720	3,853,000	3,946,820	438,535
1957	15	123	6,013	114,151	9,352	1,834	1,505,000	1,619,151	107,943
1958	12	135	7,518	118,711		1,953			
1959	18	153		139,038	10,098	2,092	488,000	627,038	34,835
1960	20	173	8,006	152,988	10,450	2,245	198,500	351,488	17,574
1961	0	173	8,205	155,369	10,604	2,401	-1,500	153,869	
1962	0	173	8,203	167,771	11,071	2,568	300,000	467,771	
1963	28	201	8,503	165,302	11,233	2,733	-3,000	162,002	5,786
1964	19	220	9,500	171,492	11,205	2,905	0	171,492	9,026
1965	14	234	8,500	178,177	11,583	3,083	0	178,177	12,727
1966	3	237	8,500	168,859	11,752	3,252	0	168,859	56,286
1967	5	242	8,500	184,961	11,937	3,437	0	184,961	36,992
1968	17	259	8,500	219,864	12,157	3,657	0	219,864	12,933
1969	32	291	8,500	271,001	21,923	3,923	9,500,000	9,771,001	305,344
1970	84	375	18,000	311,656	14,239	4,239	-8,000,000	-7,688,344	-91,528
1971	135	510	10,000	325,673	15,238	4,565	673,400	999,073	7,401
1972	137	647	10,675	395,581	15,441	4,961	26,600	422,181	3,082
1973	169	816	10,700	445,536	16,949	5,449	800,000	1,288,536	7,624
1974	168	984	11,500	501,838	17,951	5,951	500,000	1,001,838	5,963
1975	180	1,164	12,000	477,055	18,428	6,428	0	477,055	2,650
1976	130	1,294	12,000	550,319	18,478	6,978	-500,000	50,319	$ 387
1977	115	1,409	11,500	615,123	15,891	7,594	-3,202,916	-2,587,793	-22,502
1978	146	1,555	8,297	546,505	18,014	8,190	1,526,985	2,123,490	14,544
1979	134	1,769	9,826	582,943	19,776	8,773	1,178,681	1,761,644	11,439
1980	182	1,891	11,003	576,084	19,889	9,349	-463,190	112,894	620
1981			10,340						



INDONESIA



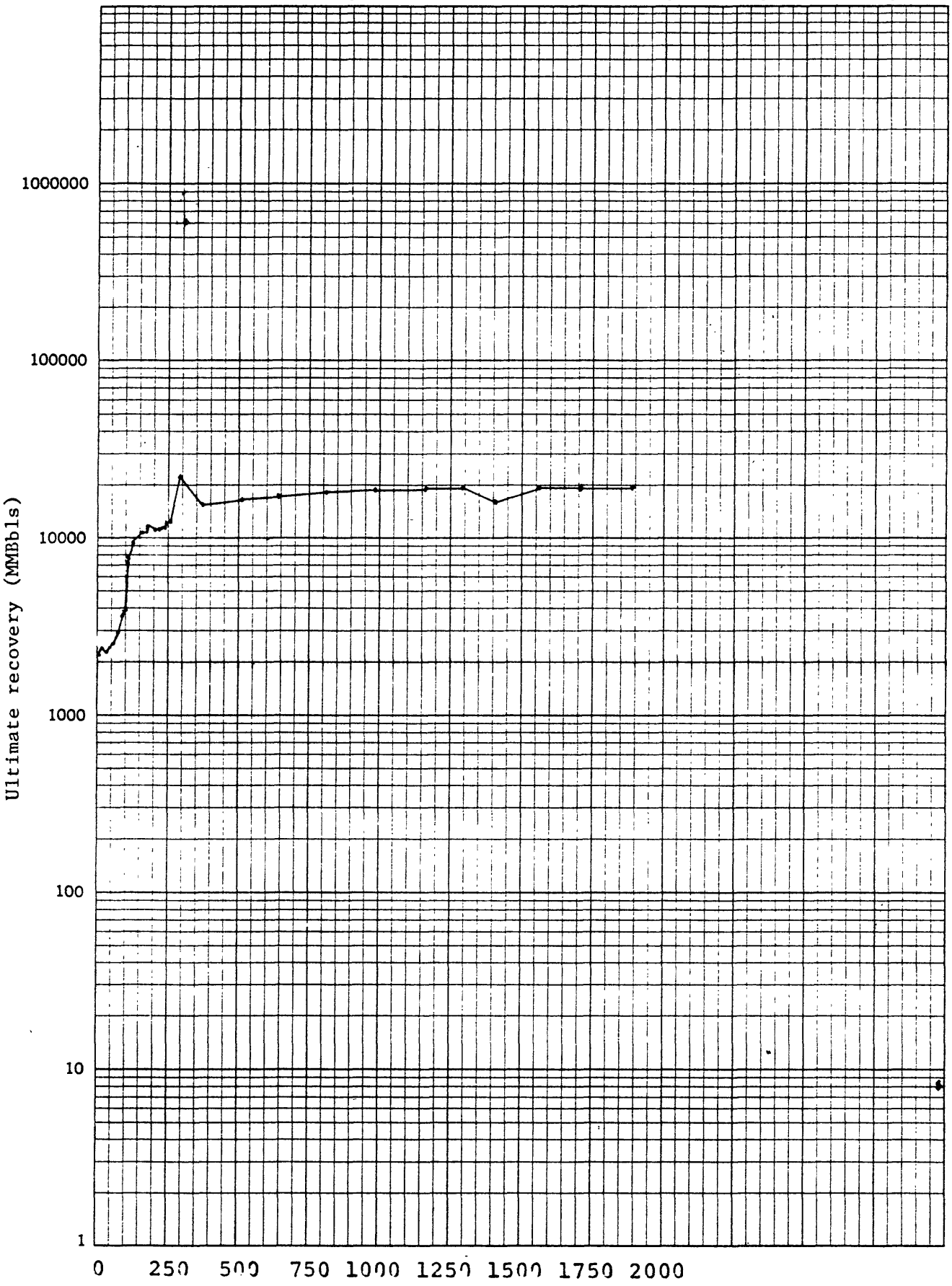
46 6463

K•E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

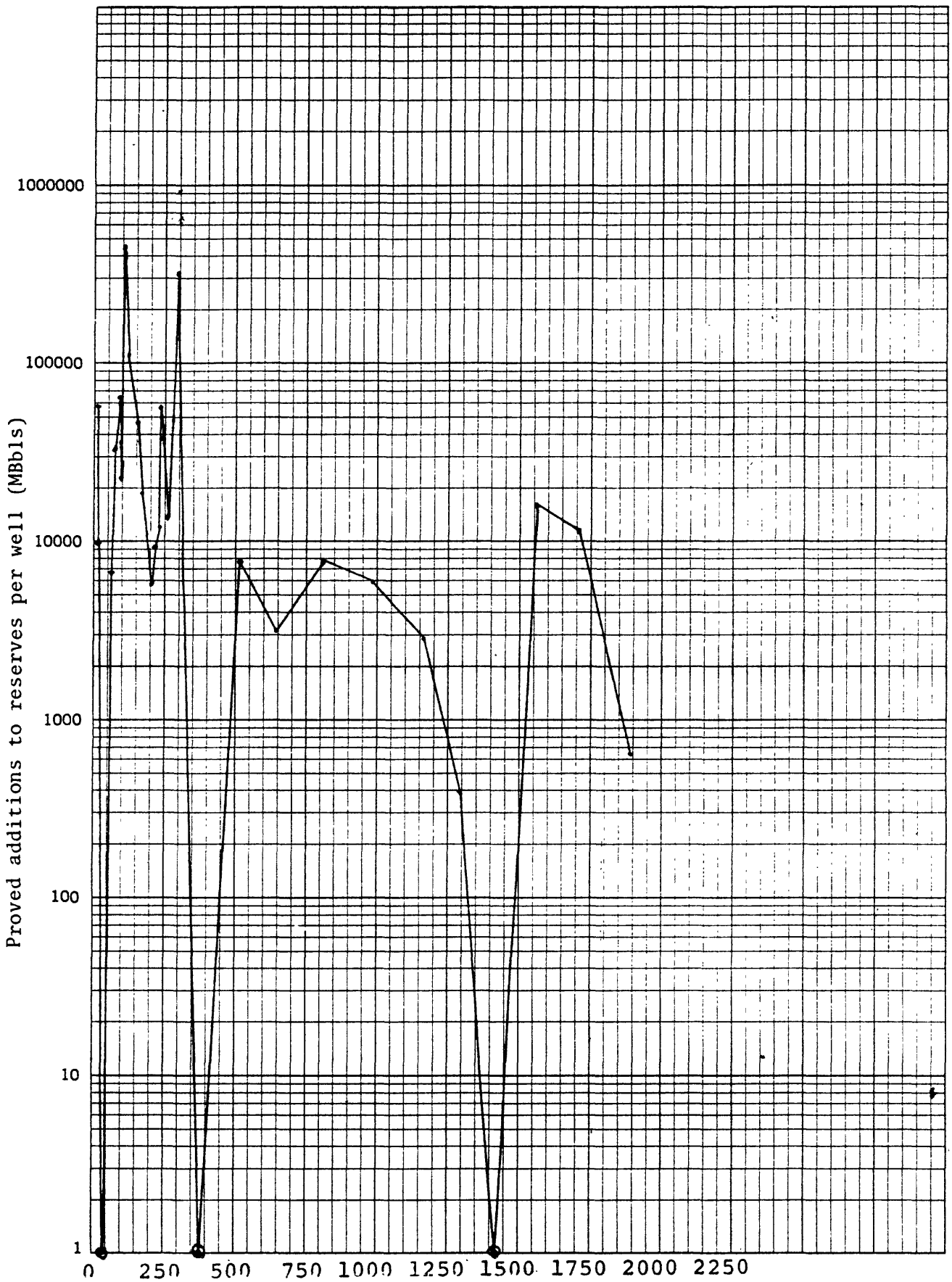
INDONESIA

5 year period	Number of exploratory wells completed	Change in reserves (MMBbls)	Avg ultimate recovery (MMBbls)	Proved additions to reserves (MMBbls)	Proved additions to reserves by well (MMBbls)
1936-1940			857		
1941-1945		1,075	1,588	1,131	
1946-1950	38	-75	2,208	57	1.5
1951-1955	61	1,160	3,250	1,520	24.9
1956-1960	74	6,045	9,480	6,544	88.4
1961-1965	61	295	11,179	1,133	18.6
1966-1970	141	1,500	14,402	2,657	18.8
1971-1975	789	2,000	16,845	4,189	5.3
1976-1980	727	-1,460	18,410	1,460	2.0

Ultimate crude oil recovery (MMBbls) vs cumulative exploratory wells completed



Proved additions to crude oil reserves per exploratory well completed (MBbls) vs cumulative exploratory wells completed



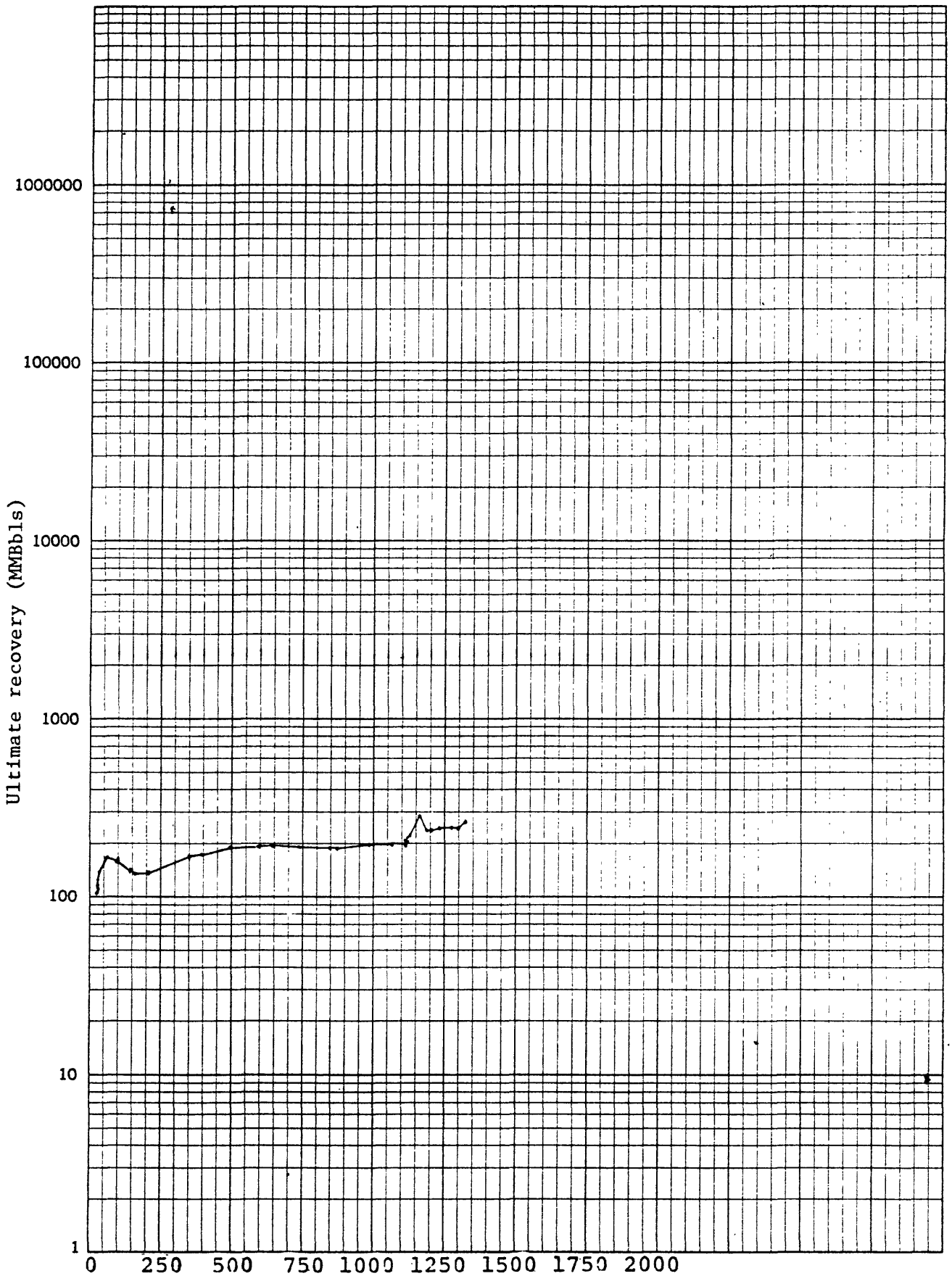
JAPAN

Year (y)	Exploratory wells completed (W_y) (AAPG)	Cumulative exploratory wells completed (CW_y)	Reserves - MMBbls (R_y) (D/M)	Crude production MBbls (P_y) (D/M, WO)	Ultimate recovery rounded MMBbls ($CP_y + R_{y+1}$)	Cumulative production rounded MMBbls (CP_y)	Change in reserves ($R_{y+1} - R_y$) = ΔR_y MBbls	Proved additions to reserves MBbls ($D_y = \Delta R_y + P_y$)	Proved additions to reserves per well MBbls (D_y/W_y)
1875				5					
1876				7					
1877				10					
1878				18					
1879				23					
1880				26					
1881				17					
1882				15					
1883				20					
1884				28					
1885				30					
1886				38					
1887				29					
1888				37					
1889				53					
1890				52					
1891				53					
1892				69	1	1			
1893				106	1	1			
1894				173	1	1			
1895				170	1	1			
1896				237	1	1			
1897				262	1	1			
1898				319	2	2			
1899				539	2	2			
1900				871	3	3			
1901				1,117	4	4			
1902				1,117	5	5			
1903				1,200	7	7			
1904				1,219	8	8			
1905				1,347	9	9			
1906				1,564	11	11			
1907				1,718	12	12			
1908				1,871	14	14			
1909				1,887	16	16			
1910				1,529	18	18			
1911				1,737	20	20			
1912				1,659	21	21			
1913				1,940	23	23			
1914				2,636	26	26			
1915				2,928	29	29			
1916				2,963	32	32			
1917				2,861	35	35			
1918				2,441	37	37			
1919				2,238	39	39			
1920				2,221	42	42			
1921				2,233	44	44			
1922				2,055	46	46			
1923				1,804	48	48			
1924				1,814	50	50			
1925				1,313	52	52			
1926				1,755	53	53			
1927				1,789	55	55			
1928				1,944	57	57			
1929				2,023	59	59			
1930				1,950	61	61			
1931				2,050	63	63			
1932				1,630	65	65			
1933				1,455	66	66			
1934				1,934	68	68			
1935				2,259	70	70			
1936				2,440	73	73			
1937				2,488	75	75			
1938				2,511	78	78			
1939				2,654	80	80			
1940				2,639	83	83			
1941				1,929	85	85			
1942				1,652	87	87			
1943				1,727	124	88	36,000	37,727	
1944			36	1,601		90			
1945				1,544	176	91	48,000	50,544	
1946			85	1,343	177	93	-1,000	343	
1947			84	1,276	127	94	-51,300	-50,224	
1948	25	25	33	1,122	110	95	-17,500	-16,378	-655
1949	1	26	15	1,353	112	97	0	1,353	1,353
1950	1	27	15	2,048	121	99	7,000	9,048	9,048
1951	6	33	22	2,337	131	101	8,000	10,337	1,723
1952	3	36	30	2,134	133	103	0	2,134	711
1953	25	61	30	2,101	165	105	30,000	32,101	1,284
1954	39	100	60	2,124	157	107	-10,000	-7,876	-202
1955	40	140	50	2,229	139	109	-20,000	-17,771	-444
1956	18	158	30	2,169	134	112	-8,000	-5,831	-324
1957	45	203	22	2,243	136	114	0	2,243	50
1958	79	282	22	2,563		116			
1959	72	354		2,852	153	119	12,500	15,352	213
1960	44	398	34	3,678	163	123	6,000	9,678	220
1961	98	496	40	4,590	188	128	20,000	24,590	251
1962	95	591	60	5,316	193	133	0	5,316	56
1963	55	646	60	5,485	198	138	0	5,485	100
1964	95	741	60	4,590	183	143	-20,000	-15,410	-162
1965	105	846	40	4,944	188	148	0	4,944	47
1966	78	924	40	5,435	188	153	-5,000	435	6
1967	67	991	35	5,511	194	159	0	5,511	82
1968	71	1,062	35	5,490	199	164	0	5,490	77
1969	49	1,111	35	5,538	197	170	-8,038	-2,500	-51
1970	0	1,111	27	5,656	201	178	-1,510	4,146	
1971	4	1,115	25	5,529	206	181	-572	4,957	1,239
1972	8	1,123	25	5,242	210	186	-880	4,362	545
1973	15	1,138	24	5,142	220	191	5,114	10,256	684
1974	28	1,166	29	4,916	272	196	47,084	52,000	1,857
1975	25	1,191	76	4,378	234	201	43,596	47,974	1,919
1976	19	1,210	33	4,241	233	205	-4,240	1	
1977	29	1,239	28	4,334	235	209	-1,349	2,985	95
1978	36	1,275	26	3,963	236	213	-2,812	1,151	32
1979	25	1,300	23	3,960	236	217	-3,518	442	13
1980	24	1,324	19	3,177	251	220	12,057	15,234	635
1981			31						

(1) Includes Taiwan prior to 1941

JAPAN

Ultimate crude oil recovery (MMBbls) vs cumulative exploratory wells completed

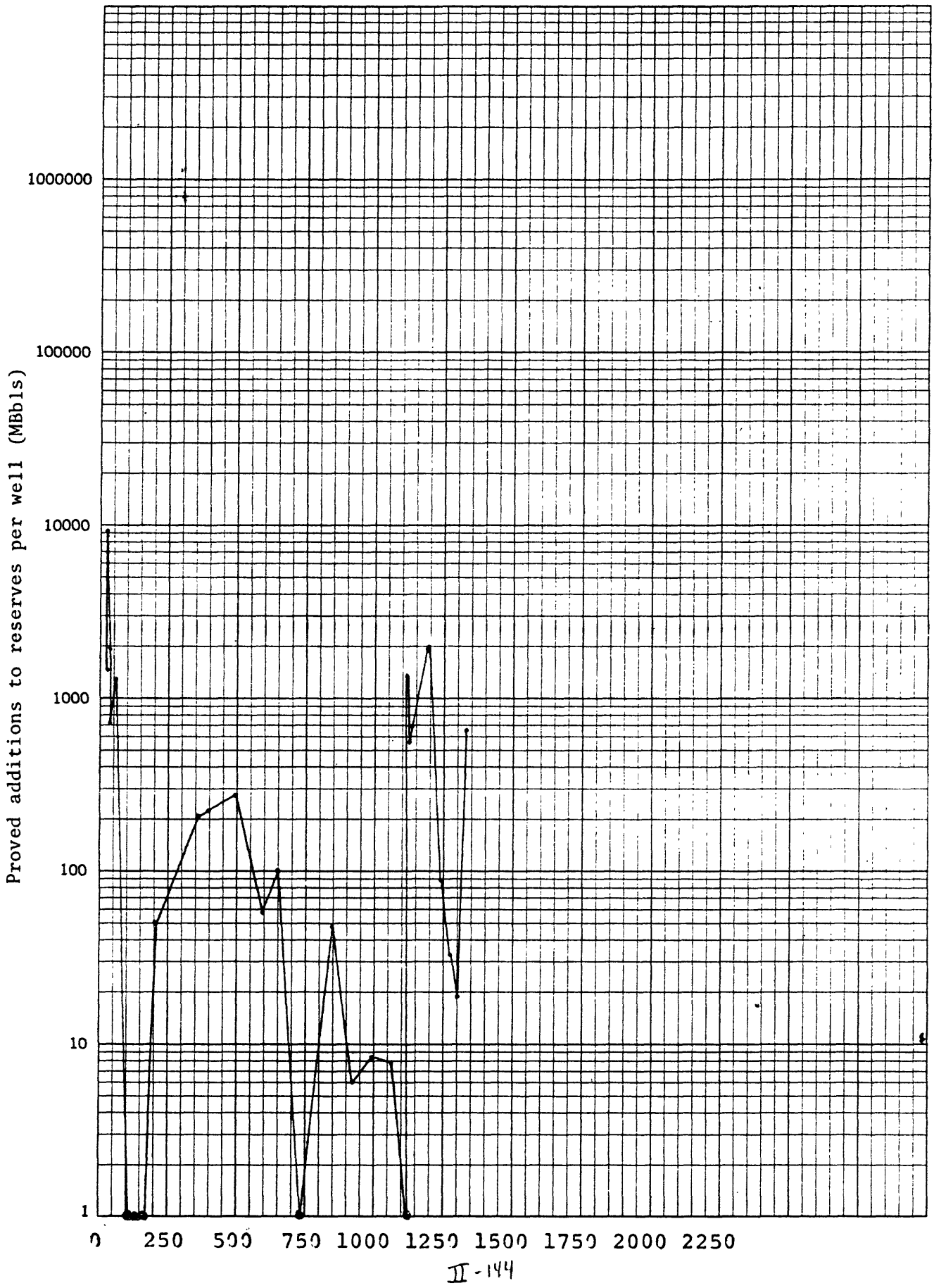


46 6463

SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.
K•E

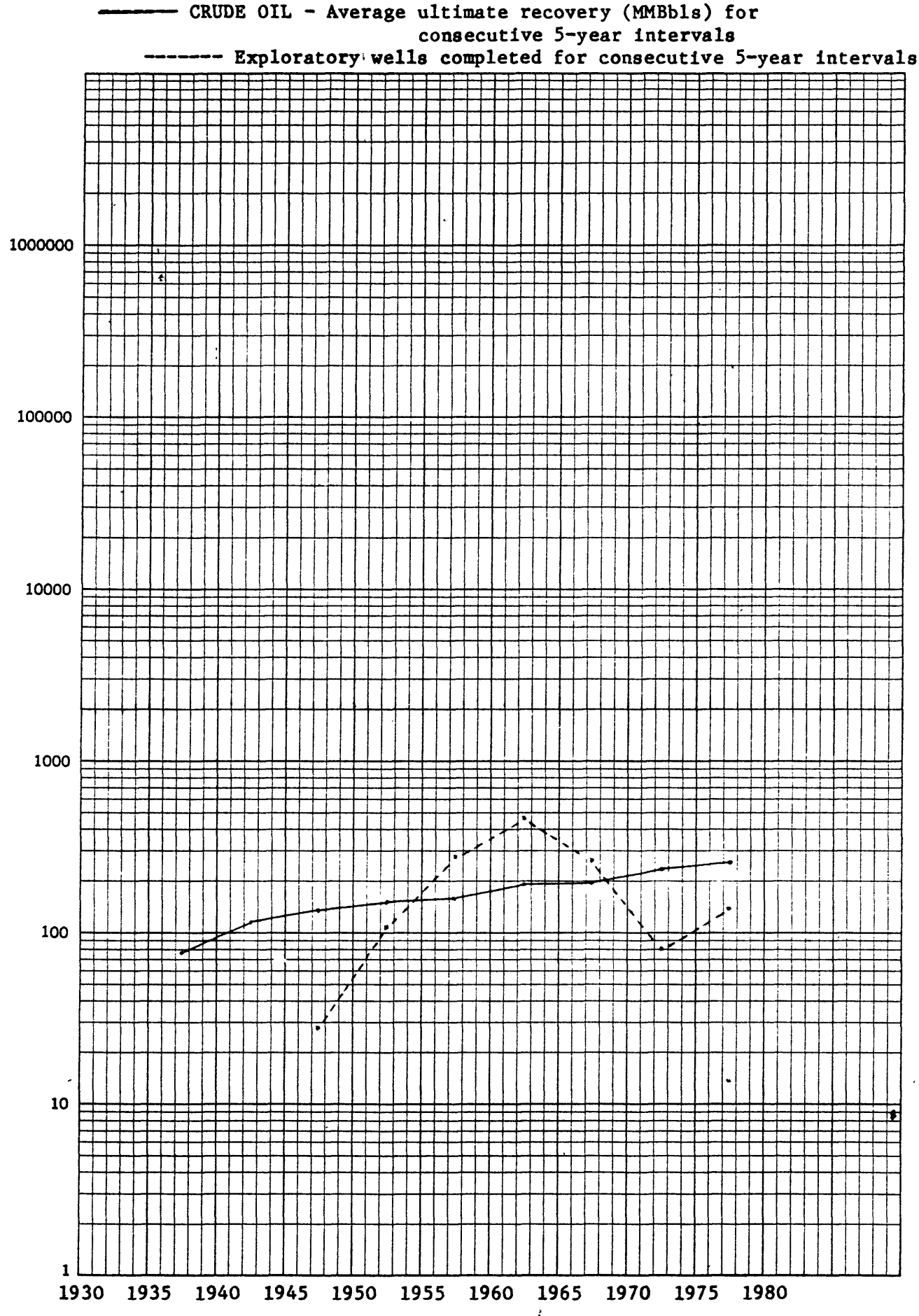
JAPAN

Proved additions to crude oil reserves per exploratory well completed (MBbls)
vs cumulative exploratory wells completed

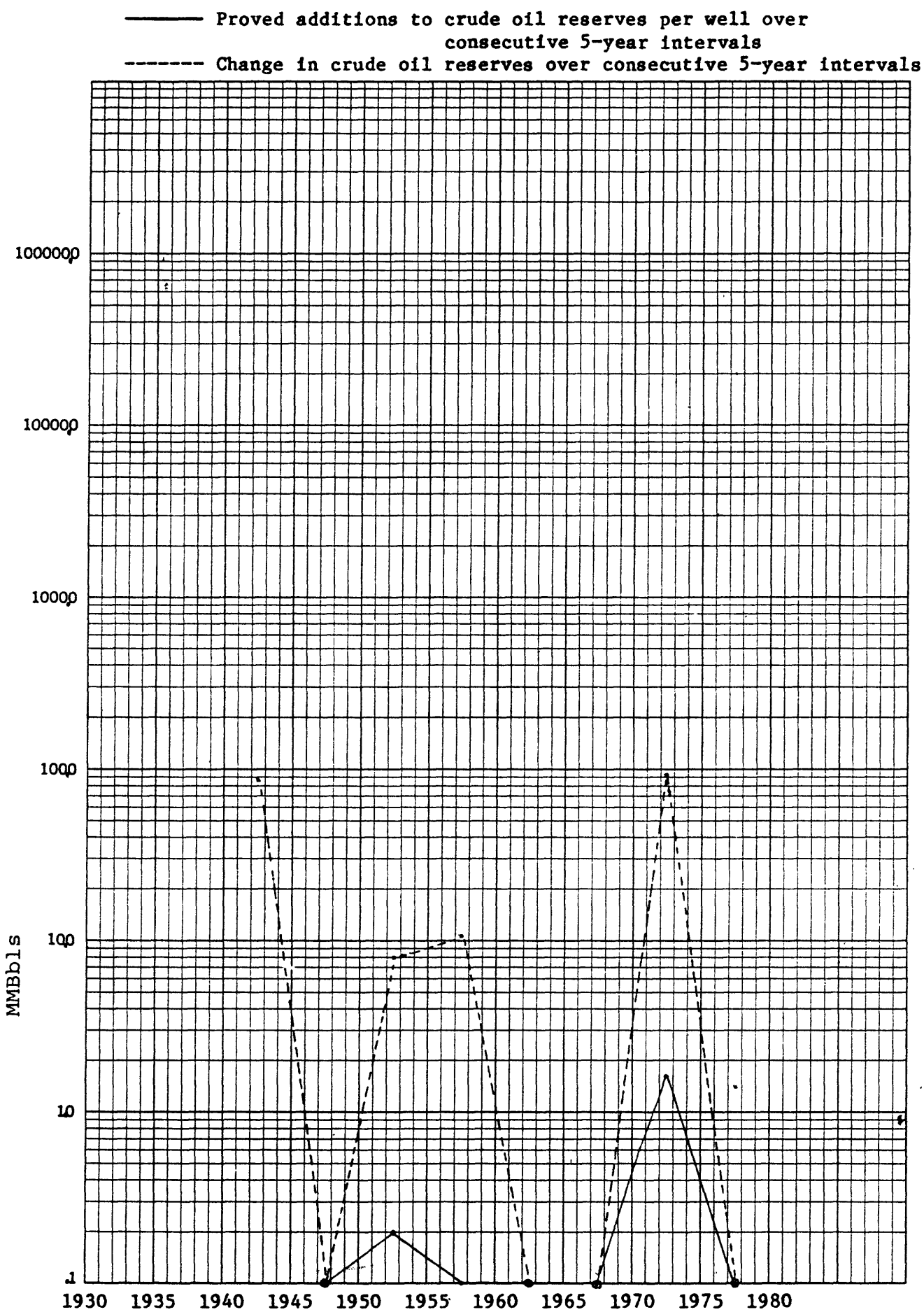


JAPAN

5 year period	Number of exploratory wells completed	Change in reserves (MMBbls)	Avg ultimate recovery (MMBbls)	Proved additions to reserves (MMBbls)	Proved additions to reserves by well (MMBbls)
1936-1940			78		
1941-1945		85	118	89	
1946-1950	27	-64	129	-56	-2.1
1951-1955	113	8	145	18	.2
1956-1960	258	11	147	21	.1
1961-1965	448	0	190	25	.1
1966-1970	265	-15	196	12	0.0
1971-1975	80	94	228	119	1.5
1976-1980	133	-1	238	18	.1



JAPAN



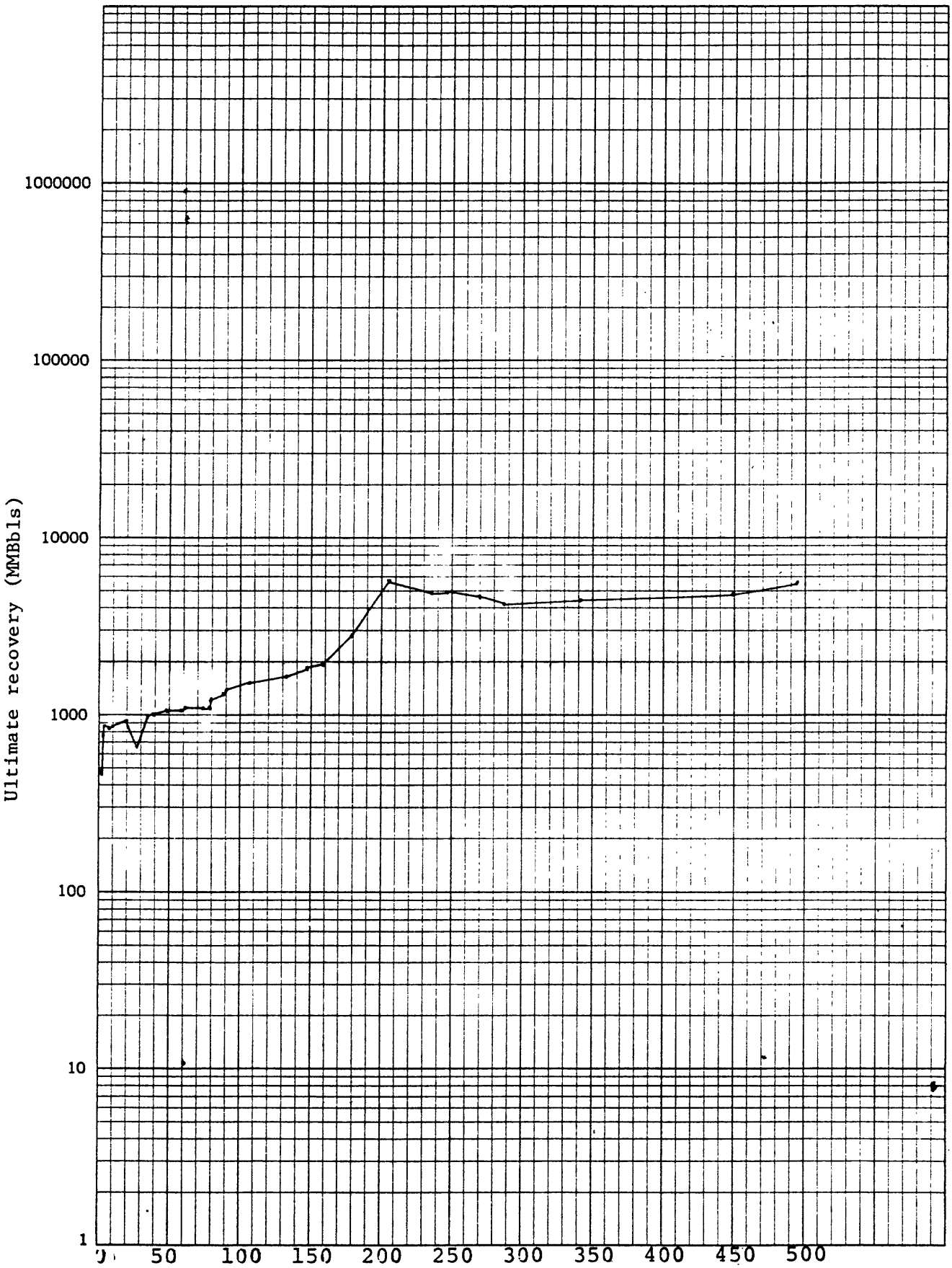
46 6463

K•E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

Year (y)	Exploratory wells completed (W_y) (AAPG)	Cumulative exploratory wells completed (CW_y)	Reserves - MMBbls (R_y) (D/M)	Crude production MBbls (P_y) (D/M, WO)	Ultimate recovery rounded MMBbls (CP_y R_{y+1})	Cumulative production rounded MMBbls (CP_y)	Change in reserves ($R_{y+1} - R_y$) = ΔR_y MBbls	Proved additions to reserves MBbls ($D_y = \Delta R_y + P_y$)	Proved additions to reserves per well MBbls (D_y/W_y)
1913				141					
1914				318					
1915				392	1	1			
1916				629	1	1			
1917				542	2	2			
1918				504	3	3			
1919				596	3	3			
1920				1,020	4	4			
1921				1,411	6	6			
1922				2,849	8	8			
1923				3,940	12	12			
1924				4,163	17	17			
1925				4,257	21	21			
1926				4,942	26	26			
1927				4,943	31	31			
1928				5,223	36	36			
1929				5,290	41	41			
1930				4,907	46	46			
1931				3,854	50	50			
1932				3,796	54	54			
1933				4,490	58	58			
1934				5,140	63	63			
1935				5,546	69	69			
1936				5,209	74	74			
1937				6,009	80	80			
1938				6,913	87	87			
1939				7,097	94	94			
1940				7,047	101	101			
1941				6,864	108	108			
1942				3,000	111	111			
1943				4,500	116	116			
1944				6,000	122	122			
1945				2,100	124	124			
1946				2,050	204	126	80,000	82,050	
1947			80	12,970	339	139	120,000	132,970	
1948	0	0	200	20,124	309	159	-50,000	-29,876	
1949	1	1	150	25,108	484	184	150,000	175,108	175,108
1950	0	1	300	30,958	465	215	-50,000	-19,042	
1951	1	2	250	37,506	752	252	250,000	287,506	287,506
1952	1	3	500	38,251	841	291	50,000	88,251	88,251
1953	4	7	550	36,848	827	327	-50,000	-13,152	-3,288
1954	3	10	500	36,315	864	364	0	36,315	12,105
1955	10	20	500	39,751	904	404	0	39,751	3,975
1956	7	27	500	42,983	656	446	10,000	52,983	7,569
1957	8	35	510	41,821	988	488	-10,000	31,821	3,977
1958	2	37	500	39,551		528			
1959	2	39		41,728	1,000	570	-70,000	-28,272	-14,136
1960	9	48	430	35,543	1,015	605	-20,000	15,543	1,727
1961	6	54	410	31,633	1,017	637	-30,000	1,633	272
1962	8	62	380	29,203	1,026	666	-20,000	9,203	1,150
1963	3	65	360	30,563	1,057	697	0	30,563	10,187
1964	4	69	360	26,265	1,133	723	49,600	75,865	18,966
1965	0	69	410	29,342	1,202	752	40,400	69,742	
1966	9	78	450	34,972	1,312	787	125,000	159,972	17,774
1967	12	90	525	38,363	1,350	825	0	38,363	3,197
1968	17	107	525	46,210	1,472	872	75,000	121,210	7,130
1969	27	134	600	48,902	1,571	921	50,000	98,902	3,663
1970	14	148	650	56,792	1,677	977	50,000	106,792	7,628
1971	11	159	700	72,553	1,870	1,050	12,000	84,553	7,686
1972	19	178	820	100,875	2,651	1,151	680,000	780,875	41,098
1973	27	205	1,500	111,727	5,463	1,263	2,700,000	2,811,727	104,138
1974	31	236	4,200	99,875	4,862	1,362	-700,000	-600,125	-19,359
1975	11	247	3,500	101,706	4,864	1,464	-100,000	1,706	155
1976	23	270	3,400	134,971	4,574	1,599	-425,000	-290,029	-12,610
1977	17	287	2,975	143,634	4,174	1,743	-544,000	-400,366	-23,550
1978	54	341	2,431	134,158	4,323	1,897	-4,665	149,493	2,768
1979	108	449	2,426	189,399	4,781	2,086	268,900	458,299	4,243
1980	45	494	2,695	180,920	5,361	2,267	399,044	579,964	12,888
1981			3,094						

MALAYSIA/BRUNEI

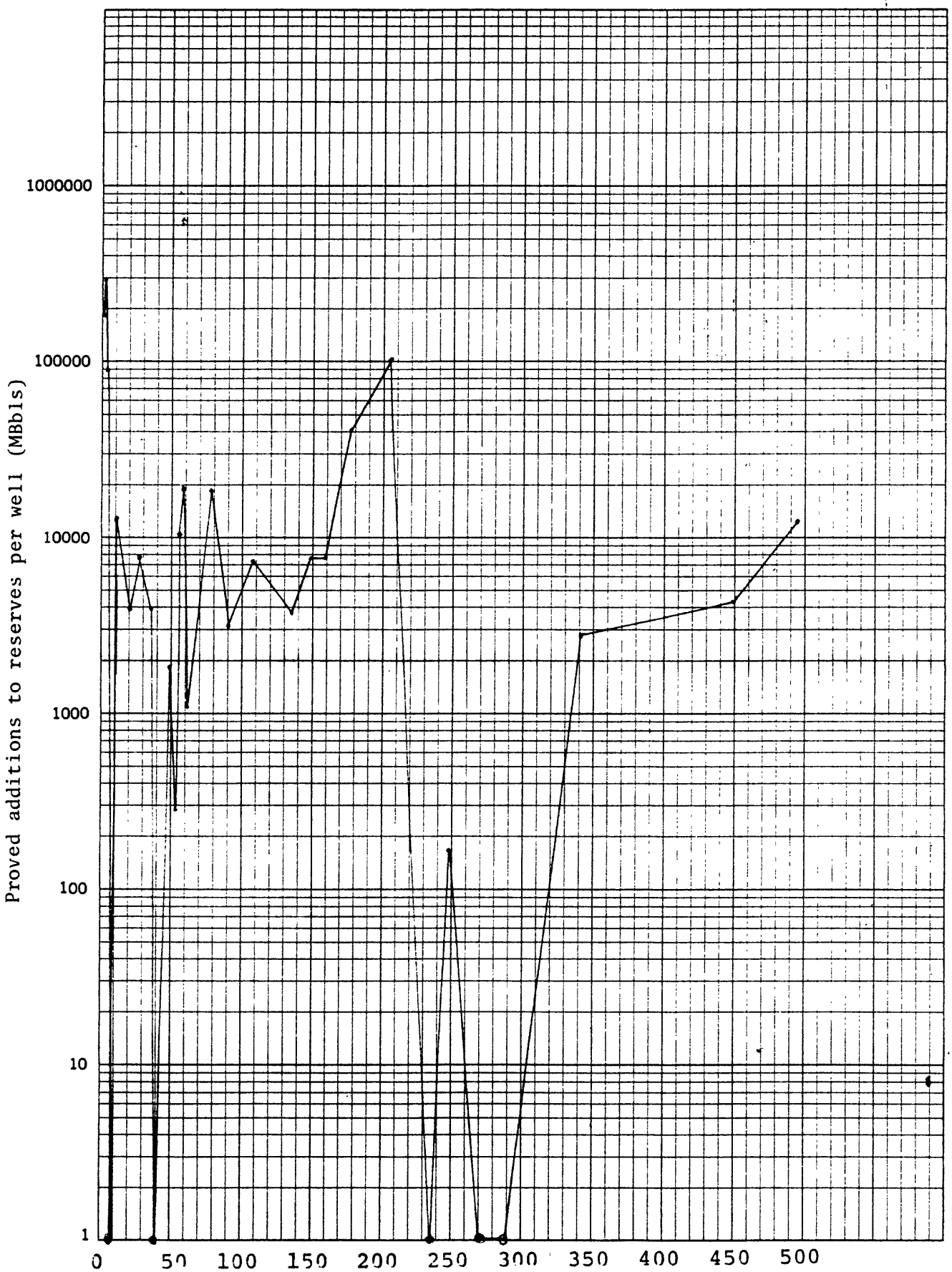
Ultimate crude oil recovery (MMBbls) vs cumulative exploratory wells completed



46 6463

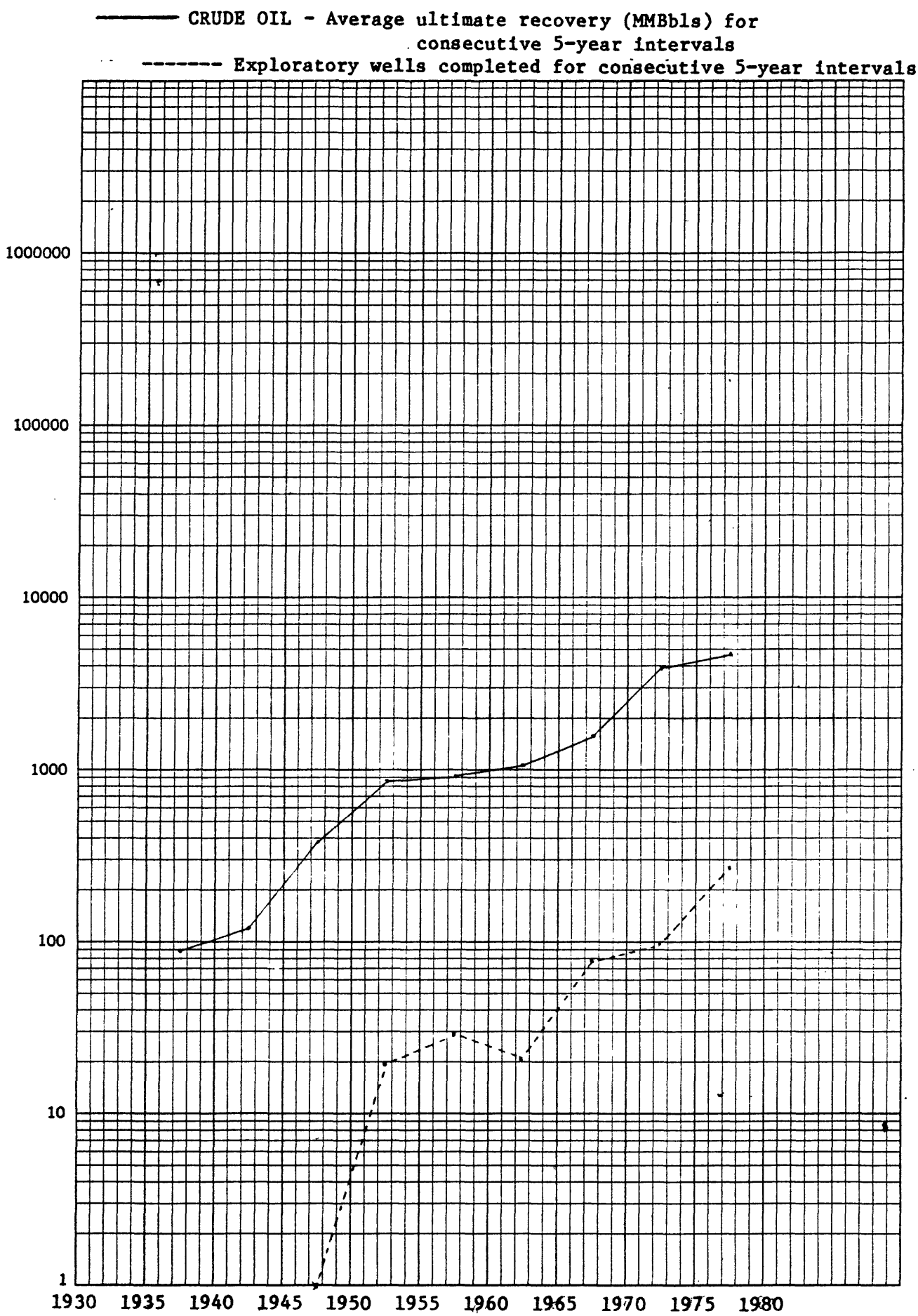
SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

Proved additions to crude oil reserves per exploratory well completed (MBbls) vs cumulative exploratory wells completed

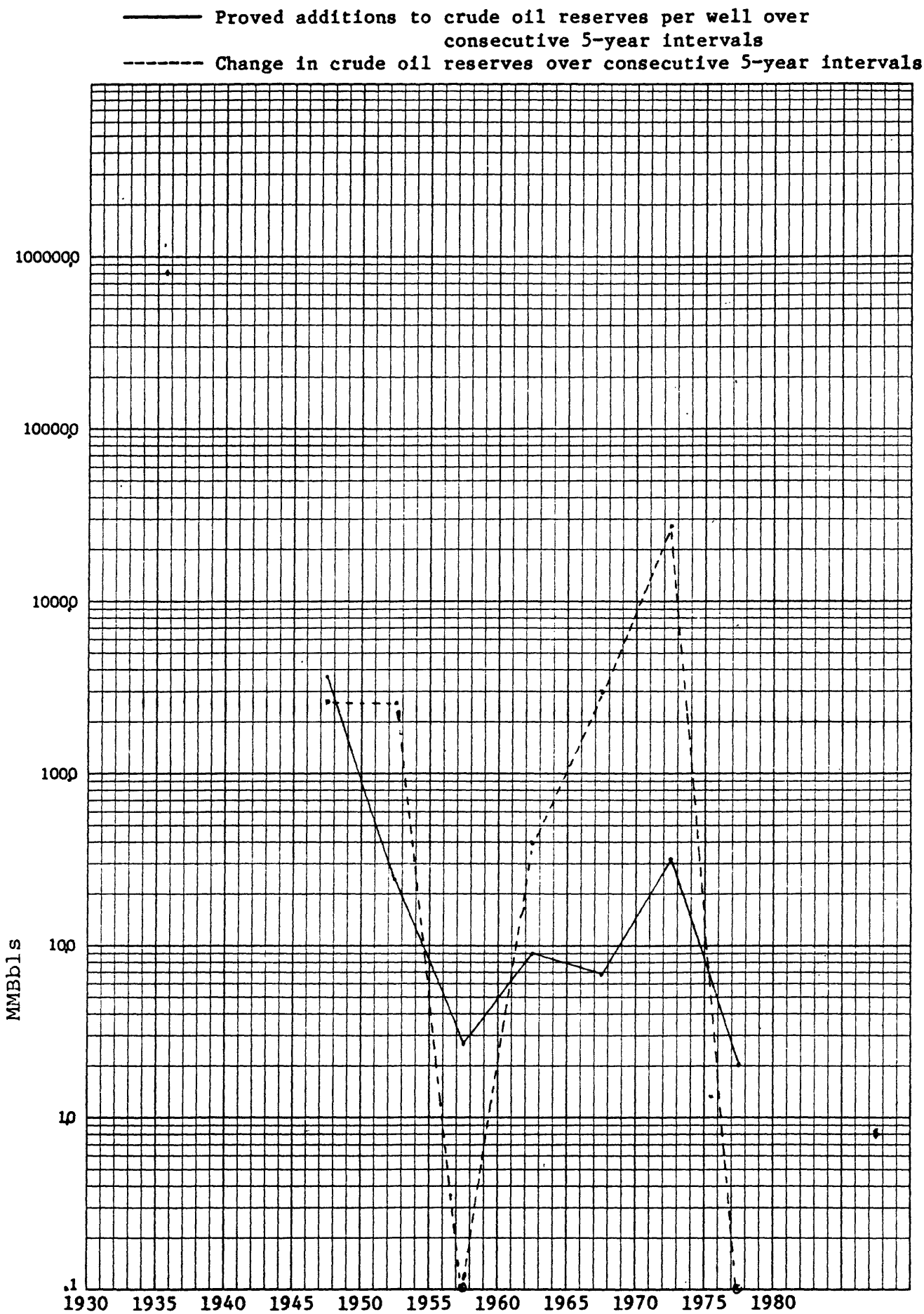


MALAYSIA/BRUNEI

5 year period	Number of exploratory wells completed	Change in reserves (MMBbls)	Avg ultimate recovery (MMBbls)	Proved additions to reserves (MMBbls)	Proved additions to reserves by well (MMBbls)
1936-1940			87		
1941-1945			116		
1946-1950	1	250	360	341	341.0
1951-1955	19	250	838	439	23.1
1956-1960	28	-90	915	73	2.6
1961-1965	21	40	1,087	188	9.0
1966-1970	79	300	1,476	525	6.6
1971-1975	99	2,592	3,942	3,080	31.1
1976-1980	247	-306	4,642	497	2.0



MALAYSIA/BRUNEI



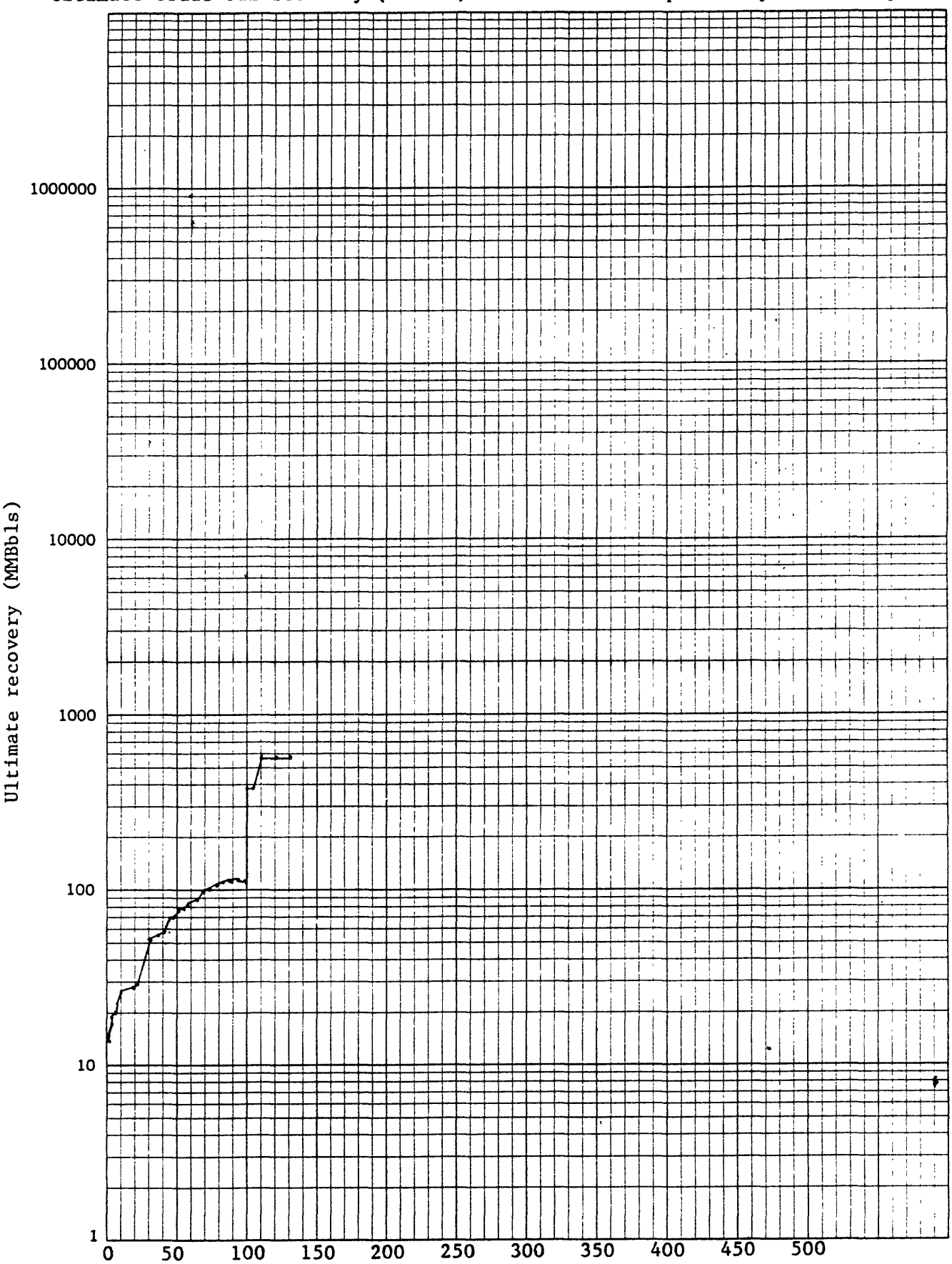
46 6463

K•E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

Year (y)	Exploratory wells completed (W_y) (AAPG)	Cumulative exploratory wells completed (CW_y)	Reserves - MMBbls (R_y) (D/M)	Crude production MBbls (P_y) (D/M, WO)	Ultimate recovery rounded MMBbls ($CP_y + R_{y+1}$)	Cumulative production rounded MMBbls (CP_y)	Change in reserves ($R_{y+1} - R_y$) = ΔR_y MBbls	Proved additions to reserves MBbls ($D_y = \Delta R_y + P_y$)	Proved additions to reserves per well MBbls (D_y/W_y)
1918									
1919									
1920									
1921									
1922				221					
1923				338	1	1			
1924				329	1	1			
1925				230	1	1			
1926				179	1	1			
1927				305	2	2			
1928				350	2	2			
1929				549	3	3			
1930				219	3	3			
1931				159	3	3			
1932				167	3	3			
1933				126	3	3			
1934				100	3	3			
1935				111	3	3			
1936				128	4	4			
1937				291	4	4			
1938				614	4	4			
1939				867	5	5			
1940				877	6	6			
1941				1,013	7	7			
1942				893	8	8			
1943				680	9	9			
1944				470	9	9			
1945				372	10	10			
1946				341	10	10			
1947				382	10	10			
1948	0	0		579	11	11			
1949	0	0		941	12	12			
1950	1	1		1,281	13	13			
1951	0	1		1,348	14	14			
1952	3	4		1,580	16	16			
1953		4		1,762	18	18			
1954	2	6		1,945	20	20			
1955	2	8		2,068	22	22			
1956	2	10		2,118	24	24			
1957	9	19		2,200	26	26			
1958	3	22		2,272	28	28			
1959	9	31		2,333	51	31	20,000	22,333	2,481
1960	6	37	20	2,636	53	33	0	2,636	439
1961	4	41	20	2,829	56	36	0	2,829	707
1962	4	45	20	3,338	67	40	7,000	10,338	2,585
1963	3	48	27	3,514	70	43	0	3,514	1,171
1964	3	51	27	3,732	74	47	0	3,732	1,244
1965	4	55	27	3,943	78	51	0	3,943	986
1966	3	58	27	3,445	81	54	0	3,445	1,148
1967	6	64	27	3,633	85	58	0	3,633	606
1968	5	69	27	3,305	96	61	8,000	11,305	2,261
1969	4	73	35	3,460	100	65	-100	3,360	840
1970	6	79	35	3,400	103	68	100	3,500	583
1971	4	83	35	3,000	107	71	500	3,500	875
1972	3	86	36	3,294	110	74	0	3,294	1,098
1973	3	89	36	2,871	109	77	-4,000	-1,129	-376
1974	5	94	32	2,923	110	80	-2,000	923	185
1975	5	99	30	2,190	108	82	-3,889	-1,699	-339
1976	1	100	26	2,562	371	85	260,000	262,562	262,562
1977	4	104	286	3,720	371	89	-3,660	60	15
1978	6	110	282	3,491	570	92	196,018	199,509	33,252
1979	11	121	478	4,000	572	96	-2,358	1,642	149
1980	10	131	476	3,620	572	100	-3,620	0	0
1981			472						

PAKISTAN

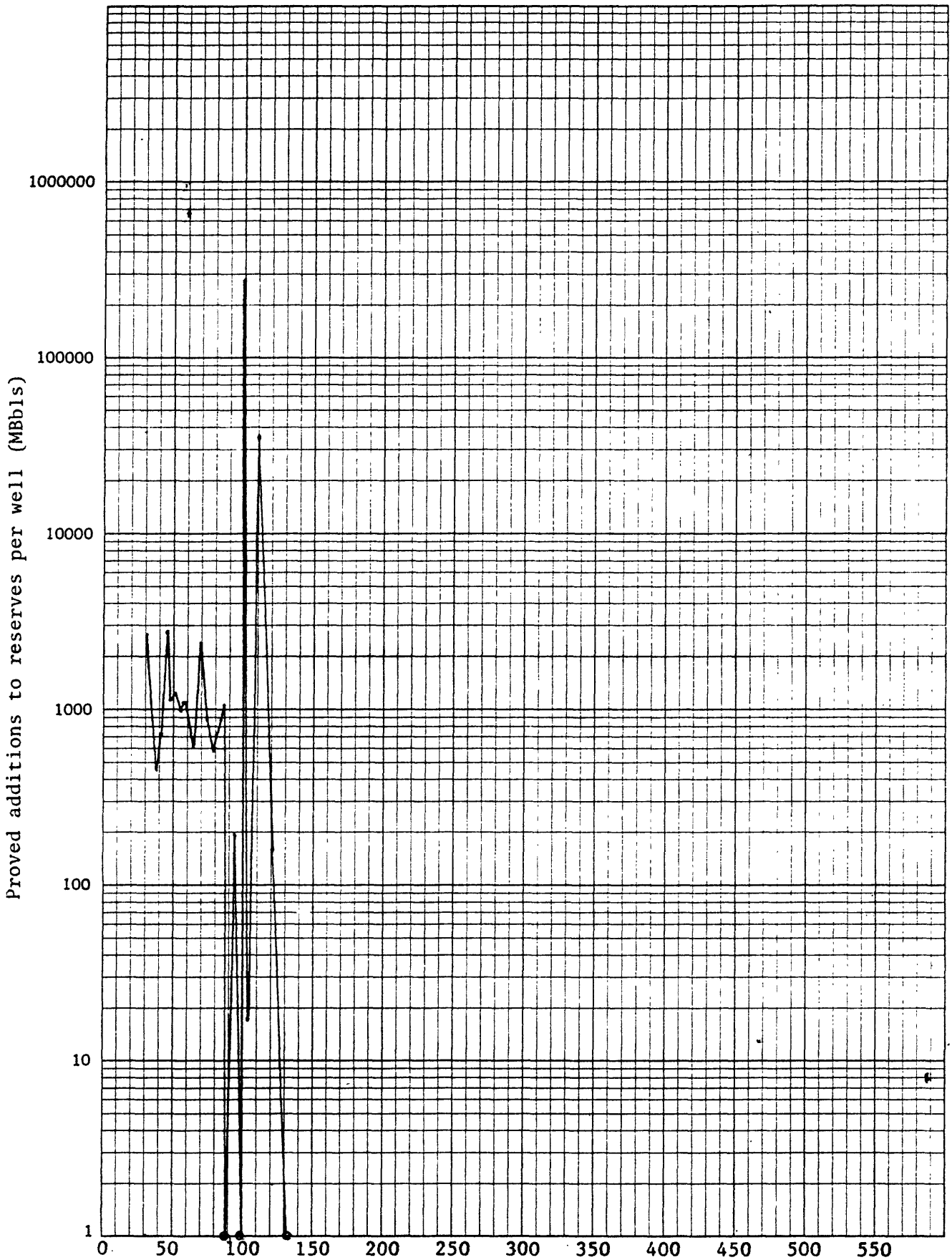
Ultimate crude oil recovery (MMBbls) vs cumulative exploratory wells completed



46 6463

K+E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS KEUFFEL & ESSER CO. MADE IN U.S.A.

Proved additions to crude oil reserves per exploratory well completed (MBbls) vs cumulative exploratory wells completed



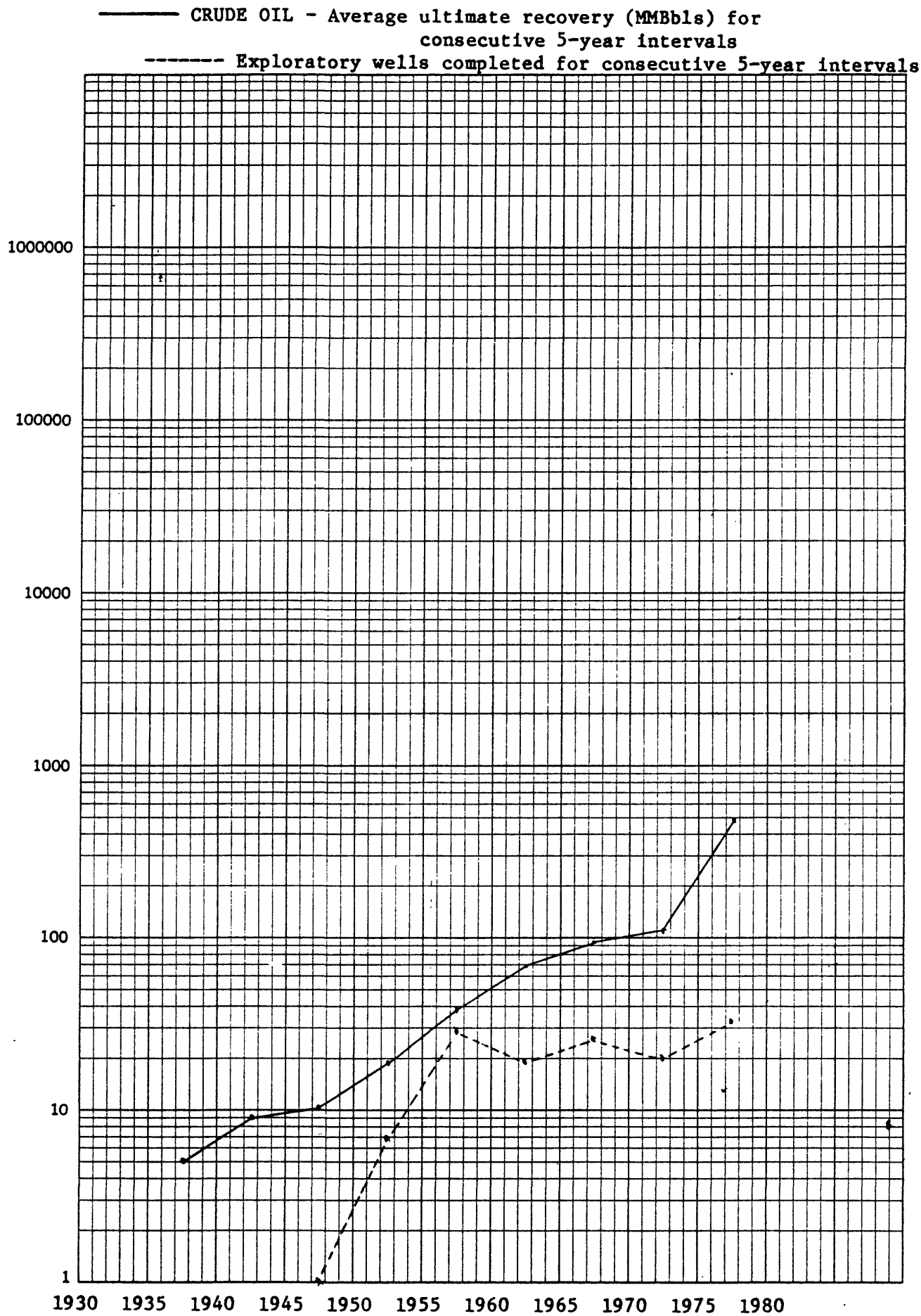
46 6463

K•E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS KEUFFEL & ESSER CO. MADE IN U.S.A.

PAKISTAN

5 year period	Number of exploratory wells completed	Change in reserves (MMBbls)	Avg ultimate recovery (MMBbls)	Proved additions to reserves (MMBbls)	Proved additions to reserves by well (MMBbls)
1936-1940			5		
1941-1945			9		
1946-1950	1		11		
1951-1955	7		18		
1956-1960	29	20	36	25	.9
1961-1965	18	7	69	25	1.4
1966-1970	24	8	93	25	1.0
1971-1975	20	-9	109	5	.3
1976-1980	32	446	491	465	14.5

PAKISTAN



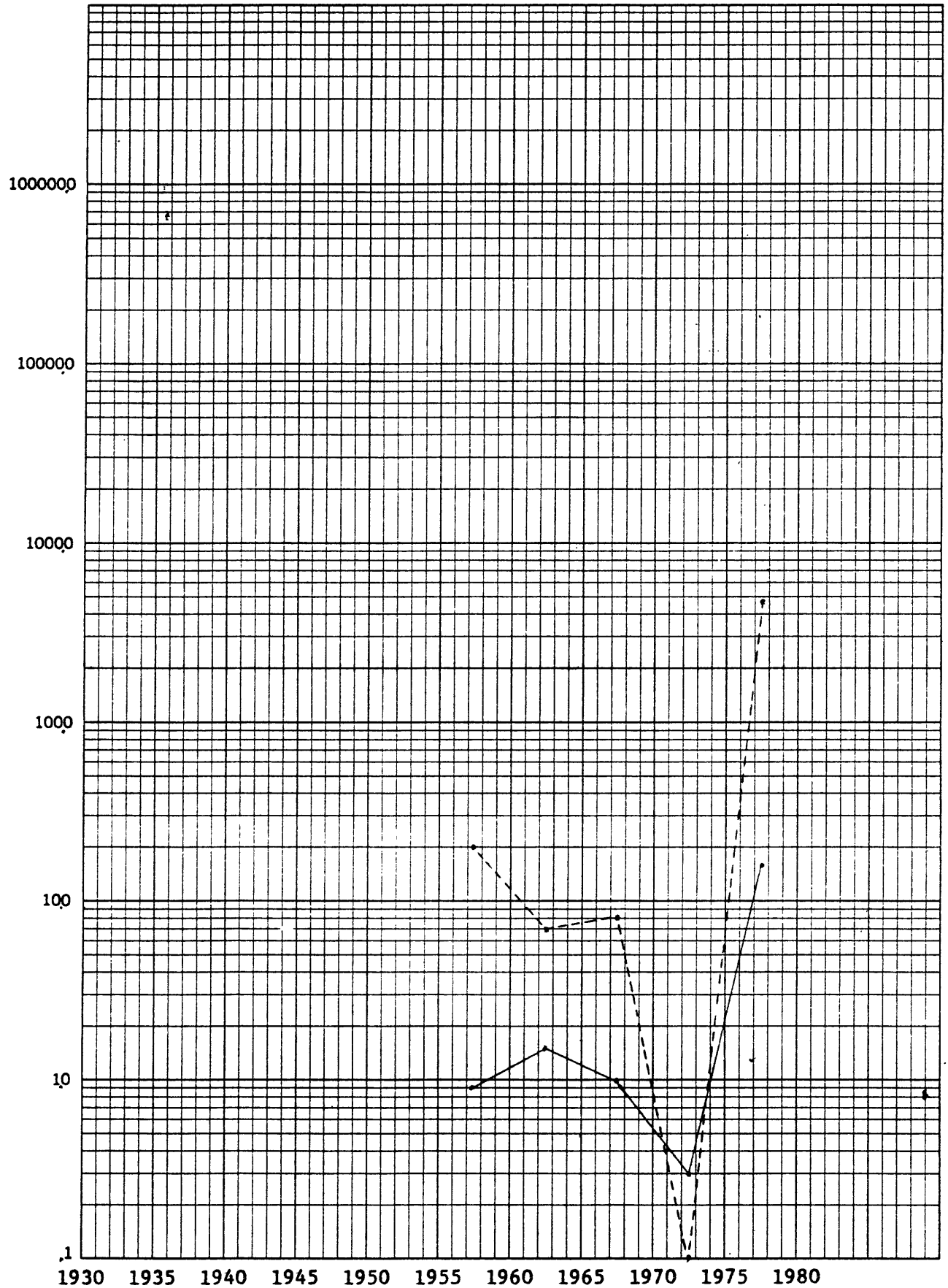
46 6463

SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

PAKISTAN

——— Proved additions to crude oil reserves per well over consecutive 5-year intervals

------- Change in crude oil reserves over consecutive 5-year intervals



46 6463

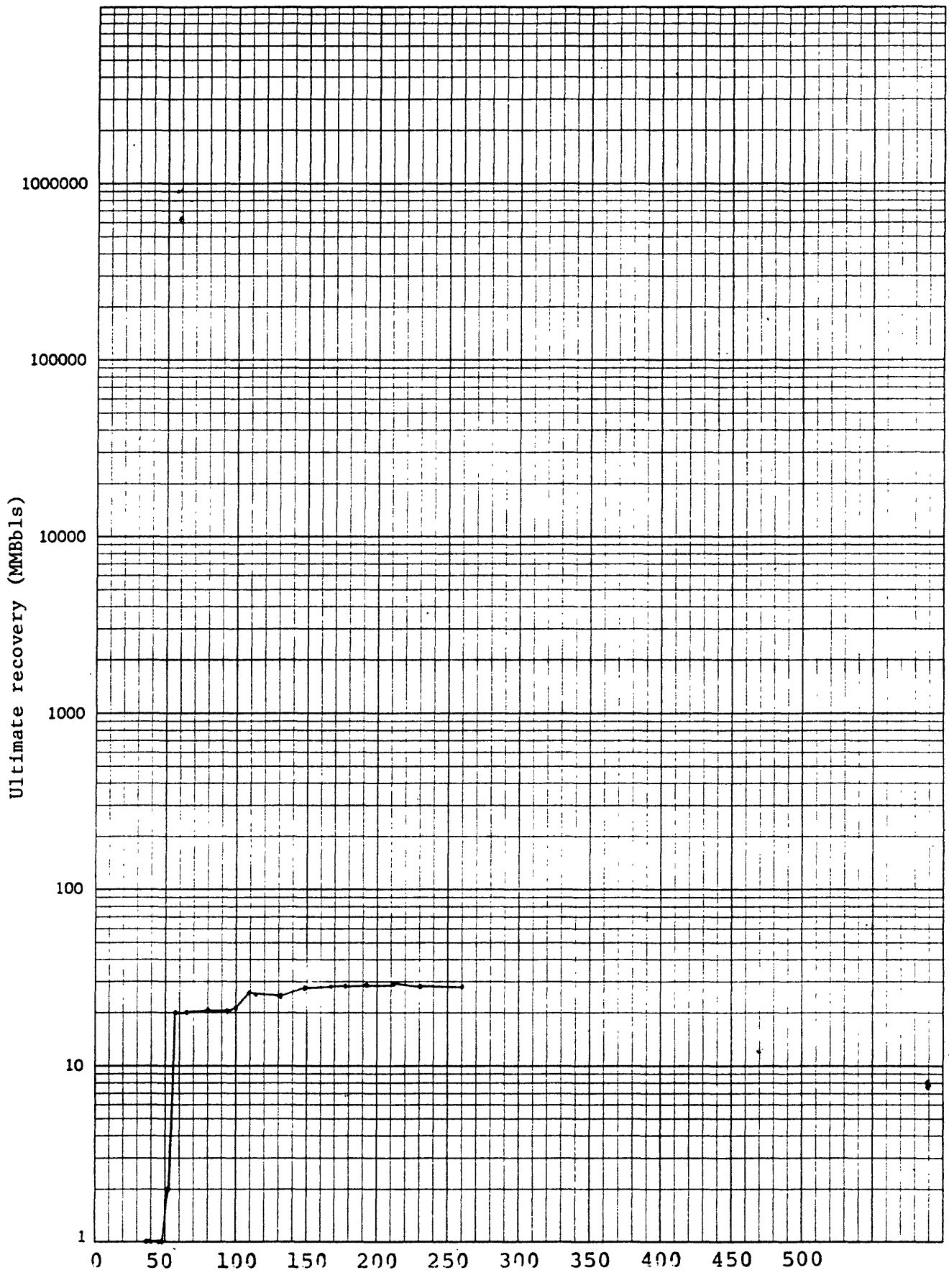
K•E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

TAIWAN

Year (y)	Exploratory Wells completed (W_y) (AAPG)	Cumulative exploratory wells completed (CW_y)	Reserves - MMBbls (R_y) (D/M)	Crude production MBbls (P_y) (D/M, WO)	Ultimate recovery rounded MMBbls ($CP_y + R_{y+1}$)	Cumulative production rounded MMBbls (CP_y)	Change in reserves ($R_{y+1} - R_y$) = ΔR_y MBbls	Proved additions to reserves MBbls ($D_y = \Delta R_y + P_y$)	Proved additions to reserves per well MBbls (D_y/W_y)
1930									
1931									
1932									
1933									
1934									
1935									
1936									
1937									
1938									
1939									
1940									
1941				62					
1942				48					
1943				38					
1944				40					
1945				11					
1946				16					
1947				18					
1948				23					
1949				22					
1950	3	3		23					
1951	0	3		21					
1952	0	3		18					
1953		3		17					
1954	2	5		35					
1955	5	10		24					
1956	4	14		21					
1957	6	20		17					
1958	0	20		15					
1959	5	25		13			75	88	18
1960	4	29		14			-35	-21	5
1961	7	36		17	1	1	60	77	11
1962	4	40		14	1	1	-15	-1	0
1963	5	45		19	1	1	15	34	7
1964	1	46		61	1	1	300	361	361
1965	5	51		131	2	1	600	731	146
1966	6	57	1	226	20	1	17,700	17,926	2,988
1967	8	65	19	245	20	1	-200	45	6
1968	15	80	19	421	21	2	600	1,021	68
1969	15	95	19	581	21	2	100	681	45
1970	5	100	19	638	22	3	-200	438	88
1971	9	109	19	803	25	4	1,850	2,653	295
1972	5	114	21	910	24	5	-2,150	-1,240	-248
1973	18	132	19	1,055	24	6	-1,060	-5	0
1974	17	149	18	1,321	26	7	916	2,237	132
1975	18	167	19	1,351	27	8	686	2,037	113
1976	10	177	19	1,555	27	10	-1,958	-403	-40
1977	15	192	17	1,597	27	11	-1,066	531	35
1978	20	212	16	1,153	28	13	-1,569	-416	-21
1979	18	230	15	1,448	27	14	-1,353	95	5
1980	30	260	13	1,354	27	15	-1,354	0	0
1981			12						

TAIWAN

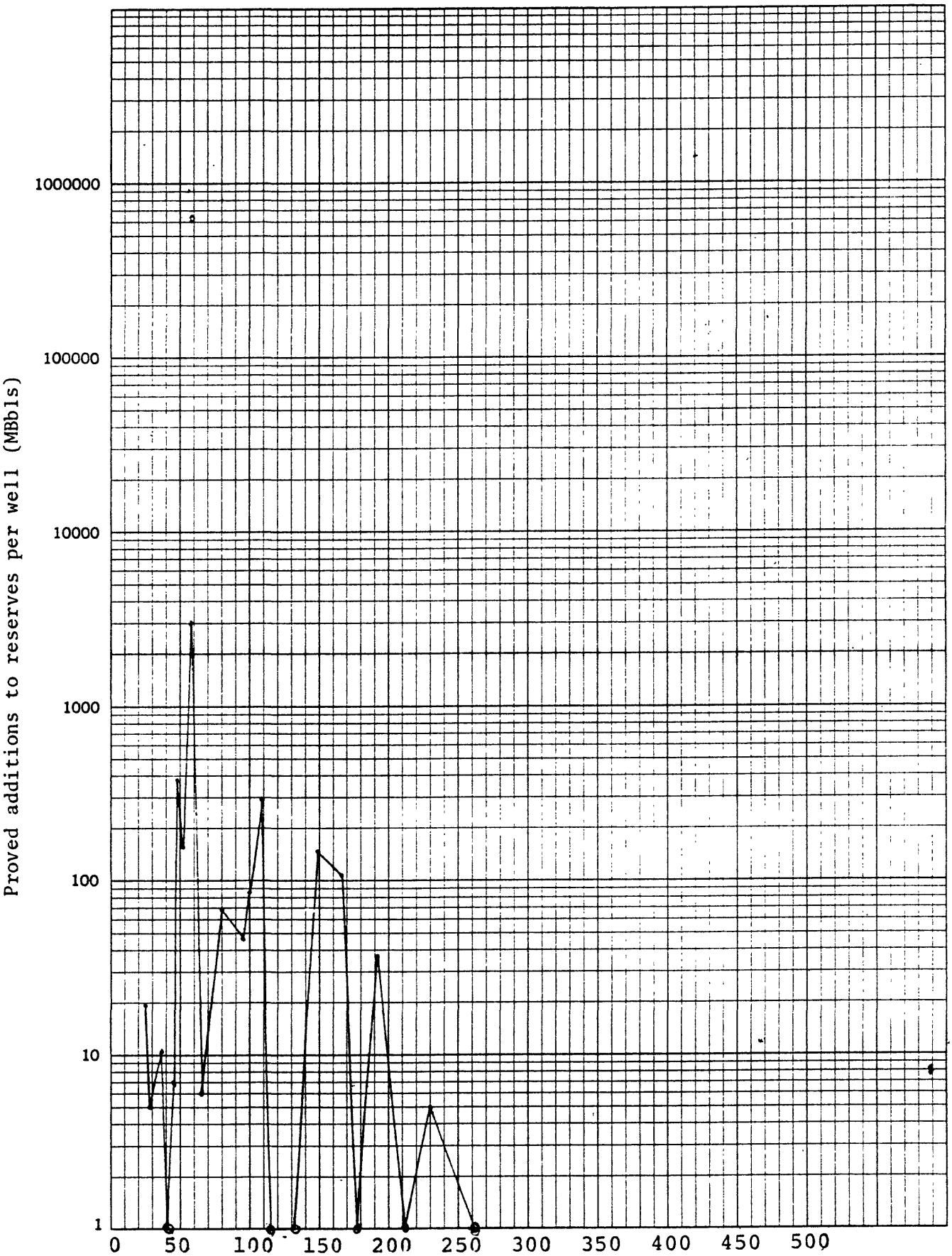
Ultimate crude oil recovery (MMBbls) vs cumulative exploratory wells completed



46 6463

K+E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

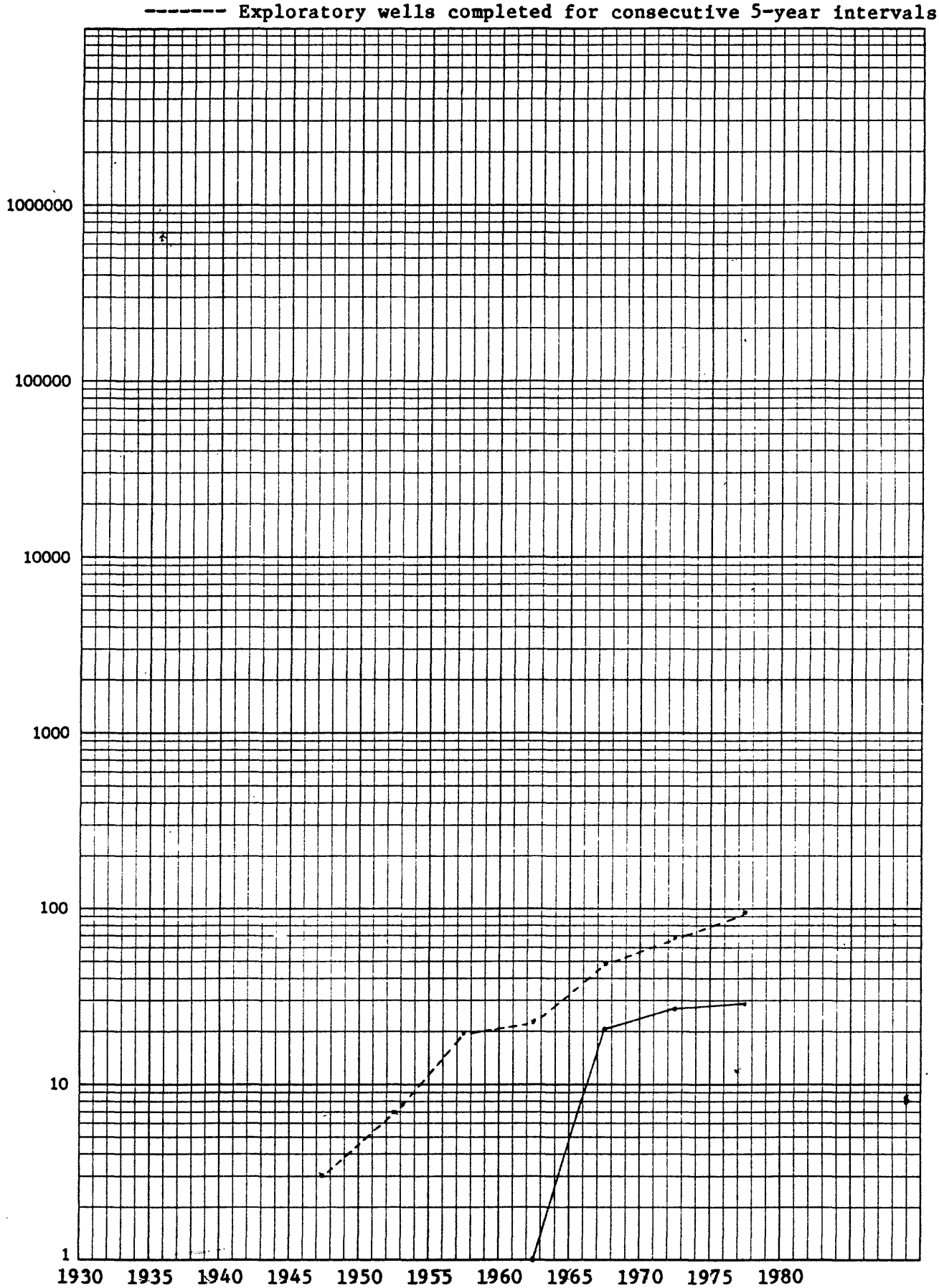
Proved additions to crude oil reserves per exploratory well completed (MBbls)
vs cumulative exploratory wells completed



TAIWAN

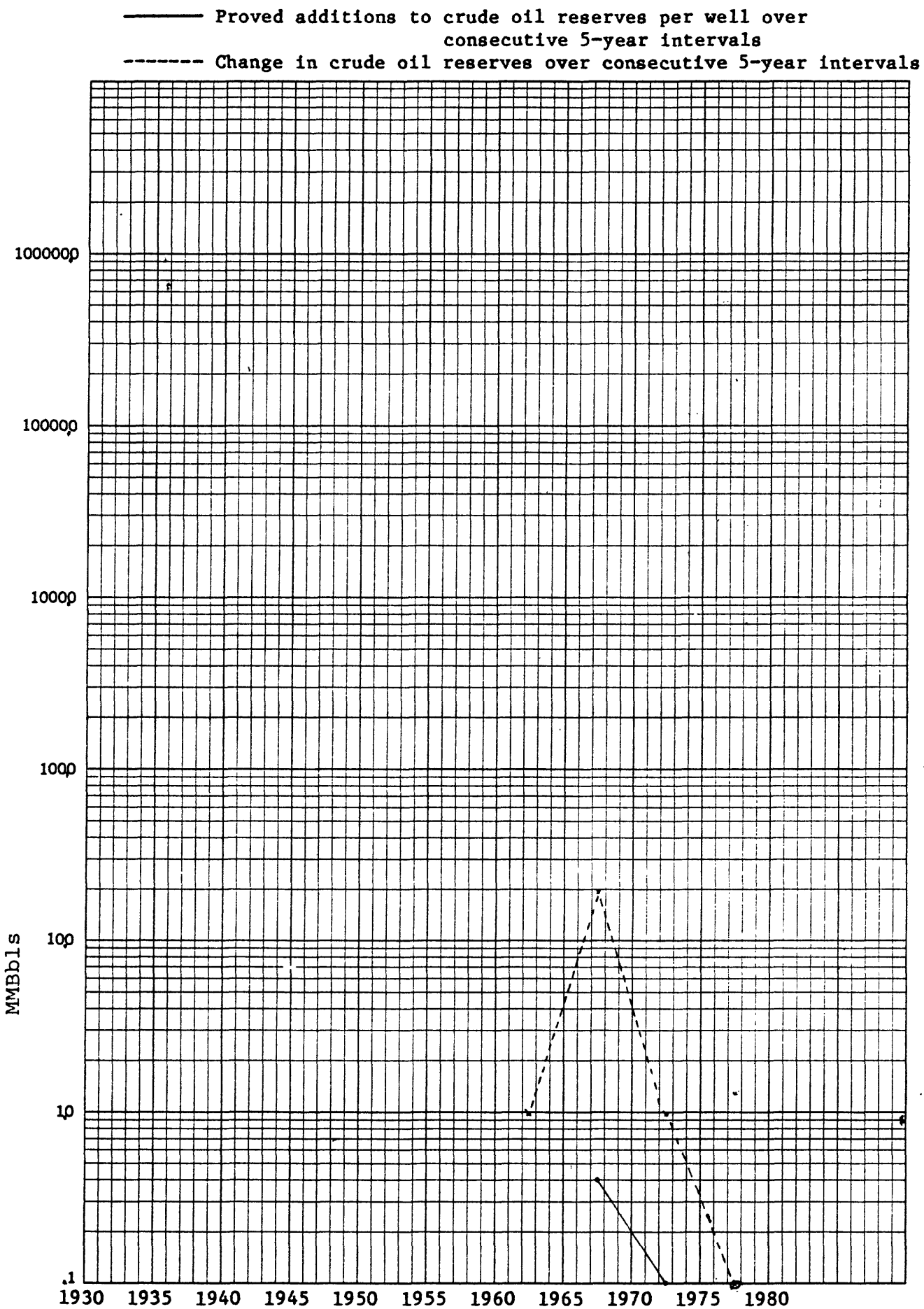
5 year period	Number of exploratory wells completed	Change in reserves (MMBbls)	Avg ultimate recovery (MMBbls)	Proved additions to reserves (MMBbls)	Proved additions to reserves by well (MMBbls)
1936-1940					
1941-1945					
1946-1950	3				
1951-1955	7				
1956-1960	19				
1961-1965	22	1	1	1	
1966-1970	49	19	21	20	.4
1971-1975	67	1	25	6	.1
1976-1980	93	-7	27	1	0.0

TAIWAN



46 6463

K+E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS KEUFFEL & ESSER CO. MADE IN U.S.A.



MIDDLE EAST

Bahrain

Iran

Iraq

Israel

Kuwait

Oman

Qatar

Saudi Arabia

Turkey

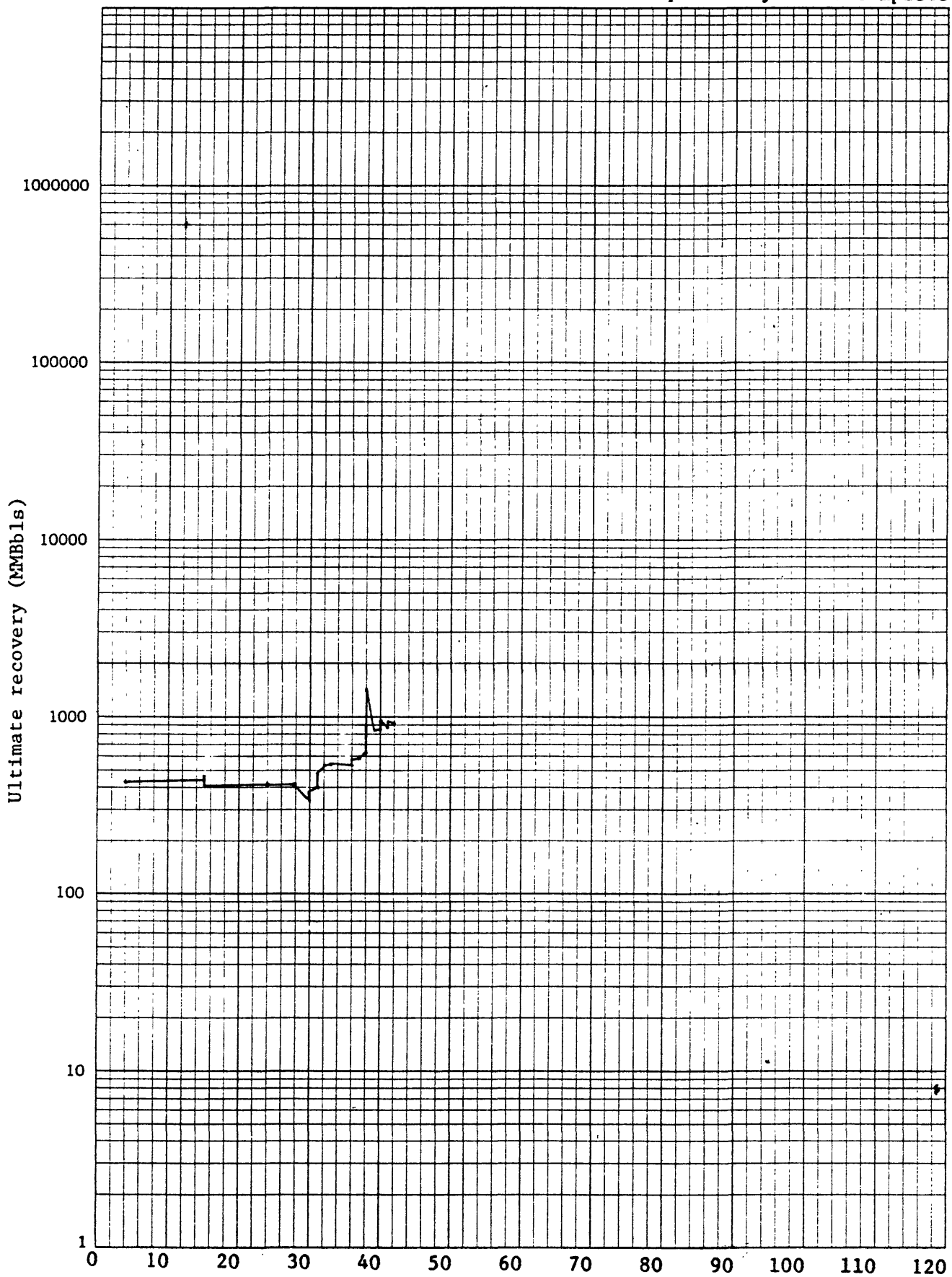
United Arab Emirates

BAHRAIN

Year (y)	Exploratory wells completed (W_y) (AAPG)	Cumulative exploratory wells completed (CW_y)	Reserves - MMBbls (R_y) (D/M)	Crude production MMbls (P_y) (D/M, WO)	Ultimate recovery rounded MMBbls ($CP_y + R_{y+1}$)	Cumulative production rounded MMBbls (CP_y)	Change in reserves $R_{y+1} - R_y = \Delta R_y$	Proved additions to reserves MBbls ($D_y = \Delta R_y + P_y$)	Proved additions to reserves per well MBbls (D_y/W_y)
1932				1					
1933				31					
1934				285					
1935				1,265	2	2			
1936				4,645	6	6			
1937				7,762	14	14			
1938				8,298	22	22			
1939				7,589	30	30			
1940				7,704	38	38			
1941				6,794	44	44			
1942				6,241	51	51			
1943				6,572	57	57			
1944				6,714	64	64			
1945				7,309	71	71			
1946				8,010	79	79			
1947	0	0		9,411	369	89	280,000	289,411	
1948	0	0	280	10,915	270	100	-90,000	-79,085	
1949	0	0	170	10,985	271	111	-10,000	985	
1950	4	4	160	11,016	422	122	140,000	151,016	37,754
1951	11	15	300	10,994	433	133	0	10,994	999
1952		15	300	11,004	444	144	0	11,004	
1953	0	15	300	10,978	405	155	-50,000	-39,022	
1954	9	24	250	10,992	401	166	-15,000	-4,008	-445
1955	4	28	235	10,982	411	176	0	10,982	2,746
1956	2	30	235	11,015	348	188	-75,000	-63,985	-31,992
1957	0	30	160	11,691	351	199	-8,000	3,691	
1958	0	30	152	14,823		214			
1959	1	31		16,473	400	230	18,000	34,473	34,473
1960	0	31	170	16,500	472	247	55,000	71,500	
1961	1	32	225	16,444	513	263	25,000	41,444	41,444
1962	1	33	250	16,446	520	280	-10,000	6,446	6,446
1963	3	36	240	16,503	536	296	0	16,503	5,501
1964	0	36	240	18,000	564	314	10,000	28,000	
1965	1	37	250	20,788	585	335	0	20,788	20,788
1966	1	38	250	22,521	608	358	0	22,521	22,521
1967	0	38	250	25,370	758	383	125,000	150,370	
1968	0	38	375	27,598	836	411	50,000	77,598	
1969	0	38	425	27,774	866	438	2,500	30,274	
1970	0	38	428	27,973	861	466	-33,000	-5,027	
1971	0	38	395	27,346	1,035	494	146,821	174,167	
1972	1	39	541	25,508	819	519	-241,321	-215,813	-215,813
1973	1	40	300	24,948	820	544	-24,000	948	948
1974	0	40	276	24,597	909	569	63,887	88,484	
1975	1	41	340	20,805	850	590	-79,887	-59,082	-59,082
1976		41	260	21,288	922	611	50,961	72,249	
1977	0	41	311	21,236	922	632	-21,288	-52	
1978	1	42	290	19,345	900	651	-40,382	-21,037	-21,037
1979	0	42	249	19,042	902	671	-18,741	301	
1980	0	42	231	17,649	902	688	-16,986	663	
1981			214						

BAHRAIN

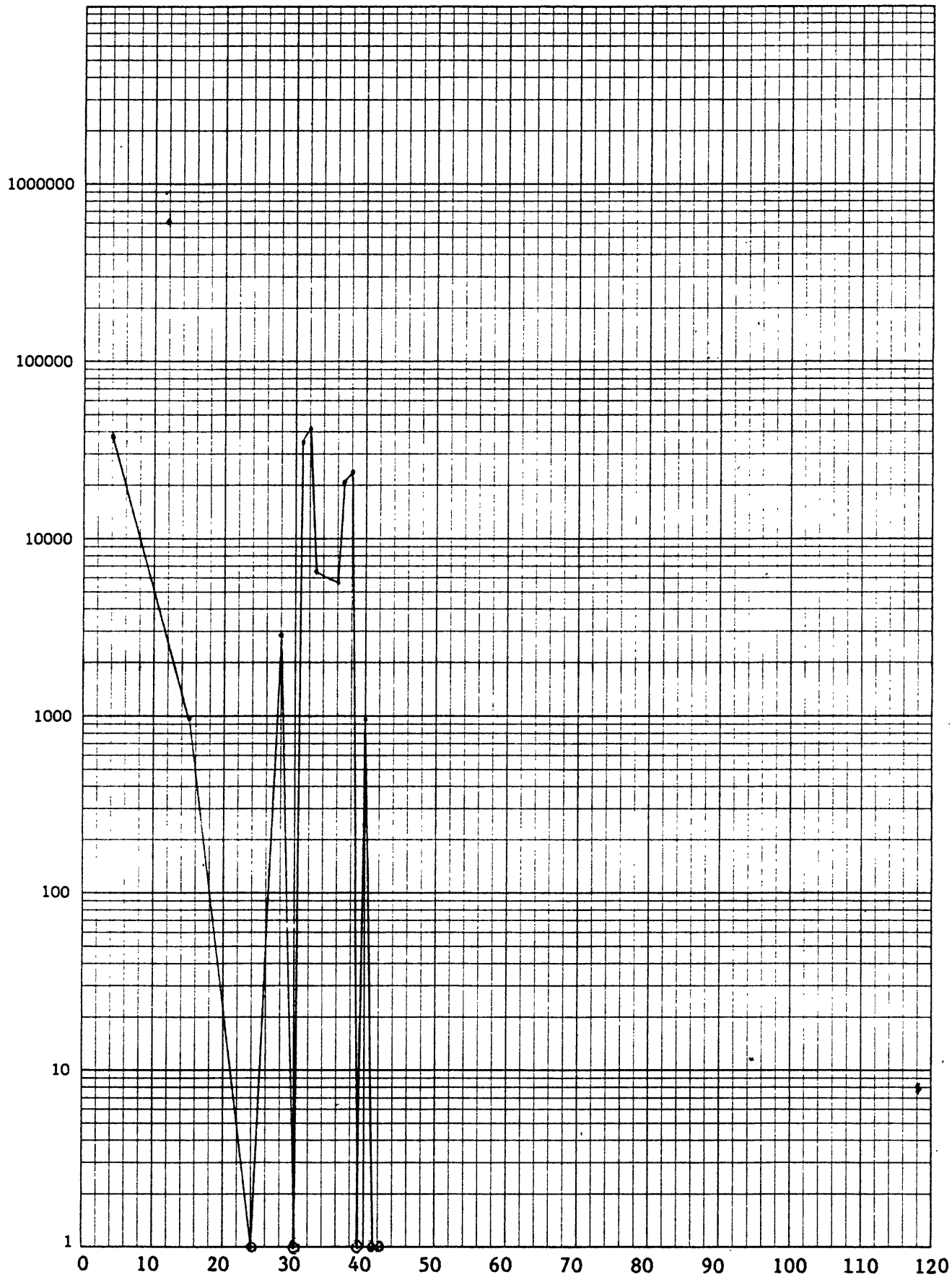
Ultimate crude oil recovery (MMBbls) vs cumulative exploratory wells completed



46 6463

K•E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS KEUFFEL & ESSER CO. MADE IN U.S.A.

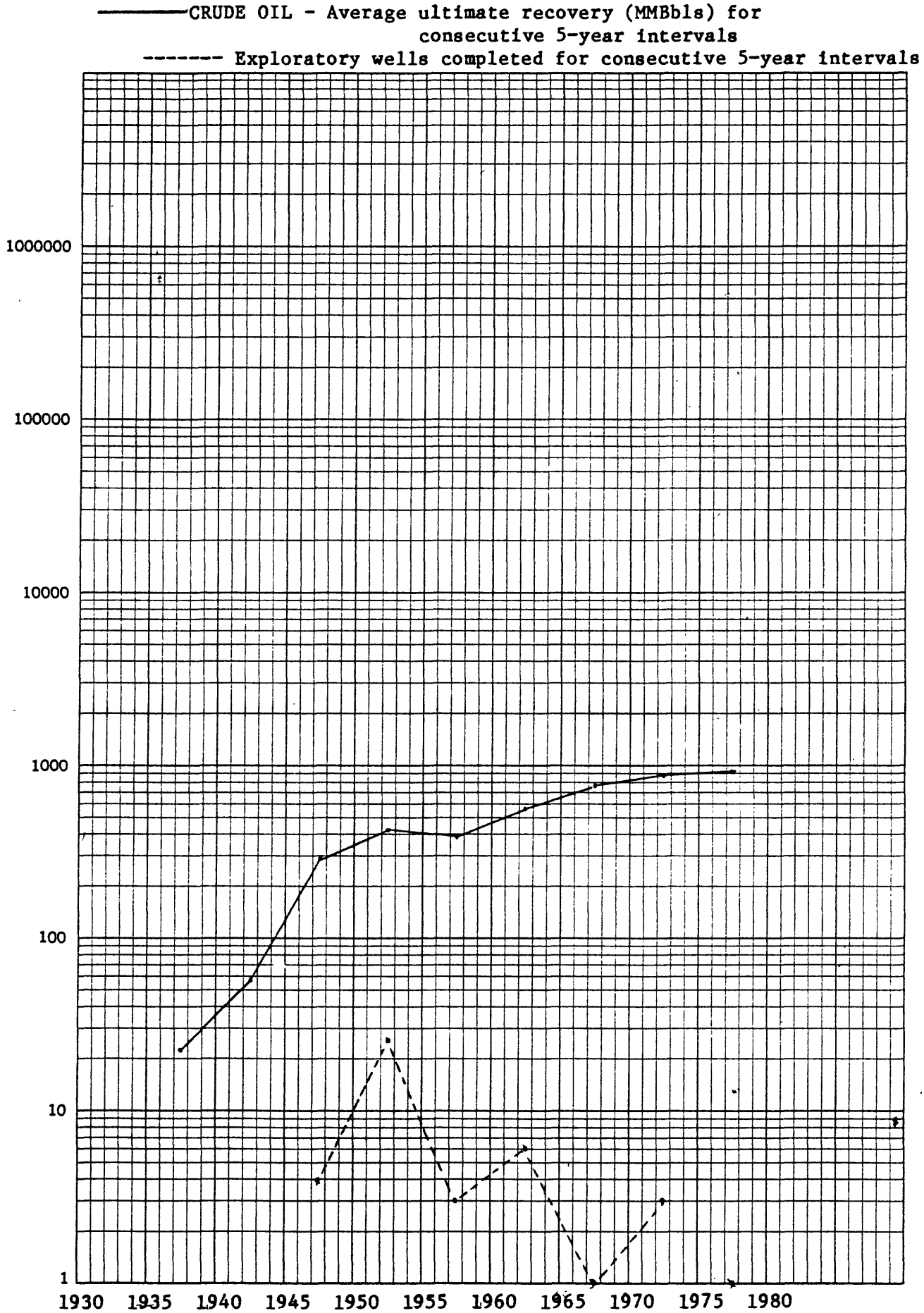
Proved additions to crude oil reserves per exploratory well completed (MBbls) vs cumulative exploratory wells completed



BAHRAIN

5 year period	Number of exploratory wells completed	Change in reserves (MMBbls)	Avg ultimate recovery (MMBbls)	Proved additions to reserves (MMBbls)	Proved additions to reserves by well (MMBbls)
1936-1940			22		
1941-1945			57		
1946-1950	4	320	282	362	90.5
1951-1955	24	-65	419	-10	-.4
1956-1960	3	-10	393	46	15.3
1961-1965	6	25	544	113	18.8
1966-1970	1	145	786	276	276.0
1971-1975	3	-134	887	-12	-4.0
1976-1980	1	-46	910	52	52.0

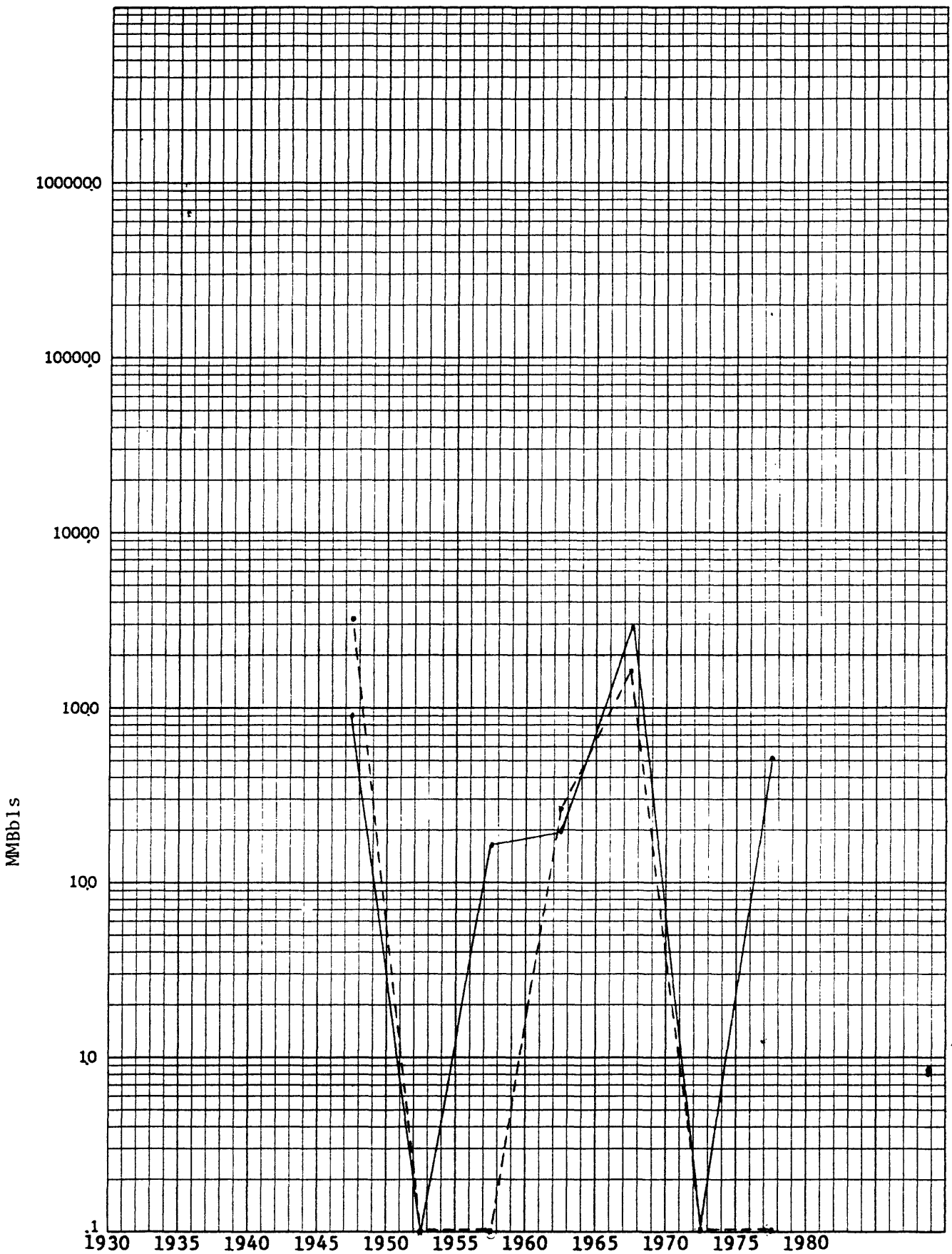
BAHRAIN



BAHRAIN

——— Proved additions to crude oil reserves per well over consecutive 5-year intervals

- - - - - - - Change in crude oil reserves over consecutive 5-year intervals

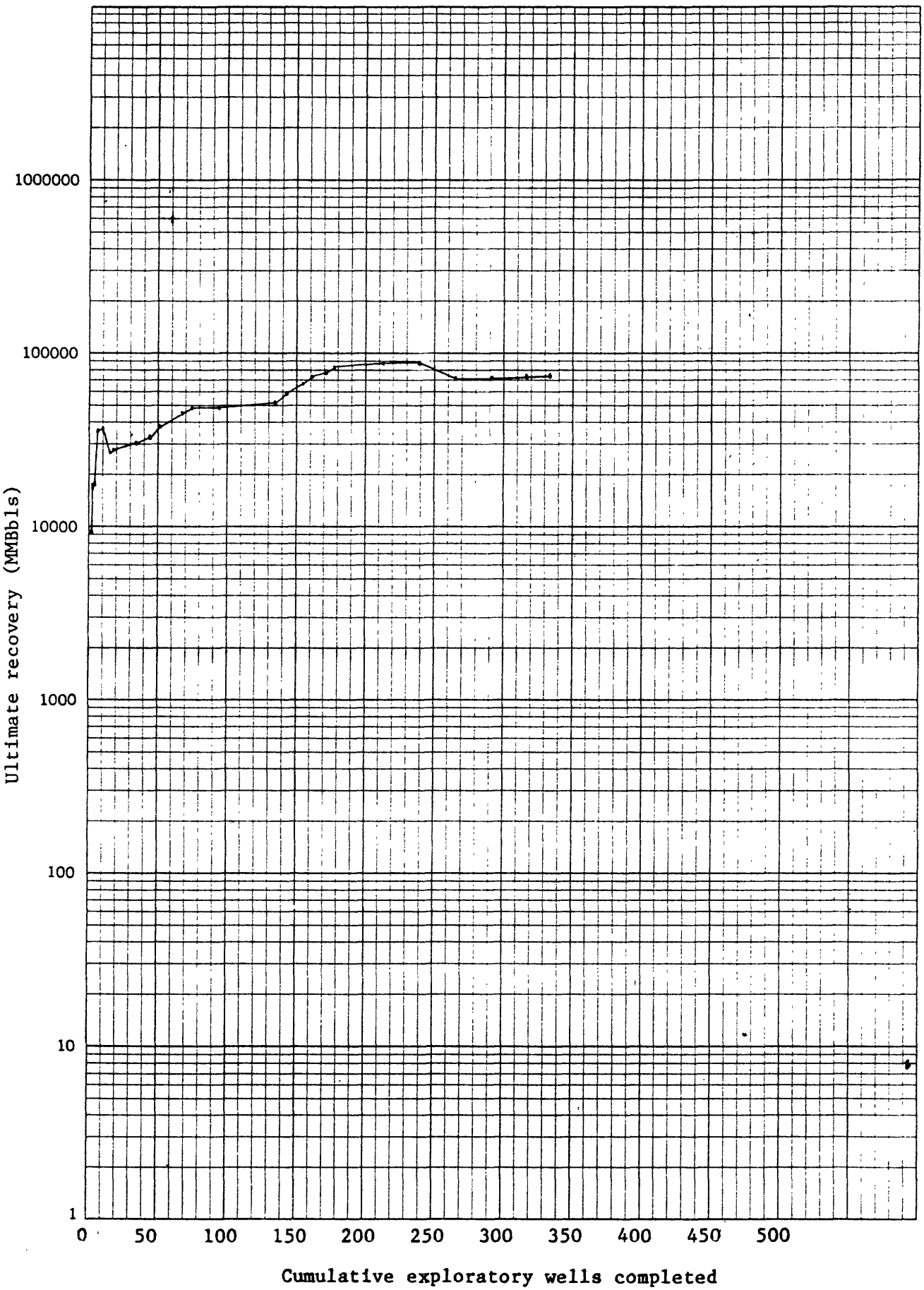


46 6463

K+E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS KEUFFEL & ESSER CO. MADE IN U.S.A.

(y)	completed (W_y)	wells completed (CW_y)	MMBbls (R_y)	MMBbls (P_y)	rounded MMBbls ($CP_y + R_{y+1}$)	rounded MMBbls (CP_y)	$(R_{y+1} - R_y) - R_y$ MBbls	reserves MBbls ($D_y - R_y + P_y$)	to reserves per well MBbls (D_y/W_y)
1913				1,857	2	2			
1914				2,910	5	5			
1915				3,616	8	8			
1916				4,477	13	13			
1917				7,147	20	20			
1918				8,623	29	29			
1919				10,139	39	39			
1920				12,230	51	51			
1921				16,673	68	68			
1922				22,247	90	90			
1923				25,230	115	115			
1924				32,373	148	148			
1925				34,038	182	182			
1926				35,842	217	217			
1927				39,688	257	257			
1928				43,461	301	301			
1929				42,145	343	343			
1930				45,833	389	389			
1931				44,376	433	433			
1932				49,471	482	482			
1933				54,392	537	537			
1934				57,851	595	595			
1935				57,283	652	652			
1936				62,718	715	715			
1937				77,804	792	792			
1938				78,372	871	871			
1939				78,151	949	949			
1940				66,317	1,015	1,015			
1941				50,777	1,066	1,066			
1942				72,256	1,138	1,138			
1943				74,612	6,213	1,213	5,000,000	5,074,612	
1944				102,045		1,315			
1945				130,526	7,445	1,445	1,000,000	1,130,526	
1946	0	0	6,000	146,819	7,592	1,592	0	146,819	
1947	0	0	6,000	154,998	8,372	1,747	625,000	779,998	
1948	0	0	6,625	190,384	8,938	1,938	375,000	565,384	
1949	1	1	7,000	204,712	9,142	2,142	0	204,712	204,712
1950	2	3	7,000	242,245	15,385	2,385	6,000,000	6,242,475	3,121,237
1951	0	3	13,000	123,512	15,508	2,508	0	123,512	
1952	1	4	13,000	7,800	15,516	2,516	0	7,800	7,800
1953	0	4	13,000	9,400	15,526	2,526	0	9,400	
1954	0	4	13,000	21,500	15,547	2,547	0	21,500	
1955	0	4	13,000	120,562	15,668	2,668	0	120,562	
1956	2	6	13,000	197,148	34,865	2,865	19,000,000	19,197,148	9,598,574
1957	4	10	32,000	263,134	35,128	3,128	0	263,134	65,783
1958	2	12	32,000	301,361		3,429		301,361	150,680
1959	3	15		344,800	25,774	3,774	-10,000,000	-9,655,200	-3,218,400
1960	3	18	22,000	385,748	26,160	4,160	0	385,748	128,582
1961	16	34	22,000	431,653	30,591	4,591	4,000,000	4,431,653	276,978
1962	9	43	26,000	481,939	32,073	5,073	1,000,000	1,481,939	164,660
1963	8	51	27,000	538,121	37,612	5,612	5,000,000	5,538,121	692,265
1964	16	67	32,000	618,731	43,230	6,230	5,000,000	5,618,731	351,171
1965	7	74	37,000	688,215	46,918	6,918	3,000,000	3,688,215	526,888
1966	19	93	40,000	771,234	48,690	7,690	1,000,000	1,771,234	93,223
1967	40	133	41,000	947,706	51,637	8,637	2,000,000	2,947,706	73,693
1968	9	142	43,000	1,039,367	59,677	9,677	7,000,000	8,039,367	893,263
1969	11	153	50,000	1,231,826	65,909	10,909	5,000,000	6,231,826	566,530
1970	8	161	55,000	1,397,460	72,306	12,306	5,000,000	6,397,460	799,683
1971	10	171	60,000	1,661,901	74,418	13,968	450,000	2,111,901	211,190
1972	6	177	60,450	1,838,825	82,057	15,807	5,800,000	7,638,825	1,273,138
1973	36	213	66,250	2,139,229	85,946	17,946	1,750,000	3,889,229	108,034
1974	26	239	68,000	2,197,901	88,194	20,144	50,000	2,247,901	86,458
1975	26	265	68,050	1,952,650	72,204	22,096	-17,942,000	-15,989,350	-614,975
1976	26	291	50,108	2,168,237	72,395	24,265	-1,978,000	190,237	7,317
1977	25	316	48,130	2,080,051	73,208	26,345	-1,262,000	818,051	32,722
1978	17	333	46,863	1,898,000	73,209	28,243	-1,897,350	650	38
1979			44,966	1,645,745	69,846	29,288	-4,407,775	-3,362,030	
1980			40,558	622,200	69,847	29,911	-622,200	0	
1981			39,936						

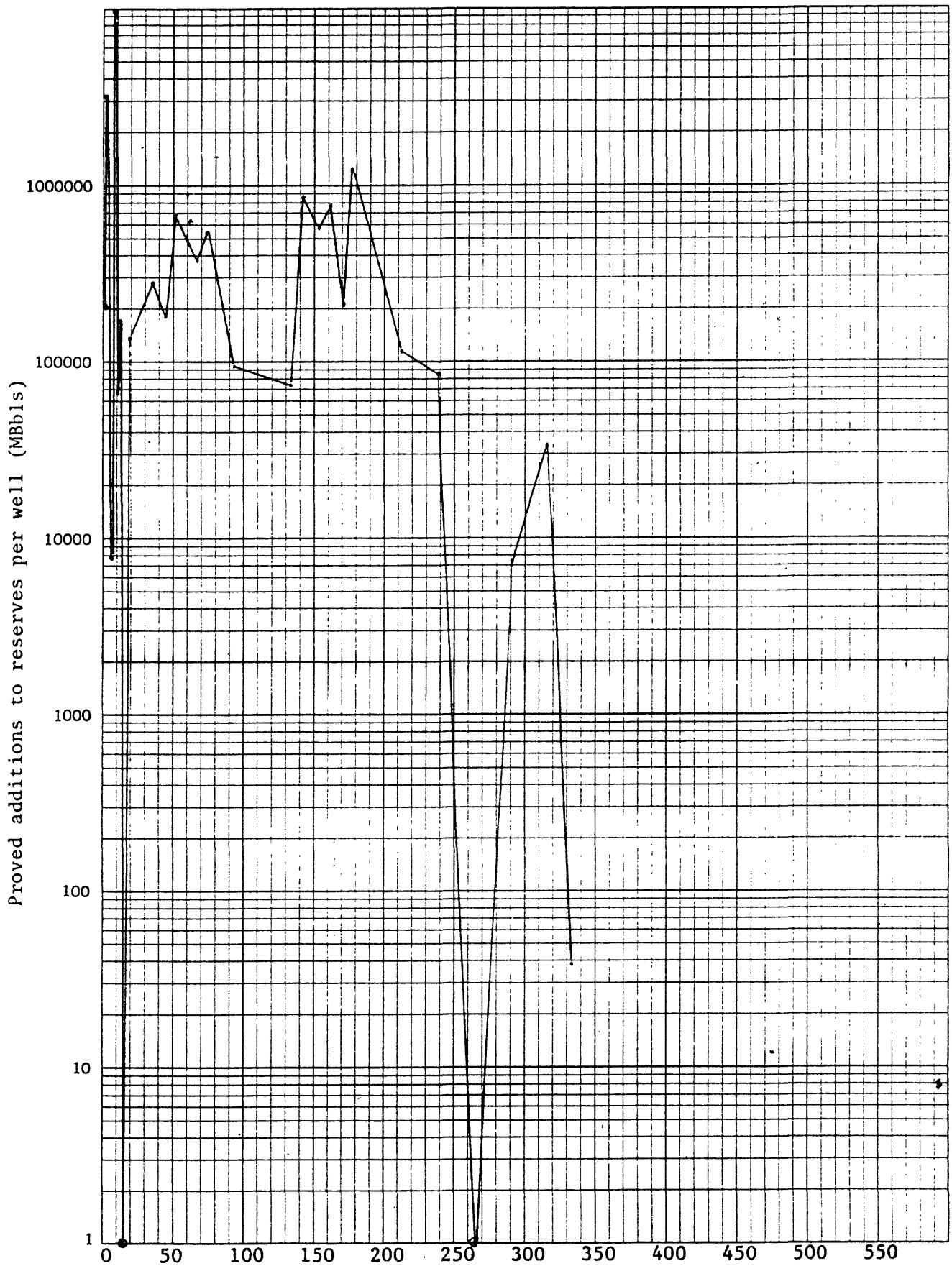
Ultimate crude oil recovery (MMBbls) vs cumulative exploratory wells completed



46 6463

K+E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS KEUFFEL & ESSER CO. MADE IN U.S.A.

Proved additions to crude oil reserves per exploratory well completed (MBbls) vs cumulative exploratory wells completed

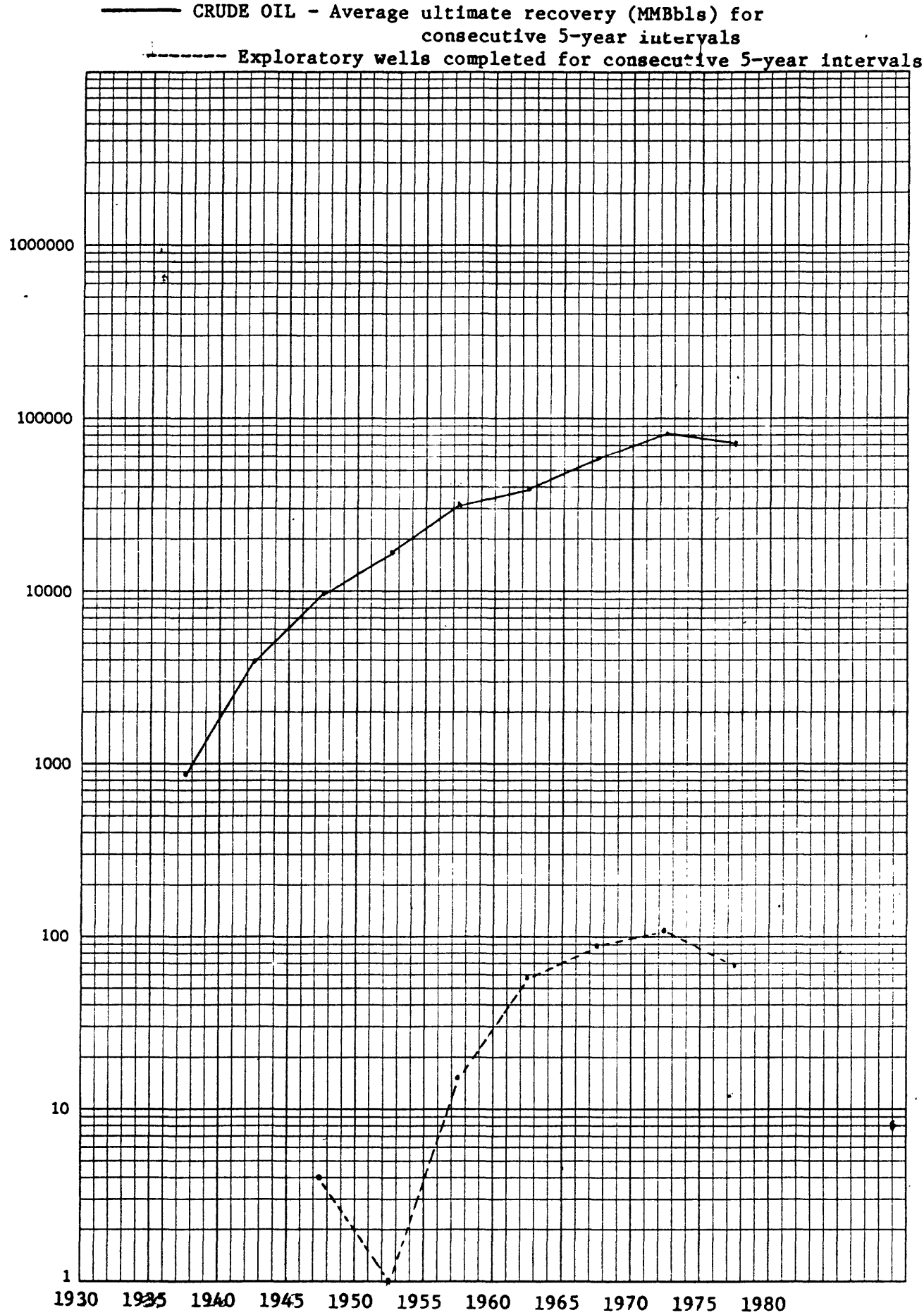


46 6463

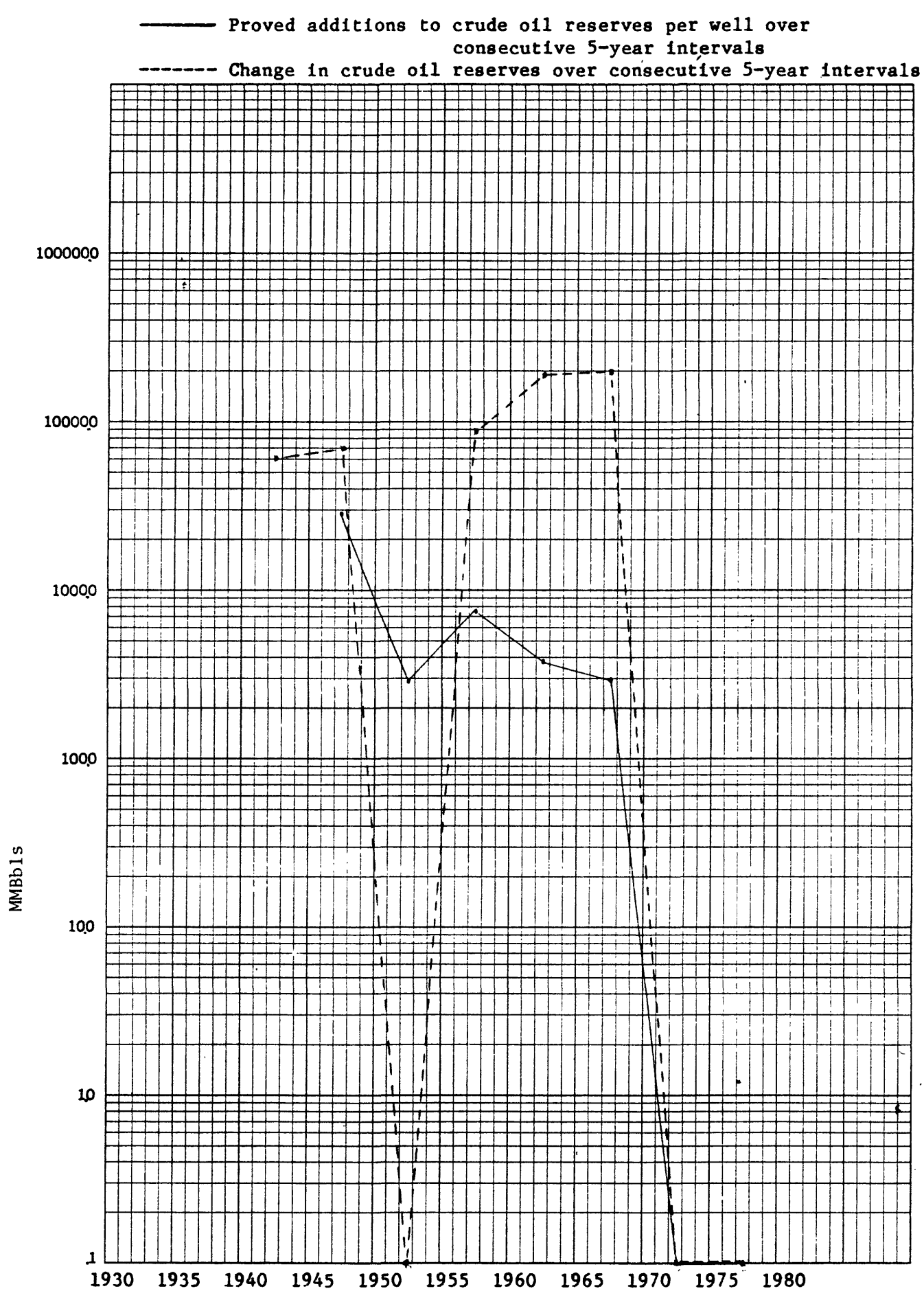
K+E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS KEUFFEL & ESSER CO. MADE IN U.S.A.

IRAN

5 year period	Number of exploratory wells completed	Change in reserves (MMBbls)	Avg ultimate recovery (MMBbls)	Proved additions to reserves (MMBbls)	Proved additions to reserves by well (MMBbls)
1936-1940			868		
1941-1945		6,000	3,965	6,206	
1946-1950	3	7,000	9,886	7,939	2,646.3
1951-1955	1	0	15,553	284	284.0
1956-1960	14	9,000	30,482	10,492	749.4
1961-1965	56	18,000	38,084	20,759	370.7
1966-1970	87	20,000	59,643	25,387	291.8
1971-1975	104	-9,892	80,564	-101	-1.0
1976-1980	68	-10,167	71,701	-2,353	-34.6



IRAN



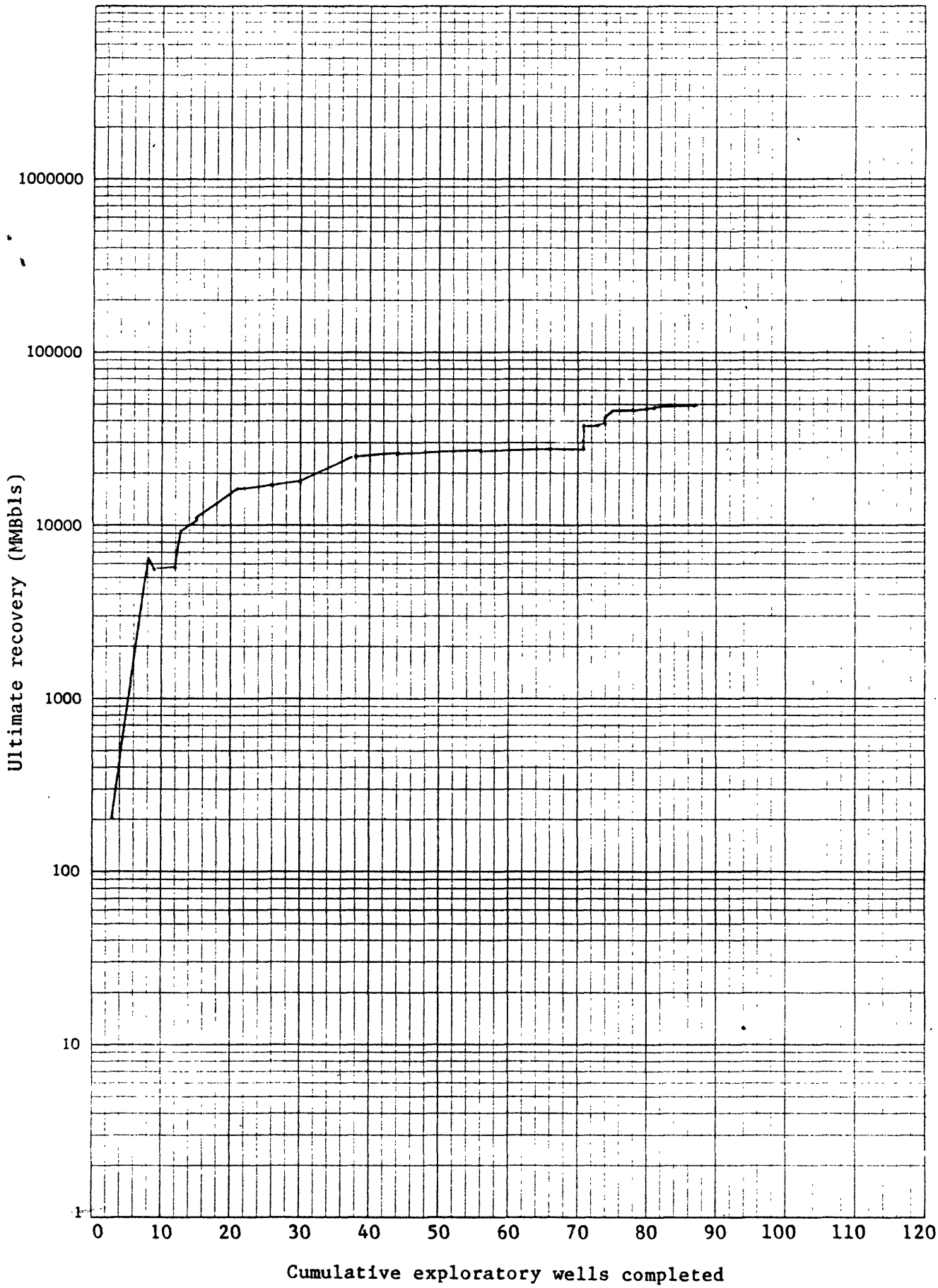
46 6463

K•E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS KEUFFEL & ESSER CO. MADE IN U.S.A.

IRAQ

Year (y)	Exploratory wells completed (W_y) (AAPG)	Cumulative exploratory wells completed (CW_y)	Reserves - MMBbls (R_y) (D/M)	Crude production MBbls (P_y) (D/M, WO)	Ultimate recovery rounded MMBbls ($CP_y + R_{y+1}$)	Cumulative production rounded MMBbls (CP_y)	Change in reserves ($R_{y+1} - R_y$) = ΔR_y MBbls	Proved additions to reserves MBbls ($Dy = \Delta R_y + P_y$)	Proved additions to reserves per well MBbls (D_y/W_y)
1927									
1928				338					
1929				713	1	1			
1930				798	2	2			
1931				913	3	3			
1932				830	4	4			
1933				836	4	4			
1934				917	5	5			
1935				7,689	13	13			
1936				27,408	40	40			
1937				30,406	71	71			
1938				31,836	103	103			
1939				32,643	135	135			
1940				30,791	166	166			
1941	3	3		24,225	190	190			
1942				12,650	203	203			
1943				19,726	223	223			
1944				24,948	248	248			
1945			4,000	30,045	4,278	278	4,000,000	4,024,948	
1946				35,112	5,063	313			
1947	5	8	4,750	35,665	6,348	348	750,000	785,112	
1948	1	9	6,000	35,834	6,384	384	1,250,000	1,285,665	
1949	3	12	6,000	26,115	5,410	410	0	35,834	7,167
1950	1	13	5,000	30,957	5,691	441	-1,000,000	-973,885	-973,885
1951	2	15	5,250	49,726	9,191	491	250,000	280,957	93,652
1952	0	15	8,700	65,122	11,056	556	3,450,000	3,499,726	3,499,726
1953	6	21	10,500	141,100	11,697	697	1,800,000	1,865,122	932,561
1954	5	26	11,000	210,268	14,908	908	500,000	641,100	
1955	4	30	14,000	228,432	15,136	1,136	3,000,000	3,210,268	535,045
1956	8	38	14,000	251,206	15,887	1,387	0	228,432	45,686
1957	6	44	14,500	232,307	23,620	1,620	500,000	751,206	187,801
1958	7	51	22,000	163,498	23,783	1,783	7,500,000	7,732,307	966,538
1959	5	56	22,000	266,125		2,049	0	163,498	27,250
1960	10	66		311,193	25,360	2,360	1,000,000	1,311,193	262,239
1961	5	71	23,000	353,833	26,714	2,714	1,000,000	1,353,833	135,383
1962	0	71	24,000	365,594	27,080	3,080	0	365,594	73,119
1963	0	71	24,000	366,832	27,447	3,447	0	366,832	
1964	0	71	24,000	423,140	27,870	3,870	0	423,140	
1965	0	71	24,000	461,961	30,332	4,332	2,000,000	2,461,961	
1966			26,000	482,461	34,814	4,814	4,000,000	4,482,461	
1967			30,000	505,428	35,320	5,320	0	505,428	
1968	0	71	30,000	448,239	34,768	5,768	-1,000,000	-551,761	
1969	2	73	29,000	548,705	34,817	6,317	-500,000	48,705	
1970	1	74	28,500	555,241	35,377	6,872	5,000	560,241	280,121
1971	0	74	28,505	568,547	36,440	7,440	495,000	1,063,547	1,063,547
1972	1	75	29,000	624,312	41,165	8,065	4,100,000	4,724,312	
1973	3	78	33,100	529,419	44,344	8,594	2,650,000	3,179,419	3,179,419
1974	2	80	35,750	736,607	45,006	9,331	-75,000	661,607	220,536
1975	1	81	35,675	720,729	45,174	10,051	-551,250	169,479	84,740
1976	1	82	35,123	825,521	45,877	10,877	-123,750	701,771	701,771
1977	5	87	35,000	884,036	46,926	11,761	165,190	1,049,226	1,049,226
1978			35,165	909,945	48,009	12,671	173,295	1,083,240	216,648
1979			35,338	917,975	47,981	13,589	-946,445	-28,470	
1980			34,392	1,264,451	49,853	14,853	607,980	1,872,431	
1981			35,000	920,124	49,853	15,773	-920,000	124	
			34,080						

Ultimate crude oil recovery (MMBbls) vs cumulative exploratory wells completed

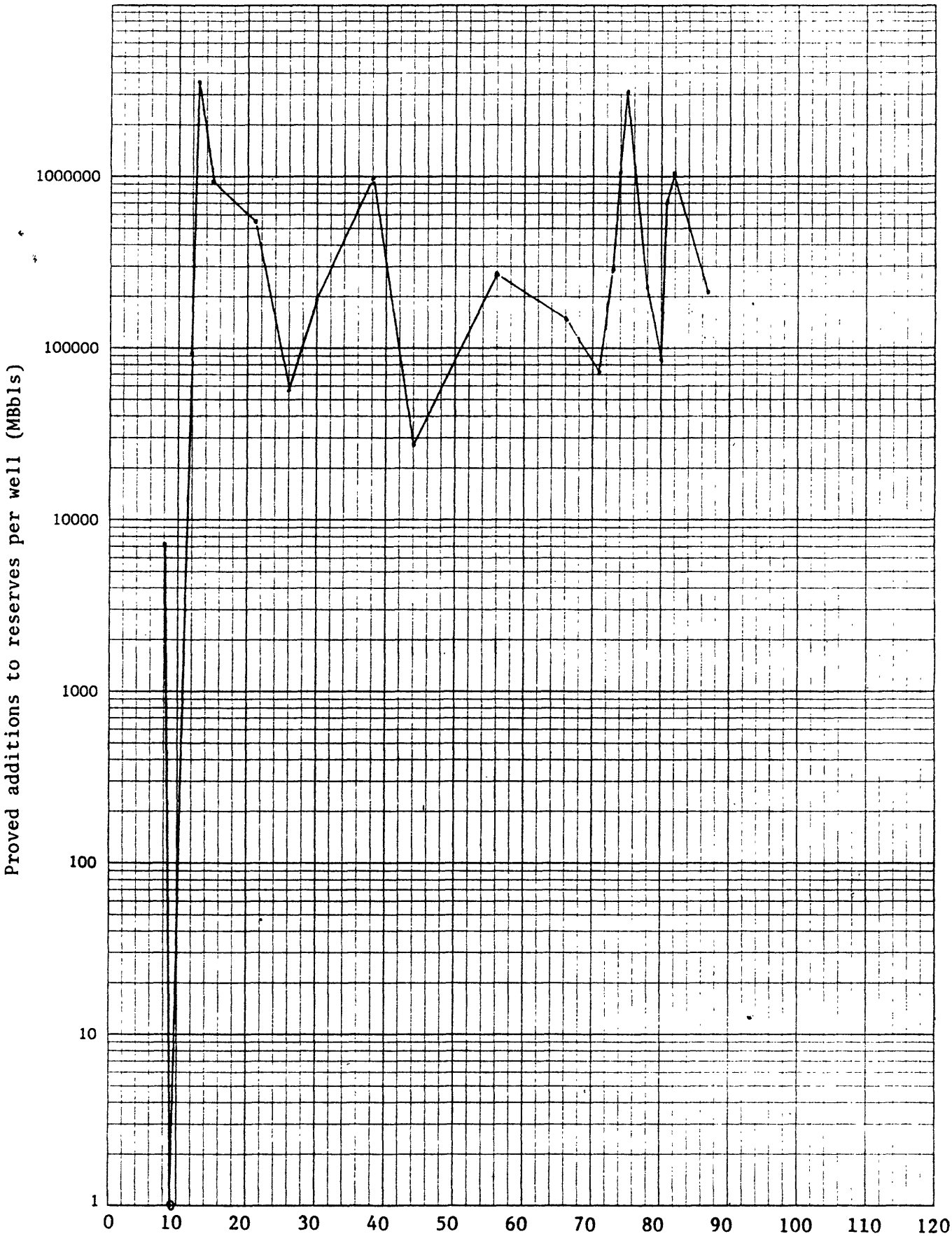


46 6463

K•E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

IRAQ

Proved additions to crude oil reserves per exploratory well completed (MBbls) vs cumulative exploratory wells completed



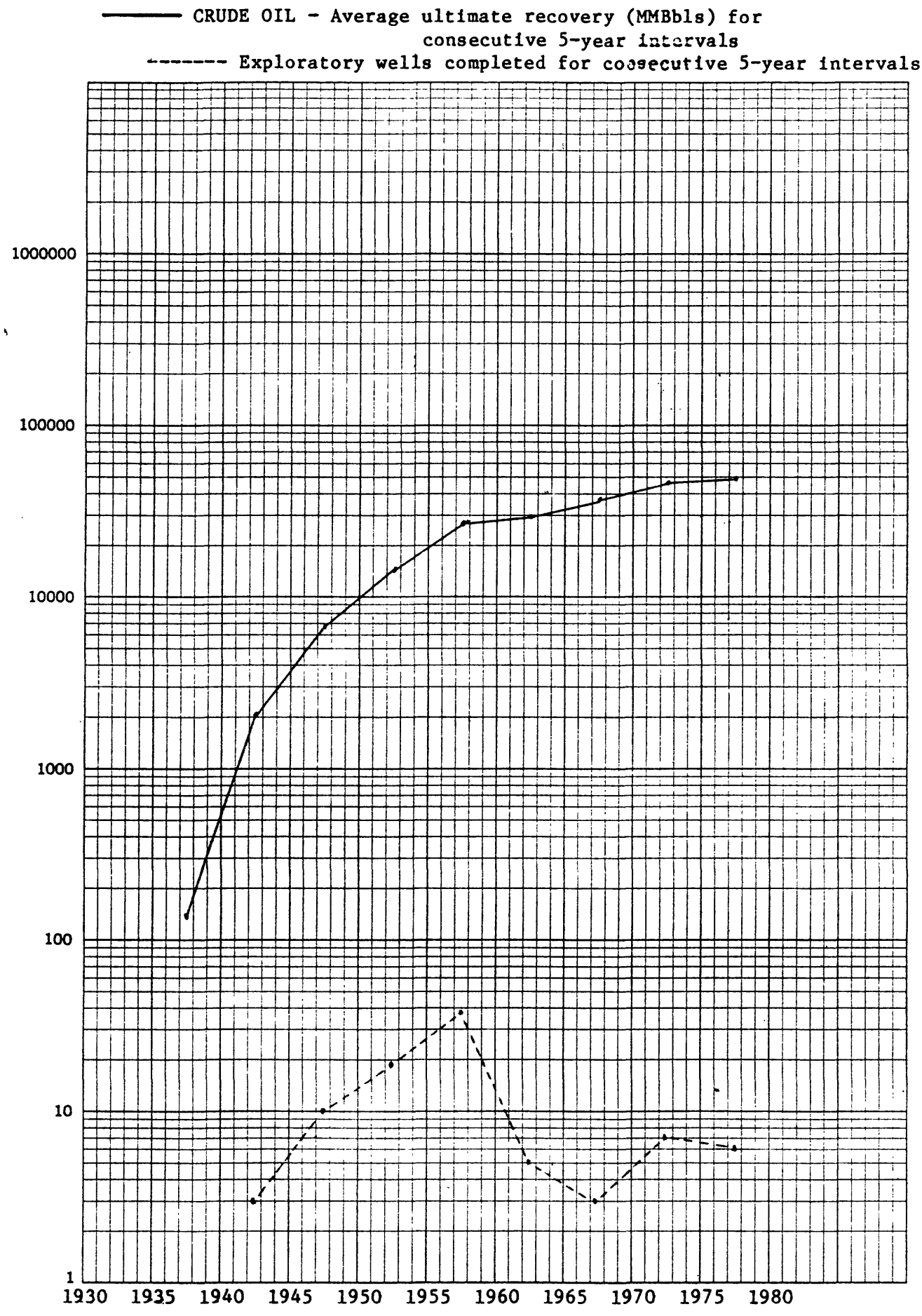
46 6463

K+E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS KEUFFEL & ESSER CO. MADE IN U.S.A.

IRAQ

5 year period	Number of exploratory wells completed	Change in reserves (MMBbls)	Avg ultimate recovery (MMBbls)	Proved additions to reserves (MMBbls)	Proved additions to reserves by well (MMBbls)
1936-1940			133		
1941-1945	3	4,750	2,003	4,810	1,603.3
1946-1950	10	3,950	6,605	4,129	412.9
1951-1955	17	5,800	13,737	6,695	393.8
1956-1960	36	9,500	24,869	10,560	293.3
1961-1965	5	6,000	29,509	8,100	1,620.0
1966-1970	3	-1,000	35,344	1,626	542.0
1971-1975	7	6,000	44,313	9,436	1,348.0
1976-1980	6	-920	48,524	3,976	662.6

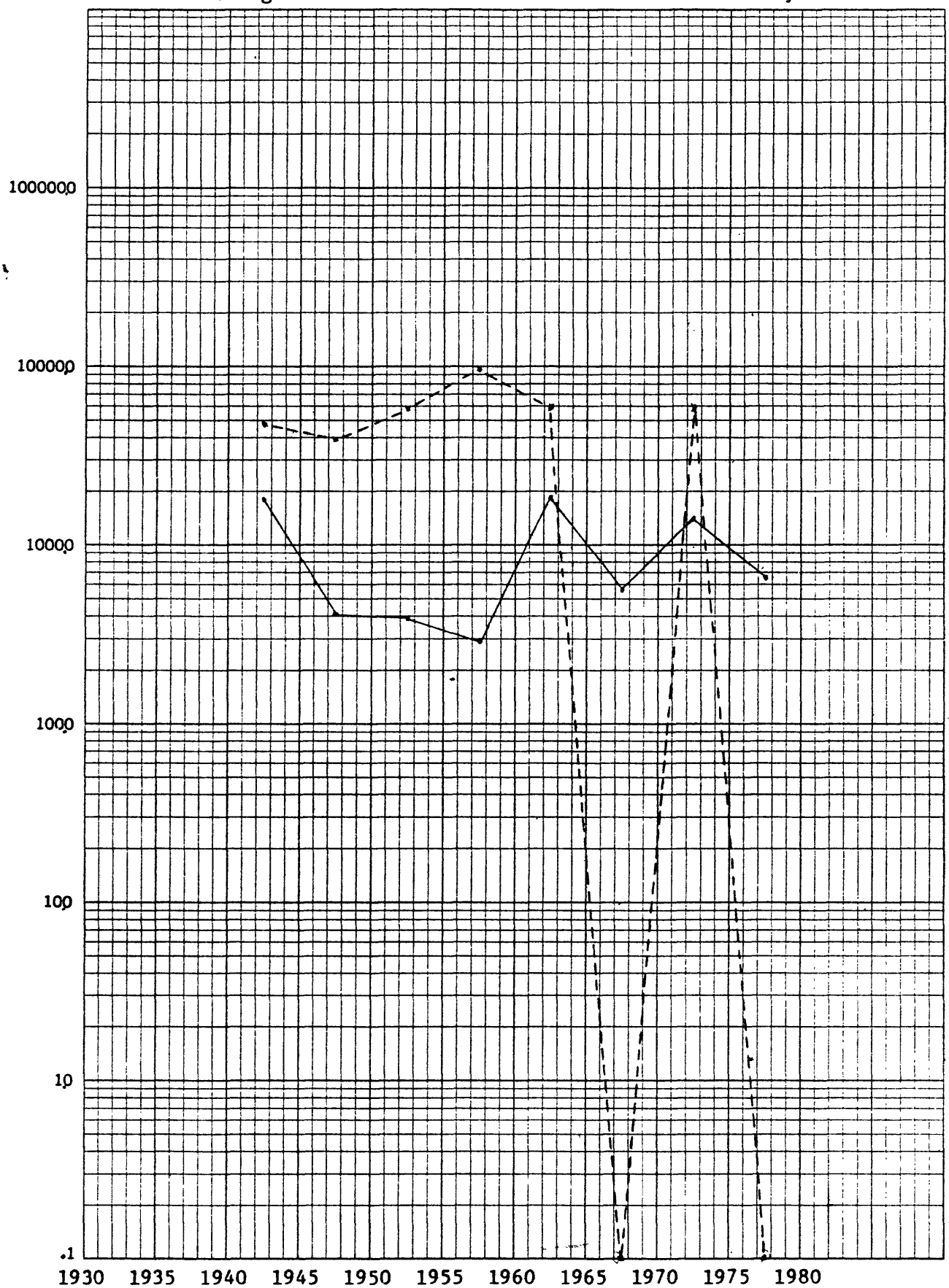
IRAQ


CRUDE OIL - Average ultimate recovery (MMBbls) for consecutive 5-year intervals
Exploratory wells completed for consecutive 5-year intervals
1000000
100000
10000
1000
100
10
1
1930
1935
1940
1945
1950
1955
1960
1965
1970
1975
1980
Years
46 6463
SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.
K&E

IRAQ

——— Proved additions to crude oil reserves per well over consecutive 5-year intervals

------- Change in crude oil reserves over consecutive 5-year intervals



46 6463

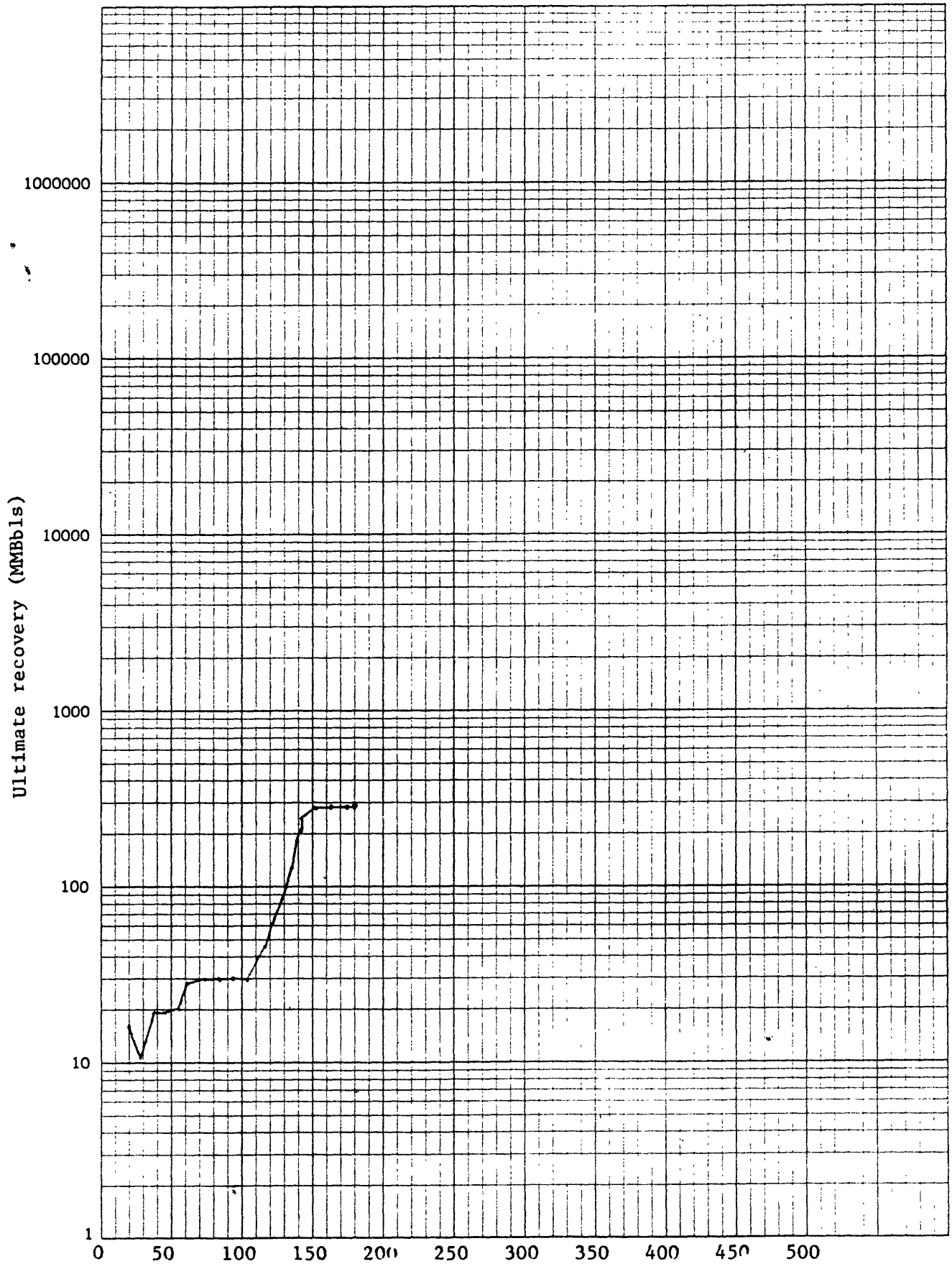
K+E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS KEUFFEL & ESSER CO. MADE IN U.S.A.

ISRAEL

Year (y)	Exploratory wells completed (W_y) (AAPG)	Cumulative exploratory wells completed (CW_y)	Reserves - MMBbls (R_y) (D/M)	Crude production MBbls (P_y) (D/M, WO)	Ultimate recovery rounded MMBbls ($CP_y + R_{y+1}$)	Cumulative production rounded MMBbls (CP_y)	Change in reserves ($R_{y+1} - R_y$) = ΔR_y MBbls	Proved additions to reserves MBbls ($D_y = \Delta R_y + P_y$)	Proved additions to reserves per well MBbls (D_y/W_y)
1947	0	0							
1948	0	0							
1949	0	0							
1950									
1951	0	0							
1952	0	0							
1953	1	1							
1954	1	2					15,000	15,146	1,515
1955	8	10		146	15		-5,000	-4,606	-658
1956	10	20	15	394	11	1			
1957	7	27	10	642		1		6,925	1,731
1958	7	34		925	18	2	6,000	-68	-11
1959	4	38		932	18	3	-1,000	1,133	283
1960	6	44	16	1,133	19	4	0	1,126	161
1961	4	48	15	1,126	20	5	0	6,091	1,015
1962	7	55	15	1,091	26	6	5,000	1,435	120
1963	6	61	20	1,435	28	8	0	1,469	147
1964	12	73	20	1,469	29	9	0	-141	-13
1965	10	83	20	1,359	30	11	-1,500	-813	-81
1966	11	94	19	8,687	28	19	-9,500	15,689	1,307
1967	10	104	9	14,689	44	34	1,000	17,042	3,408
1968	12	116	10	18,042	61	52	-1,000	24,798	3,100
1969	5	121	9	31,798	86	84	-7,000	44,618	7,436
1970	8	129	2	44,618	130	128	0	43,720	10,930
1971	6	135	2	43,920	174	172	-200	32,682	16,341
1972	4	139	2	32,193	207	205	489	36,211	36,211
1973	2	141	2	36,500	243	241	-289	26,845	2,983
1974	1	142	2	27,345	270	268	-500	2	
1975	9	151	2	268	270	269	-266	43	3
1976	12	163	1	256	270	269	-213	-36	-3
1977	12	175	1	177	270	269	-213	0	
1978	5	180	1	164	270	269	-164	1	
1979			1	165			-164		
1980									
1981									

ISRAEL

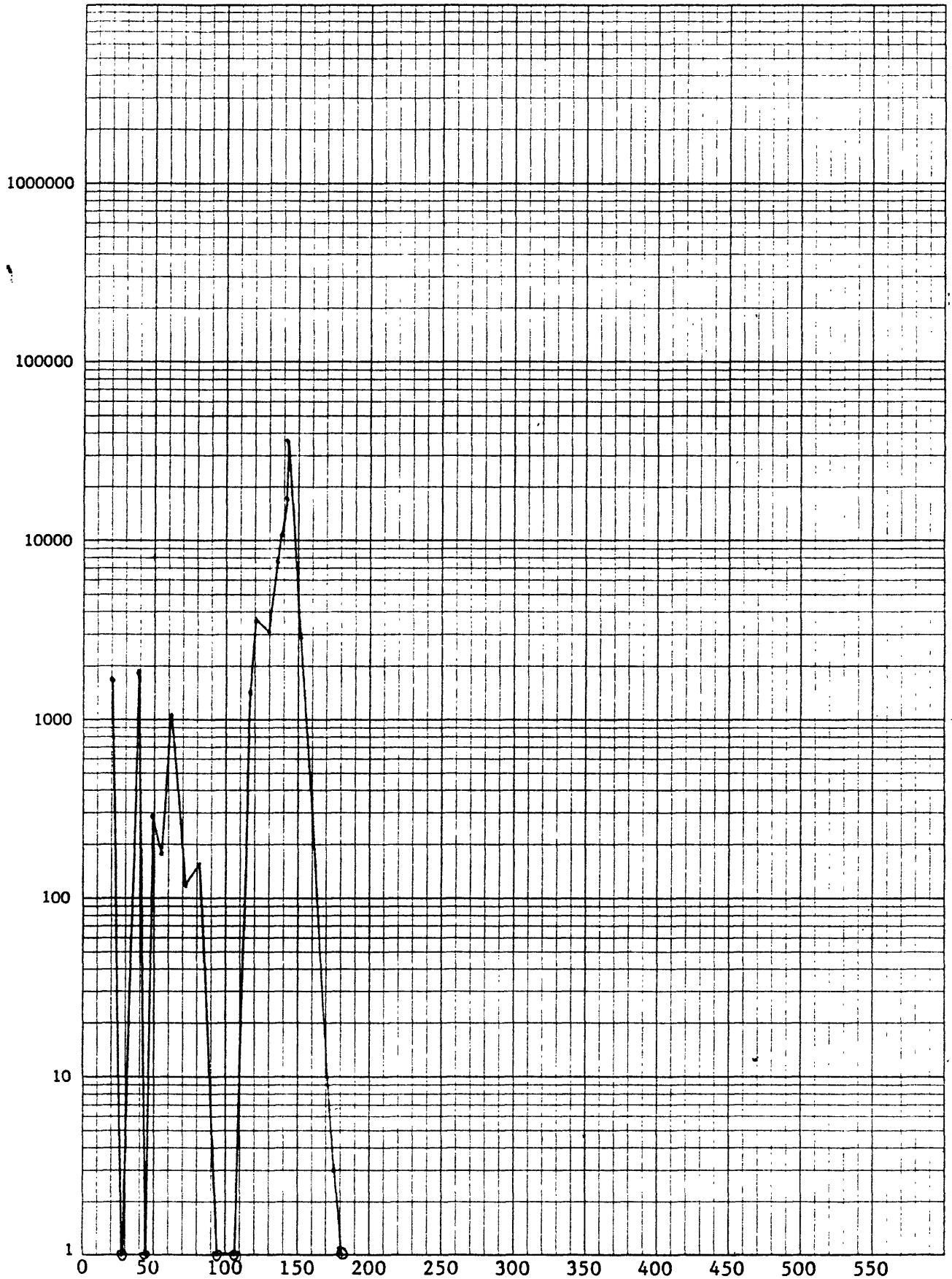
Ultimate crude oil recovery (MMBbls) vs cumulative exploratory wells completed



46 6463

SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

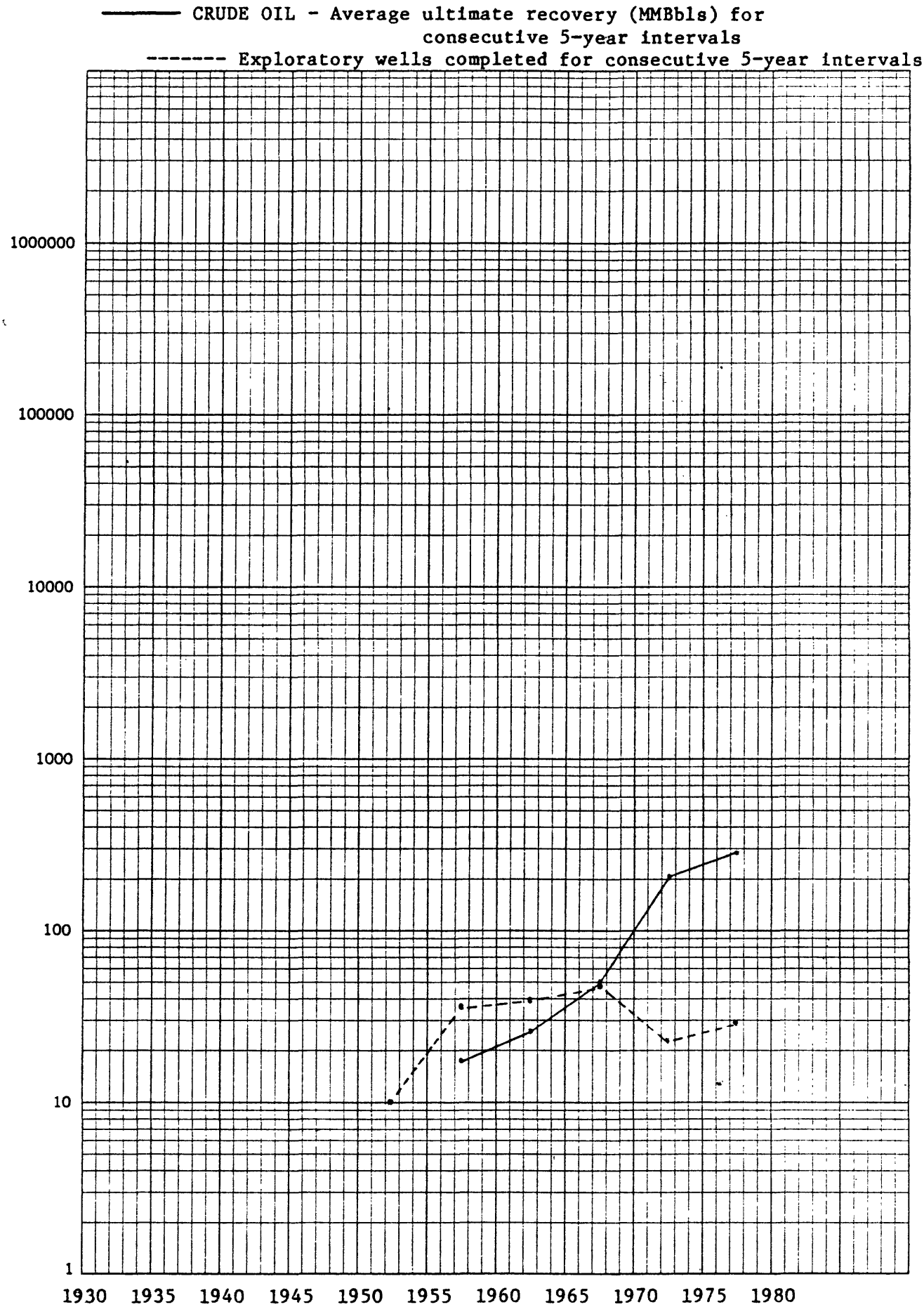
Proved additions to crude oil reserves per exploratory well completed (MBbls) vs cumulative exploratory wells completed



ISRAEL

5 year period	Number of exploratory wells completed	Change in reserves (MMBbls)	Avg ultimate recovery (MMBbls)	Proved additions to reserves (MMBbls)	Proved additions to reserves by well (MMBbls)
1936-1940					
1941-1945					
1946-1950					
1951-1955	10				
1956-1960	34	15	16	17	.5
1961-1965	39	5	24	10	.3
1966-1970	46	-19	50	57	1.2
1971-1975	22	-1	205	185	8.4
1976-1980	29	-1	270	0	

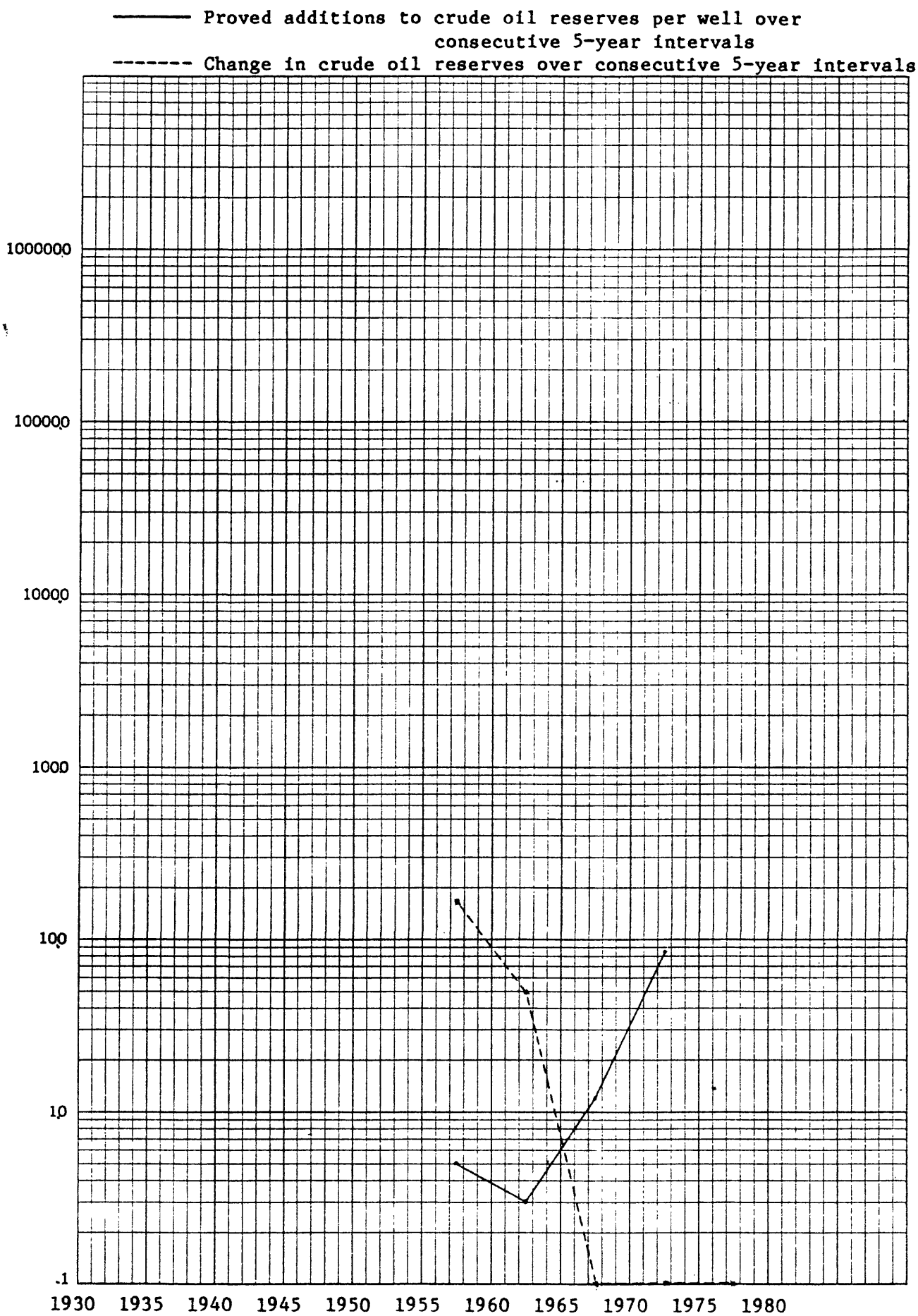
ISRAEL



46 6463

K+E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS KEUFFEL & ESSER CO. MADE IN U.S.A.

ISRAEL



46 6463

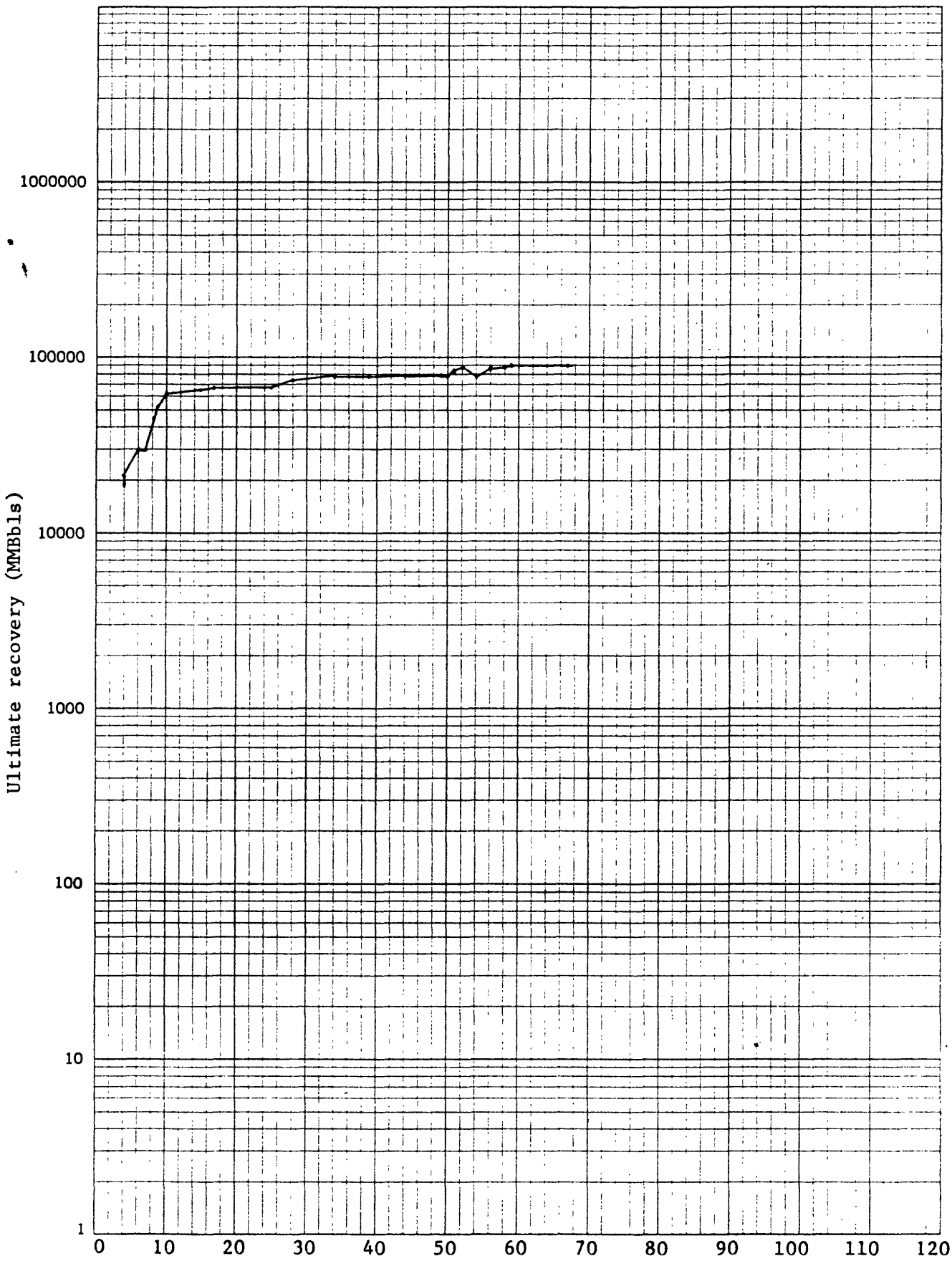
K+E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

KUWAIT

Year (y)	Exploratory wells completed (W_y) (AAPG)	Cumulative exploratory wells completed (CW_y)	Reserves - MMBbls (R_y) (D/M)	Crude production MMBbls (P_y) (D/M, MO)	Ultimate recovery rounded MMBbls ($CP_y + R_{y+1}$)	Cumulative production rounded MMBbls (CP_y)	Change in reserves ($R_{y+1} - R_y$) = ΔR_y MBbls	Proved additions to reserves MBbls ($D_y = \Delta R_y + P_y$)	Proved additions to reserves per well MBbls (D_y/W_y)
1944					4,000		4,000,000	4,000,000	
1945			4,000		4,000		0	0	
1946			4,000	5,931	9,006	6	5,000,000	5,005,931	
1947	0	0	9,000	16,225	9,522	22	500,000	516,225	
1948	0	0	9,500	46,500	11,019	69	1,450,000	1,496,500	
1949	0	0	10,950	90,000	11,159	159	50,000	140,000	
1950	0	0	11,000	125,722	15,284	284	4,000,000	4,125,722	
1951	2	2	15,000	204,910	16,489	489	1,000,000	1,204,910	602,455
1952	2	4	16,000	273,433	18,763	763	2,000,000	2,273,433	1,136,716
1953	0	4	18,000	314,592	21,077	1,077	2,000,000	2,314,592	
1954	2	6	20,000	347,319	29,425	1,425	6,000,000	6,347,319	4,173,659
1955	1	7	28,000	398,493	29,323	1,823	-500,000	-101,507	-101,507
1956	2	9	27,500	399,874	52,223	2,223	22,500,000	22,899,874	11,449,937
1957	1	10	50,000	416,045	60,639	2,639	8,000,000	8,416,045	8,416,045
1958	2	12	58,000	509,654		3,149		509,654	254,827
1959	3	15		504,855	63,654	3,654	2,000,000	2,504,855	834,951
1960	2	17	60,000	594,278	64,248	4,248	0	594,278	297,139
1961	8	25	60,000	600,226	64,848	4,848	0	600,226	75,028
1962	3	28	60,000	669,284	72,517	5,517	7,000,000	7,669,284	2,556,428
1963	6	34	67,000	705,471	76,223	6,223	3,000,000	3,705,471	617,579
1964	5	39	70,000	774,815	76,998	6,998	0	774,815	154,963
1965	5	44	70,000	791,903	77,790	7,790	0	791,903	158,380
1966	5	49	70,000	830,537	78,620	8,620	0	830,537	166,107
1967	1	50	70,000	836,719	79,457	9,457	0	836,719	836,719
1968	1	51	70,000	886,125	80,843	10,343	500,000	1,386,125	1,386,125
1969	0	51	70,500	940,041	82,493	11,283	710,000	1,650,041	
1970	1	52	71,210	998,110	87,781	12,281	4,290,000	5,288,110	5,288,110
1971	2	54	75,500	1,067,795	79,372	13,349	-9,477,000	-8,409,205	-4,204,602
1972	2	56	66,023	1,097,719	88,421	14,447	7,951,000	9,048,719	4,524,359
1973	0	56	73,974	1,007,002	88,423	15,454	-1,005,000	2,002	
1974	0	56	72,969	830,580	87,174	16,284	-2,079,000	-1,248,420	
1975	0	56	70,890	670,918	87,174	16,955	-671,000	-82	
1976	2	58	70,219	700,000	89,455	17,655	1,581,000	2,281,000	1,140,500
1977	1	59	71,800	650,795	90,306	18,306	200,000	850,795	850,795
1978	0	59	72,000	680,725	90,387	18,987	-600,000	80,725	
1979	8	67	71,400	814,986	90,393	19,802	-809,000	5,986	748
1980			70,591	507,642	88,332	20,309	-2,568,000	-2,060,358	
1981			68,023						

KUWAIT

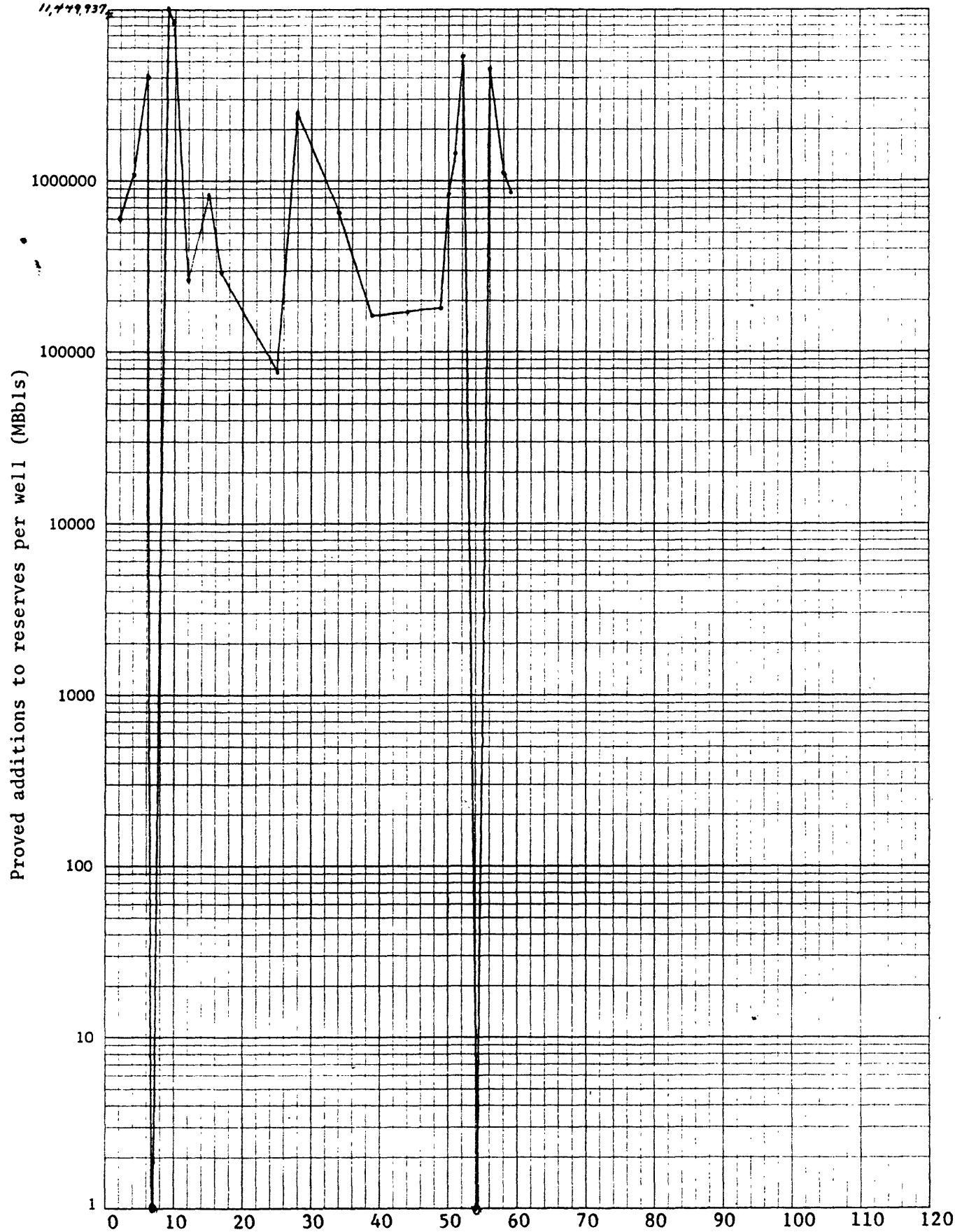
Ultimate crude oil recovery (MMBbls) vs cumulative exploratory wells completed



46 6463

K+E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

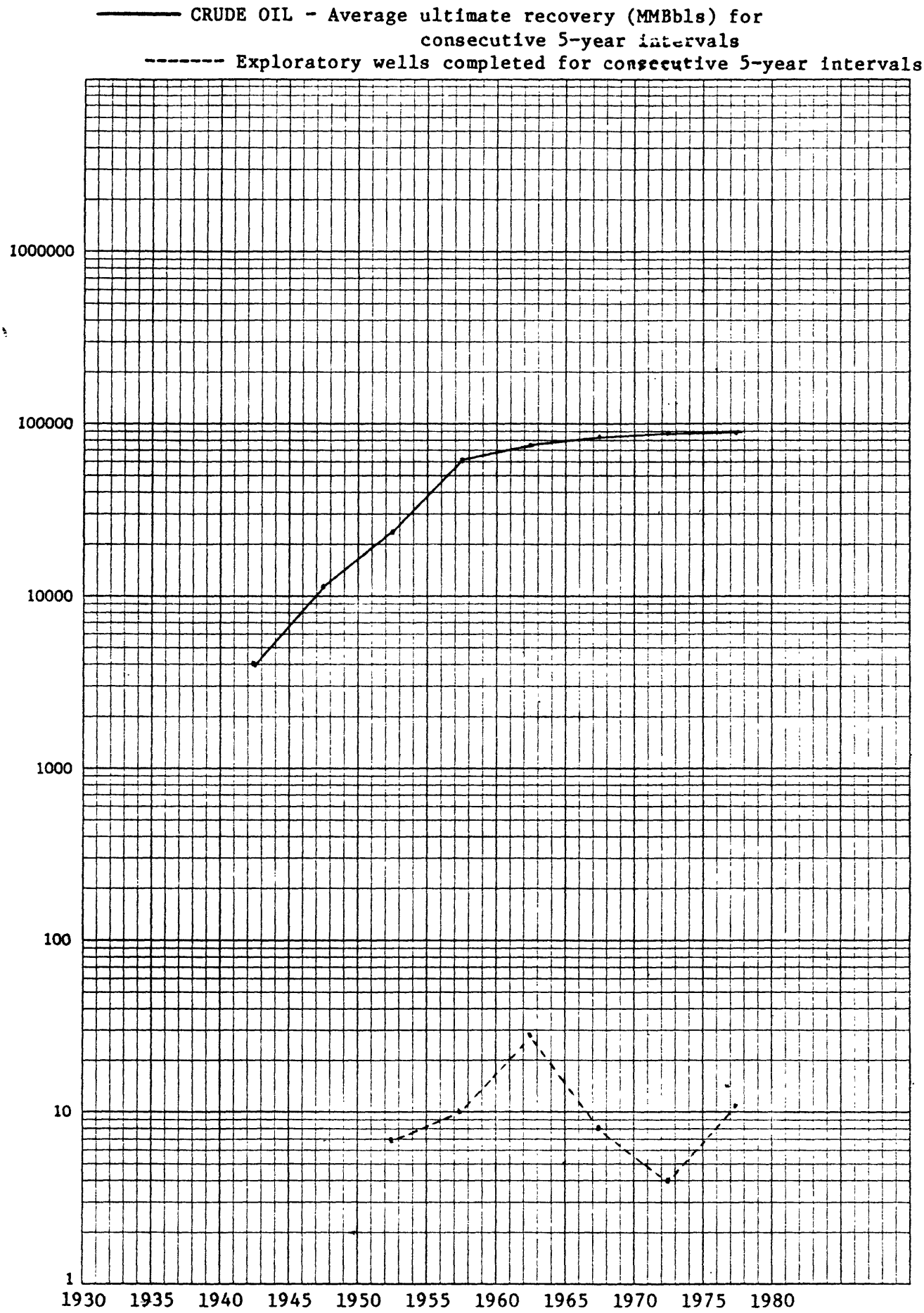
Proved additions to crude oil reserves per exploratory well completed (MBbls) vs cumulative exploratory wells completed



KUWAIT

5 year period	Number of exploratory wells completed	Change in reserves (MMBbls)	Avg ultimate recovery (MMBbls)	Proved additions to reserves (MMBbls)	Proved additions to reserves by well (MMBbls)
1936-1940					
1941-1945		4,000	4,000	4,000	
1946-1950		11,000	11,198	11,285	
1951-1955	7	12,500	23,015	14,038	2,005.0
1956-1960	10	32,500	60,191	34,915	3,492.5
1961-1965	27	10,000	73,675	13,541	501.5
1966-1970	8	5,500	81,838	9,992	1,249.0
1971-1975	4	-5,281	86,112	-606	-151.5
1976-1980	11	-2,196	89,774	1,159	105.4

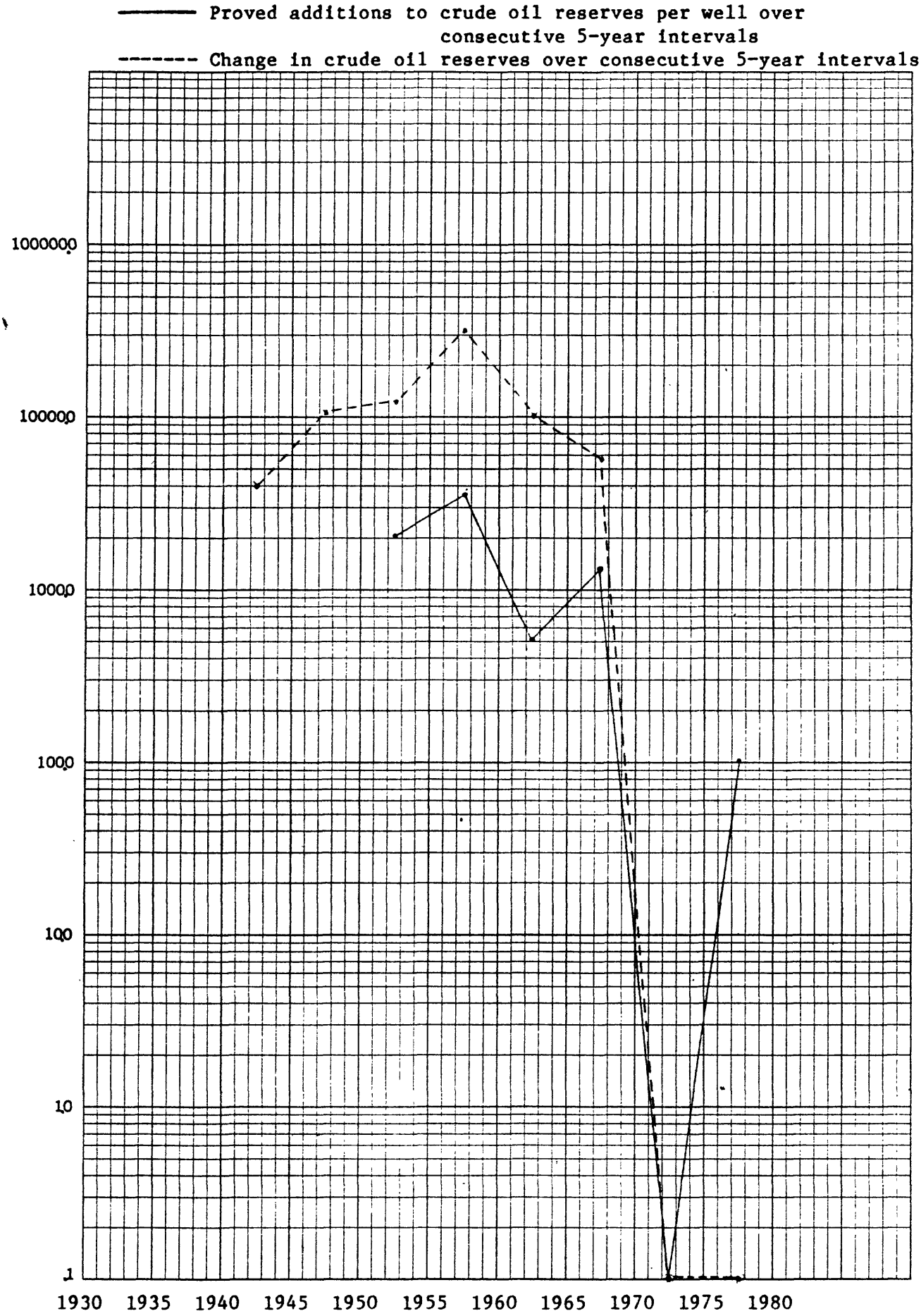
KUWAIT



46 6463

K+E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS KEUFFEL & ESSER CO. MADE IN U.S.A.

KUWAIT



46 6463

K+E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS KEUFFEL & ESSER CO. MADE IN U.S.A.

OMAN

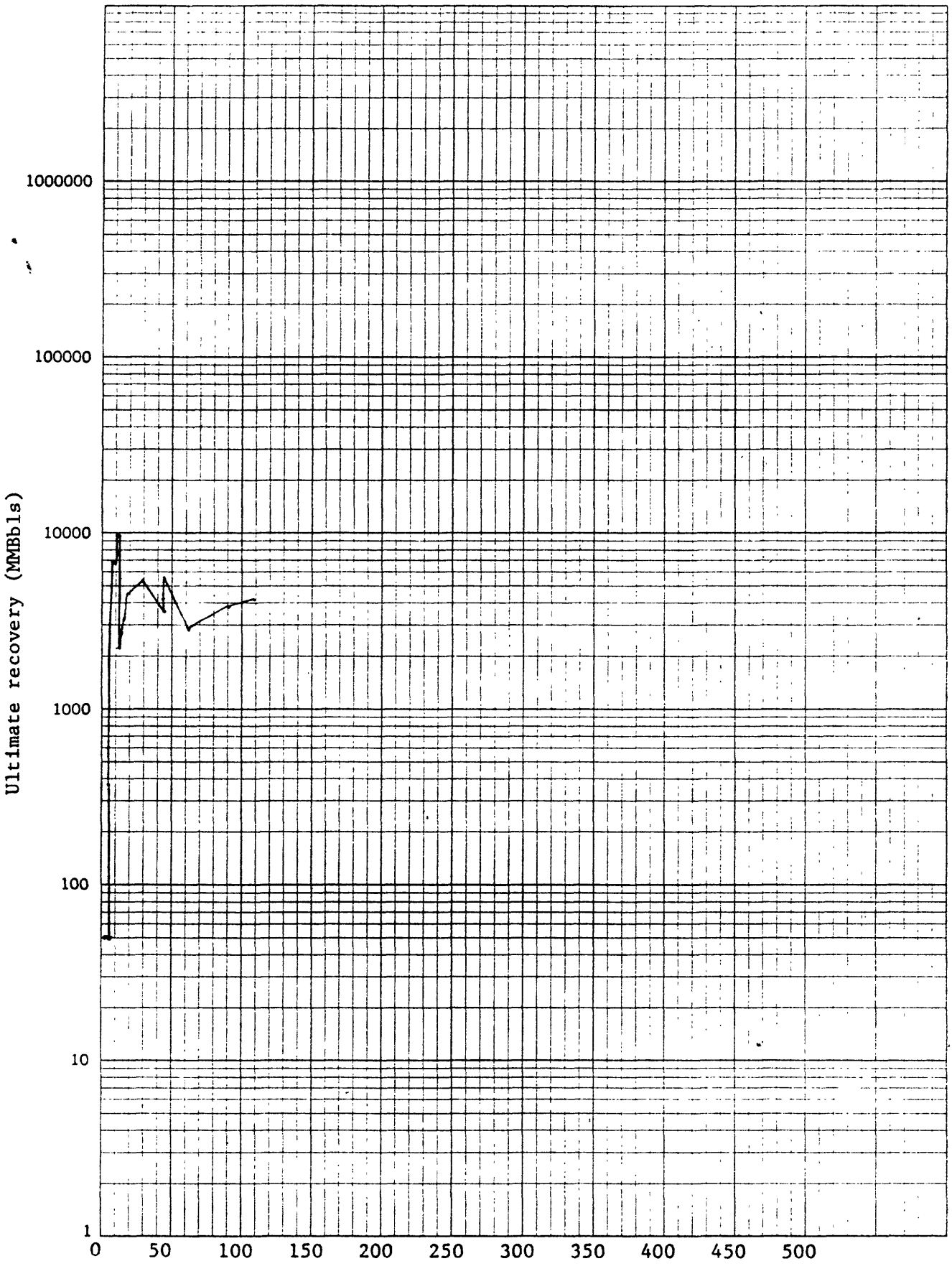
Year (y)	Exploratory wells completed (W_y) (AAPG)	Cumulative exploratory wells completed (CW_y)	Reserves - MMBbls (R_y) (D/M)	Crude production MBbls (P_y) (D/M, WO)	Ultimate recovery rounded MMBbls ($CP_y + R_{y+1}$)	Cumulative production rounded MMBbls (CP_y)	Change in reserves ($R_{y+1} - R_y$) = ΔR_y MMbls	Proved additions to reserves MBbls ($D_y = \Delta R_y + P_y$)	Proved additions to reserves per well MBbls (D_y/W_y)
1951	0	0							
1952									
1953	0	0							
1954	0	0			50		50,000	50,000	
1955	0	0	*50		50		0	0	
1956	1	1	*50		50		0	0	
1957	1	2	*50						
1958	0	2							
1959	1	3			50		0	0	
1960	2	5	*50		350		300,000	300,000	150,000
1961	0	5	*350		1,500		1,150,000	1,150,000	
1962	3	8	*1,500		6,500		5,000,000	5,000,000	1,667,000
1963	2	10	*6,500		6,500		0	0	
1964	0	10	*6,500		6,500		0	0	
1965	1	11	*6,500		7,500		1,000,000	1,000,000	1,000,000
1966	0	11	*7,500		9,500		2,000,000	2,000,000	
1967	0	11	*9,500	23,030	2,023	23	-7,500,000*	-7,476,970*	
1968		11	2,000	87,854	2,611	111	500,000	587,854	
1969	5	16	2,500	119,710	3,231	231	500,000	619,710	123,942
1970	2	18	3,000	121,210	4,352	352	1,000,000	1,121,210	560,605
1971	10	28	4,000	107,430	5,209	459	750,000	857,430	85,743
1972	16	44	4,750	103,131	3,562	562	-1,723,000	-1,619,869	-101,241
1973			3,027	106,926	3,990	669	294,000	400,926	
1974	0	44	3,321	106,046	4,069	775	-27,276	78,770	
1975	0	44	3,294	124,600	4,194	900	0	124,600	
1976			3,294	133,795	4,194	1,034	-133,429	366	
1977	9	53	3,160	123,626	4,243	1,157	-74,159	49,467	5,496
1978	19	72	3,086	114,975	2,792	1,272	-1,566,136	-1,451,146	-76,375
1979	19	91	1,520	111,290	3,623	1,383	720,000	831,290	43,752
1980	17	108	2,240	102,838	4,126	1,436	400,000	502,838	29,579
1981			2,640						

*includes Abu Dhabi

*reflects loss of Abu Dhabi

OMAN

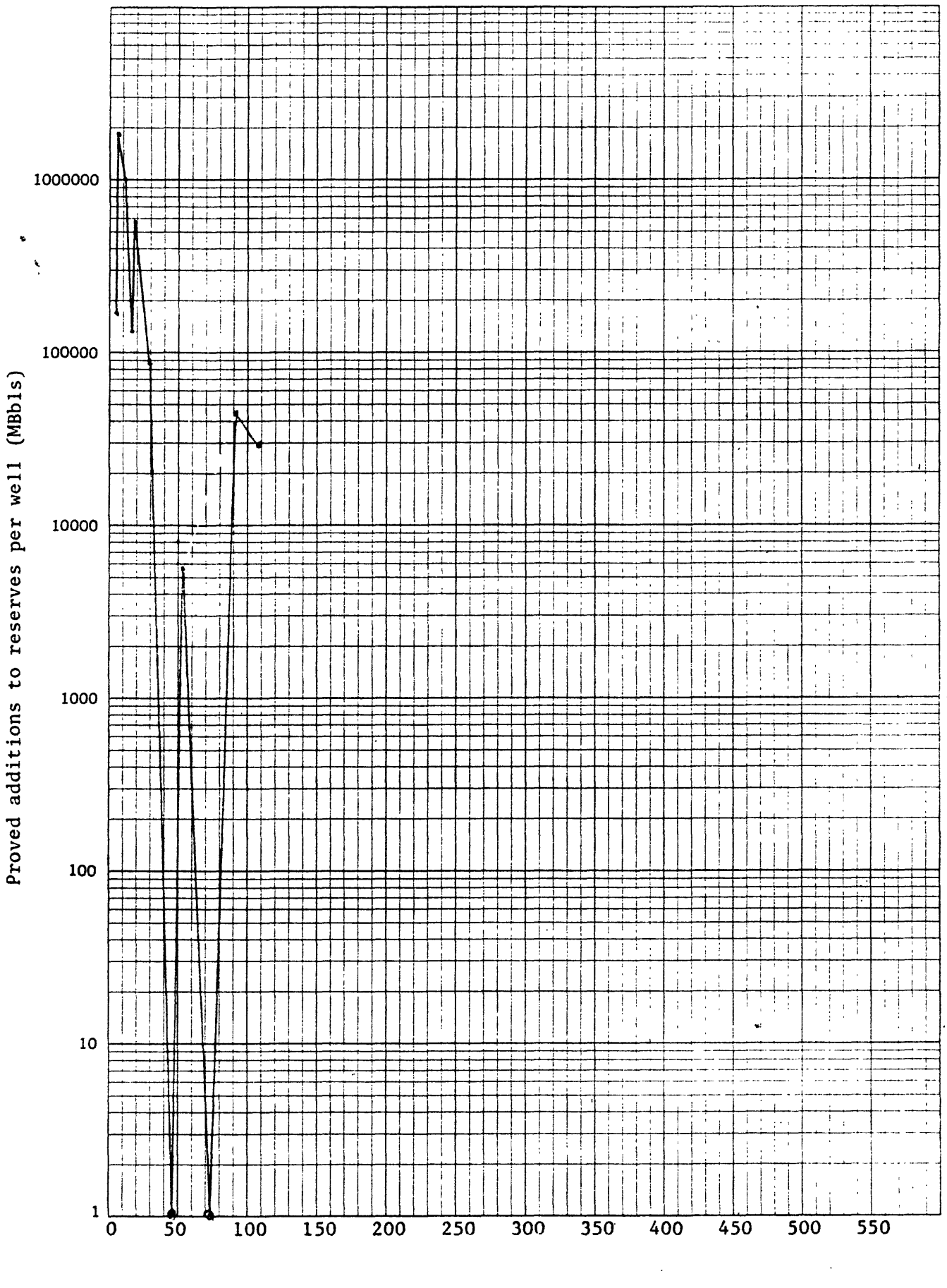
Ultimate crude oil recovery (MMBbls) vs cumulative exploratory wells completed



46 6463

K+E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

Proved additions to crude oil reserves per exploratory well completed (MBbls) vs cumulative exploratory wells completed



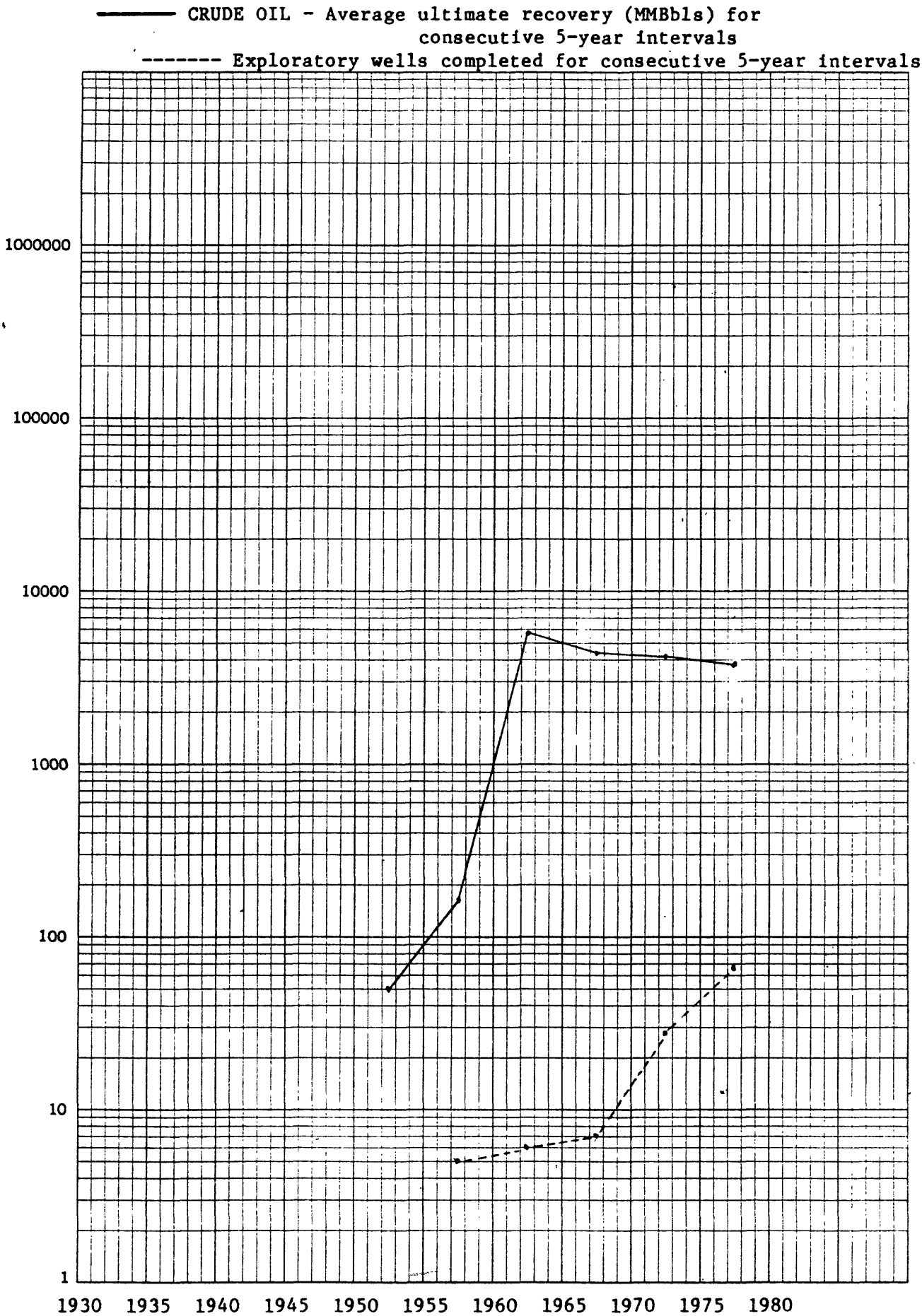
46 6463

K+E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS KEUFFEL & ESSER CO. MADE IN U.S.A.

OMAN

5 year period	Number of exploratory wells completed	Change in reserves (MMBbls)	Avg ultimate recovery (MMBbls)	Proved additions to reserves (MMBbls)	Proved additions to reserves by well (MMBbls)
1936-1940					
1941-1945					
1946-1950					
1951-1955		50	50	50	
1956-1960	5	300	150	300	60.0
1961-1965	6	7,150	5,700	7,150	1,191.7
1966-1970	7	-3,500	4,343	-3,148	-449.7
1971-1975	26	-706	4,205	-158	-6.1
1976-1980	64	-653	3,796	-68	-1.1

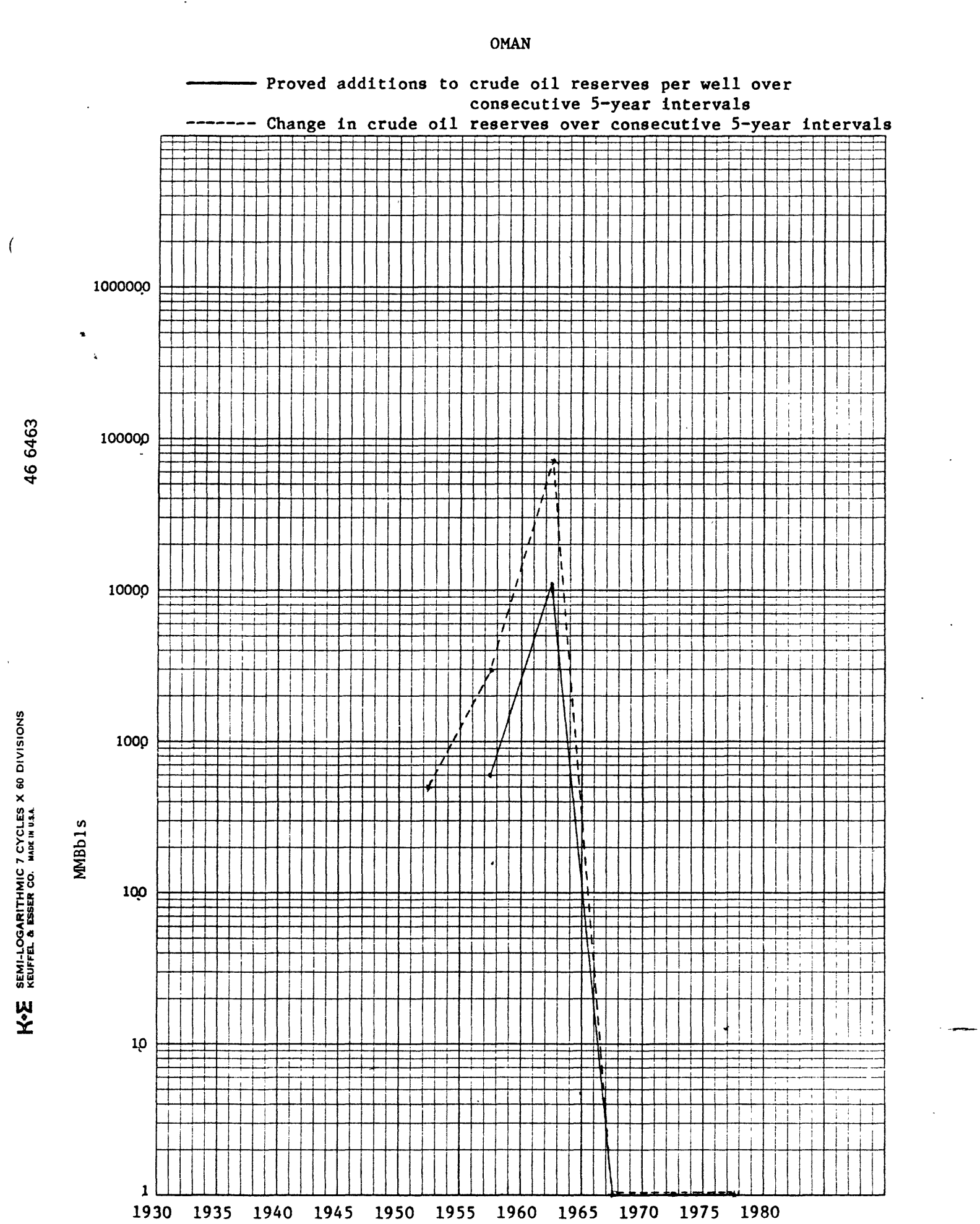
OMAN



46 6463

K+E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS KEUFFEL & ESSER CO. MADE IN U.S.A.

OMAN



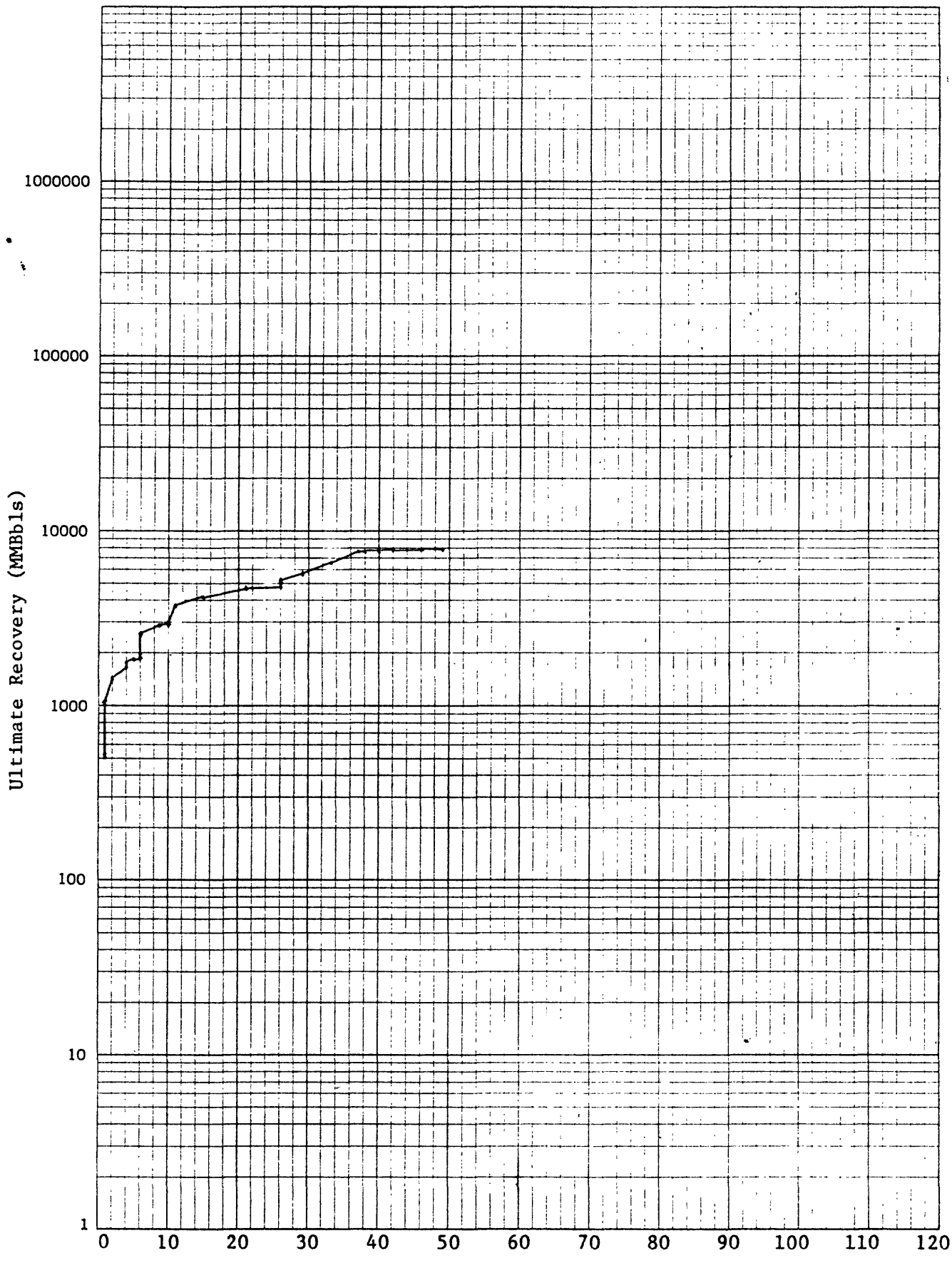
46 6463

K+E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS KEUFFEL & ESSER CO. MADE IN U.S.A.

Year (y)	Exploratory wells completed (W_y) (AAPG)	Cumulative exploratory wells completed (CW_y)	Reserves - MMBbls (R_y) (D/M)	Crude production MBbls (P_y) (D/M, WO)	Ultimate recovery rounded MMBbls ($CP_y + R_{y+1}$)	Cumulative production rounded MMBbls (CP_y)	Change in reserves ($R_{y+1} - R_y$) = ΔR_y MBbls	Proved additions to reserves MBbls ($D_y = \Delta R_y + P_y$)	Proved additions to reserves per well MBbls (D_y/W_y)
1943					500		500,000	500,000	
1944			500						
1945					500		0	0	
1946			500						
1947	0	0			1,000		500,000	500,000	
1948	0	0	1,000		500		-500,000	-500,000	
1949	1	1	500	750	501	1	0	750	750
1950	0	1	500	12,268	1,013	13	500,000	512,268	
1951	0	1	1,000	18,009	1,031	31	0	18,009	
1952	1	2	1,000	25,255	1,306	56	250,000	275,255	275,225
1953	2	4	1,250	31,025	1,587	87	250,000	281,025	140,512
1954	0	4	1,500	36,450	1,624	124	0	36,450	
1955	1	5	1,500	41,983	1,666	166	0	41,983	41,993
1956	1	6	1,500	45,300	1,711	211	0	45,300	45,300
1957	0	6	1,500	50,798	1,912	262	150,000	200,798	
1958	0	6	1,650	63,412		325		63,412	
1959	0	6		61,431	2,387	387	350,000	411,431	
1960	3	9	2,000	63,088	2,750	450	300,000	363,088	121,026
1961		10	2,300	64,386	2,814	514	0	64,386	
1962	1	11	2,300	67,911	3,582	582	700,000	767,911	767,911
1963	4	15	3,000	70,123	4,152	652	500,000	570,123	142,530
1964	6	21	3,500	77,885	4,480	730	250,000	327,885	54,648
1965	0	21	3,750	84,215	4,614	814	50,000	134,215	
1966	0	21	3,800	105,945	4,620	920	-100,000	5,945	
1967	5	26	3,700	118,428	4,639	1,039	-100,000	18,428	3,685
1968	0	26	3,600	124,266	5,043	1,163	280,000	404,266	
1969	0	26	3,880	129,746	5,193	1,293	20,000	149,746	
1970	3	29	3,900	132,456	5,525	1,425	200,000	332,456	110,818
1971	4	33	4,100	156,882	6,382	1,582	700,000	856,882	214,220
1972	4	37	4,800	176,545	7,591	1,759	1,032,000	1,208,545	302,136
1973	1	38	5,832	208,152	7,591	1,967	-208,000	152	152
1974	0	38	5,624	189,348	7,555	2,156	-185,000	4,348	
1975	0	38	5,439	159,482	7,594	2,316	-160,000	-518	
1976	2	40	5,278	181,644	6,598	2,497	-1,177,000	-995,356	-497,678
1977		40	4,101	162,316	6,601	2,659	-159,000	-3,316	
1978	2	42	3,942	176,537	6,684	2,836	-94,000	82,537	41,268
1979	4	46	3,848	184,730	6,905	3,021	36,000	220,730	55,182
1980	3	49	3,884	173,014	6,781	3,194	-297,000	-123,986	-41,328
1981			3,587						

QATAR

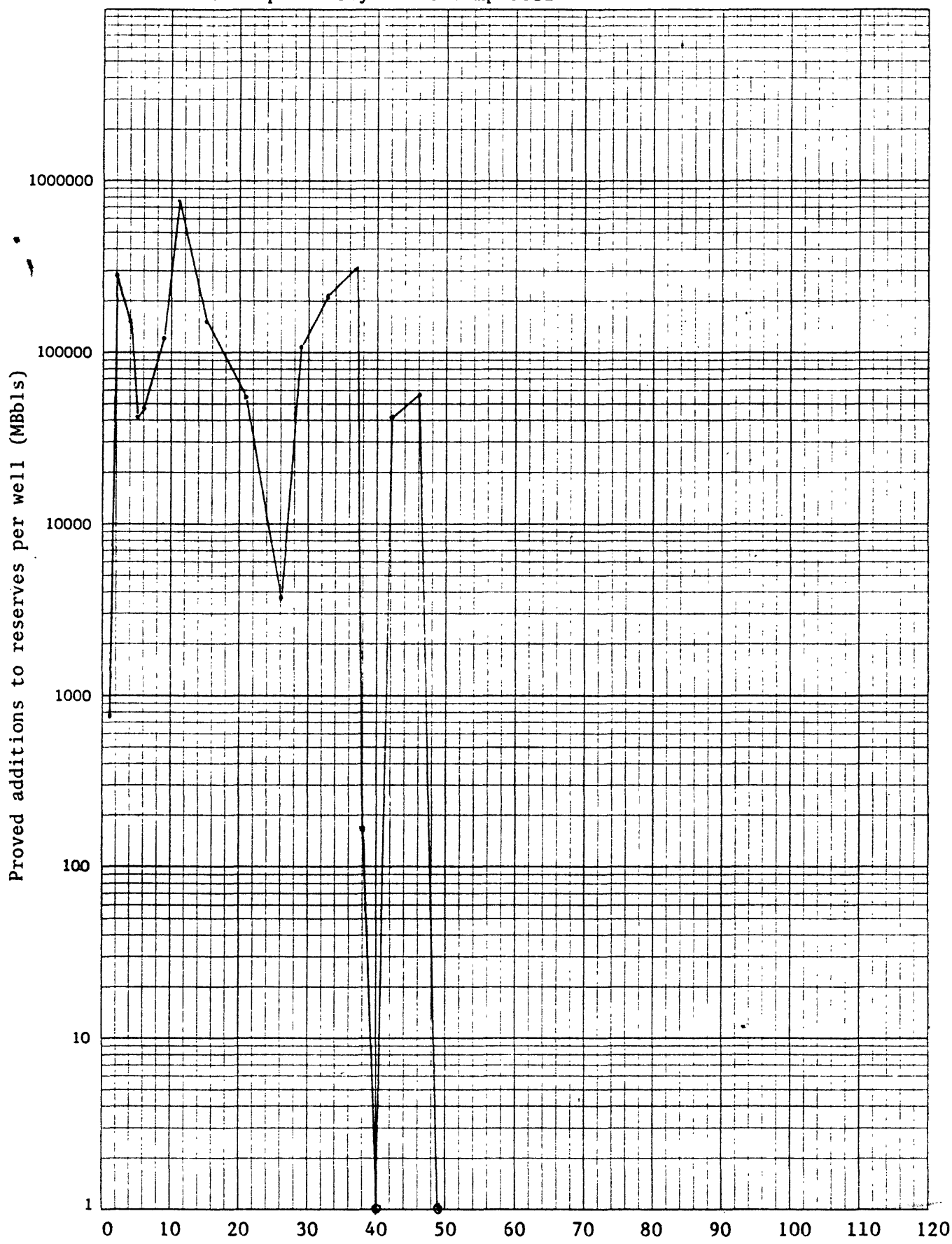
Ultimate crude oil recovery (MMBbls) vs cumulative exploratory wells completed



46 6463

K+E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

Proved additions to crude oil reserves per exploratory well completed (MBbls)
vs cumulative exploratory wells completed



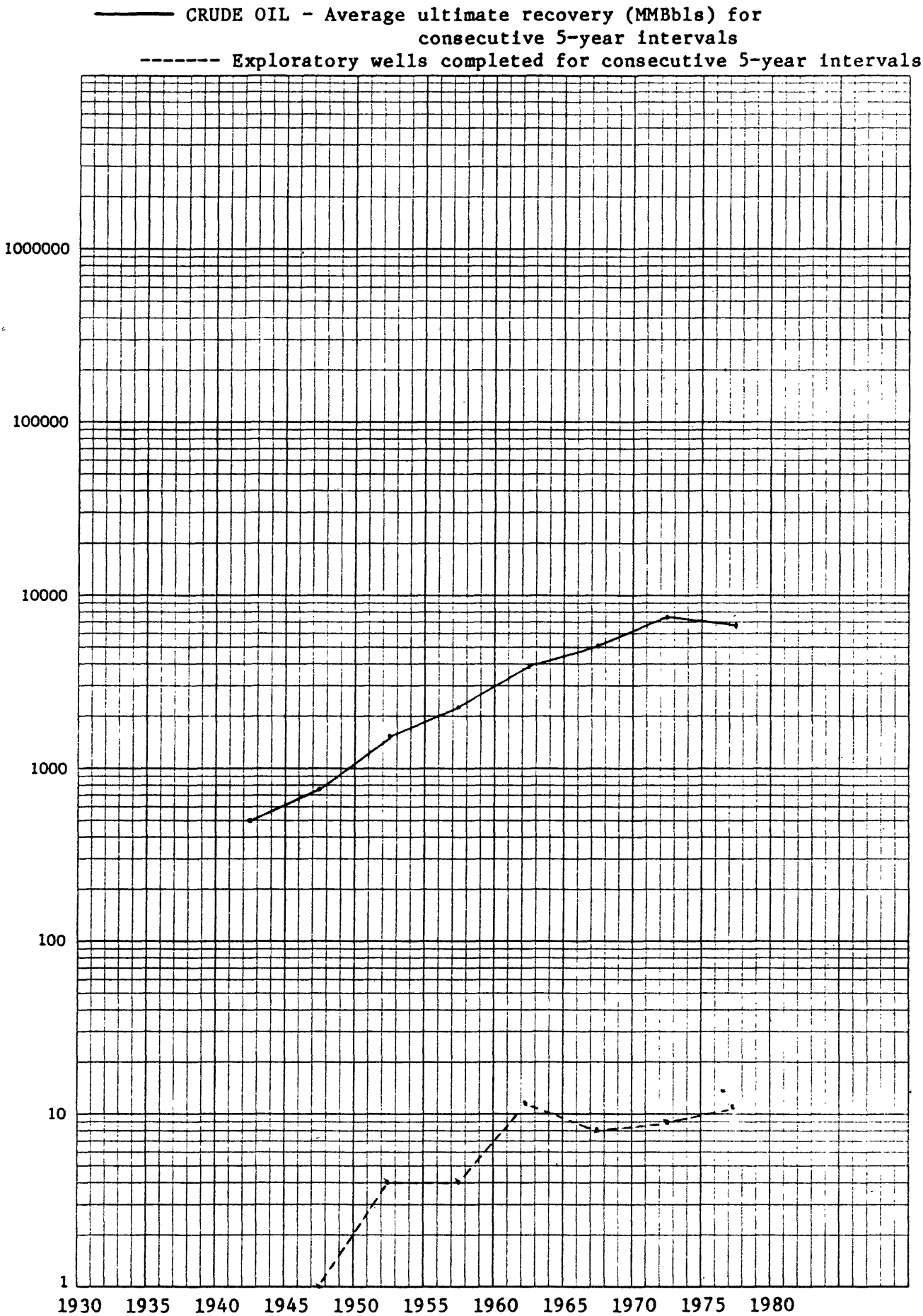
46 6463

K•E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

QATAR

5 year period	Number of exploratory wells completed	Change in reserves (MMBbls)	Avg ultimate recovery (MMBbls)	Proved additions to reserves (MMBbls)	Proved additions to reserves by well (MMBbls)
1936-1940					
1941-1945		- 500	500	500	
1946-1950	1	500	754	513	513.0
1951-1955	4	500	1,443	652	163.0
1956-1960	4	800	2,190	1,083	270.8
1961-1965	12	1,500	3,928	1,864	155.3
1966-1970	8	300	5,004	910	113.8
1971-1975	9	1,179	7,351	2,069	229.8
1976-1980	11	-1,691	6,714	-818	-74.4

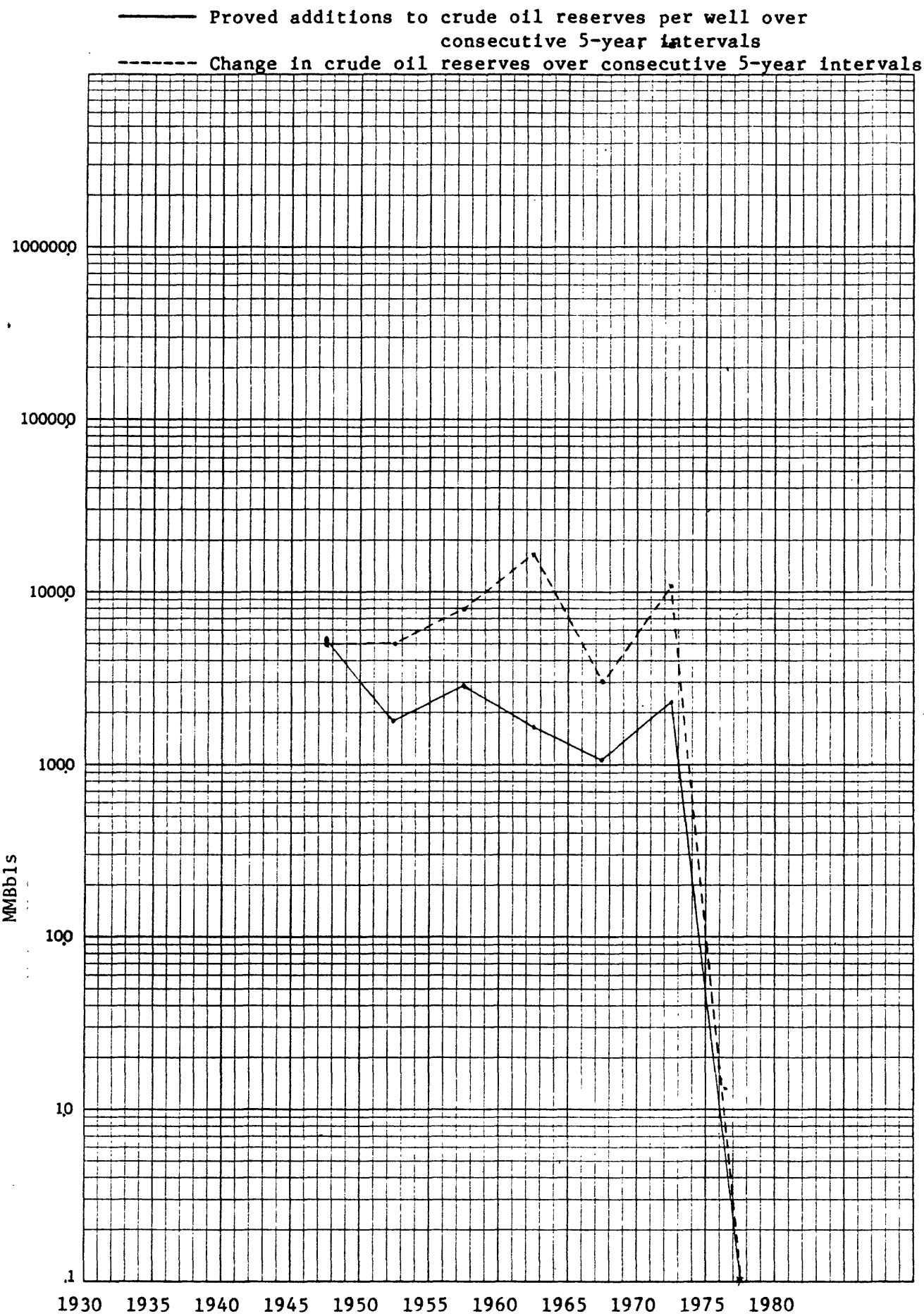
QATAR



46 6463

SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

QATAR



46 6463

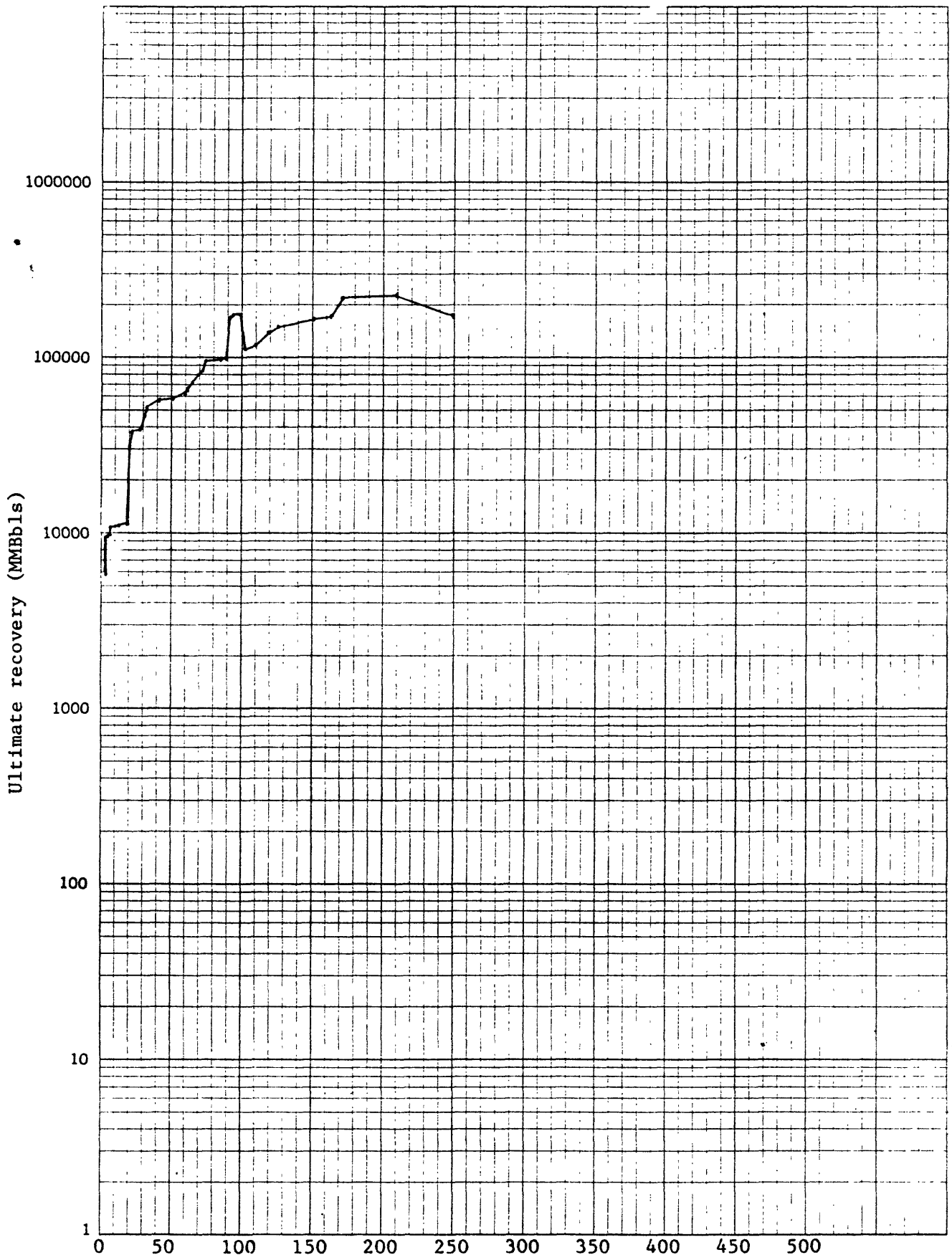
SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

Year (y)	Exploratory wells completed (W_y) (AAPG)	Cumulative exploratory wells completed (CW_y)	Reserves - MMBbls (R_y) (D/M)	Crude production MBbls (P_y) (D/M, WO)	Ultimate recovery rounded MMBbls ($CP_y + R_{y+1}$)	Cumulative production rounded MMBbls (CP_y)	Change in reserves ($R_{y+1} - R_y = \Delta R_y$) MBbls	Proved additions to reserves MBbls ($D_y = \Delta R_y + P_y$)	Proved additions to reserves per well MBbls (D_y/W
1936				20					
1937				65					
1938				495	1	1			
1939				3,934	5	5			
1940				5,075	10	10			
1941				4,310	14	14			
1942				4,530	18	18			
1943				4,868	23	23			
1944				7,794	2,031	31	2,000,000	2,007,794	
1945			*2,000	21,311	3,302	52	1,250,000	1,271,311	
1946			*3,250	59,944		112			
1947	3	3		89,852	5,802	202	2,350,000	2,439,852	813,284
1948	1	4	5,600	142,853	9,345	345	3,400,000	3,542,853	3,542,853
1949	2	6	9,000	174,008	9,519	519	0	174,008	87,004
1950	0	6	9,000	199,547	10,719	719	1,000,000	1,199,547	
1951	7	13	10,000	277,963	11,997	997	1,000,000	1,277,963	182,566
1952	6	19	11,000	301,861	19,299	1,299	7,000,000	7,301,861	1,216,976
1953	1	20	18,000	308,294	31,607	1,607	12,000,000	12,308,294	12,308,294
1954	2	22	30,000	347,845	36,955	1,955	5,000,000	5,347,845	2,673,922
1955	6	28	35,000	352,240	38,307	2,307	1,000,000	1,352,240	225,373
1956	3	31	36,000	360,923	44,668	2,668	6,000,000	6,360,923	2,120,307
1957	1	32	42,000	362,121	48,030	3,030	3,000,000	3,362,121	3,362,121
1958		32	45,000	370,486		3,400		370,486	
1959		32		399,821	51,800	3,800	3,000,000	3,399,821	
1960	10	42	48,000	456,453	55,257	4,257	3,000,000	3,456,453	345,645
1961	10	52	51,000	508,269	57,765	4,765	2,000,000	2,508,269	250,827
1962	8	60	53,000	555,056	62,320	5,320	4,000,000	4,555,056	569,082
1963	2	62	57,000	594,592	63,761	5,950	811,000	1,405,592	702,796
1964	3	65	57,811	628,095	71,339	12,227	1,361,000	1,989,095	663,032
1965	7	72	59,172	739,078	83,325	19,618	4,535,000	5,274,078	753,440
1966	3	75	63,707	873,349	95,235	20,491	11,037,000	11,910,349	3,970,116
1967	8	83	74,744	948,110	98,441	21,439	2,258,000	3,206,110	400,764
1968	6	89	77,002	1,035,773	99,975	22,475	498,000	1,533,773	255,629
1969	3	92	77,500	1,092,322	160,636	23,567	59,569,000	60,661,322	20,220,441
1970	2	94	137,069	1,295,335	163,529	24,862	1,598,000	2,893,335	1,446,668
1971	4	98	138,667	1,641,615	163,544	26,504	-1,627,000	14,615	3,654
1972	5	103	137,040	2,098,422	121,602	28,610	-44,048,000	-41,949,578	-8,389,916
1973	7	110	92,992	2,677,146	128,202	31,280	3,930,000	6,607,146	943,878
1974	9	119	96,922	2,996,543	137,756	34,276	6,558,000	9,554,543	1,061,616
1975	17	136	103,480	2,491,834	144,625	36,768	4,337,000	6,868,834	404,049
1976	16	152	107,857	3,053,887	150,009	39,822	2,330,000	5,383,887	336,493
1977	12	164	110,187	3,290,000	153,512	43,112	213,000	3,503,000	291,917
1978	8	172	110,400	3,113,470	213,206	46,140	56,666,000	59,779,470	7,472,434
1979	37	209	167,066	3,465,976	218,536	49,606	1,864,000	5,329,976	144,053
1980	40	249	168,930	3,525,080	166,622	53,131	-55,439,000	-51,913,920	-1,297,840
1981			113,491						

*Includes Bahrain

SAUDI ARABIA

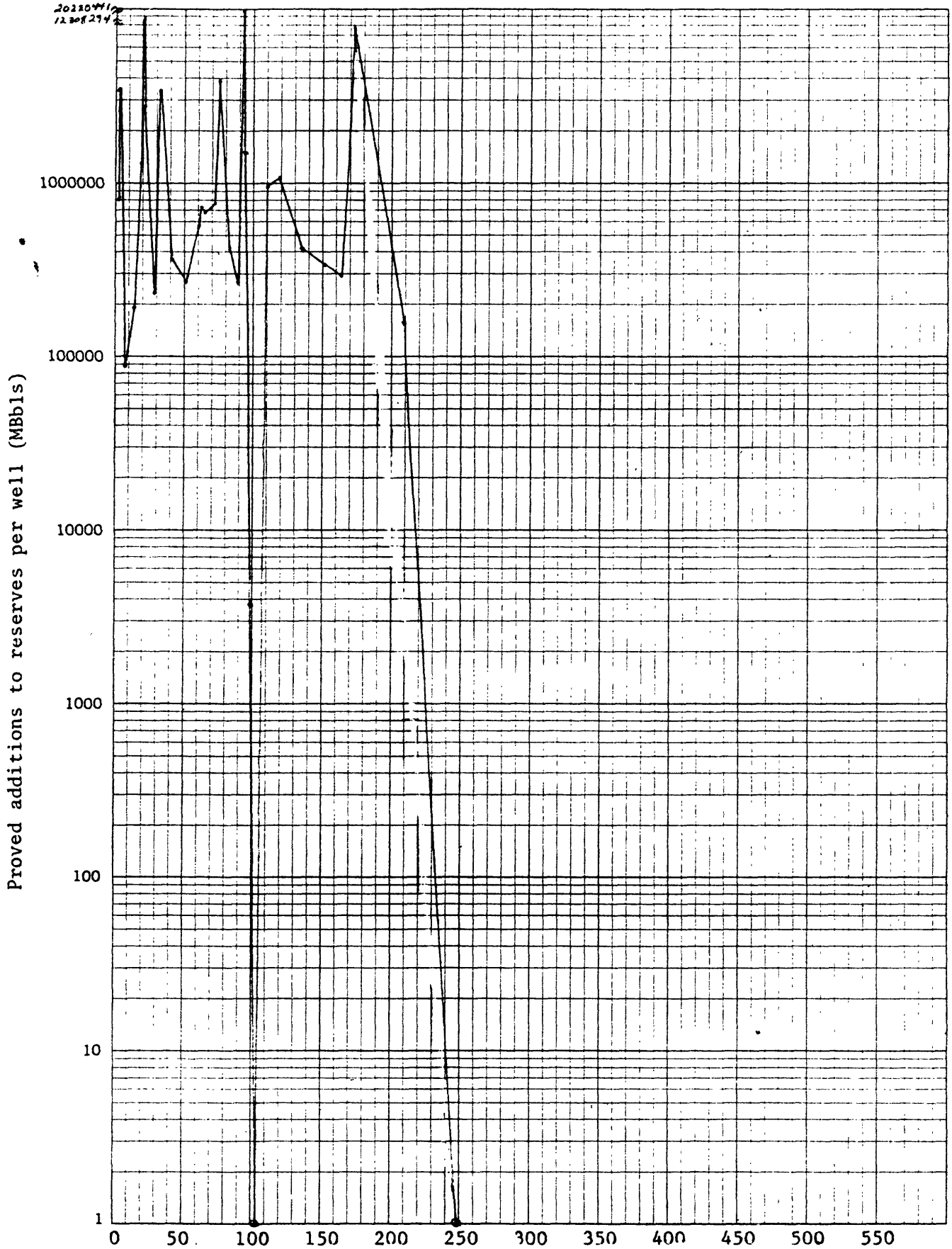
Ultimate crude oil recovery (MMBbls) vs cumulative exploratory wells completed



46 6463

SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

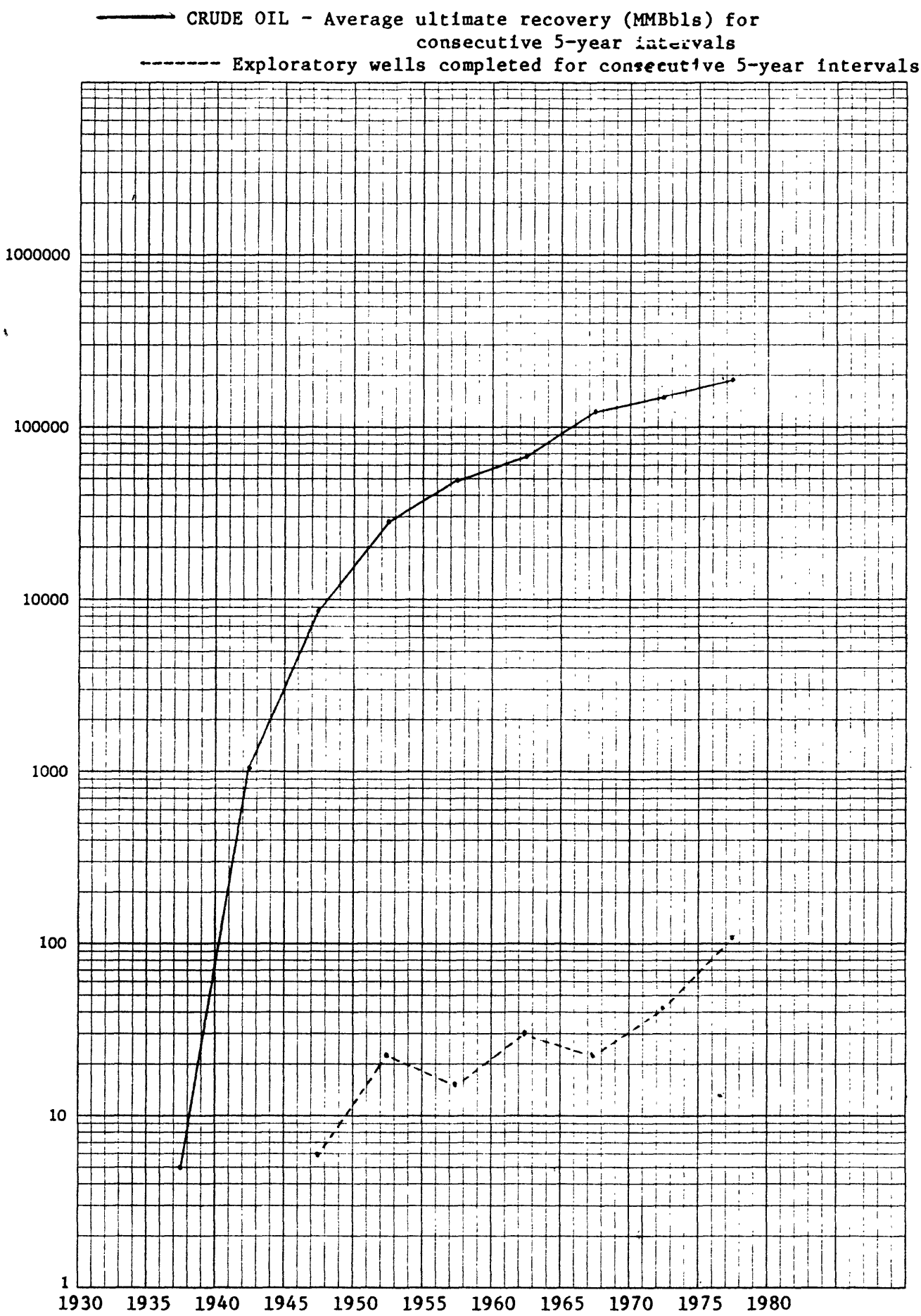
Proved additions to crude oil reserves per exploratory well completed (MBbls) vs cumulative exploratory wells completed



SAUDI ARABIA

5 year period	Number of exploratory wells completed	Change in reserves (MMBbls)	Avg ultimate recovery (MMBbls)	Proved additions to reserves (MMBbls)	Proved additions to reserves by well (MMBbls)
1936-1940			5		
1941-1945		3,250	1,078	3,278	
1946-1950	6	6,750	8,846	7,357	1,226.2
1951-1955	22	26,000	27,633	27,588	1,254.0
1956-1960	14	15,000	49,938	16,949	1,210.6
1961-1965	30	12,707	67,702	15,732	524.4
1966-1970	22	74,960	123,563	80,204	3,645.6
1971-1975	42	-30,810	139,146	-18,904	-450.1
1976-1980	113	5,634	180,377	22,082	195.4

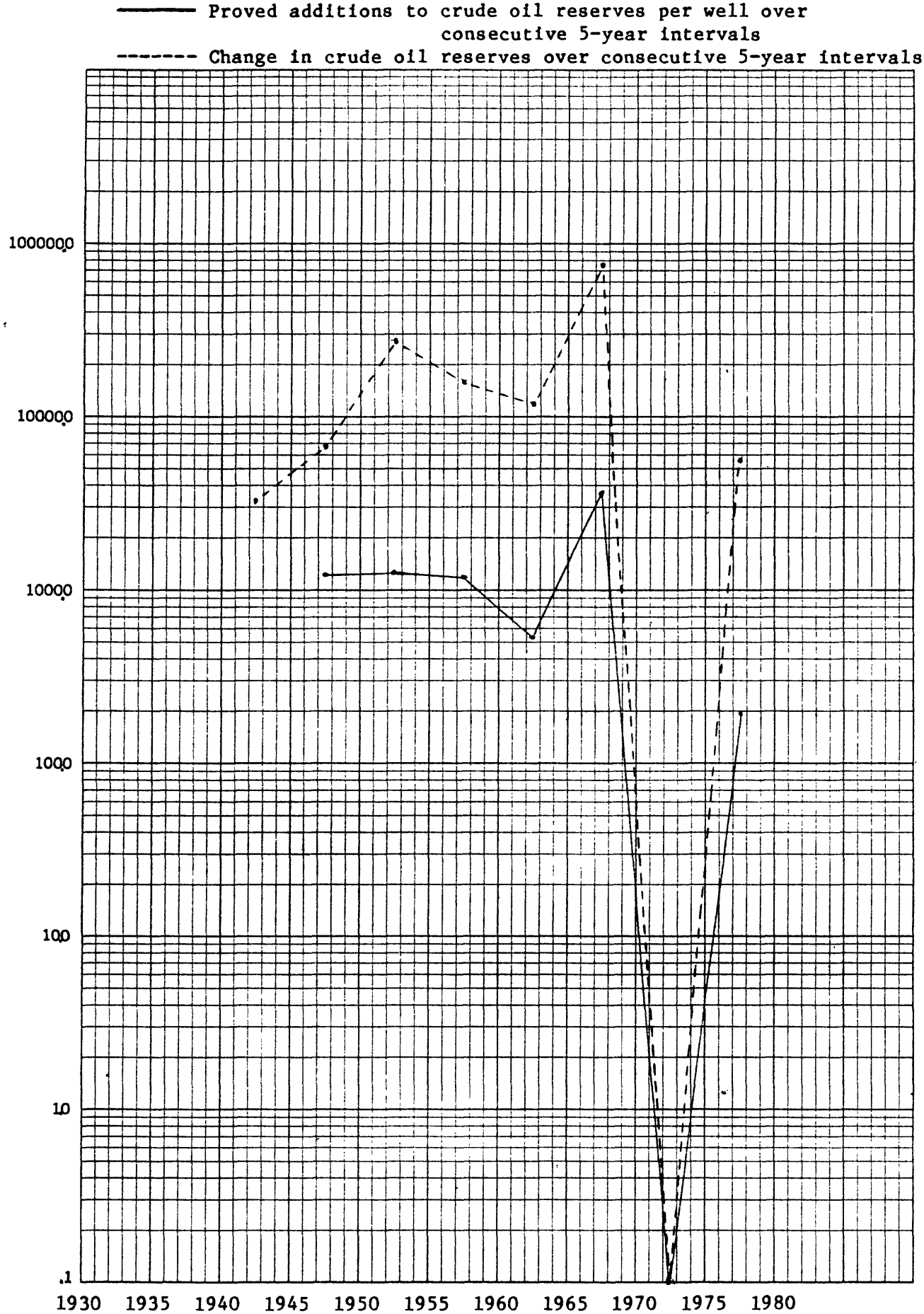
SAUDI ARABIA



46 6463

K&E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

SAUDI ARABIA



46 6463

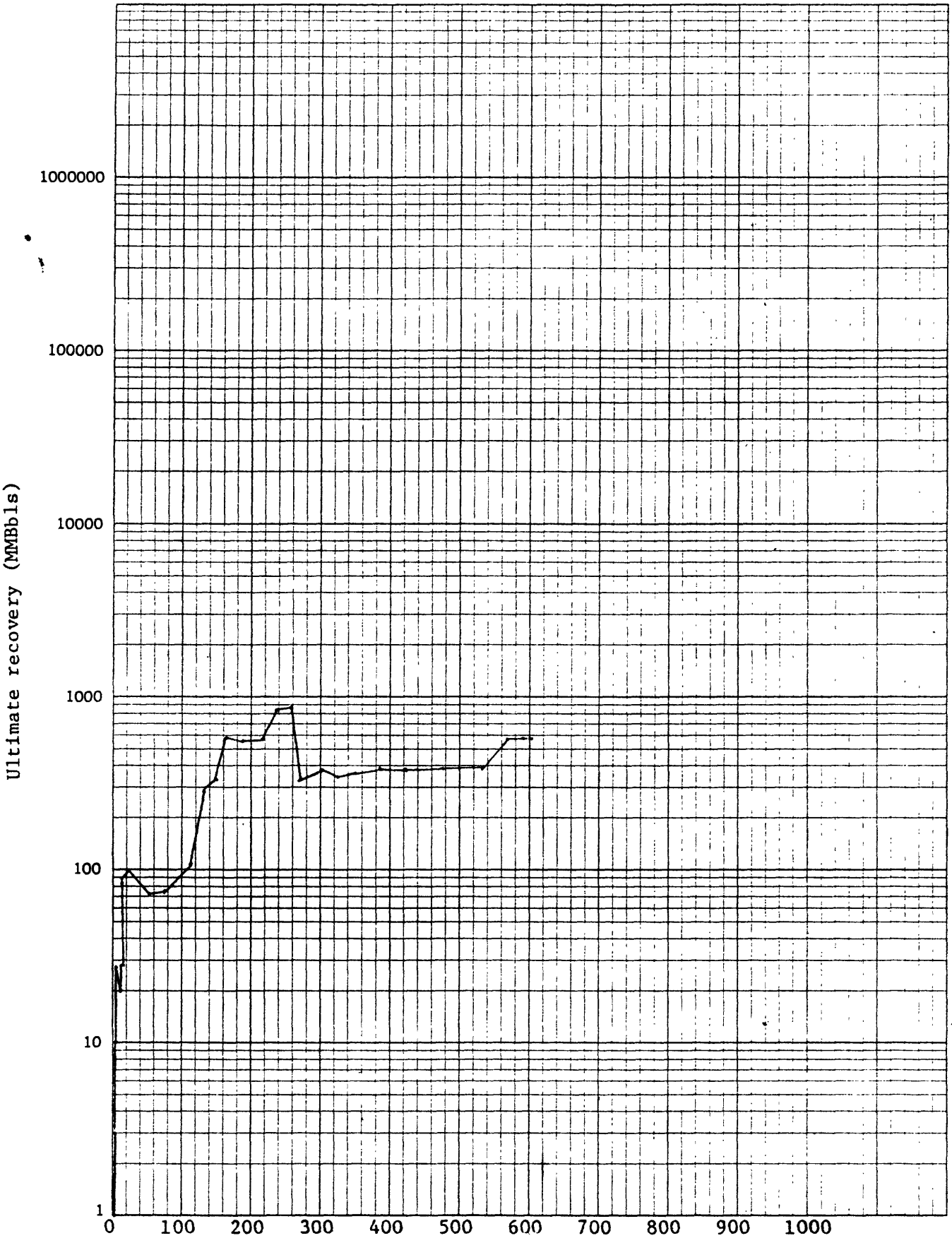
K+E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS KEUFFEL & ESSER CO. MADE IN U.S.A.

TURKEY

Year (y)	Exploratory wells completed (W_y) (AAPG)	Cumulative exploratory wells completed (CW_y)	Reserves - MMBbls (R_y) (D/M)	Crude production MMbls (P_y) (D/M, WO)	Ultimate recovery rounded MMBbls ($CP_y + R_{y+1}$)	Cumulative production rounded MMBbls (CP_y)	Change in reserves ($R_{y+1} - R_y$) = ΔR_y MBbls	Proved additions to reserves MBbls ($D_y = \Delta R_y + P_y$)	Proved additions to reserves per well MBbls (D_y/W_y)
1946	0	0							
1947	0	0							
1948	1	1		13	1		1,000	1,013	1,013
1949	2	3	1	95	3		2,000	2,095	1,048
1950	1	4	3	108	10		7,000	7,108	7,108
1951	4	8	10	133	25		15,000	15,133	3,783
1952	4	12	25	146	20		-5,000	-4,854	-1,213
1953	2	14	20	179	26	1	5,000	5,179	2,589
1954	1	15	25	399	26	1	0	399	399
1955	0	15	25	1,205	82	2	55,000	56,205	
1956	0	15	80	2,213	89	4	5,000	7,213	
1957	7	22	85	2,159	97	7	5,000	7,159	1,022
1958	11	33	90	2,379		9		2,379	216
1959	21	54		2,700	72	12	-30,000	-27,300	-1,300
1960	21	75	60	2,624	74	14	0	2,624	125
1961	39	114	60	3,075	117	17	40,000	43,075	1,104
1962	19	133	100	4,157	272	22	150,000	154,157	8,114
1963	16	149	250	5,201	327	27	50,000	52,201	3,263
1964	14	163	300	6,397	583	33	250,000	256,397	18,314
1965	23	186	550	10,827	544	44	-50,000	-39,173	-1,703
1966	31	217	500	13,277	557	57	0	13,277	428
1967	21	238	500	19,526	827	77	250,000	269,526	12,835
1968	21	259	750	22,235	849	99	0	22,235	1,059
1969	11	270	750	25,774	325	125	-550,000	-524,226	-47,657
1970	34	304	200	24,766	350	150	0	24,766	728
1971	21	325	200	25,031	356	175	-19,000	6,031	287
1972	25	350	181	24,416	341	199	-39,000	-14,584	-583
1973	35	385	142	24,273	366	223	1,000	25,273	722
1974	37	422	143	24,555	367	248	-24,000	555	15
1975	56	478	119	22,167	369	270	-20,000	2,167	38
1976	53	531	99	18,585	373	289	-15,000	3,585	68
1977	33	564	84	19,428	552	308	160,000	179,428	5,437
1978	26	590	244	19,595	552	328	-20,000	-405	-16
1979	12	602	224	20,478	555	348	-17,000	3,478	290
1980	27	629	207	16,397	640	365	68,000	84,397	3,126
1981			275						

TURKEY

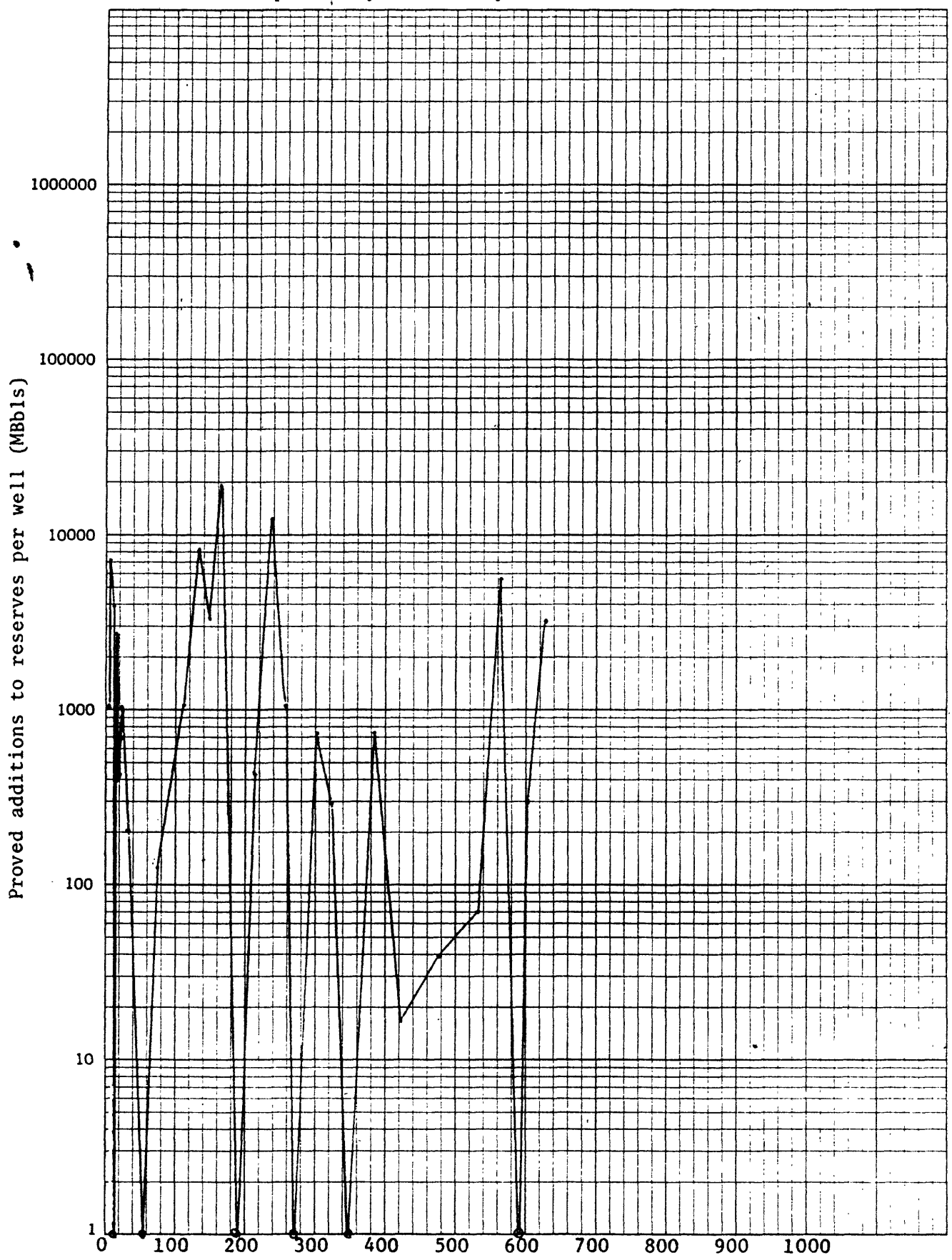
Ultimate crude oil recovery (MMBbls) vs cumulative exploratory wells completed



46 6463

K+E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS KEUFFEL & ESSER CO. MADE IN U.S.A.

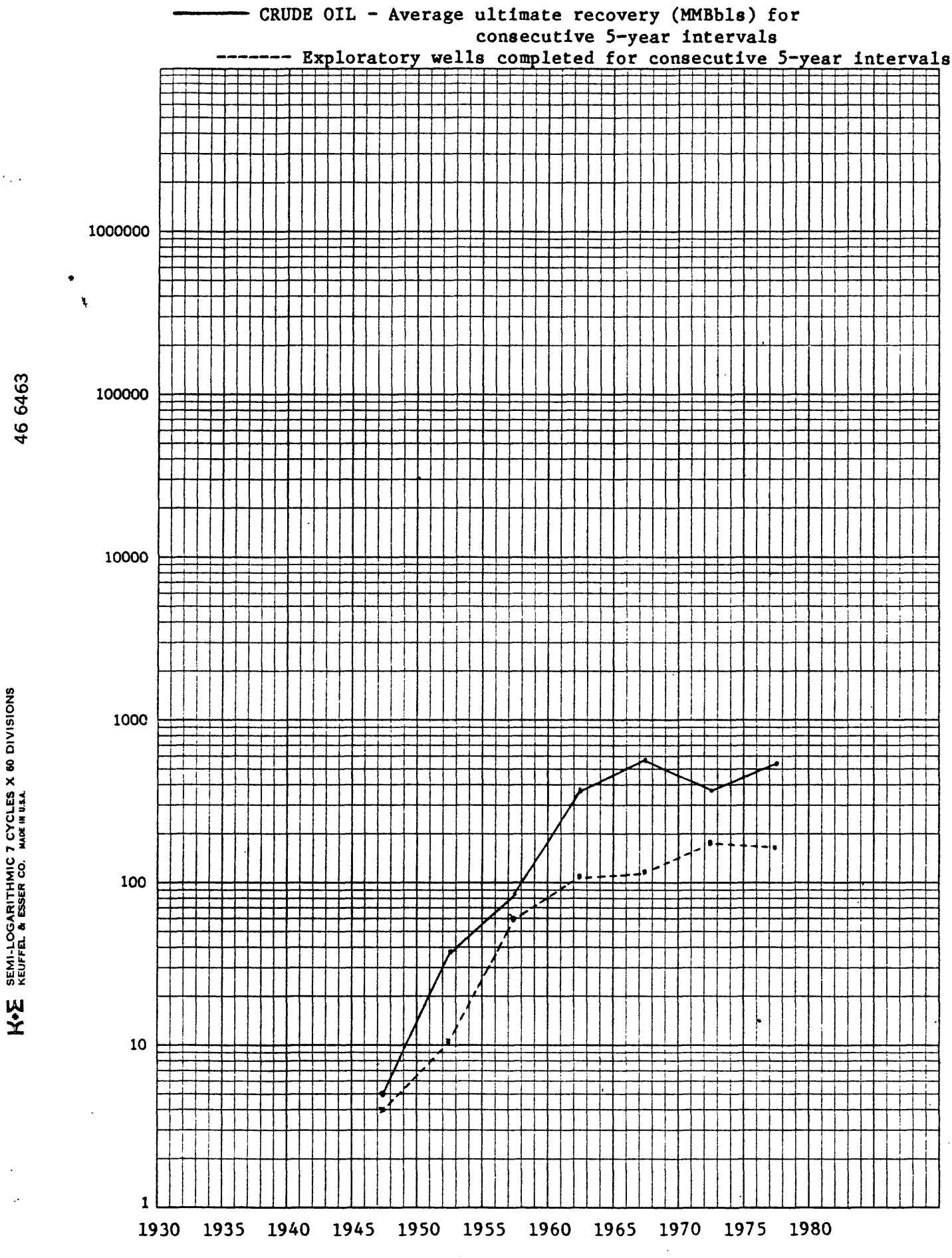
Proved additions to crude oil reserves per exploratory well completed (MBbls)
vs cumulative exploratory wells completed



TURKEY

5 year period	Number of exploratory wells completed	Change in reserves (MMBbls)	Avg ultimate recovery (MMBbls)	Proved additions to reserves (MMBbls)	Proved additions to reserves by well (MMBbls)
1936-1940					
1941-1945					
1946-1950	4	10	5	10	2.5
1951-1955	11	70	36	71	6.5
1956-1960	60	-20	83	-8	-.1
1961-1965	111	440	369	466	4.2
1966-1970	118	-300	582	-194	-1.6
1971-1975	174	-101	360	19	.1
1976-1980	151	176	534	270	1.8

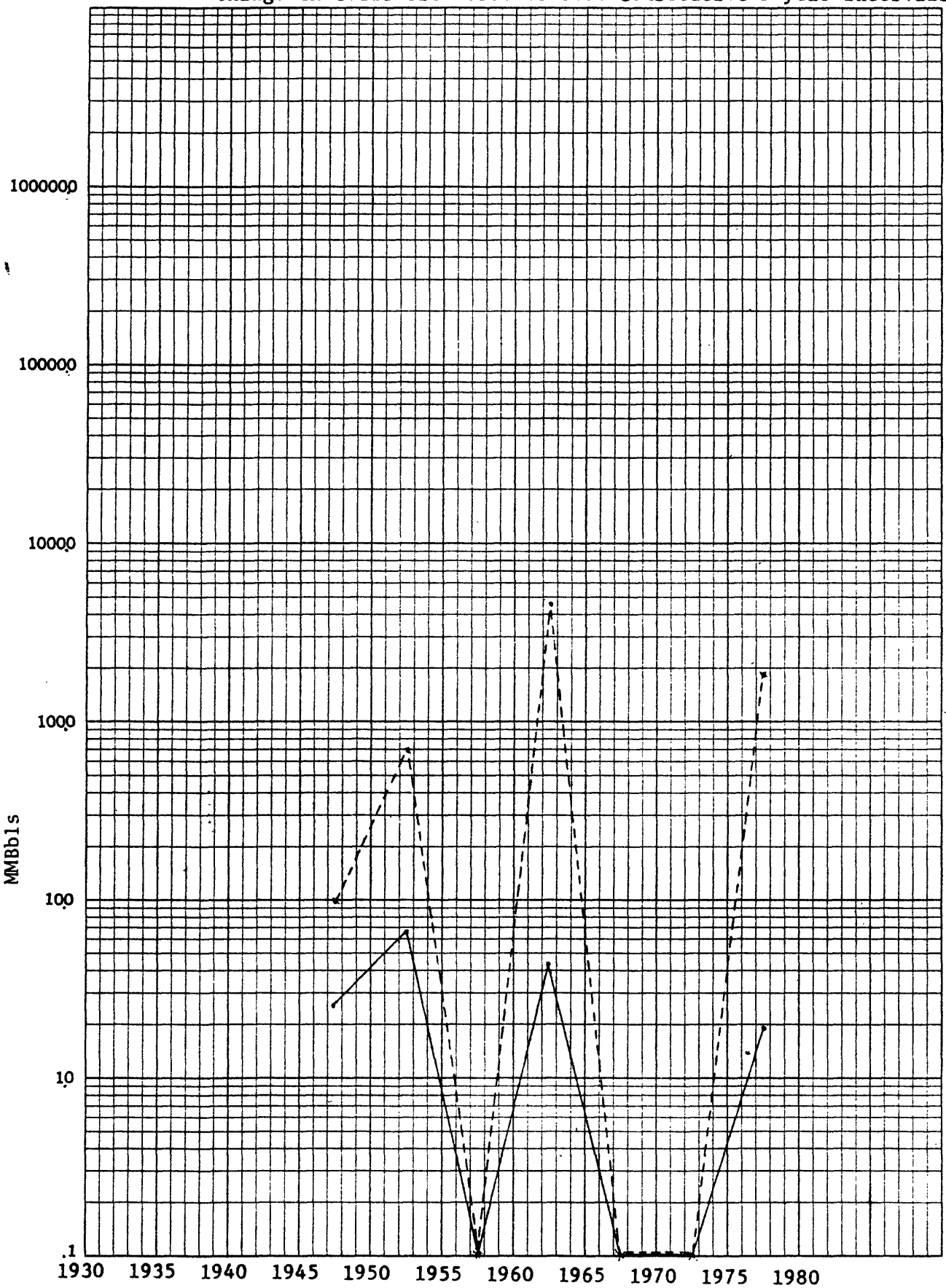
TURKEY


CRUDE OIL - Average ultimate recovery (MMBbls) for consecutive 5-year intervals
Exploratory wells completed for consecutive 5-year intervals
1000000
100000
10000
1000
100
10
1
1930
1935
1940
1945
1950
1955
1960
1965
1970
1975
1980
Years
46 6463
SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.
K•E

TURKEY

------- Proved additions to crude oil reserves per well over consecutive 5-year intervals

------- Change in crude oil reserves over consecutive 5-year intervals



46 6463

SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

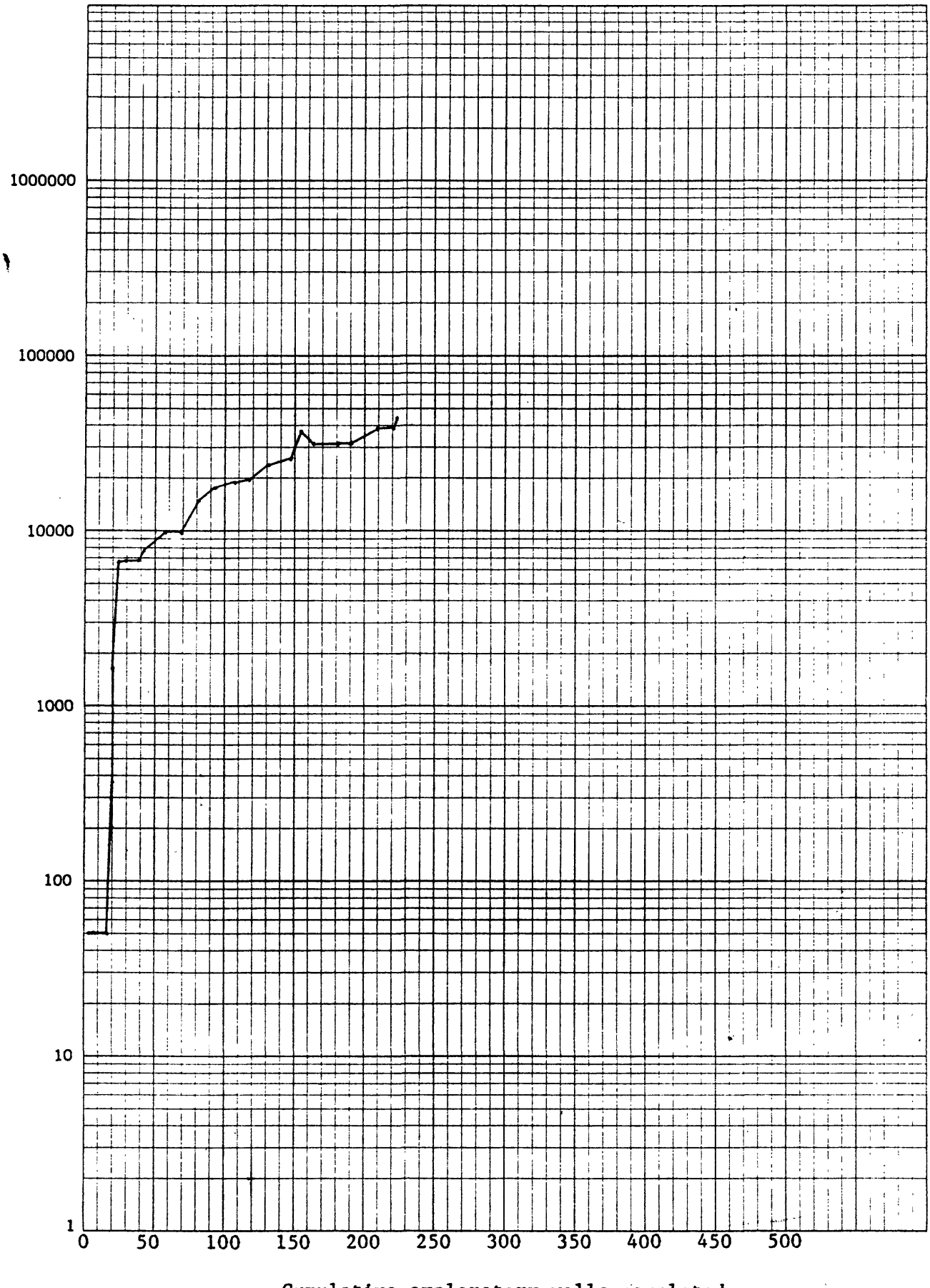
UNITED ARAB EMIRATES

Year (y)	Exploretory wells completed (W_y) (AAPG)	Cumulative exploratory wells completed (CW_y)	Reserves - MMBbls (R_y) (D/M)	Crude production MBbls (P_y) (D/M, WO)	Ultimate recovery rounded MMBbls ($CP_y + R_{y+1}$)	Cumulative production rounded MMBbls (CP_y)	Change in reserves ($R_{y+1} - R_y$)= ΔR_y MBbls	Proved additions to reserves MBbls ($D_y = \Delta R_y + P_y$)	Proved additions to reserves per well MBbls (D_y/W_y)
1941									
1942									
1943									
1944									
1945									
1946									
1947									
1948	0	0							
1949	1	1							
1950	0	1							
1951	1	2							
1952	1	3							
1953	0	3							
1954	1	4			50		50,000	50,000	50,000
1955	1	5	* 50		50		0	0	0
1956	2	7	* 50		50		0	0	0
1957	2	9	* 50						
1958	3	12							
1959	4	16			50		0	0	0
1960	4	20	* 50		350		300,000	300,000	75,000
1961	0	20	* 350		1,500		1,150,000	1,150,000	
1962	4	24	* 1,500	5,976	6,506	6	5,000,000	5,005,976	1,251,494
1963	5	29	* 6,500	17,571	6,524	24	0	17,571	3,514
1964	8	37	* 6,500	67,465	6,591	91	0	67,465	8,433
1965	5	42	* 6,500	102,804	7,694	194	1,000,000	1,102,804	220,560
1966	16	58	* 7,500	131,279	9,825	325	2,000,000	2,131,279	133,205
1967	11	69	* 9,500	140,117	9,465	465	-500,000	-359,883	-32,716
1968	13	82	9,000	181,756	13,647	647	4,000,000	4,181,756	321,674
1969	12	94	13,000	222,598	16,870	870	3,000,000	3,222,598	268,549
1970	14	108	16,000	283,500	17,303	1,153	150,000	433,500	30,964
1971	9	117	16,150	386,655	18,140	1,540	450,000	836,655	92,962
1972	14	131	16,600	440,132	22,689	1,980	4,109,000	4,549,000	324,929
1973	16	147	20,709	559,399	23,736	2,539	486,000	1,045,399	65,337
1974	7	154	21,195	616,485	35,576	3,156	11,225,000	11,841,485	1,691,640
1975	9	163	32,420	618,310	31,849	3,774	-4,345,000	-3,726,690	-414,076
1976	18	181	28,075	712,614	31,209	4,487	-1,353,000	-640,386	-35,577
1977	9	190	26,722	729,506	31,226	5,216	-712,000	17,506	1,945
1978	19	209	26,010	667,950	37,468	5,884	5,574,000	6,241,950	328,524
1979	12	221	31,584	662,620	37,970	6,347	-161,000	501,620	41,801
1980	12	233	31,423	625,594	42,652	7,172	4,057,000	4,682,594	390,216
1981			35,480						

*Includes Oman

UNITED ARAB EMIRATES

Ultimate crude oil recovery (MMBbls) vs cumulative exploratory wells completed

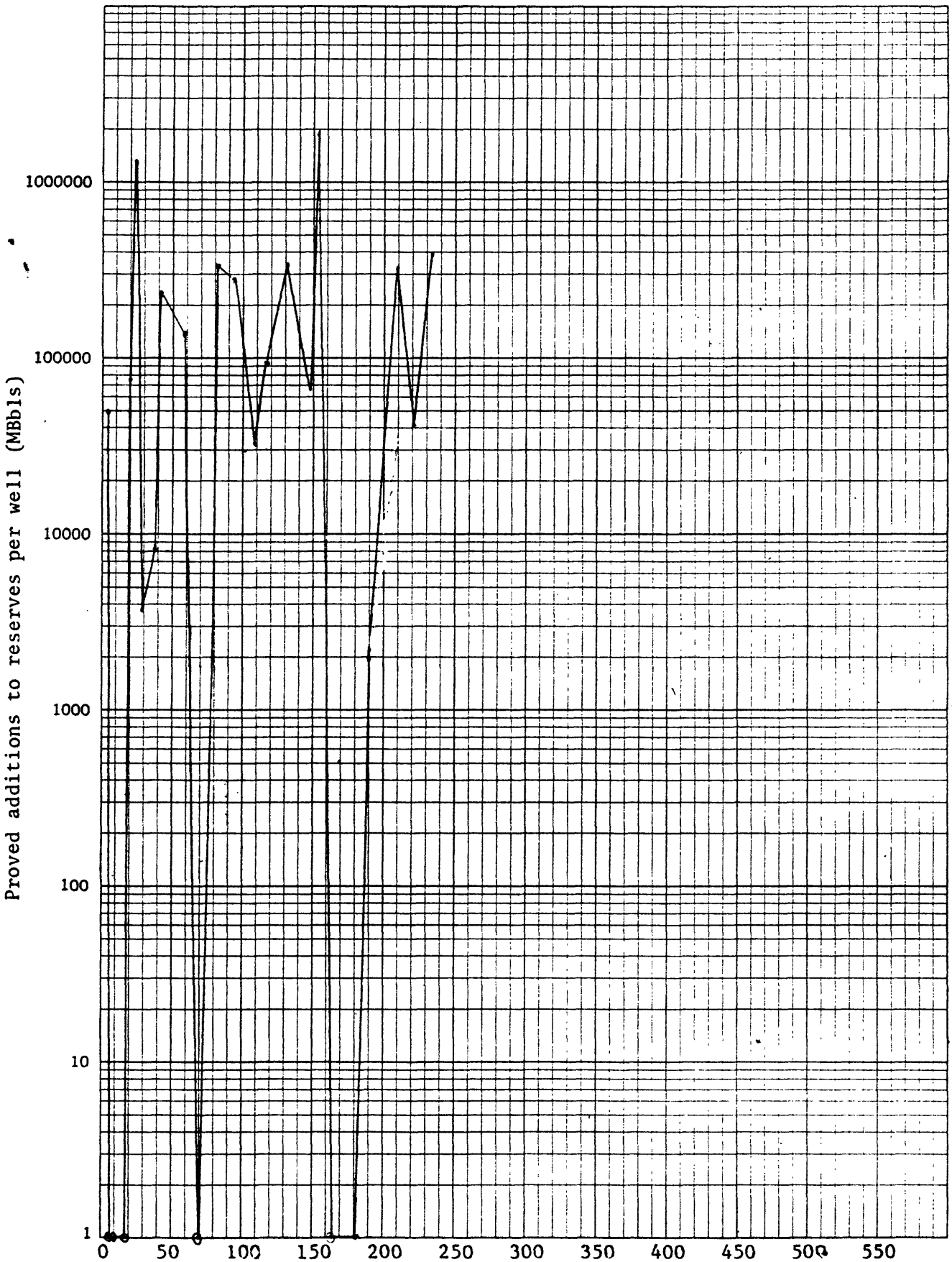


46 6463

K+E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS KEUFFEL & ESSER CO. MADE IN U.S.A.

UNITED ARAB EMIRATES

Proved additions to crude oil reserves per exploratory well completed (MBbls) vs cumulative exploratory wells completed



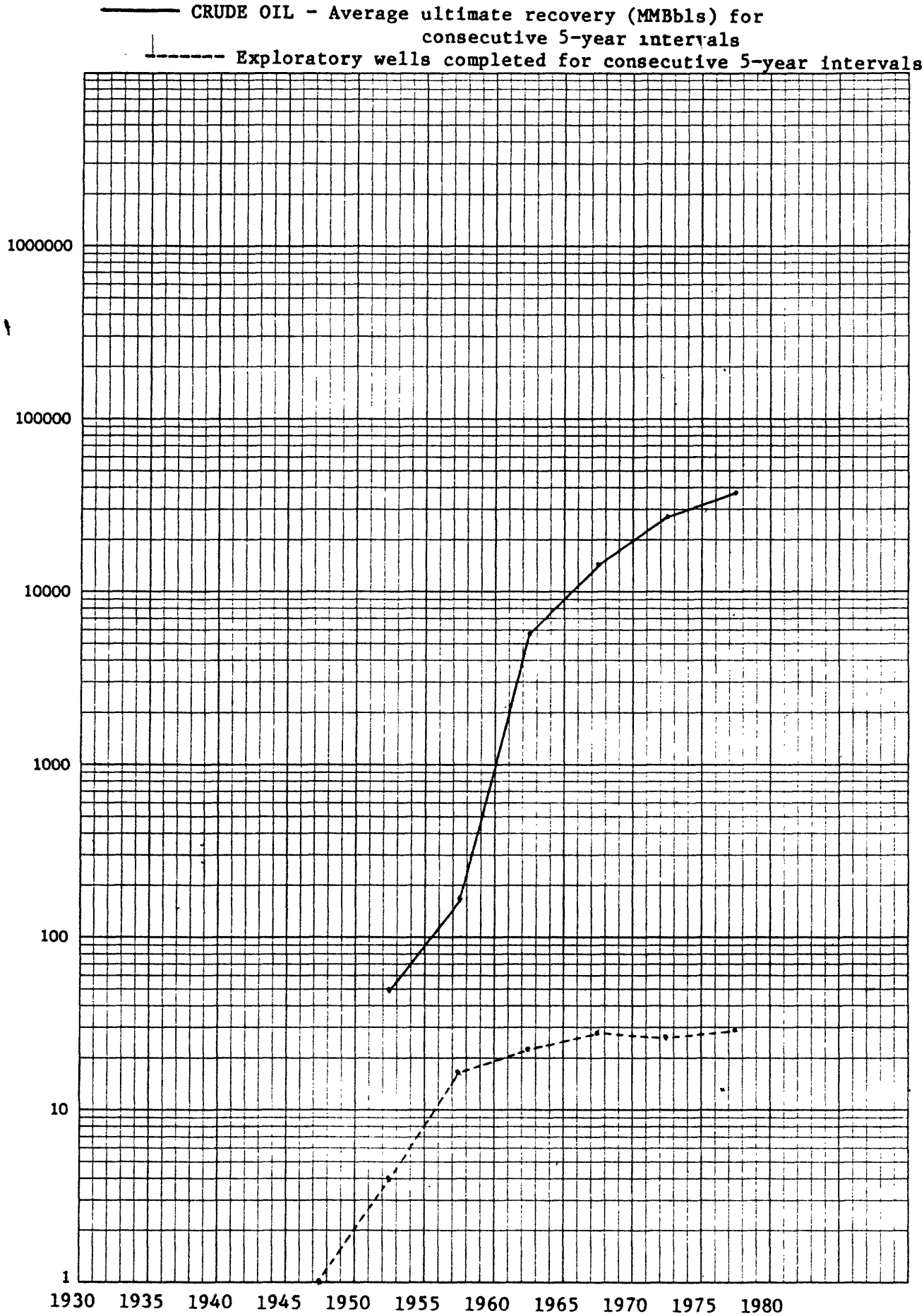
46 6463

K+E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS KEUFFEL & ESSER CO. MADE IN U.S.A.

UNITED ARAB EMIRATES

5 year period	Number of exploratory wells completed	Change in reserves (MMBbls)	Avg ultimate recovery (MMBbls)	Proved additions to reserves (MMBbls)	Proved additions to reserves by well (MMBbls)
1936-1940					
1941-1945					
1946-1950	1				
1951-1955	4	50	50	50	12.5
1956-1960	15	300	150	300	20.0
1961-1965	22	7,150	5,763	7,344	333.8
1966-1970	66	8,650	13,422	9,610	145.6
1971-1975	55	11,925	26,398	14,545	264.5
1976-1980	70	7,405	36,105	10,805	154.4

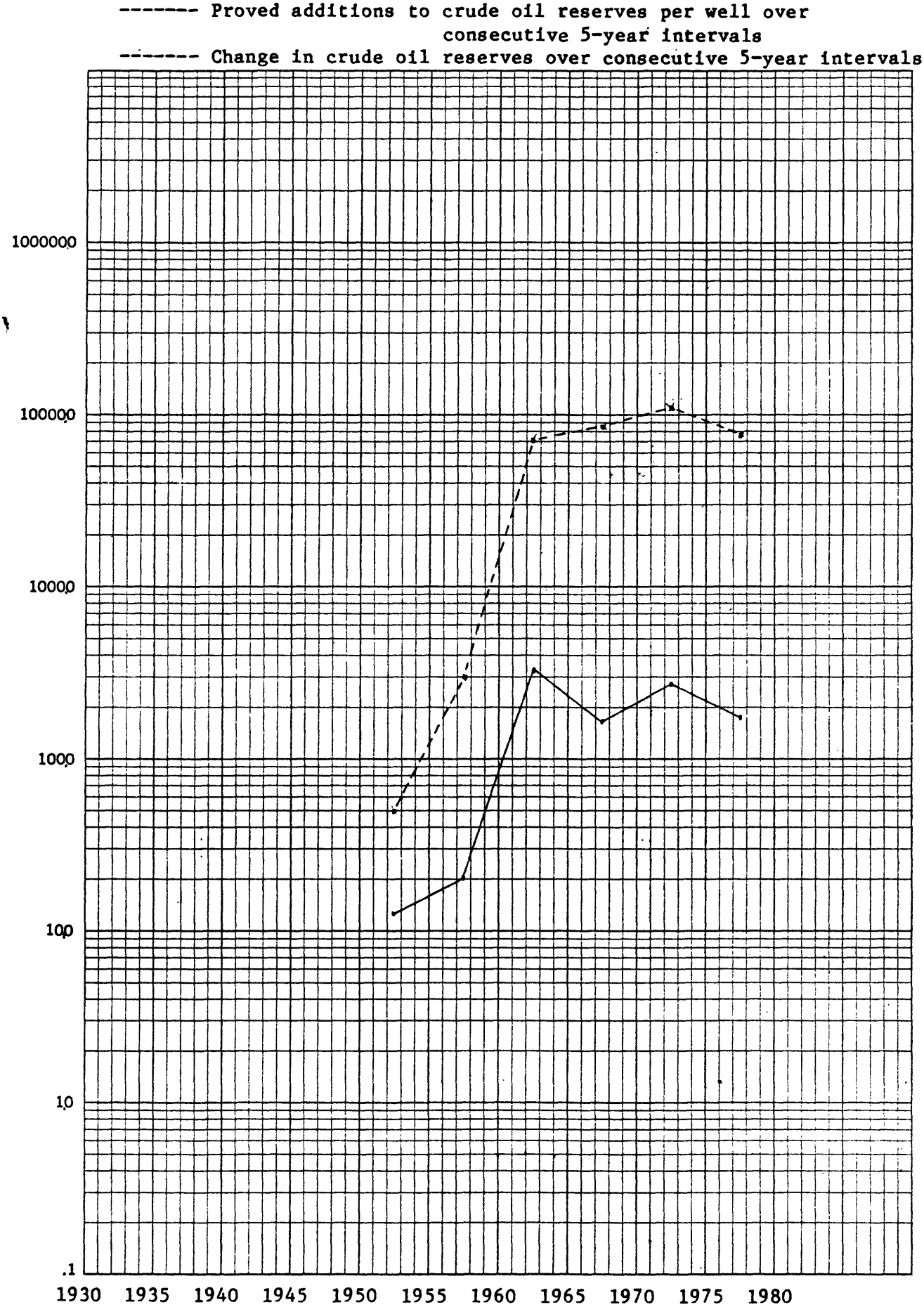
UNITED ARAB EMIRATES



46 6463

K+E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS KEUFFEL & ESSER CO. MADE IN U.S.A.

UNITED ARAB EMIRATES



46 6463

K•E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS KEUFFEL & ESSER CO. MADE IN U.S.A.

NORTH AFRICA

Algeria

Egypt

Libya

Tunisia

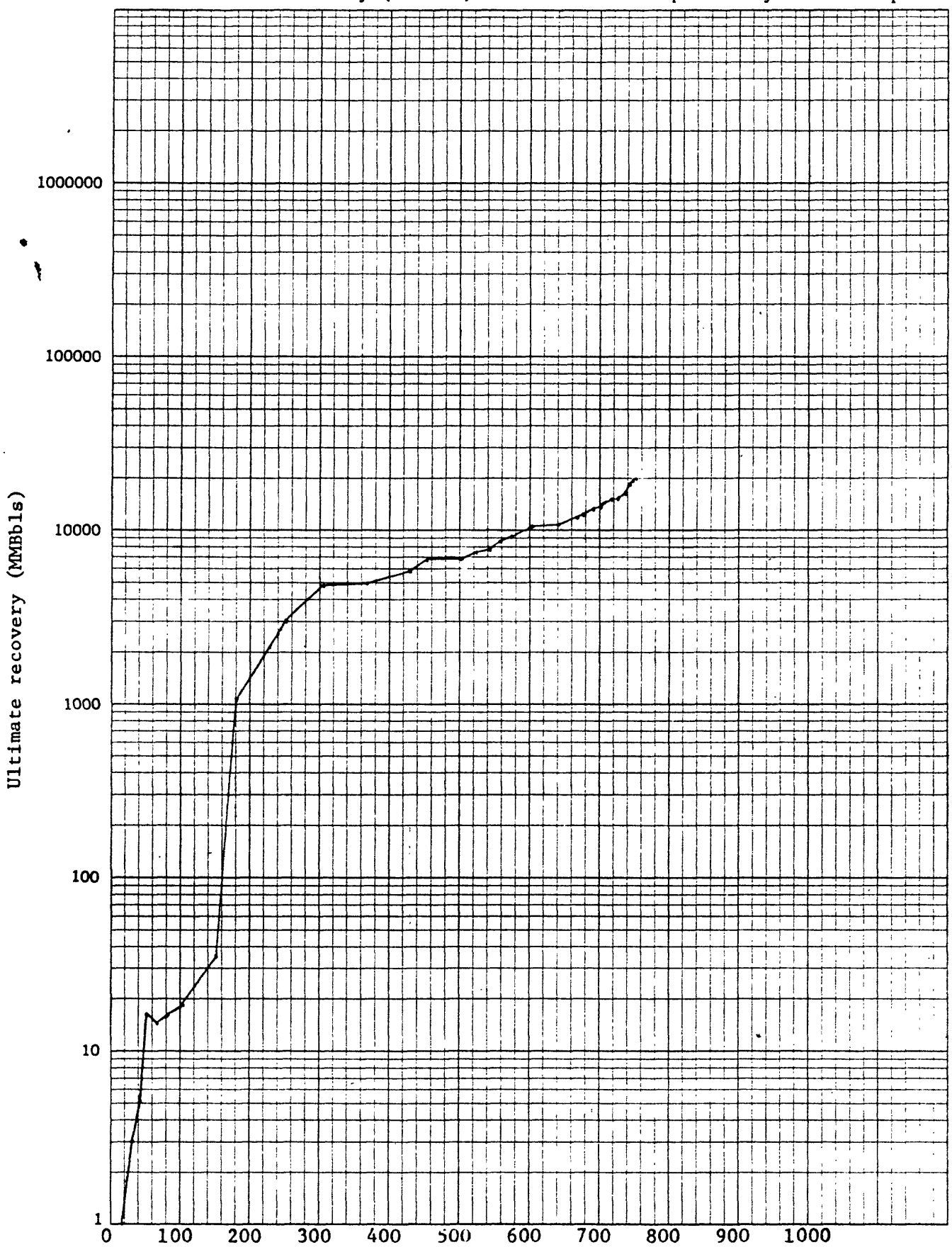
ALGERIA

Year (y)	Exploratory wells completed (W_y) (AAPG)	Cumulative exploratory wells completed (CW_y)	Reserves - MMBbls (R_y) (D/M)	Crude production MBbls (P_y) (D/M, WO)	Ultimate recovery rounded MMBbls ($CP_y + R_{y+1}$)	Cumulative production rounded MMBbls (CP_y)	Change in reserves ($R_{y+1} - R_y$) = ΔR_y MBbls	Proved additions to reserves MBbls ($D_y = \Delta R_y + P_y$)	Proved additions to reserves per well MBbls (D_y/W_y)
1914				1					
1915				4					
1916				8					
1917				9					
1918				7					
1919				5					
1920				4					
1921				3					
1922				9					
1923				9					
1924				11					
1925				12					
1926				9					
1927				8					
1928				8					
1929				20					
1930				16					
1931				na					
1932				na					
1933				na					
1934				na					
1935				na					
1936				na					
1937				na					
1938				na					
1939				na					
1940				na					
1941				na					
1942				na					
1943				na					
1944				4					
1945				2					
1946				1					
1947	1	1		1			100	101	101
1948	15	16		1	1		900	901	60
1949			1	2	3		1,500	1,502	
1950	14	30	3	24	3		700	724	52
1951	12	42	3	49	5		1,850	1,899	158
1952	11	53	5	348	15	1	8,950	9,298	845
1953	11	64	14	638	13	1	-2,000	-1,362	-124
1954	18	82	12	570	15	2	1,300	1,870	104
1955	22	104	13	438	17	2	2,000	2,438	111
1956	46	150	15	253	34	2	17,000	17,253	375
1957	30	180	32	101	1,010	3	974,700	974,801	32,493
1958	39	219	1,007	3,515		6			
1959	37	256		10,205	3,016	16	1,993,300	2,003,505	54,148
1960	48	304	3,000	67,613	4,684	84	1,600,000	1,667,613	34,741
1961	64	368	4,600	121,494	4,905	205	100,000	221,494	3,460
1962	62	430	4,700	158,094	5,613	363	550,000	708,094	11,420
1963	25	455	5,250	184,311	6,548	548	750,000	934,311	37,372
1964	46	501	6,000	204,300	6,752	752	0	204,300	4,441
1965	24	525	6,000	206,258	7,258	958	300,000	506,258	21,094
1966	17	542	6,300	262,377	7,721	1,221	200,000	462,377	27,198
1967	17	559	6,500	297,715	8,418	1,518	400,000	697,715	41,042
1968	17	576	6,900	330,922	9,049	1,849	300,000	630,922	37,113
1969	31	607	7,200	345,436	10,220	2,195	175,000	520,436	16,788
1970	37	644	8,025	376,024	10,669	2,571	73,300	449,324	12,144
1971	25	669	8,098	279,627	12,690	2,850	1,741,300	2,020,927	80,837
1972	10	679	9,840	384,858	12,985	3,235	-89,600	295,258	29,526
1973	13	692	9,750	400,515	12,965	3,636	-421,000	-20,485	1,576
1974	9	701	9,329	368,139	13,039	4,004	-294,616	73,523	8,169
1975	17	718	9,035	350,753	14,355	4,355	965,129	1,315,882	77,405
1976	11	729	10,000	383,816	14,355	4,738	-383,250	556	51
1977	11	740	9,617	409,864	15,148	5,148	383,250	793,114	72,101
1978	3	743	10,000	401,500	17,138	5,550	1,588,496	1,989,996	663,332
1979	3	746	11,588	410,575	18,101	5,960	552,197	962,772	320,924
1980	2	748	12,141	366,000	18,101	6,326	-336,000	30,000	15,000
1981			11,775						

na = not available

ALGERIA

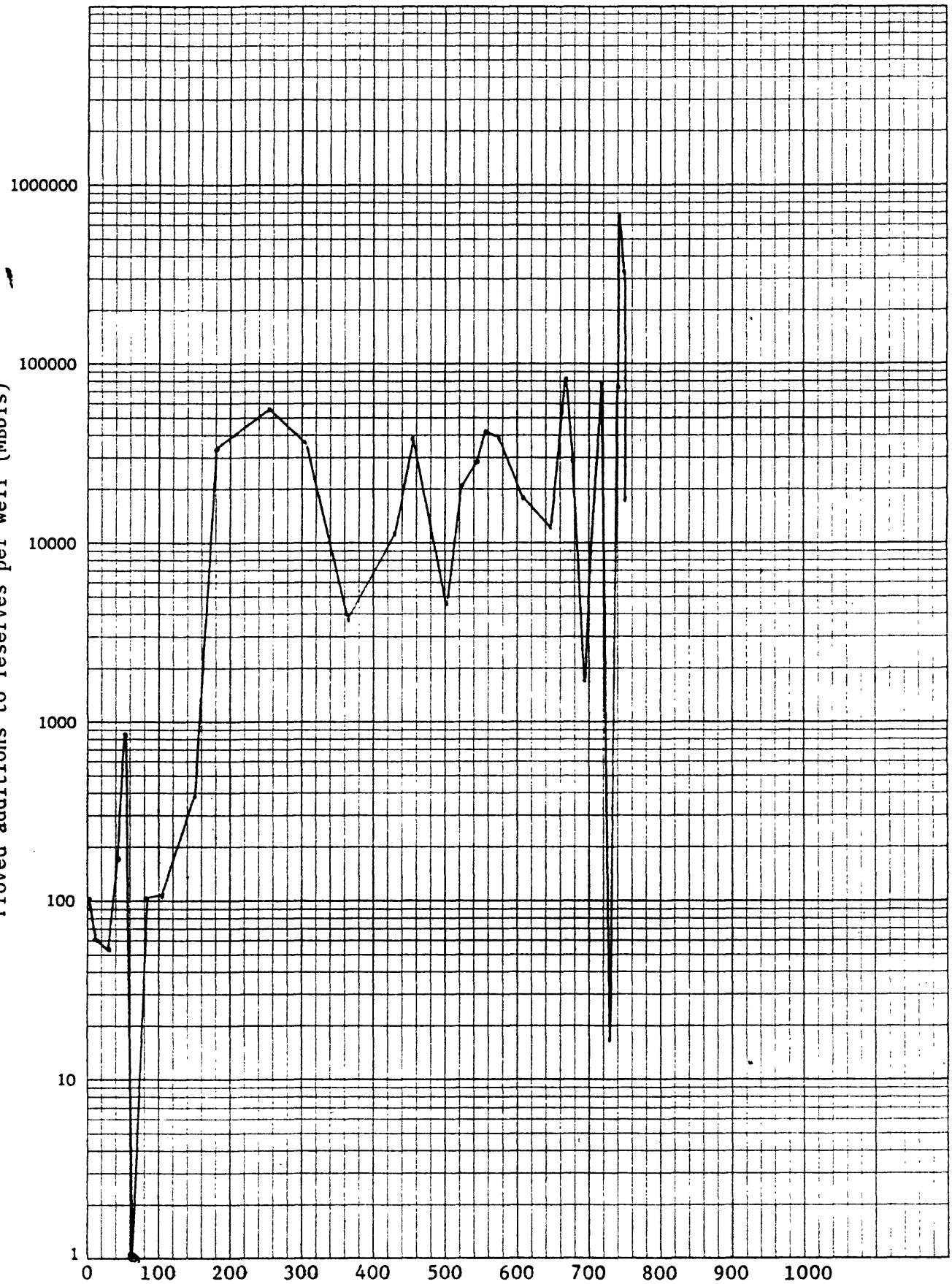
Ultimate crude oil recovery (MMBbls) vs cumulative exploratory wells completed



46 6463

SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

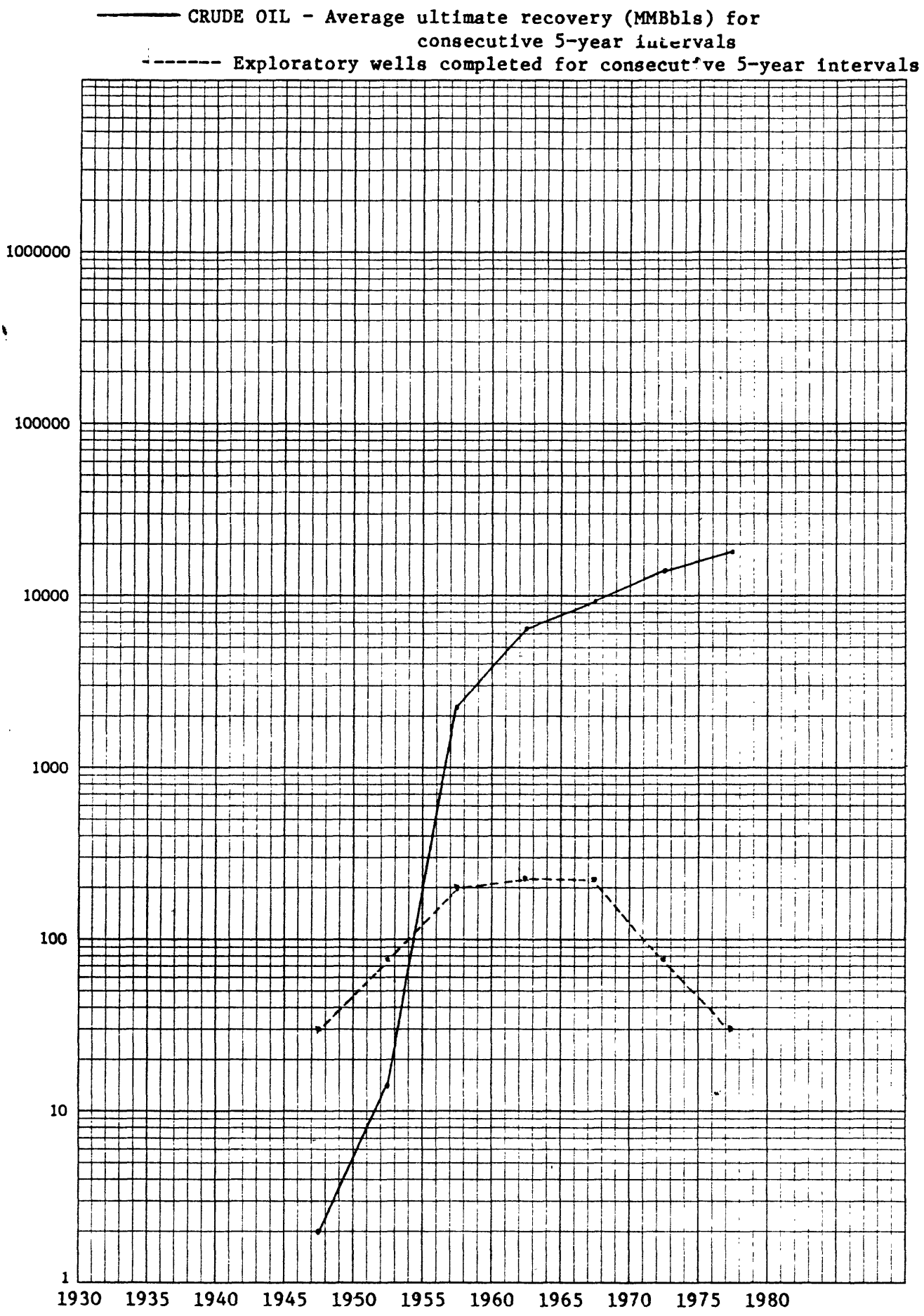
Proved additions to crude oil reserves per exploratory well completed (MBbls)
vs cumulative exploratory wells completed



ALGERIA

5 year period	Number of exploratory wells completed	Change in reserves (MMBbls)	Avg ultimate recovery (MMBbls)	Proved additions to reserves (MMBbls)	Proved additions to reserves by well (MMBbls)
1936-1940					
1941-1945					
1946-1950	30	4	2	4	.1
1951-1955	74	12	13	14	.2
1956-1960	200	4,585	2,186	4,664	23.3
1961-1965	221	1,700	6,215	2,573	11.6
1966-1970	119	1,148	9,215	2,760	23.1
1971-1975	74	1,900	13,207	3,686	49.8
1976-1980	30	1,804	16,569	3,777	125.9

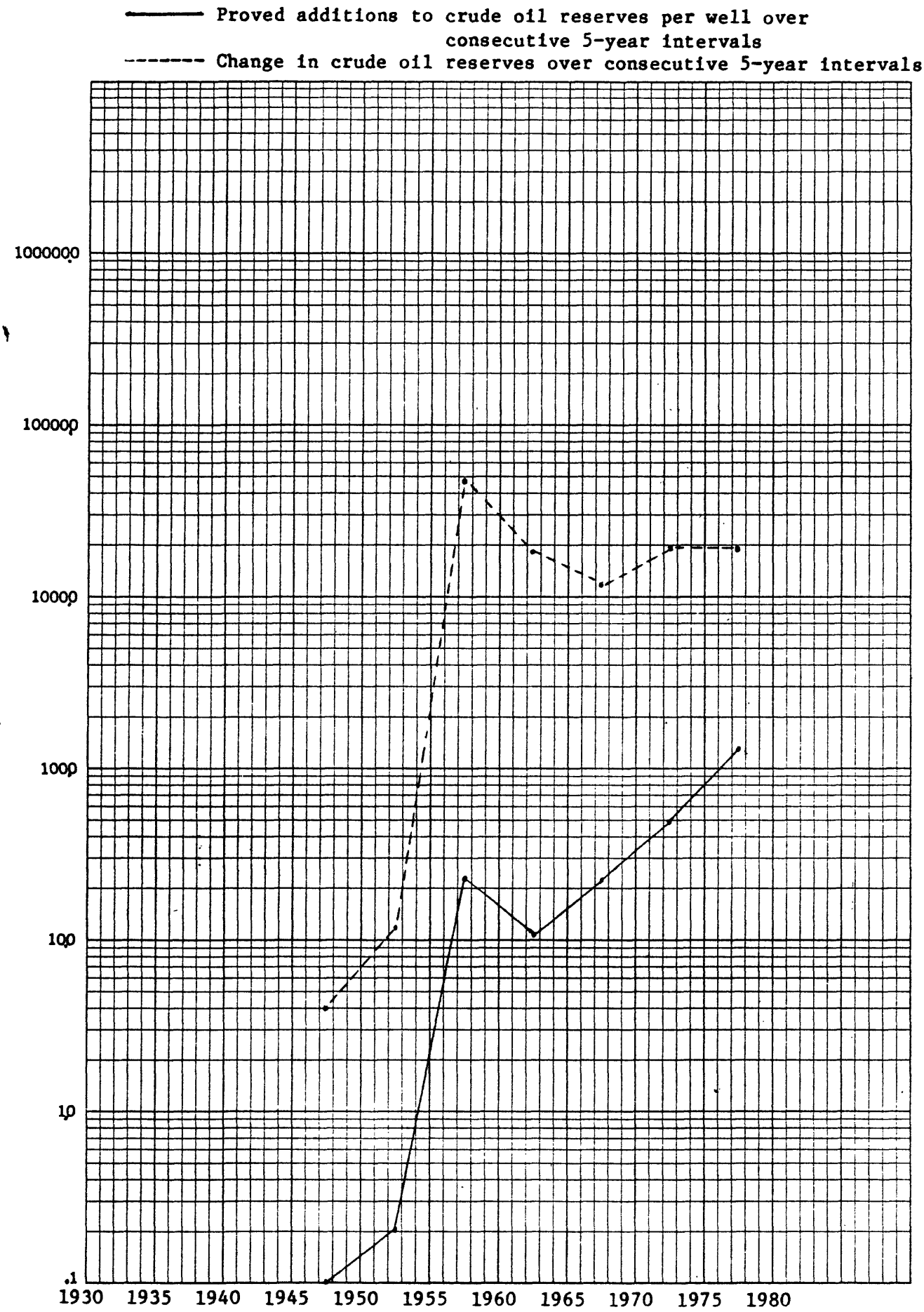
ALGERIA



46 6463

K+E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

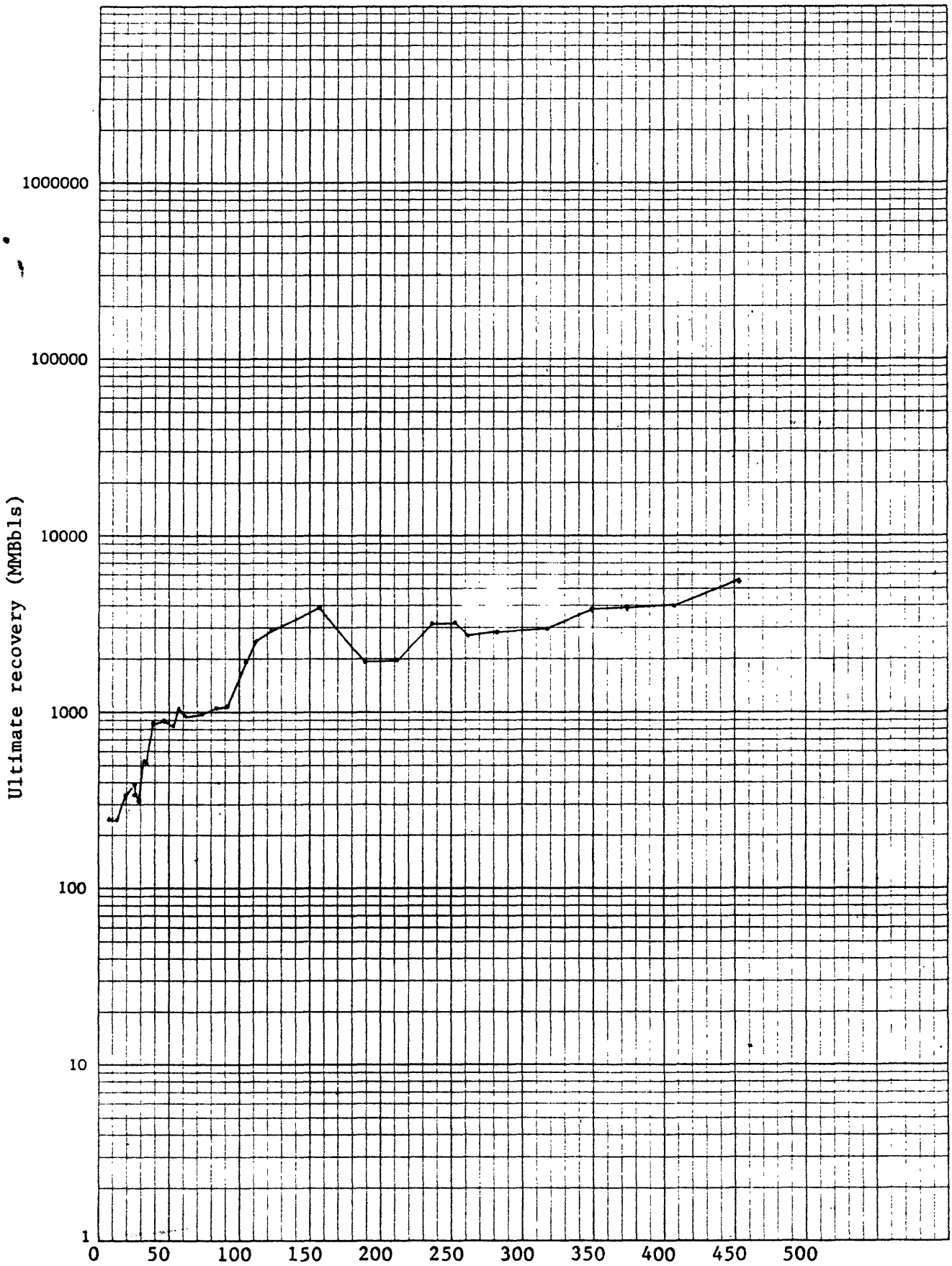
ALGERIA


Proved additions to crude oil reserves per well over consecutive 5-year intervals
Change in crude oil reserves over consecutive 5-year intervals
1000000
100000
10000
1000
100
10
.1
MMBbls
1930
1935
1940
1945
1950
1955
1960
1965
1970
1975
1980
Years
46 6463
K+E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

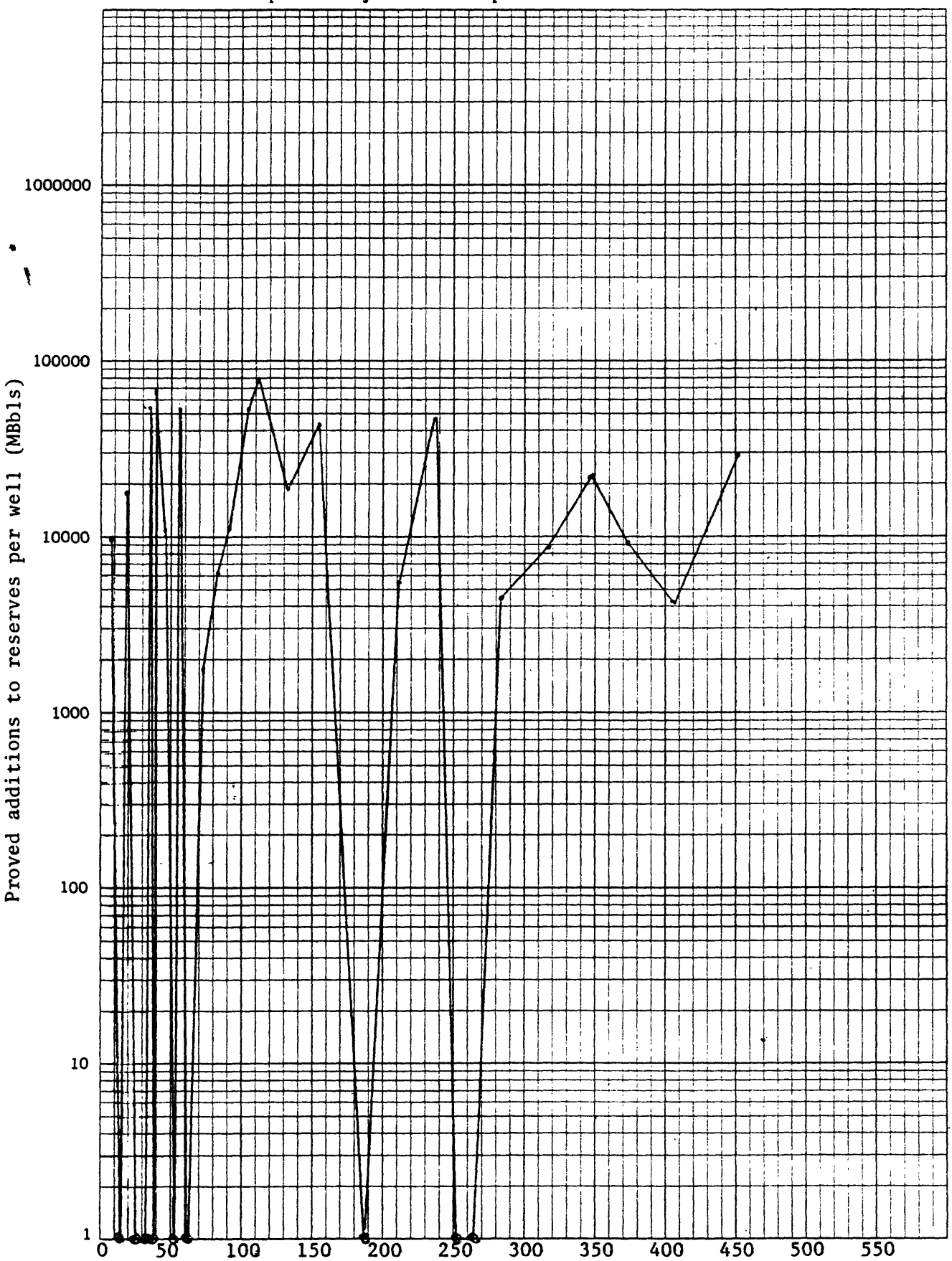
Year (y)	Exploratory wells completed (W_y) (AAPG)	Cumulative exploratory wells completed (CW_y)	Reserves - MMBbls (R_y) (D/M)	Crude production MBbls (P_y) (D/M, WO)	Ultimate recovery rounded MMBbls ($CP_y + R_{y+1}$)	Cumulative production rounded MMBbls (CP_y)	Change in reserves ($R_{y+1} - R_y$) = ΔR_y MBbls	Proved additions to reserves MBbls ($D_y = \Delta R_y + P_y$)	Proved additions to reserves per well MBbls (D_y/W_y)
1911				21					
1912				214					
1913				98					
1914				753	1	1			
1915				212	1	1			
1916				404	2	2			
1917				943	3	3			
1918				1,935	5	5			
1919				1,517	6	6			
1920				1,042	7	7			
1921				1,255	8	8			
1922				1,188	10	10			
1923				1,054	11	11			
1924				1,122	12	12			
1925				1,226	13	13			
1926				1,188	14	14			
1927				1,267	15	15			
1928				1,842	17	17			
1929				1,868	19	19			
1930				1,996	21	21			
1931				2,038	23	23			
1932				1,895	25	25			
1933				1,663	27	27			
1934				1,546	28	28			
1935				1,301	30	30			
1936				1,278	31	31			
1937				1,196	32	32			
1938				1,581	34	34			
1939				4,666	38	38			
1940				6,505	45	45			
1941				8,546	53	53			
1942				8,275	62	62			
1943				8,953	157	71	86,000	95,953	
1944			86	9,416		80			
1945				9,406	164	89	-11,000	-1,594	
1946			75	9,070	178	98	5,000	14,070	
1947	7	7	80	8,627	248	107	61,000	69,627	9,947
1948	6	13	141	13,398	241	121	-21,000	-7,602	-1,267
1949	6	19	120	15,997	337	137	80,000	95,997	16,000
1950	6	25	200	16,373	333	153	-20,000	-3,627	-604
1951	0	25	180	16,311	333	169	-16,000	311	
1952	0	25	164	16,464	386	186	36,000	52,464	
1953	0	25	200	16,501	332	202	-70,000	-53,499	
1954	3	28	130	13,774	316	216	-30,000	-16,226	-5,409
1955	4	32	100	12,634	529	229	200,000	212,634	53,159
1956	2	34	300	12,185	516	241	-25,000	-12,815	-6,408
1957	5	39	275	16,157	857	257	325,000	341,157	68,231
1958	5	44	600	21,960		279			
1959	2	46		21,303	900	300	0	21,303	10,652
1960	6	52	600	23,968	824	324	-100,000	-76,032	-12,672
1961	4	56	500	26,129	1,035	350	185,000	211,129	52,782
1962	6	62	685	32,321	947	383	-121,000	-88,679	-14,779
1963	12	74	564	38,760	966	421	-19,000	19,760	1,647
1964	9	83	545	43,915	1,021	465	11,270	55,185	6,132
1965	8	91	556	45,556	1,111	511	43,730	89,286	11,161
1966	14	105	600	44,070	1,855	555	700,000	744,070	53,148
1967	7	112	1,300	39,552	2,394	594	500,000	539,552	77,079
1968	21	133	1,800	62,208	2,757	657	300,000	362,208	17,248
1969	23	156	2,100	89,601	3,746	746	900,000	989,601	43,026
1970	33	189	3,000	119,165	1,855	865	-2,009,900	-1,890,735	-57,295
1971	22	211	990	106,993	1,972	972	9,900	116,893	5,313
1972	26	237	1,000	84,693	3,179	1,057	1,121,500	1,206,193	46,395
1973	15	252	2,122	60,483	3,179	1,118	-60,500	-17	-1
1974	12	264	2,061	53,715	2,594	1,171	-632,000	-578,285	-48,190
1975	20	284	1,423	84,348	2,678	1,256	6,000	90,348	4,517
1976	34	318	1,429	120,180	2,975	1,376	177,000	297,180	8,741
1977	31	349	1,599	150,925	3,608	1,527	482,475	633,400	20,432
1978	24	373	2,081	169,480	3,829	1,696	51,052	220,532	9,189
1979	34	407	2,133	182,000	3,968	1,878	-41,834	140,166	4,123
1980	45	452	2,090	212,927	5,291	2,091	1,109,307	1,322,234	29,383

EGYPT

Ultimate crude oil recovery (MMBbls) vs cumulative exploratory wells completed



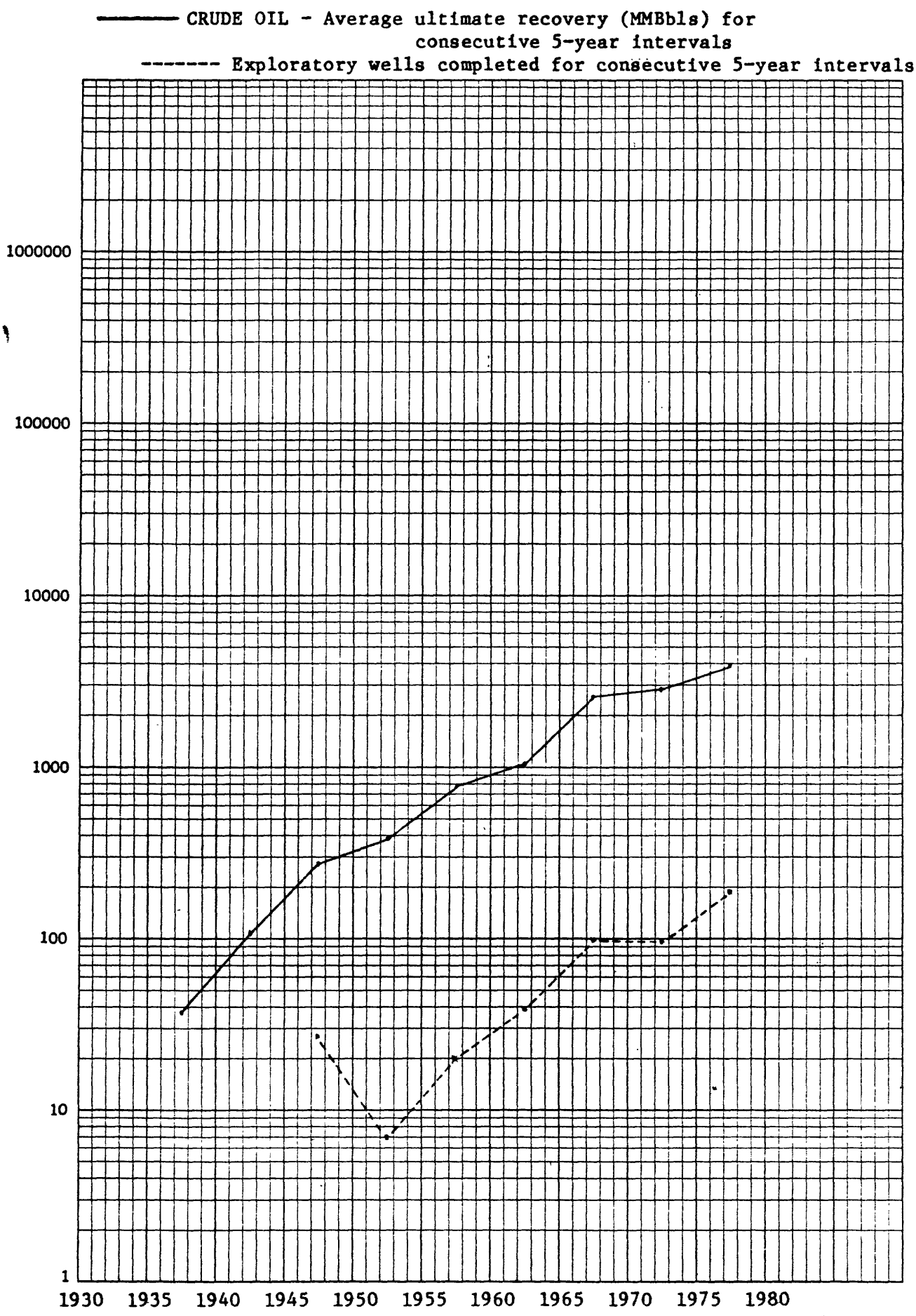
Proved additions to crude oil reserves per exploratory well completed (MBbls) vs cumulative exploratory wells completed



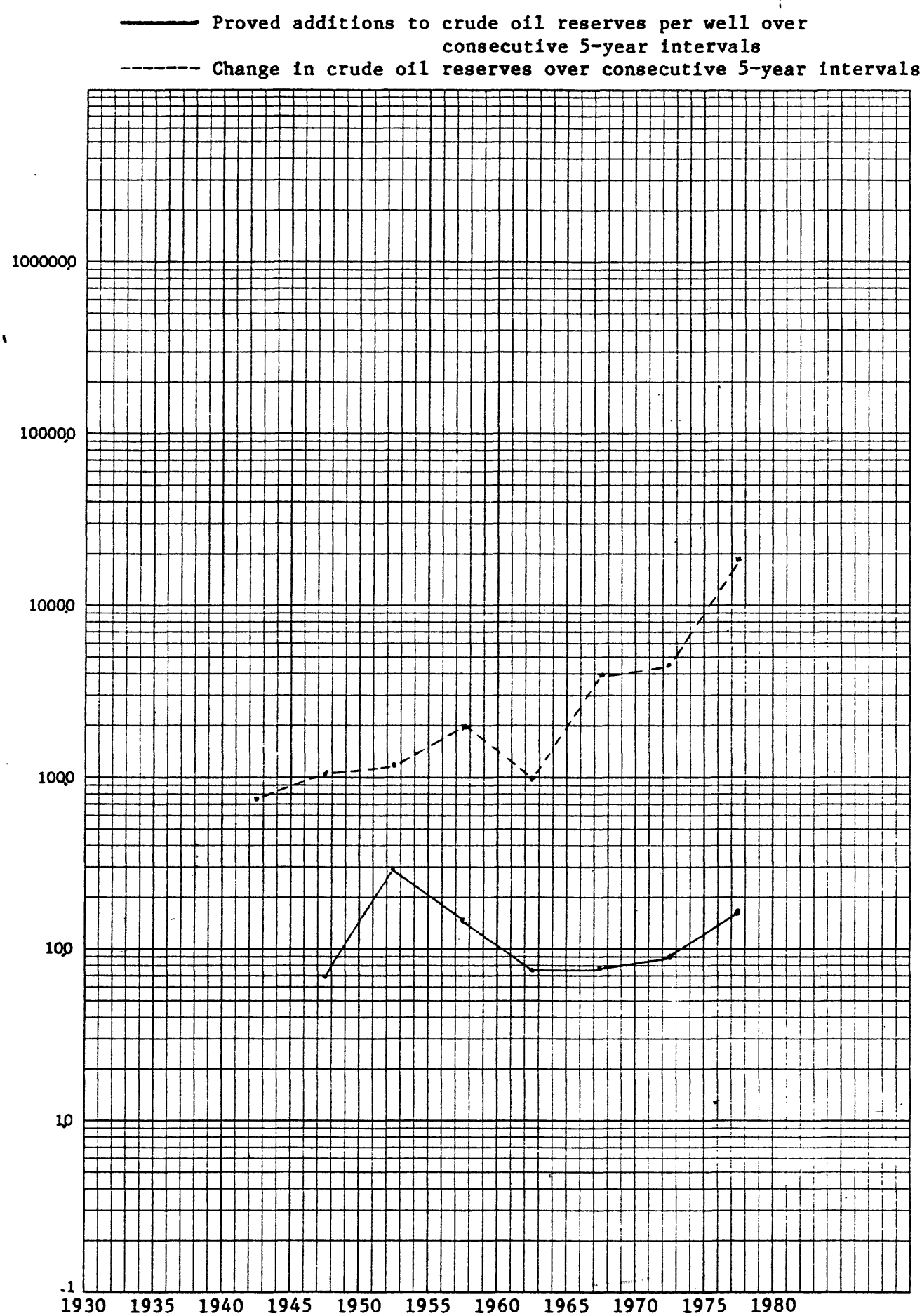
EGYPT

5 year period	Number of exploratory wells completed	Change in reserves (MMBbls)	Avg ultimate recovery (MMBbls)	Proved additions to reserves (MMBbls)	Proved additions to reserves by well (MMBbls)
1936-1940			36		
1941-1945		75	109	94	
1946-1950	25	105	267	168	6.7
1951-1955	7	120	379	196	28.0
1956-1960	20	200	774	273	13.7
1961-1965	39	100	1,016	286	7.3
1966-1970	98	390	2,521	745	7.6
1971-1975	95	445	2,720	835	8.8
1976-1980	168	1,777	3,934	2,613	15.6

EGYPT


CRUDE OIL - Average ultimate recovery (MMBbls) for consecutive 5-year intervals
Exploratory wells completed for consecutive 5-year intervals
1000000
100000
10000
1000
100
10
1
1930
1935
1940
1945
1950
1955
1960
1965
1970
1975
1980
Years
46 6463
SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

EGYPT



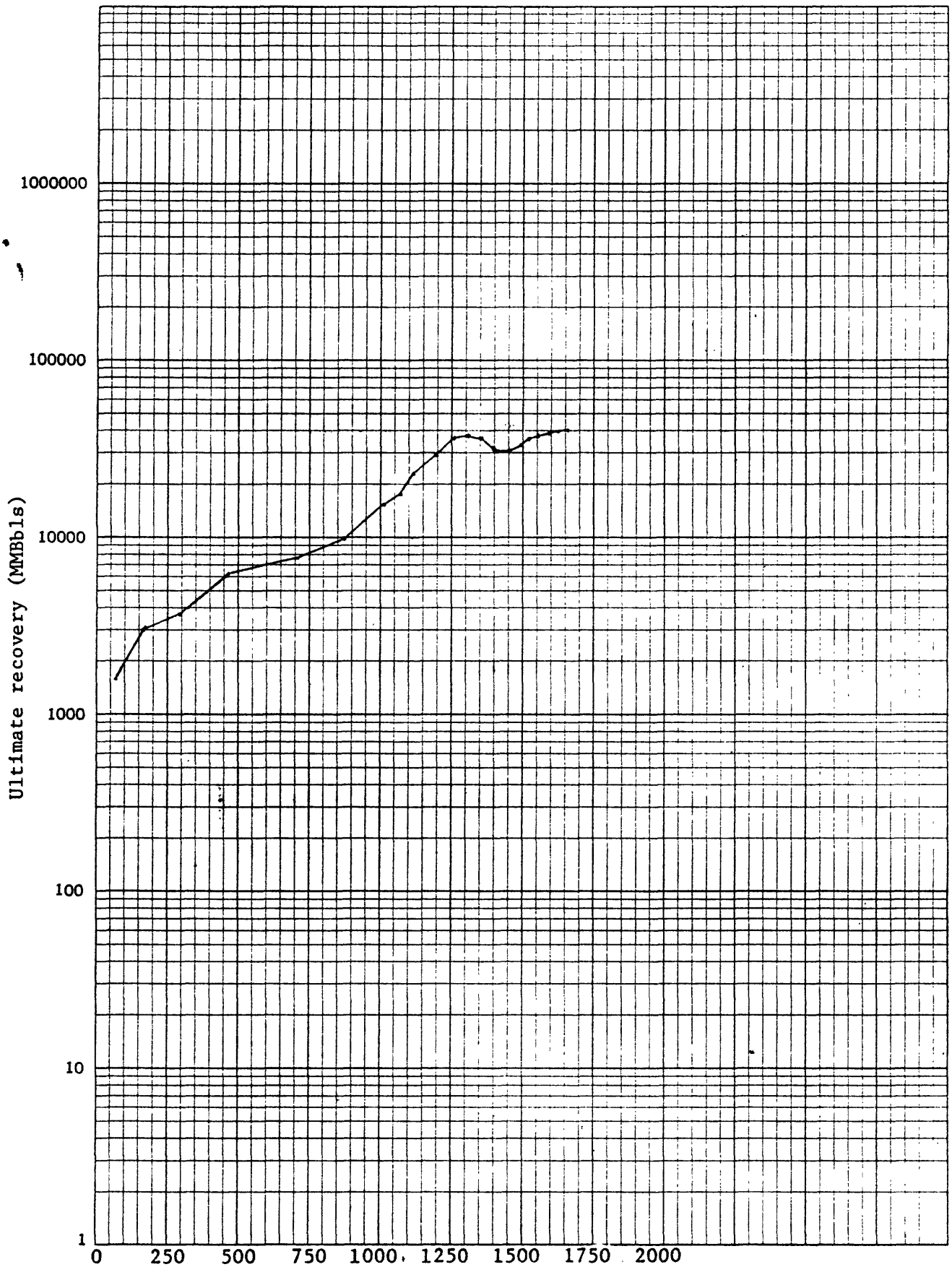
46 6463

K•E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

Year (y)	Exploratory wells completed (W_y) (AAPG)	Cumulative exploratory wells completed (CW_y)	Reserves - MMBbls (R_y) (D/M)	Crude production MBbls (P_y) (D/M, WO)	Ultimate recovery rounded MMBbls ($CP_y + R_{y+1}$)	Cumulative production rounded MMBbls (CP_y)	Change in reserves ($R_{y+1} - R_y$) = ΔR_y MBbls	Proved additions to reserves MBbls ($D_y = \Delta R_y + P_y$)	Proved additions to reserves per well MBbls (D_y/W_y)
1940									
1941									
1942									
1943									
1944									
1945									
1946									
1947									
1948									
1949	0								
1950	0								
1951	0								
1952	0								
1953	0								
1954									
1955									
1956									
1957	4	4							
1958	25	29							
1959	41	70			1,500		1,500,000	1,500,000	36,585
1960	98	168	1,500		3,000		1,500,000	1,500,000	15,306
1961	125	293	3,000	6,642	3,507	7	500,000	506,642	4,053
1962	173	466	3,500	67,052	6,074	74	2,500,000	2,567,052	14,838
1963	245	711	6,000	169,414	7,743	243	1,500,000	1,669,414	6,814
1964	167	878	7,500	315,642	9,559	559	1,500,000	1,815,642	10,872
1965	136	1,014	9,000	445,374	14,004	1,004	4,000,000	4,445,374	32,687
1966	62	1,076	13,000	550,186	16,054	1,554	1,500,000	2,050,186	33,068
1967	41	1,117	14,500	636,504	22,191	2,191	5,500,000	6,136,504	149,671
1968	80	1,197	20,000	951,345	28,142	3,142	5,000,000	5,951,345	74,392
1969	70	1,267	25,000	1,135,684	34,278	4,278	5,000,000	6,135,684	87,652
1970	51	1,318	30,000	1,209,314	35,487	5,487	0	1,209,314	23,712
1971	41	1,359	30,000	1,007,687	34,495	6,495	-2,000,000	-992,313	-24,203
1972	34	1,393	28,000	819,619	31,414	7,314	-3,900,000	-3,080,381	-90,599
1973	25	1,418	24,100	793,839	31,316	8,108	-892,000	-98,161	-3,926
1974	32	1,450	23,208	555,291	31,664	8,664	-208,000	347,291	10,853
1975	45	1,495	23,000	555,150	33,219	9,219	1,000,000	1,555,150	34,559
1976	25	1,520	24,000	704,011	34,416	9,923	492,665	1,196,676	47,867
1977	33	1,553	24,493	753,178	36,003	10,676	834,770	1,587,948	48,119
1978	40	1,593	25,327	720,875	38,601	11,397	1,876,362	2,597,237	64,931
1979	30	1,623	27,204	769,115	38,612	12,166	-757,375	11,740	391
1980	35	1,658	26,446	658,800	38,613	12,825	-658,800	0	
1981			25,788						

LIBYA

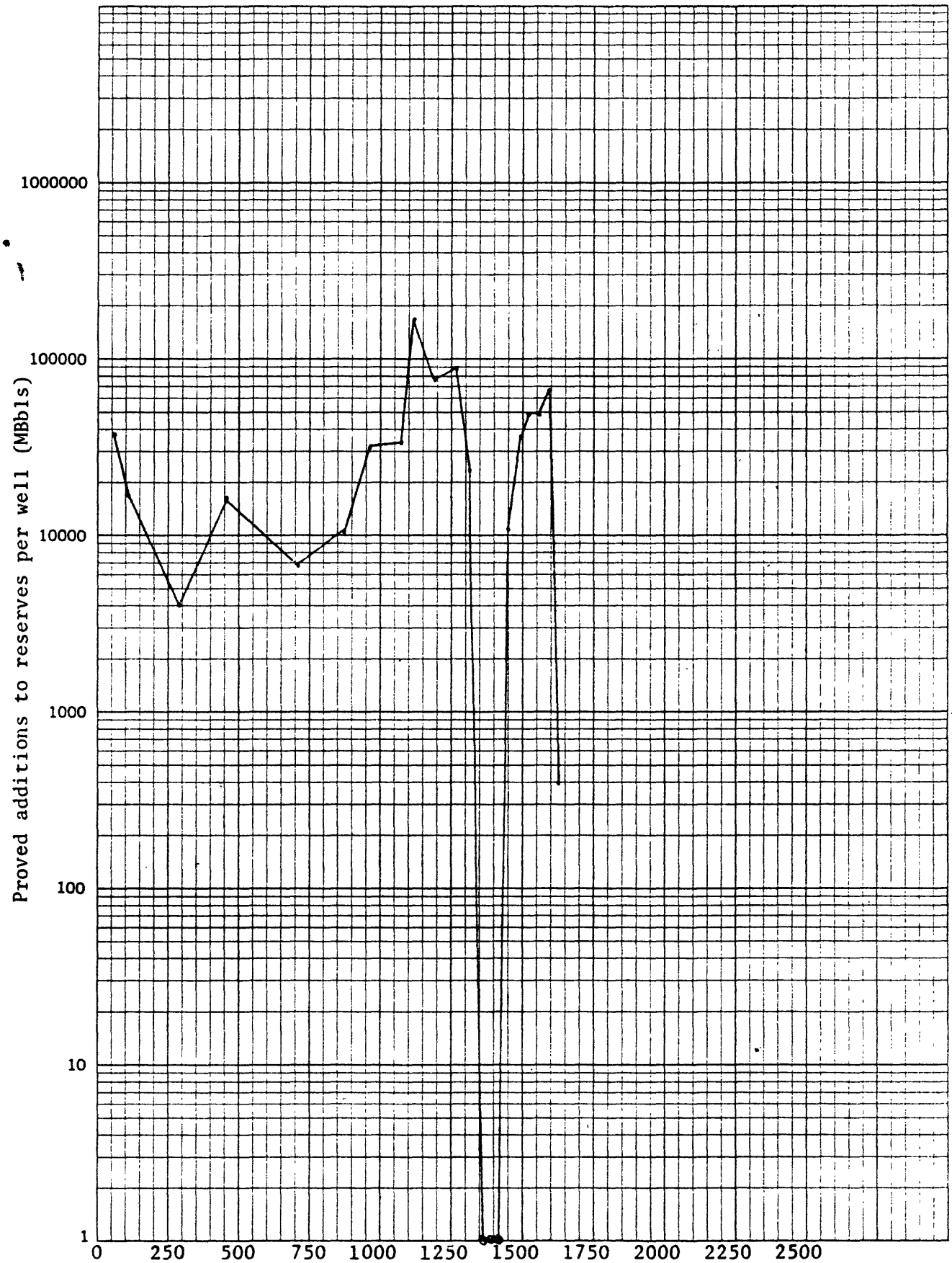
Ultimate crude oil recovery (MMBbls) vs cumulative exploratory wells completed



46 6463

K+E SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

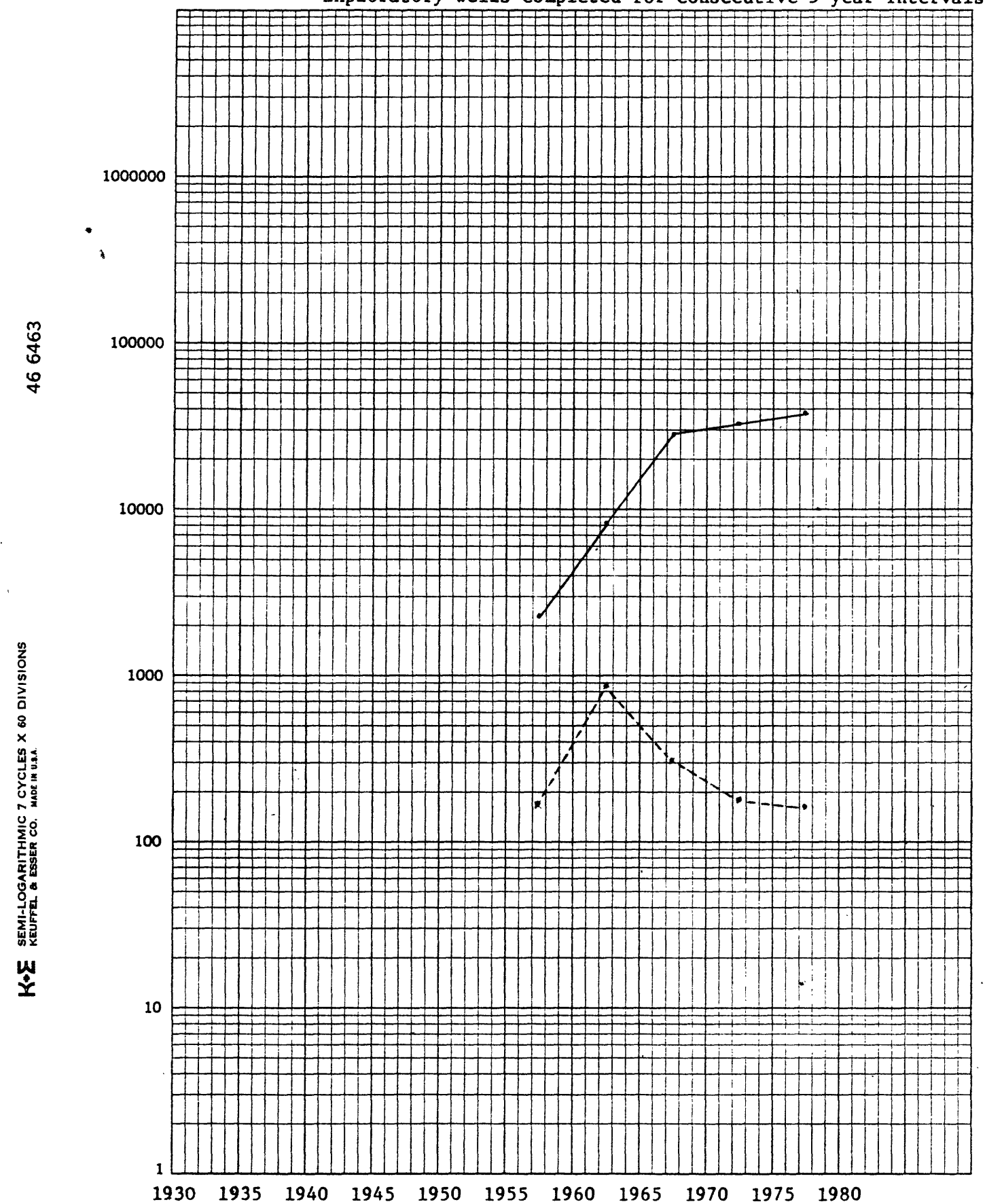
Proved additions to crude oil reserves per exploratory well completed (MBbls) vs cumulative exploratory wells completed



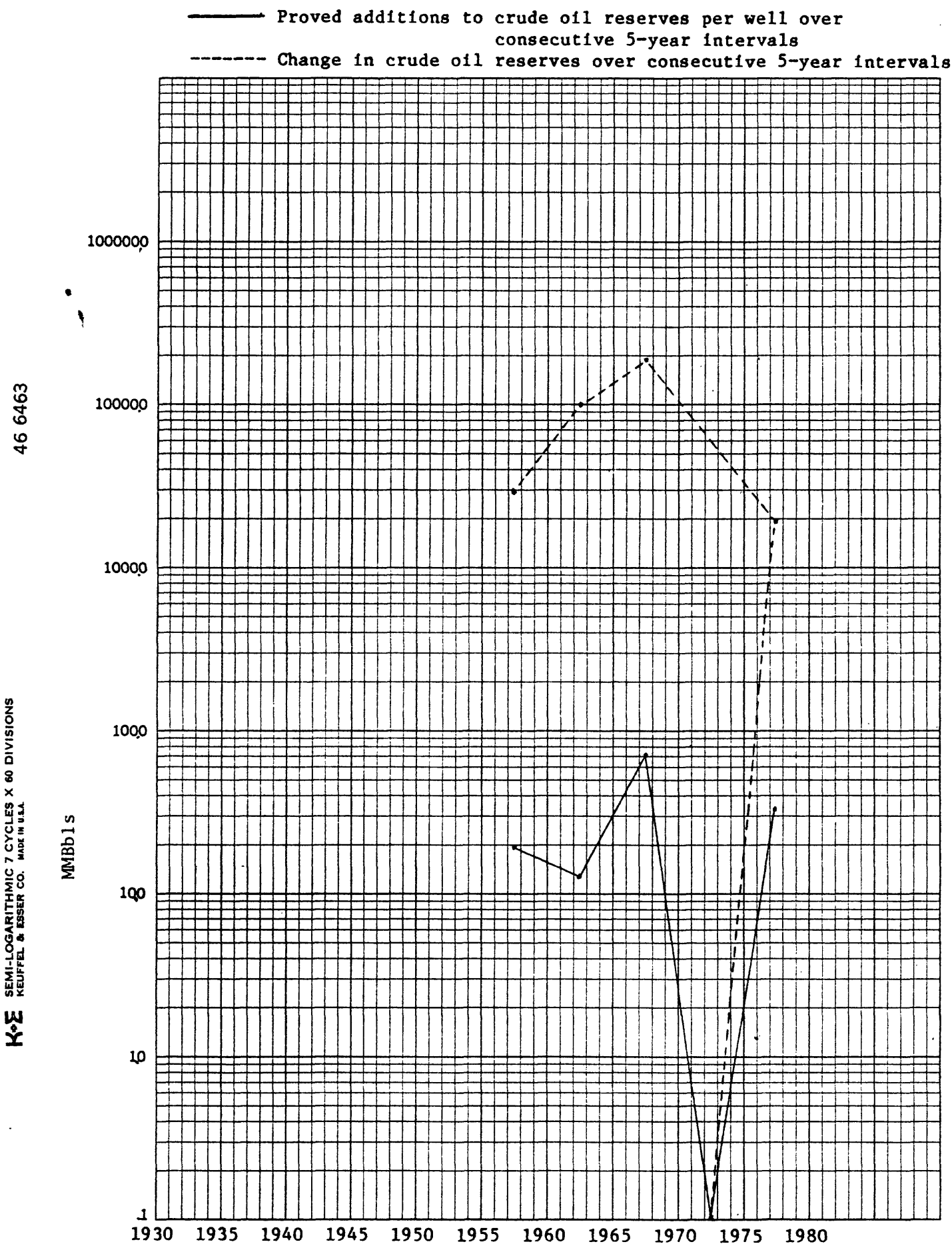
LIBYA

5 year period	Number of exploratory wells completed	Change in reserves (MMBbls)	Avg ultimate recovery (MMBbls)	Proved additions to reserves (MMBbls)	Proved additions to reserves by well (MMBbls)
1936-1940					
1941-1945					
1946-1950					
1951-1955					
1956-1960	168	3,000	2,250	3,000	17.9
1961-1965	846	10,000	8,177	11,004	13.0
1966-1970	304	17,000	27,230	21,483	70.7
1971-1975	177	-6,000	32,422	-2,268	-12.8
1976-1980	163	1,788	37,249	5,394	33.1

LIBYA


CRUDE OIL - Average ultimate recovery (MMBbls) for consecutive 5-year intervals
Exploratory wells completed for consecutive 5-year intervals
1000000
100000
10000
1000
100
10
1
1930
1935
1940
1945
1950
1955
1960
1965
1970
1975
1980
Years
46 6463
SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.
K+E

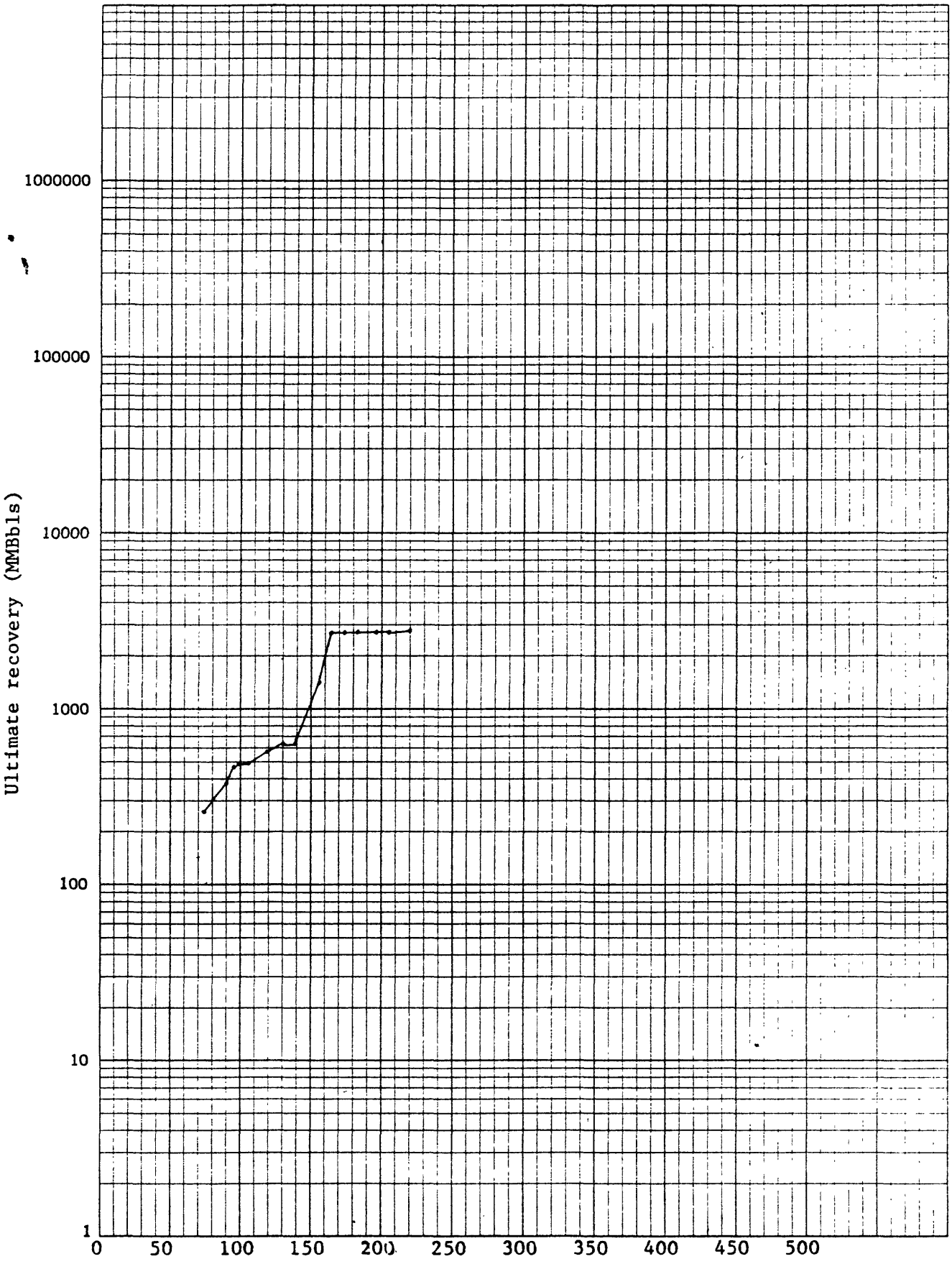
LIBYA


Proved additions to crude oil reserves per well over consecutive 5-year intervals
Change in crude oil reserves over consecutive 5-year intervals
1000000
100000
10000
1000
100
10
1
MMBbls
1930
1935
1940
1945
1950
1955
1960
1965
1970
1975
1980
Years
46 6463
SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.
K+E

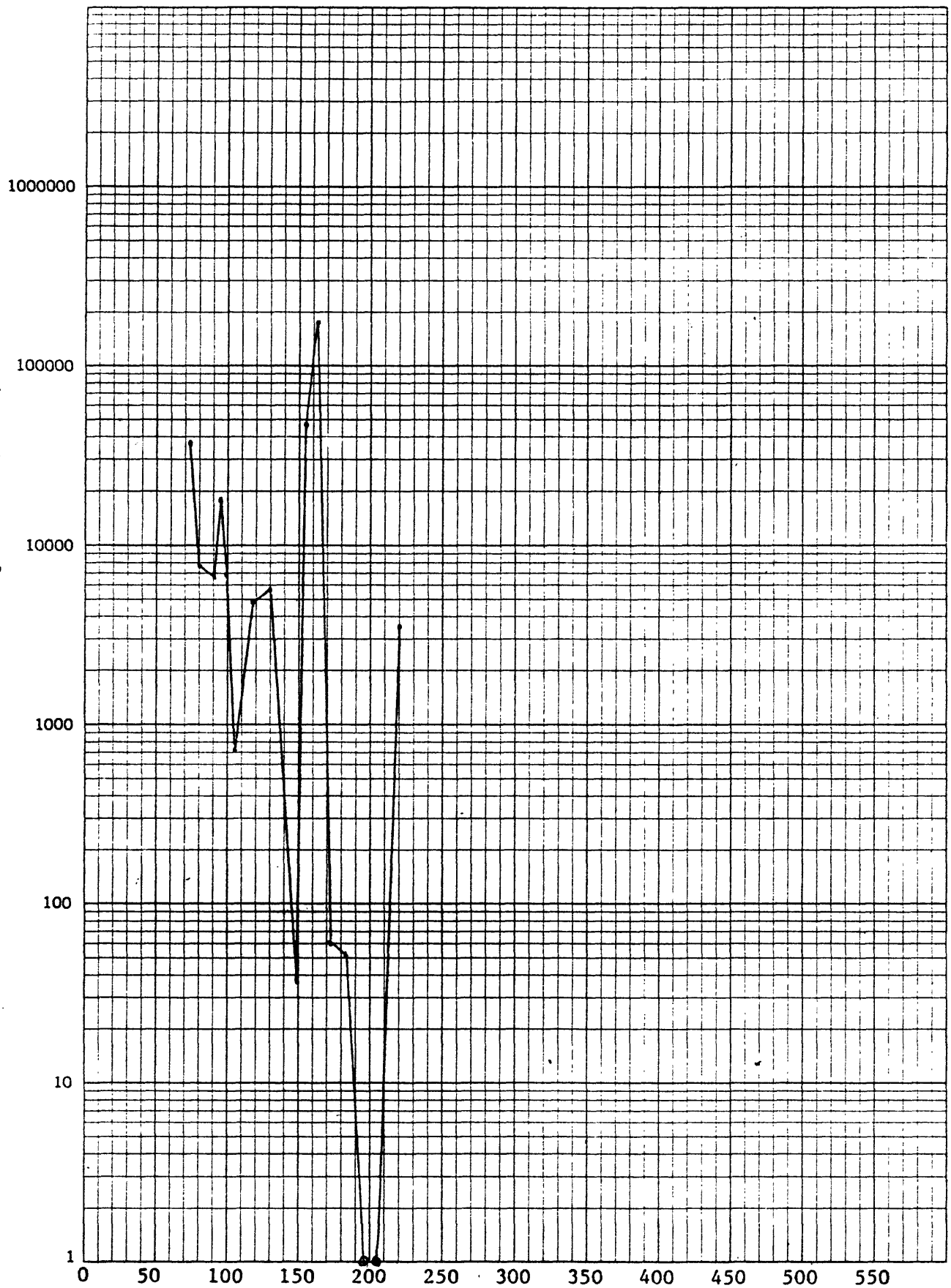
TUNISIA

Year (y)	Exploratory wells completed (W_y) (AAPG)	Cumulative exploratory wells completed (CW_y)	Reserves - MMBbls (R_y) (D/M)	Crude production MBbls (P_y) (D/M, WO)	Ultimate recovery rounded MMBbls ($CP_y + R_{y+1}$)	Cumulative production rounded MMBbls (CP_y)	Change in reserves ($R_{y+1} - R_y$) = ΔR_y MBbls	Proved additions to reserves MBbls ($D_y = \Delta R_y + P_y$)	Proved additions to reserves per well MBbls (D_y/W_y)
1947									
1948	0								
1949	1	1							
1950	3	4							
1951	0	4							
1952	3	7							
1953	7	14							
1954	12	26							
1955	5	31							
1956	4	35							
1957	4	39							
1958	5	44							
1969	5	49							
1960	0	49							
1961	1	50							
1962	8	58							
1963	4	62							
1964	4	66							
1965	7	73			250		250,000	250,000	35,714
1966	7	80	250	4,402	304	4	50,000	54,402	7,772
1967	10	90	300	17,068	371	21	50,000	67,068	6,707
1968	5	95	350	24,539	456	46	60,000	84,539	16,908
1969	4	99	410	27,942	484	74	0	27,942	6,986
1970	6	105	410	34,296	488	108	-30,000	4,296	716
1971	13	118	380	31,542	550	140	30,000	61,542	4,734
1972	12	130	410	31,607	617	171	36,400	68,007	5,667
1973	9	139	446	29,828	617	201	-29,497	331	37
1974	16	155	416	31,841	1,333	233	683,097	714,938	44,684
1975	8	163	1,100	34,567	2,591	268	1,223,493	1,258,060	157,258
1976	10	173	2,323	28,600	2,591	296	-28,000	600	60
1977	10	183	2,295	32,519	2,592	329	-32,000	519	52
1978	13	196	2,263	36,500	2,590	365	-37,595	-1,095	-84
1979	9	205	2,225	41,800	2,580	407	-52,753	-10,953	-1,217
1980	15	220	2,173	42,542	2,631	450	8,000	50,542	3,369
1981			2,181						

Ultimate crude oil recovery (MMBbls) vs cumulative exploratory wells completed



Proved additions to crude oil reserves per exploratory well completed (MBbls) vs cumulative exploratory wells completed



TUNISIA

Number of exploratory wells completed	Change in reserves (MMBbls)	Avg ultimate recovery (MMBbls)	Proved additions to reserves (MMBbls)	Proved additions to reserves by well (MMBbls)
4				
27				
18				
24	250	250	250	10.4
32	130	421	238	7.4
58	1,943	1,142	2,103	36.3
57	-143	2,597	41	.7