# NATURAL GAS RATE SITUATION

OF

# THE UNITED FUEL GAS COMPANY

IN

# WEST VIRGINIA, KENTUCKY, AND OHIO

BY

SAMUEL S. WYER
CONSULTING ENGINEER
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April 30, 1919.

United Fuel Gas Company,

Charleston, W. Va.

Gentlemen:

I have just completed an extended examination of your natural gas operating conditions and find the following:

1. Your domestic consumers utilize only about 17% of the gas they receive. That is, they waste about 83% of the gas as now used.

2. The efficiency of the domestic consumers' appliances could easily be trebled so as to make 1 ft. of gas do the work for which 3 ft. are now required. 90c gas with efficient utilization would cost the consumer no more than 30c gas under the present conditions, and would treble the time that natural gas will be available.

3. Demand for natural gas is now greater than the available supply, during the peak load period.

4. Number of acres natural gas land available per well now only one-fourth what it was in 1910.

5. Rock pressure decline has been general and very marked.

6. It has been necessary to greatly increase your compressing station capacity, to meet the rapid decline in rock pressure.

7. Average volume of new wells now drilled is much lower than that of earlier wells.

8. There has been a marked decline in average production of existing wells.

9. Length of haul is now greater than it was several years ago, because of the necessity of going farther away to supplement the rapidly decreasing supply in the old fields.

10. Operating costs and costs of material and labor have increased very rapidly.

11. Taxes have been greatly increased.

12. The total amount of gas available is declining rapidly, simultaneously with marked increased costs in pro-

duction, the two having the immediate effect of greatly increasing the cost per "M" cu. ft. of gas that can be delivered to consumers.

13. During the past several years, you have doubtless reached your maximum output of gas, and you should bear in mind that the reserve for depreciation and depletion during the future should be greatly increased over the past. Moreover, you should adopt every reasonable method tending to conservation.

The preceding operating conditions make it imperative for you to obtain a higher price for your natural gas service, and for the consumers to give more attention to efficient utilization.

My reasons for arriving at these conclusions are given in detail in the following:

Respectfully submitted,

Samuel S Wyer

# LIST OF PLATES

# PART I

## FUNDAMENTAL PRINCIPLES

**Sec. 1—Natural Gas is a Crude Mineral**

Natural gas, as it comes from the ground, is a crude mineral in the form of a mechanical mixture of permanent gases and condensible vapors. However, on account of its adventitious origin, migratory habits and fugitive tendencies, it is regarded as a mineral with special attributes. Only the permanent gases are of use to the ultimate consumer.

The service made necessary in prospecting for and finding natural gas, reserving acreage for future drilling operations, holding the gas for the consumers' future use, reducing the gas to possession, hauling or transmitting it to market, and converting it into a controlled and usable service, are the dominating features of natural gas costs.

**Sec. 2—Wrong Impression of Word "Natural"**

While natural gas is a natural product made by nature, it is no more natural than other minerals like coal, oil, etc. Merely being made by nature does not mean that a substance is cheap and of low value. The misconception regarding the position of natural gas has arisen from failing to appreciate that all commercial activities are carried forward upon the resources of nature, and that every product of industry owes its origin, originally, to some natural resource.

**Sec. 3—Regeneration**

Natural gas is an exhaustible resource that is becoming scarcer every year. There is no regeneration in the present fields that are now being depleted. Food and trees can be grown, water supplies are constantly replenished by nature, but when natural gas is once used it is gone forever. Every time a natural gas company sells 1,000 cu. ft. of gas it is selling a part of its property.

**Sec. 4—Demand for Natural Gas**

The demand for natural gas is now greater than the available supply. The number of domestic consumers is increasing faster than the number of producing wells.

Furthermore, the producing wells that are coming in to replace those previously drilled are, on the average, of much smaller capacity than wells that were drilled 10 years ago.

**Sec. 5—Waste**

Natural gas has been considered so cheap in the past as not to be worth saving. It is a well recognized fact that there can be no effective conservation without adequate prices.* The amount of natural gas wasted, today, is greater than the amount actually used.

There are at least 4,400 free consumers** in West Virginia who are wasting at least 350 "M" cu. ft. for each free consumer per year. This free consumer waste item for West Virginia amounts, therefore, to at least 1,540,000 "M" cu. ft. of natural gas per year. This, incidentally, is just about equal to one-fourth the total amount of domestic gas used in the year 1918 by all of the United Fuel Gas Co.'s own domestic consumers.

The carbon black industry in West Virginia wastes 50% more gas than is furnished to all of the domestic natural gas consumers in the state.

The inefficient use of the gas by the ultimate consumer, for the reasons given in the next section, has been nearly universal.

**Sec. 6—Few Improvements in Art of Using Natural Gas**

On account of the low prices that have prevailed, gas appliance manufacturers have not been stimulated to the development of efficient natural gas appliances. There have been few improvements resulting in increased efficiency in the last 15 years.

In using natural gas in the ordinary natural gas cook stove, 87% of the gas is wasted. In using natural gas in

* Most of the natural gas service problems of today are the direct result of failure to appreciate the underlying engineering and economic principles controlling the natural gas industry. These are discussed in detail in the recent December, 1918, Bulletin 102, Part 7, of the Smithsonian Institution, Washington, D. C., on Natural Gas: its Production, Service and Conservation.

** The term "free consumer" means the land owner who either has a gas well on or a gas line crossing his farm and was given the right to use natural gas without compensation (and which he interprets as without limitation) when the gas well lease or right of way contracts were made. The average consumption for each West Virginia "free consumer" is at least equal to 480 "M" cu. ft. Allowing a reasonable use of 130 "M" cu. ft. accounts for the waste of 350 "M" cu. ft. for each consumer per annum.

the fire pot of the ordinary coal furnace, 75% of the gas is wasted, or, to state it in terms of money, for every dollar's worth of gas purchased, in using the gas in cooking operations, 87c worth is thrown away, and in using the gas for heating in the fire pot of a coal furnace, 75c worth is thrown away. This feature is shown in graphical form on Plate 1, and the average home wastes of natural gas are analyzed on Plate 2, which shows that of the total amount of gas received and paid for by the domestic consumer, only 17% is utilized, or, stated in terms of money, for every dollar's worth of gas received at the domestic consumer's meter, on an average of 83c worth is wasted.

Efficient gas using appliances are on the market, easily obtainable, and not expensive. The financial importance of this is obvious when we consider that 90c natural gas used with low pressures and properly directed short flames in cooking, and in correctly designed and built natural gas furnaces will cost the consumer no more than 30c gas as now almost universally used, and will make the gas supply last three times as long.

**Sec. 7—Conservation Possible Only by Increased Prices**

> "The only wise way for cities to do is to allow gas companies sufficient price so that they can afford to prospect for, buy and hold gas territory for the present and future use. Show the profit and conservation will take care of itself."
>
> —U. S. Bureau of Mines—Technical Paper No. 38, p. 28.

> "As natural gas is the cleanest of fuels and is particularly adapted to household use, it does not seem unreasonable to consider it as strictly a domestic fuel and not a commercial one. It should be limited to the use where it will do the most good."
>
> —U. S. Bureau of Mines—Technical Paper No. 45, p. 50.

If the gas is made worth saving it will automatically result: First, in taking much more of the gas out of the ground; second, in transmitting the gas from the field to the consumer with a minimum of waste, and, third, in the consumer using the gas in an efficient manner.

**Sec. 8—Competitive Condition in Field**

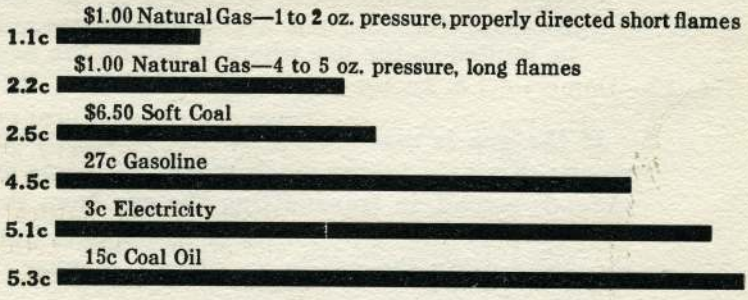
The extensive and intensive competitive production of gas, from many small acreage tracts, for industrial uses

like steel making, glass making, and carbon black, has worked great injury to the field. This competitive condition in the field has been responsible for most of the waste. In fact, competition here is always an economic waste. One of the striking needs of the natural gas industry today is to get the Government and the public to appreciate that "unity of action" should be applied to the many operations in the natural gas field, and that each field should be operated as a unit. If this were done it would very greatly reduce the waste and prolong the life of the field, and, therefore, the period of time when natural gas will be available for the public's use.

## Sec. 9—Value of Natural Gas

West Virginia natural gas is purer and has about twice the heating value of any manufactured gas that can be commercially made. That is, this natural product is superior to any man-made gas. The average price of manufactured gas is now about $1.25 per "M" cu. ft. On this basis natural gas is worth $2.50 per "M" cu. ft.

In tests* made by the Department of Home Economics, Ohio State University, Columbus, Ohio, on "relative cost of five different fuels," it was found that $1.00 natural gas, when properly used, was by far the cheapest fuel. This relationship is shown in the accompanying diagram, which represents the fuel cost of five different fuels, each used for cooking a dinner consisting of thick or Swiss steak, escalloped potatoes, spinach, bread, butter, rice pudding, coffee, cream, sugar, with portions for six people:




* Kitchen Tests of relative cost of natural gas, soft coal, coal oil, gasoline and electricity for cooking—Made by the Department of Home Economics, The Ohio State University, Columbus, Ohio. Reprinted, October, 1918.

Incidentally the above emphasizes the advantage to the consumer of using natural gas at low pressures with properly directed short flames as against higher pressures and long flames.

**Sec. 10—What the Domestic Consumers Have Gained by Having Natural Gas**

From 1910 to 1918 the United Fuel Gas Company's own domestic consumers received 45 billion cu. ft. of natural gas. To replace this with manufactured gas would require 90 billion cu. ft.

| | |
|---|---|
| The cost to the consumers of the 90 billion cu. ft. @ $1.25 per "M" would be..... | $112,500,000 |
| The cost to the domestic consumers of the 45 billion cu. ft. at average rate of 22c was | 9,900,000 |
| The United Fuel Gas Company's saving to its own domestic consumers was therefore | $102,600,000 |

**Sec. 11—Industry in Transition Stage**

The natural gas industry is now in a critical period, and is in a transition stage going from a basis of large volume and low rates to lower volume and higher rates. This does not mean that the industry is on the road to destruction; on the contrary, the following of rational conservation policies will greatly lengthen the life and stabilize the industry for future service.

The reserve acreage holdings of the United Fuel Gas Company may prolong the life of its producing property beyond the average, provided a fair percentage of the untested lands shall prove valuable. Its life, however, in any event, will be greatly diminished if exhaustion continues at the rate of the past two years, due largely to the sale of gas to factories in competition with coal.

**Sec. 12—Domestic Load Characteristics**

The variation in seasonable domestic natural gas loads is shown on Plate 3. Abnormal peaks of very short duration and closely related to atmospheric temperature fluctuations are characteristic of all natural gas load curves for domestic consumption. The total monthly natural gas sold and purchased by the United Fuel Gas Company is shown on Plate 3, while the variation in the demands of the United Fuel Gas Company's own industrial and domestic consumers is shown on Plate 4. It is important to note here that the industrial load very

largely only fills in the off-peak demands of the domestic consumers. The variation in hourly rates of flow for the United Fuel Gas Company's own domestic consumers is shown in the following:

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Maximum hourly rate of flow | | | | | ..... | 2,030 | "M" | cu. ft. |
| Average | " | " | " | " | ..... | 710 | " | " |
| Minimum | " | " | " | " | ..... | 178 | " | " |

The variation in average annual domestic consumption of all of the United Fuel Gas Company's own domestic consumers is shown on Plate 5.

The variation in annual domestic consumption at Ashland, Kentucky; Ironton, Ohio; Huntington, Charleston and Spencer, West Virginia, is shown on Plates 6, 7, 8, 9 and 10.

At Louisville, Kentucky, the domestic heating service demands increased on an average of 150 "M" cu. ft. of natural gas per day for each degree below 70° Fahrenheit.

## Sec. 13—Why Industrial Gas Has Been Sold

"In the preceding section it was shown that the average load on a natural gas plant was only about one-third of the total capacity necessary to meet the winter demand. This emphasizes the many opportunities for rendering service which the domestic consumer cannot utilize. In order to sell gas cheaper to the domestic consumer and use the plant for a larger number of hours, the companies began selling gas to industrial users during the summer months, when the domestic consumption was very low. Since in most fields there is unrestricted competition between various companies, this had the immediate effect to make it impossible for any one company to conserve the gas for future use without co-operation with its competitors. The public has frowned upon any arrangements for co-operation on the theory that competition was desirable. This has resulted in a wild race between the various companies, each trying to get the gas out of the field, with the result that the supplies were drained very heavily and are, therefore, not available for further use."

—United States Fuel Administration, Use and Conservation of Natural Gas—Especially adapted for use in schools.

"The prices of natural gas for domestic consumption have generally been so low as not to provide, if only domestic sales were made, even sufficient income for overhead charges and operating expenses, so that in every case recourse has been had to large sales for industrial purposes to make up the deficiency. For these large sales which do not appreciably increase operating expenses, and do not require additional investment, and therefore do not increase overhead charges, the prices made have been relatively very low. Sometimes, of course, these sales have brought in large profits to the company, with the result that fields have been depleted in one-quarter or one-third of the time that they would have been under a different adjustment of rates and sales. Restricted use of natural gas for industrial purposes is of immeasurable benefit to a community, but unlimited and uneconomical use, because of cheapness, is a calamity for which every individual of the community will eventually have to pay."

—U. S. Bureau of Mines—Dallas, Texas, Report—January, 1916.

**Sec. 14—Reserve Acreage**

In order to render service in the future, it is necessary to carry undrilled acreage at the present time in order to have it available for future drilling. The decline of the United Fuel Gas Company's average is shown on Plate 11. The general decline for the entire state of West Virginia is shown on Plate 12.

The carrying of this reserve acreage represents a substantial part of the total cost of the service. In the case of the United Fuel Gas Company, for every dollar received, 10 cents goes back to the land owner for lease rentals and royalties. The small producer with no obligation to the public does not do this, and while his present production cost may be lower for this reason, he is unable to render the continuous service required of public utility companies.

The relation of the operated, reserve, and total natural gas acreage of the United Fuel Gas Company is shown on Plate 13.

# PART II

## CONSPICUOUS INCREASED COST FEATURES

### Sec. 15—Difference in Service Standards

The public has asked for many refinements of service that were not dreamed of by natural gas companies ten years ago. As these refinements increase the cost of the service, they must naturally have the immediate effect of increasing the cost of the gas.

### Sec. 16—Regulating Measures

Within the last ten years, numerous national, state and local regulating measures have been enforced, which are more or less troublesome to operating companies. All reports that gas companies must make require money for their preparation, and this money can come ultimately from only one source, namely, the natural gas consumer.

### Sec. 17—Rock Pressure Decline

The term "rock pressure" means the natural pressure of the gas in the gas sand, resulting from the inherent tendency of the gas to expand. Rock pressure decline curves of typical wells of the United Fuel Gas Company are shown on Plates 14 to 25. The rock pressure of wells has a direct bearing on the intake pressure that may be maintained at the gas compressors.

The output of a typical compressor operating against a discharge pressure of 300 lbs. gage is as follows, for the respective intake pressures:

| Intake pressure above atmosphere | Capacity in million cu. ft. free gas per 24 hours, based on 14.4 lbs. atmospheric pressure |
|---|---|
| 150 lbs. | 30 |
| 100 " | 20 |
| 75 " | 15 |
| 50 " | 10 |
| 30 " | 6 |
| 20 " | 4 |

This accounts for the increased compressor capacity necessary, as shown on Plate 26.

**Sec. 18—Intensive and Extensive Use of Gas Compressors**

In order to get every foot of gas out of the ground that can be obtained, it will be desirable in the future to use more compressing stations and operate existing compressing stations at lower intake pressures. In the broad public interest it will be desirable to remove every foot of gas from the ground that can be obtained, and every appliance known to gas mining should be used to bring about the most complete exhaustion of the gas sands that can be commercially obtained. The increase in horse power of compressors necessary to render service is shown on Plate 26.

**Sec. 19—Decline in Average Open Flow of Natural Gas Wells**

The term "open" or "natural flow" means merely the entire volume of gas that will issue from the mouth of a gas well when retarded only by the atmospheric pressure. While the open flow is an index of a well's delivering capacity, it is not an exact measure of its output under routine operating conditions, because the actual delivery, on account of the back pressure that the well must discharge against, will always be less than the open flow.

The decline in average open flow capacity of new wells is shown on Plate 27.

**Sec. 20—Decline in Average Annual Production**

The average decline of production per well and increasing number of wells necessary is shown on Plate 28.

**Sec. 21—Increasing Cost of Wells**

The increasing cost of producing natural gas wells is shown on Plate 29.

**Sec. 22—Increasing Length of Haul**

The increase in total length of mains in use at end of each year as an index of length of haul is shown on Plate 30.

**Sec. 23—Commodity Prices**

Prices of wholesale clothing, wholesale metals, wholesale farm products and wholesale food products in the United States have increased much faster than the United Fuel Gas Company's domestic rates, as shown on Plates 31 to 34 inclusive.

## Sec. 24—Increasing Labor Costs

The following shows some representative unit prices of labor for the years 1913 and 1918, with the percentage of increase:

| | 1913 | 1918 | Percentage increase 1918 over 1913 |
|---|---|---|---|
| Tester | $100.00 mo. | $160.00 mo. | 60% |
| Rouster | 71.50 " | 95.00 " | 33% |
| Line Walker | 66.00 " | 95.00 " | 44% |
| Well Blower | 71.50 " | 100.00 " | 39% |
| Laborer | 71.50 " | 90.00 " | 25% |
| Well Man | 71.50 " | 90.00 " | 25% |
| Station Man | 71.50 " | 95.00 " | 33% |
| Meter Man | 75.00 " | 100.00 " | 33% |
| Teamster | 65.00 " | 100.00 " | 54% |
| Lineman | 65.00 " | 110.00 " | 69% |
| Compr. Sta. Engineer | 70.00 " | 120.00 " | 71% |
| Tool Dresser | 4.25 day | 8.00 day | 88% |
| Driller | 5.25 " | 9.00 " | 71% |

## Sec. 25—Increasing Material Costs

The following shows some representative prices of typical natural gas plant material for the years 1913 and 1918, with the percentage of increase for this 5-year period:

| | Price 1913 | Price 1918 | Percentage increase 1918 over 1913 |
|---|---|---|---|
| Manilla Drilling Cables | .1425 | .34 | 138% |
| Rig Irons | 142.50 | 266.65 | 87% |
| Rig Timbers | 20.00 M. | 50.00 M. | 150% |
| Rig Patterns | 19.60 M. | 50.00 M. | 155% |
| Pipe—1" | .033 | .105 | 218% |
| " 2" | .08 | .19 | 137% |
| Tubing—2" | .12 | .2975 | 148% |
| " 3" | .19 | .51 | 168% |
| Casing—5 3/16" | .31 | .81 | 161% |
| " 6 5/8" | .46 | 1.22 | 165% |
| " 8 1/4" | .62 | 1.50 | 141% |
| Belts—95 ft. | .56 ft. | 1.40 ft. | 150% |
| Anchor Packer | 22.75 | 39.89 | 75% |
| Gate Valves—2" | 4.43 | 12.00 | 170% |
| " " 3" | 9.60 | 20.40 | 112% |
| " " 4" | 14.65 | 29.75 | 103% |
| Line Pipe—3" | .15 | .475 | 216% |
| " " 6" | .37 | 1.19 | 221% |
| " " 8" | .62 | 1.76 | 184% |
| " " 10" | .94 | 2.25 | 139% |

**Sec. 26—Increasing Taxes**

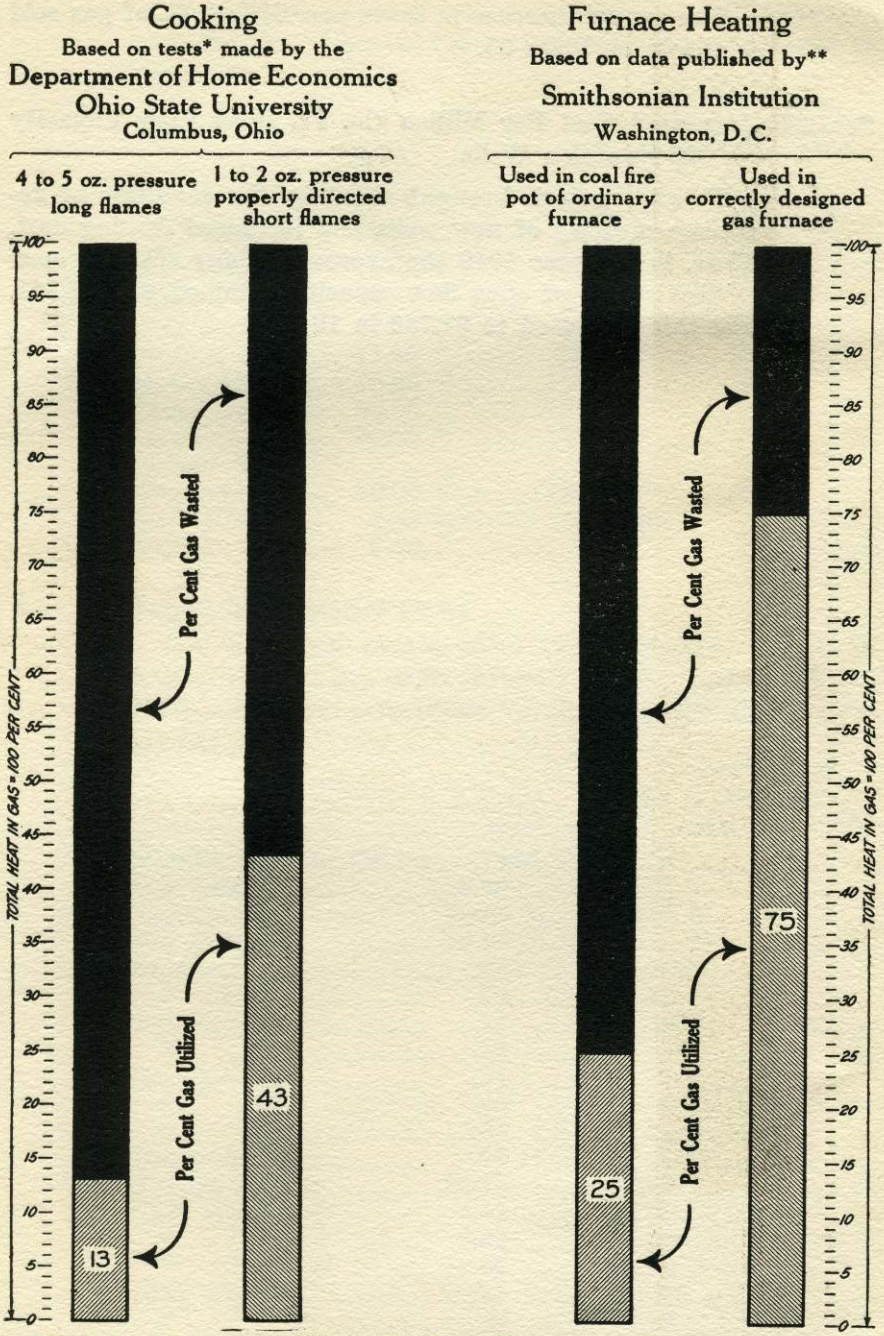
The annual increase in taxes per "M" cu. ft. of gas sold is shown on Plate 35.

**Sec. 27—Increased Cost Per Million Cu. Ft. Open Flow Capacity of New Gas Wells**

This increase is brought about by the condition of declining capacity of new wells and increased drilling cost. Thus, in the year 1910 the average drilling cost for each million cu. ft. of open flow capacity obtained was $1,248, and this increased to $2,730 in 1918.

## PLATE 1

### HOME WASTES OF NATURAL GAS

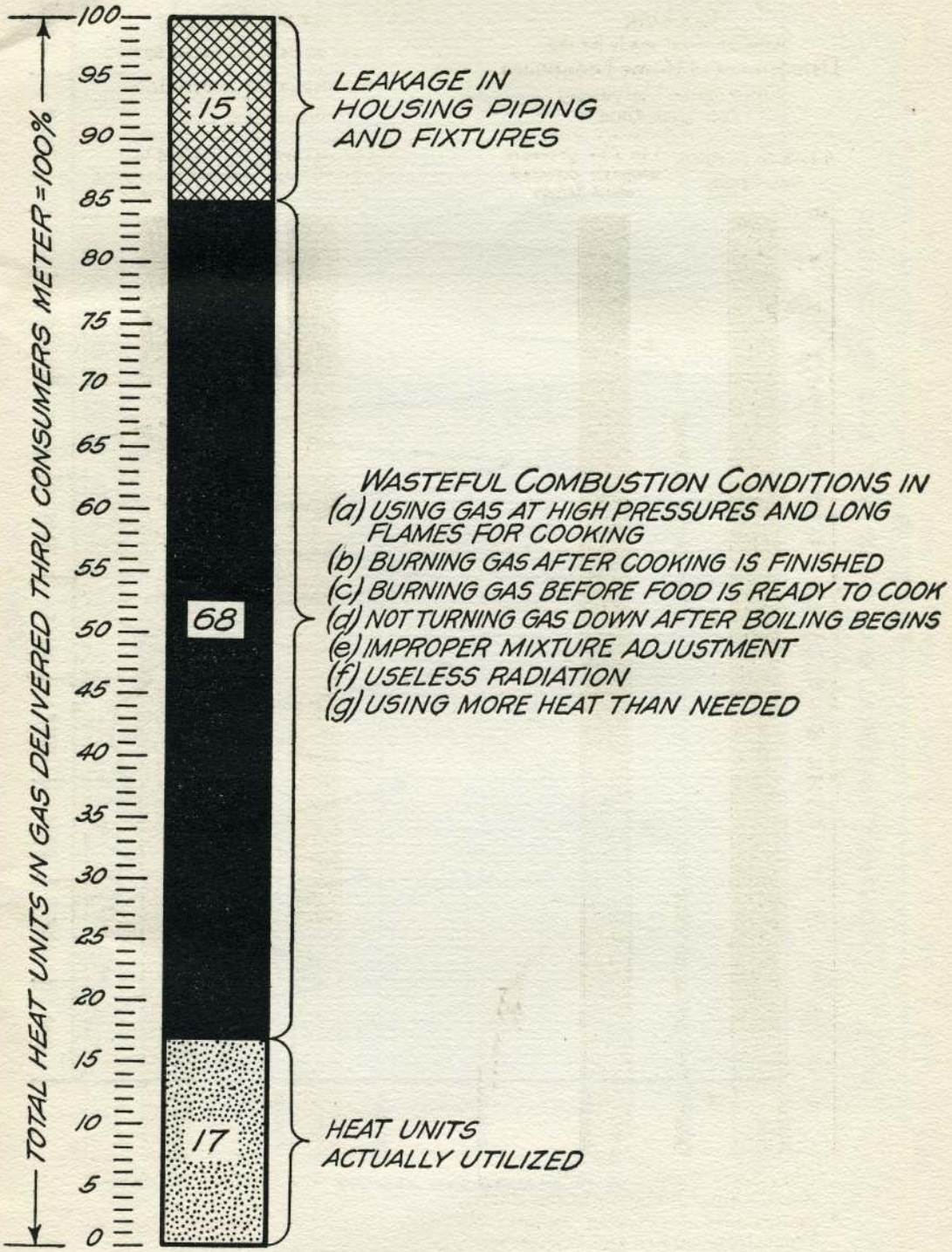



*Ohio State University Bulletin No. 28. Effect of Gas Pressure on Natural Gas Cooking Operation in the Home.

**Smithsonian Institution Bulletin No. 102, Part 7 on "Natural Gas: its Production, Service and Conservation."

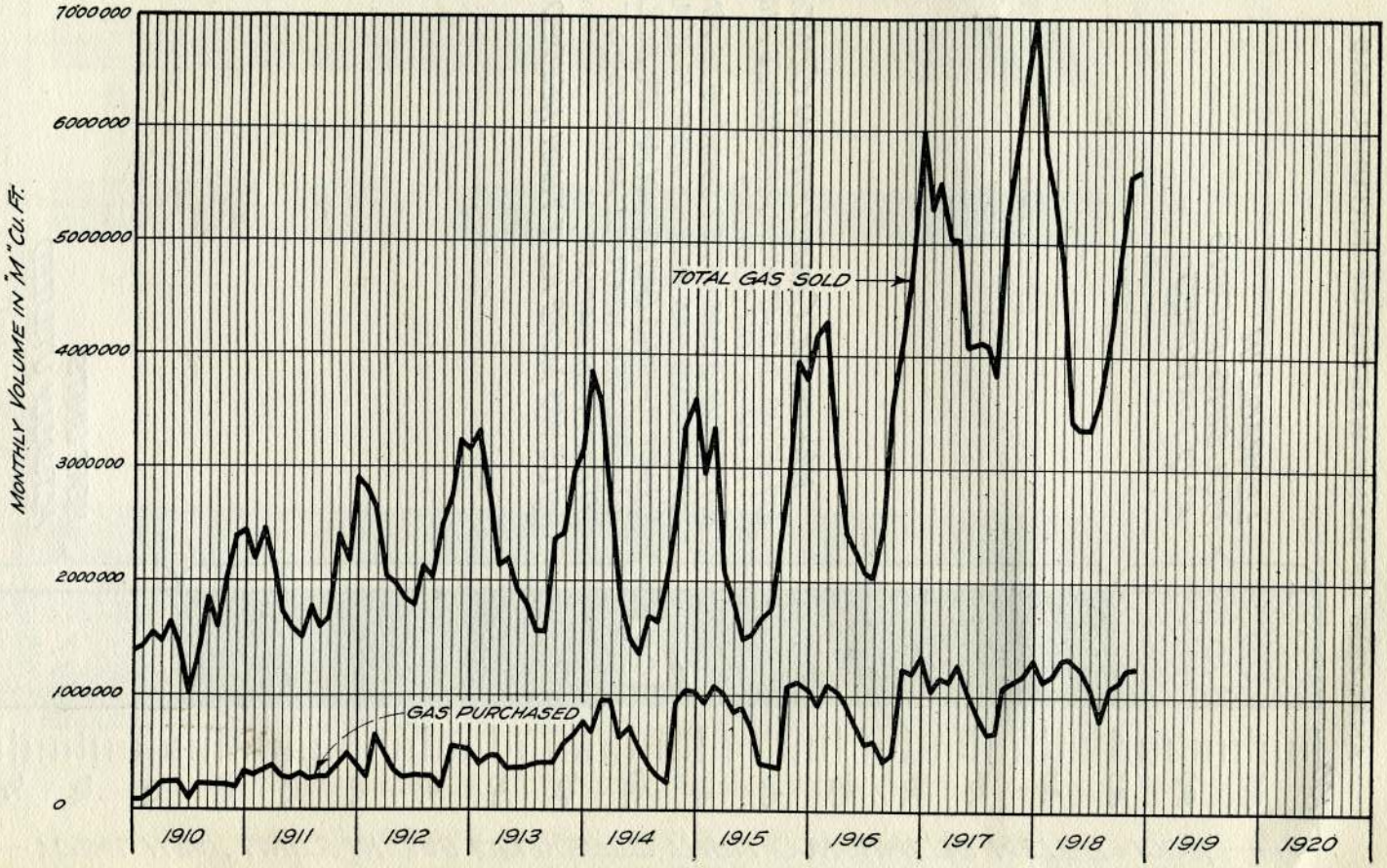
## PLATE 2

### ANALYSIS OF HOME WASTES OF NATURAL GAS



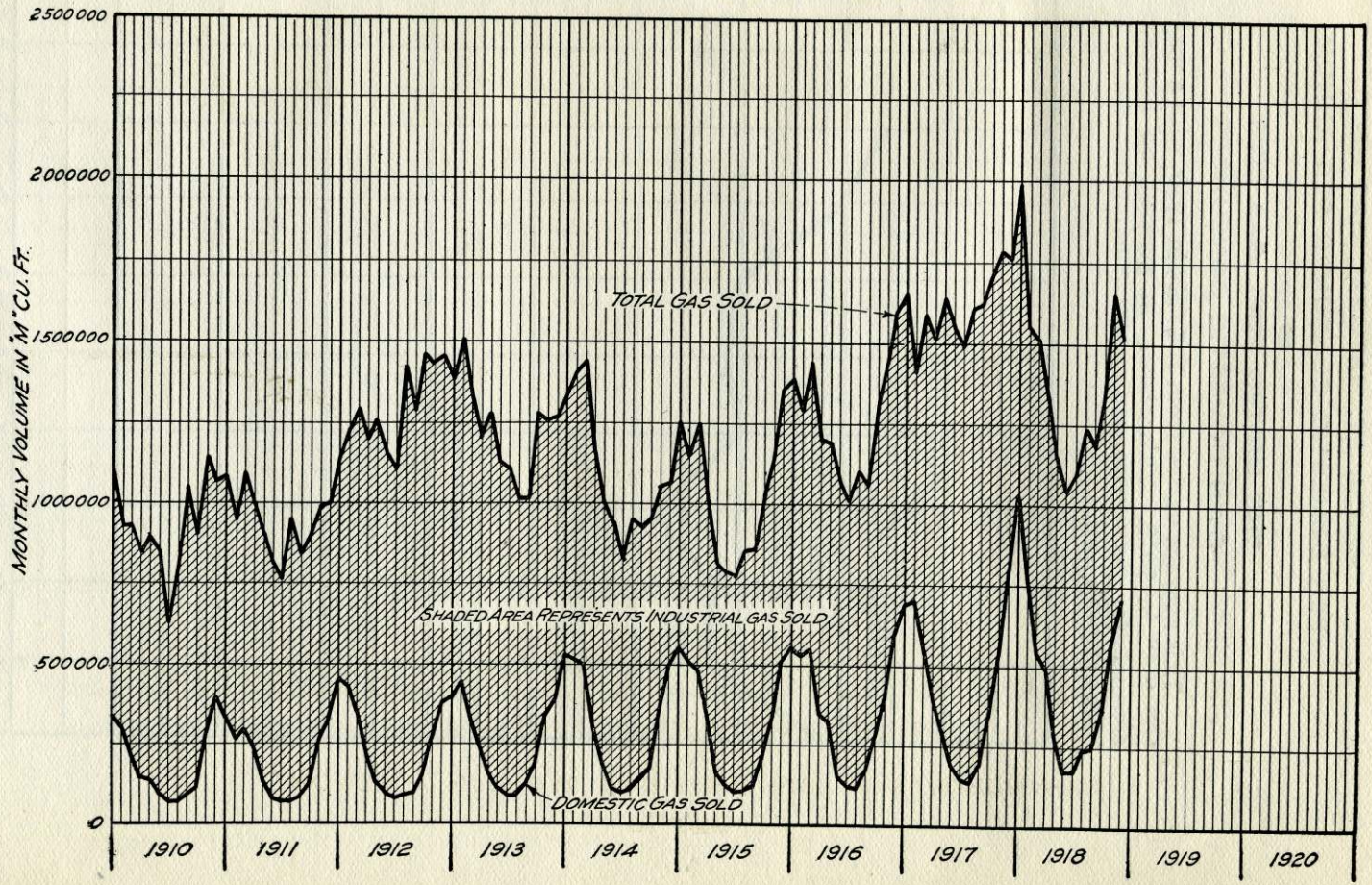
# PLATE 3

## MONTHLY NATURAL GAS SOLD AND GAS PURCHASED
## OF
## THE UNITED FUEL GAS COMPANY



# PLATE 4

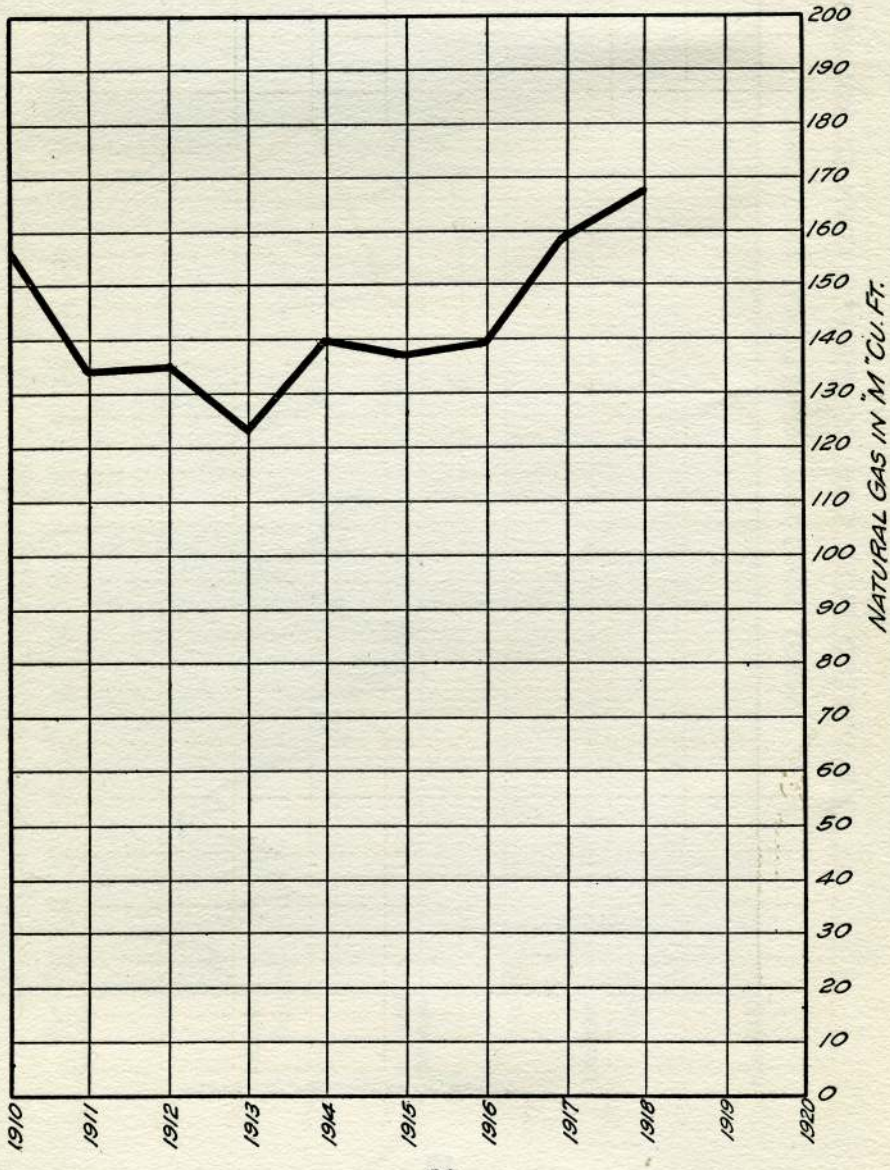
## MONTHLY DOMESTIC AND INDUSTRIAL NATURAL GAS SOLD TO THE UNITED FUEL GAS COMPANY'S OWN CONSUMERS IN WEST VIRGINIA, KENTUCKY, AND OHIO



# PLATE 5

## "M" CU. FT. NATURAL GAS USED PER DOMESTIC CONSUMER PER ANNUM BY THE UNITED FUEL GAS CO'S OWN DOMESTIC CONSUMERS

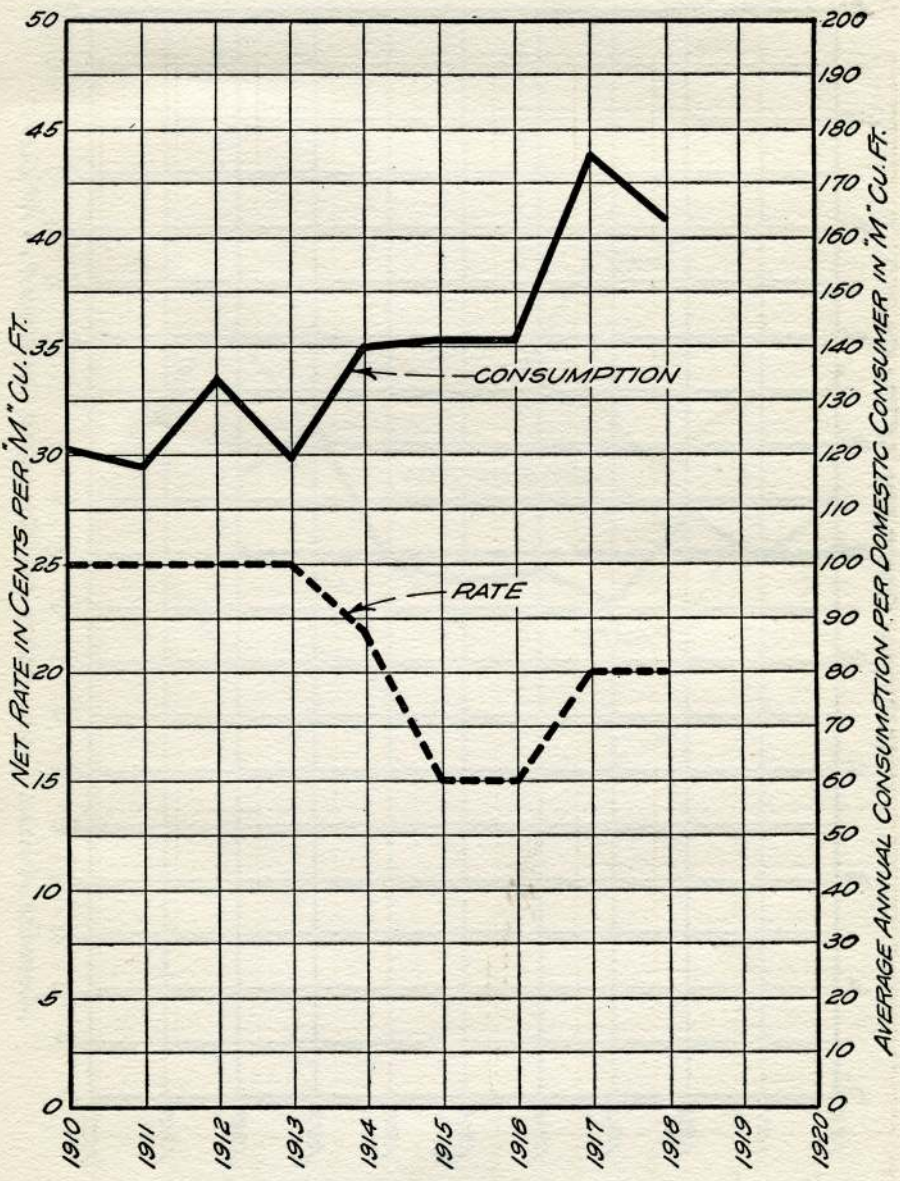
This average varied from 156 "M" in 1910, with a maximum of 167 "M" in 1918. This shows, in general, an increase in the demands for gas service, and a corresponding increase in the variability of peak load.



# PLATE 6

## DOMESTIC NATURAL GAS RATES AND DOMESTIC NATURAL GAS CONSUMPTION OF THE UNITED FUEL GAS COMPANY, AT ASHLAND, KY.

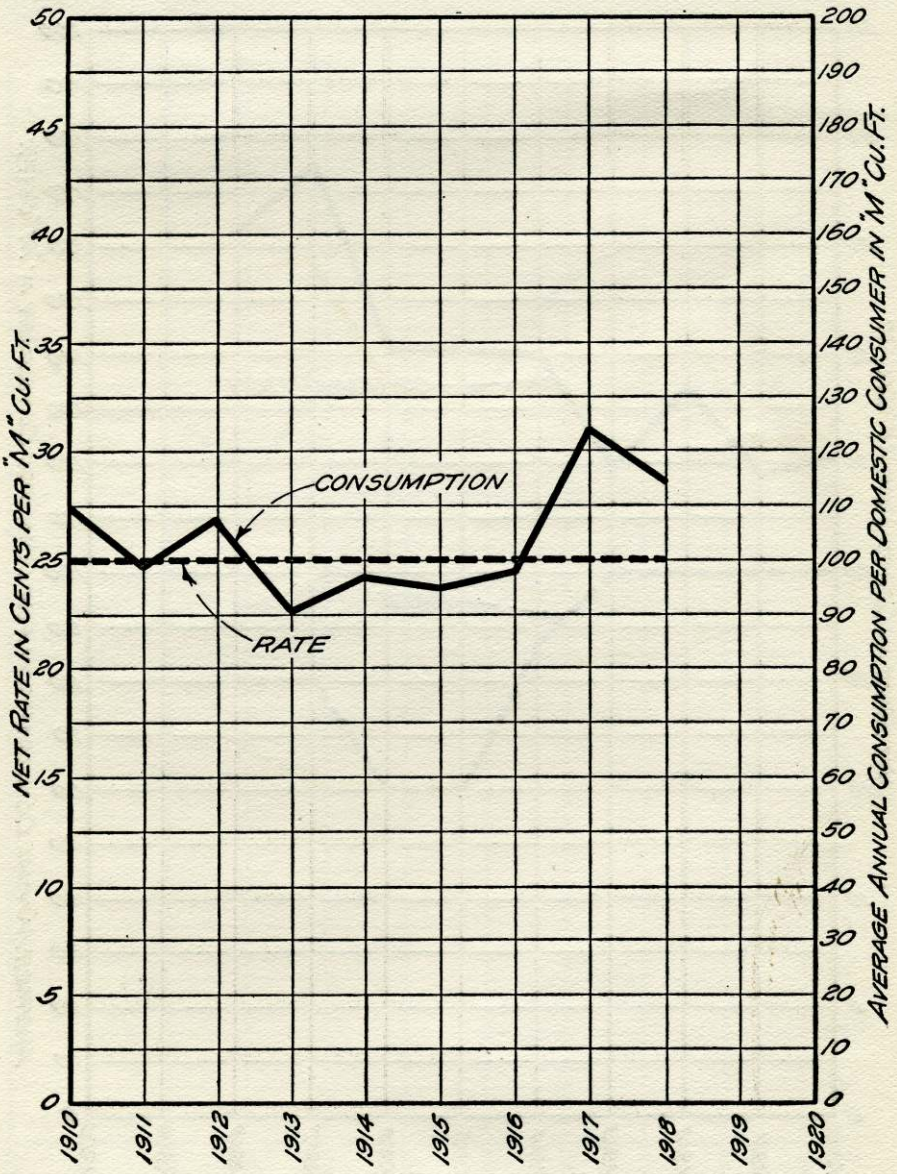
The consumption increased from 121 "M" cu. ft. in 1910 to 163 "M" cu. ft. in 1918. During this same period the rate decreased from 25c net per "M" cu. ft. to 20c net per "M" cu. ft.



# PLATE 7

## DOMESTIC NATURAL GAS RATES
AND
## DOMESTIC NATURAL GAS CONSUMPTION
OF
## THE UNITED FUEL GAS COMPANY, AT IRONTON, OHIO

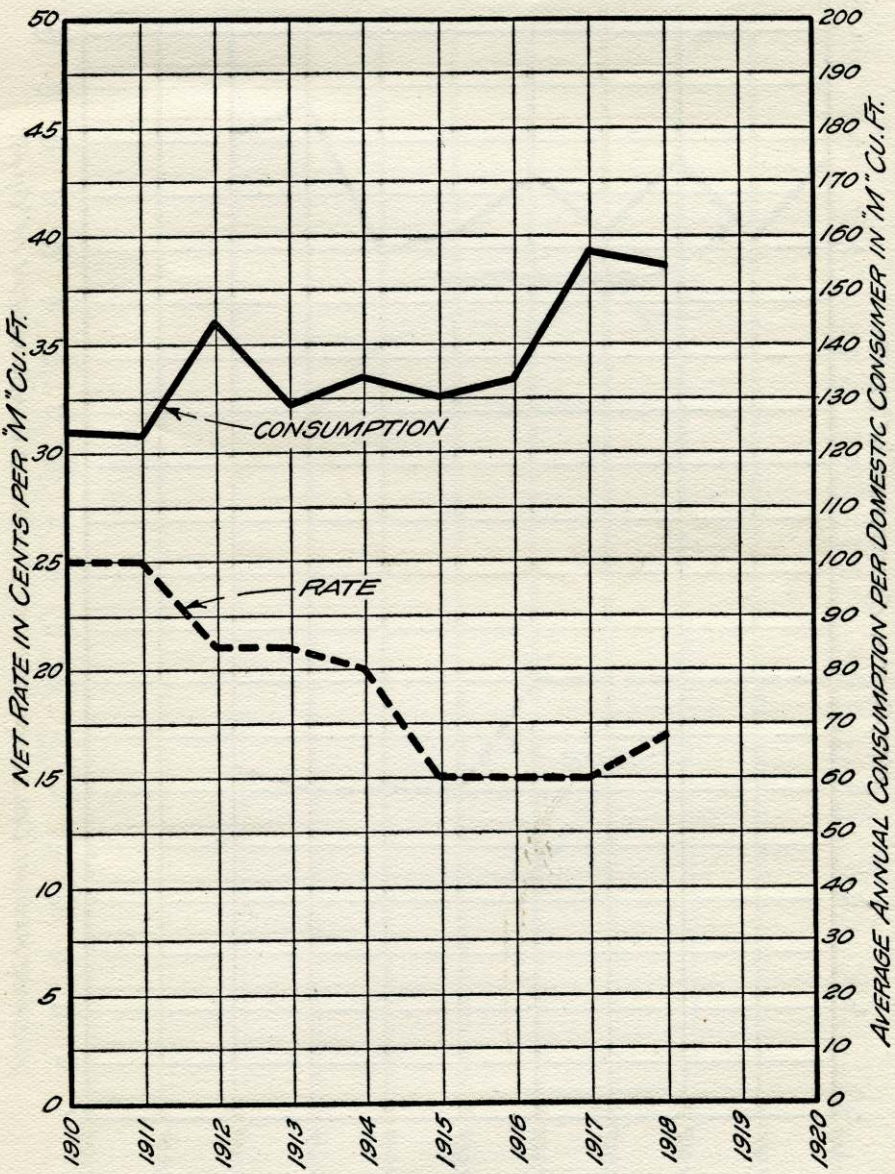
The consumption increased from 110 "M" cu. ft. in 1910 to 114 "M" cu. ft. in 1918. During this same period the rate remained uniform.



# PLATE 8

## DOMESTIC NATURAL GAS RATES
AND
## DOMESTIC NATURAL GAS CONSUMPTION
OF
## THE UNITED FUEL GAS CO., AT HUNTINGTON, W. VA.

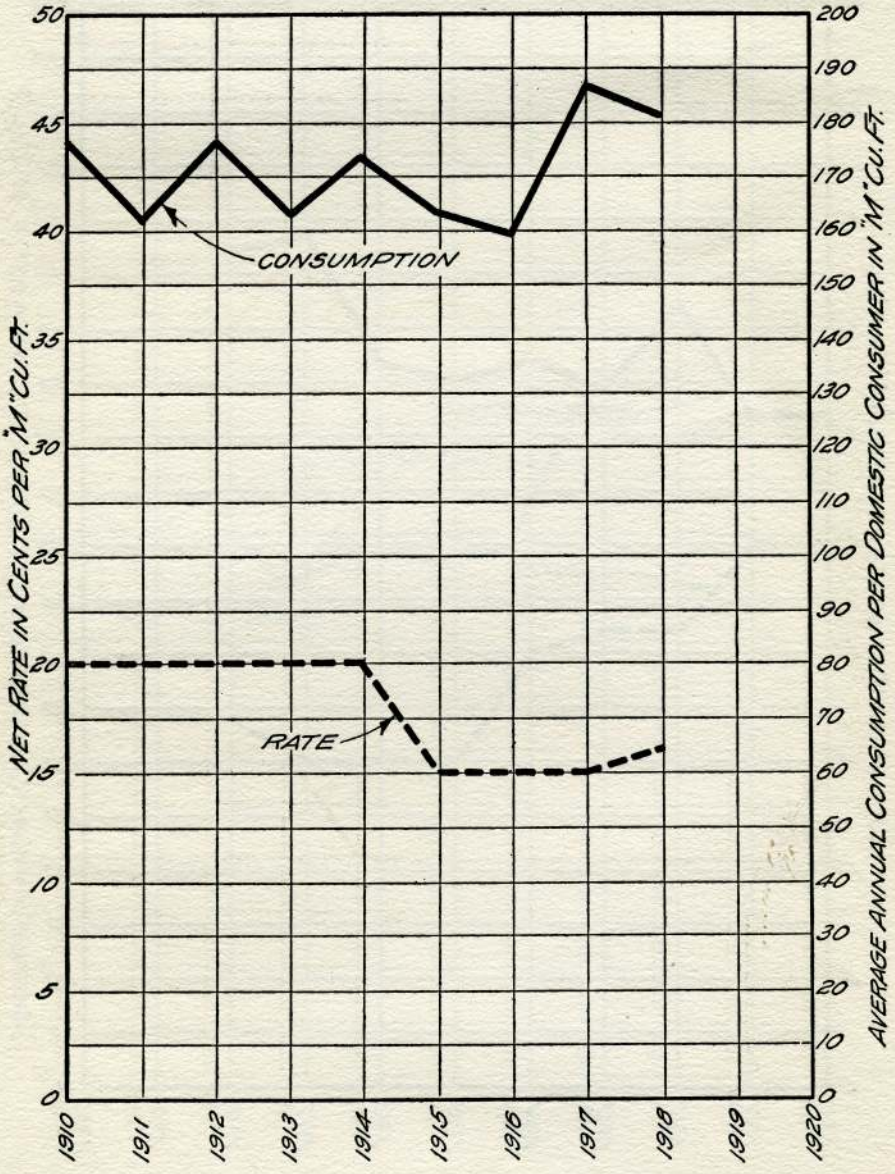
The consumption increased from 124 "M" cu. ft. in 1910 to 154 "M" cu. ft. in 1918. During this same period the rate decreased from 25c net per "M" cu. ft. to 17c net per "M" cu. ft.



# PLATE 9

## DOMESTIC NATURAL GAS RATES
AND
## DOMESTIC NATURAL GAS CONSUMPTION
OF
## THE UNITED FUEL GAS CO., AT CHARLESTON, W. VA.

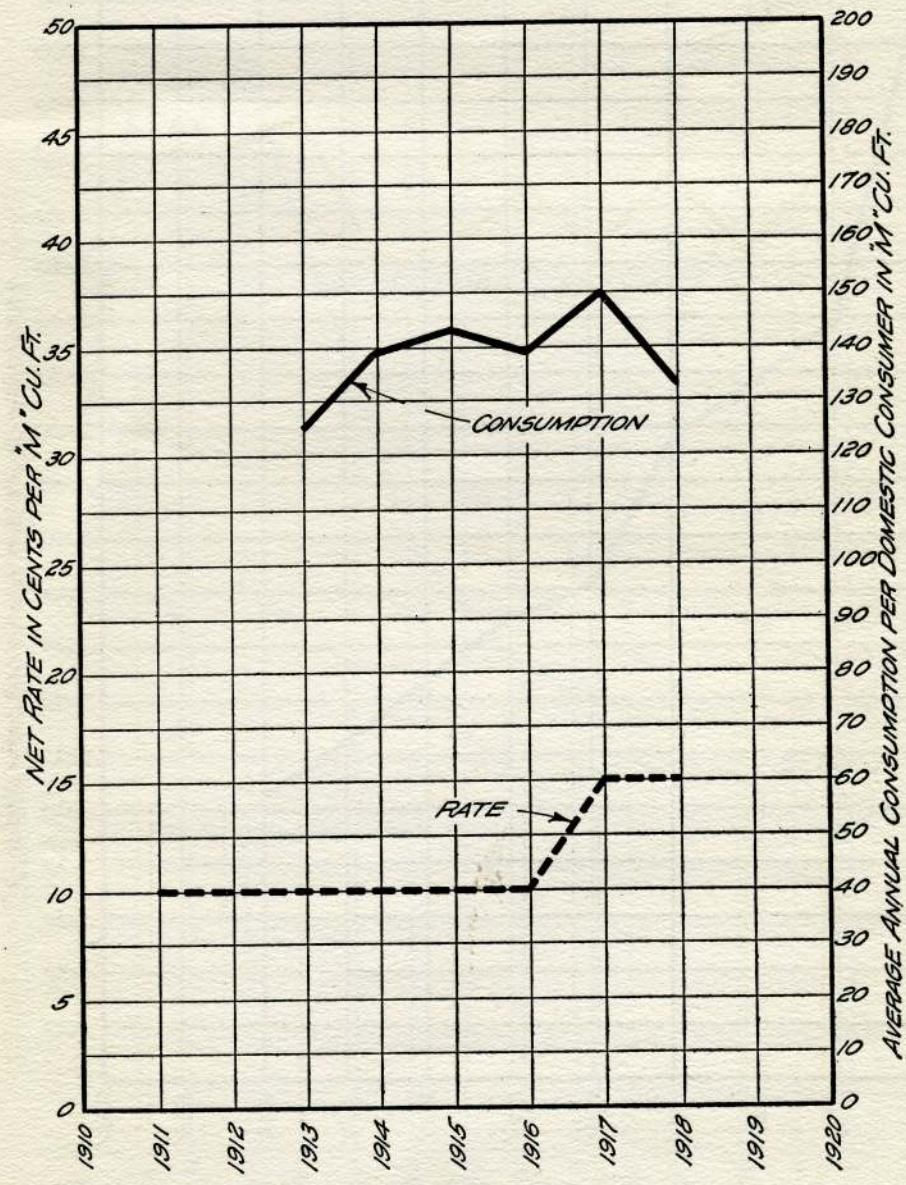
The consumption increased from 176 "M" cu. ft. in 1910 to 181 "M" cu. ft. in 1918. During this same period the rate decreased from 20c net per "M" cu. ft. to 16c net per "M" cu. ft.



# PLATE 10

## DOMESTIC NATURAL GAS RATES AND DOMESTIC NATURAL GAS CONSUMPTION OF THE UNITED FUEL GAS COMPANY, AT SPENCER, W. VA.

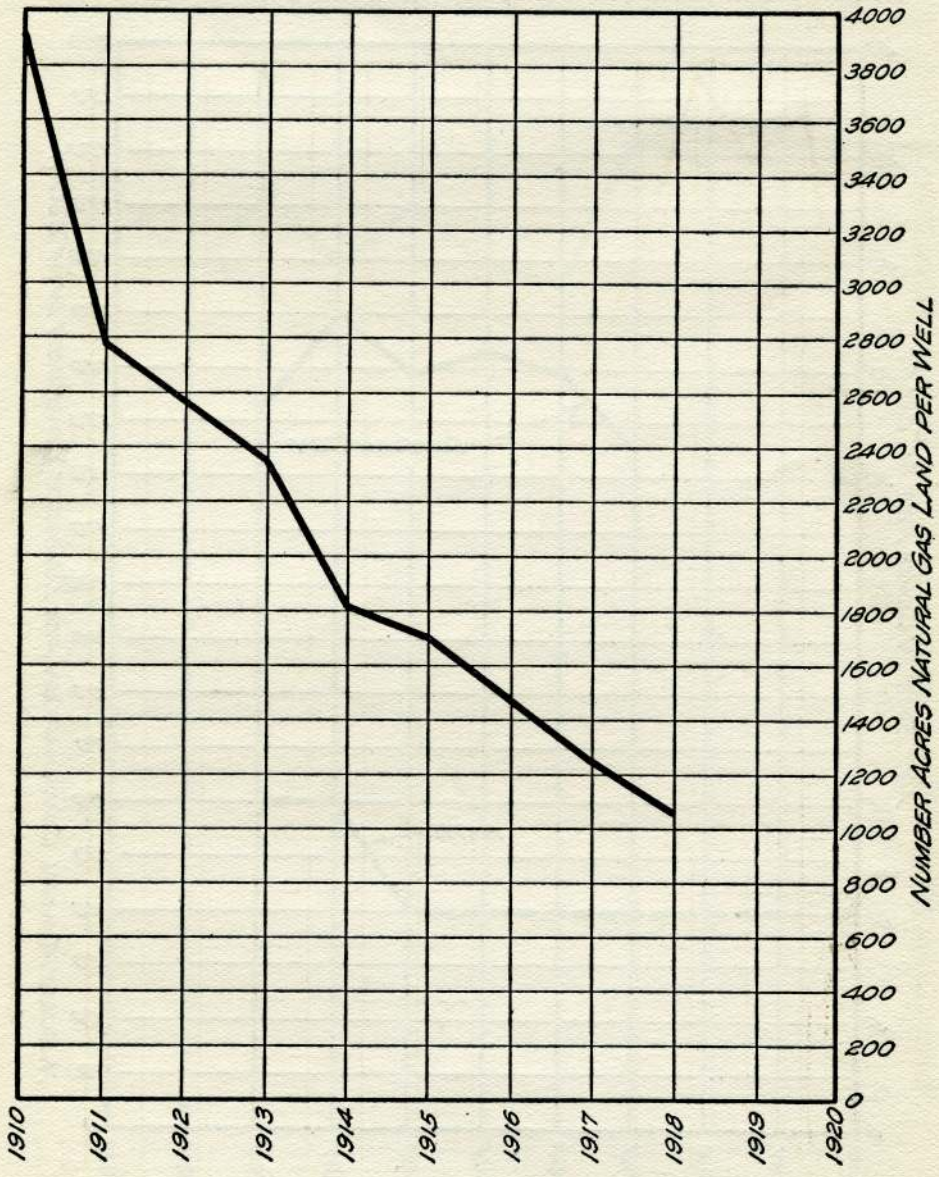
The consumption increased from 125 "M" cu. ft. in 1913 to 133 "M" cu. ft. in 1918. During this same period the rate increased from 10c net per "M" cu. ft. to 15c net per "M" cu. ft.



## PLATE 11

### DECLINE IN NUMBER ACRES NATURAL GAS LAND RESERVED FOR EACH PRODUCING NATURAL GAS WELL OF THE UNITED FUEL GAS COMPANY, IN W. VA. AND KY.

In 1910 an average of 3,912 acres was held for each producing well. This declined by 1918 to 1,074 acres.

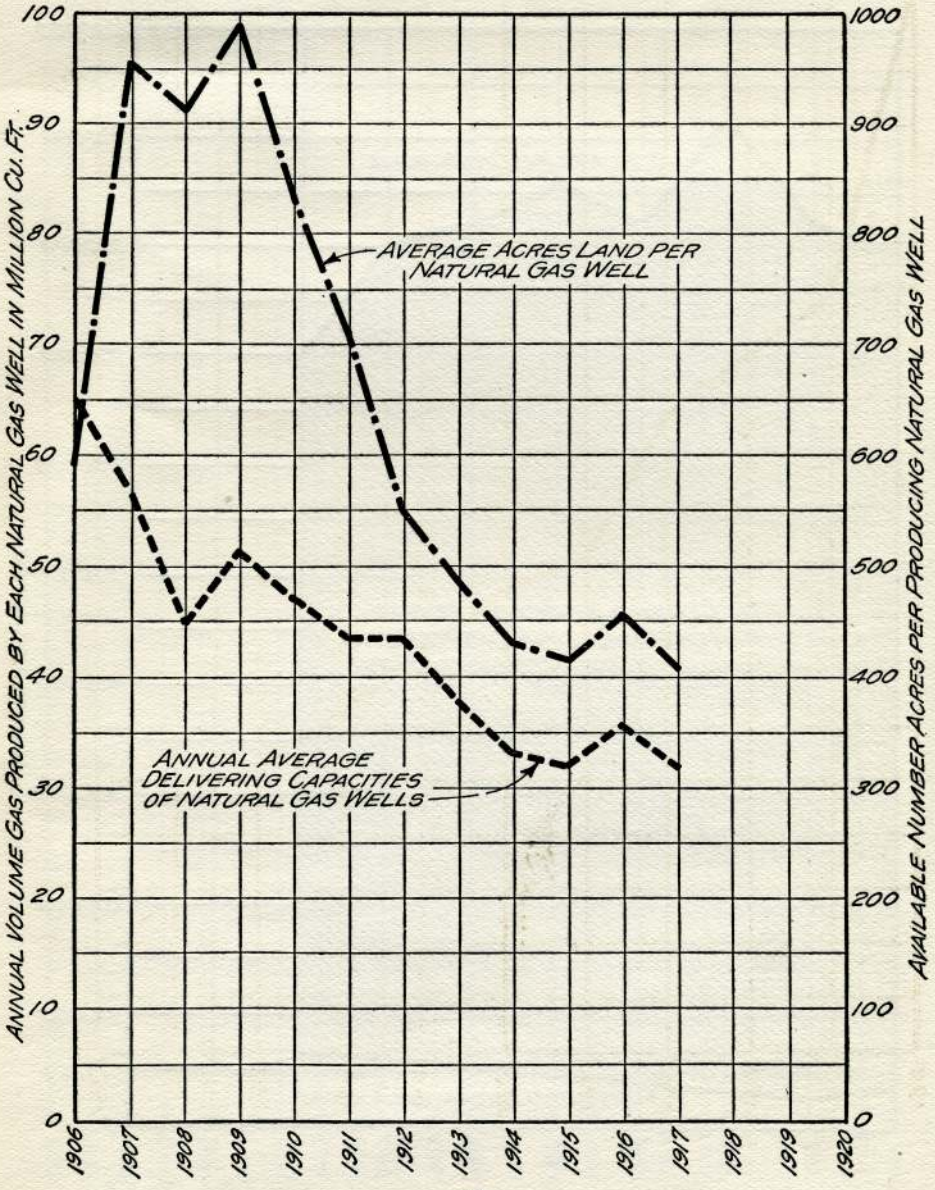


# PLATE 12

## GENERAL DECLINE WEST VIRGINIA

## NATURAL GAS RESOURCES

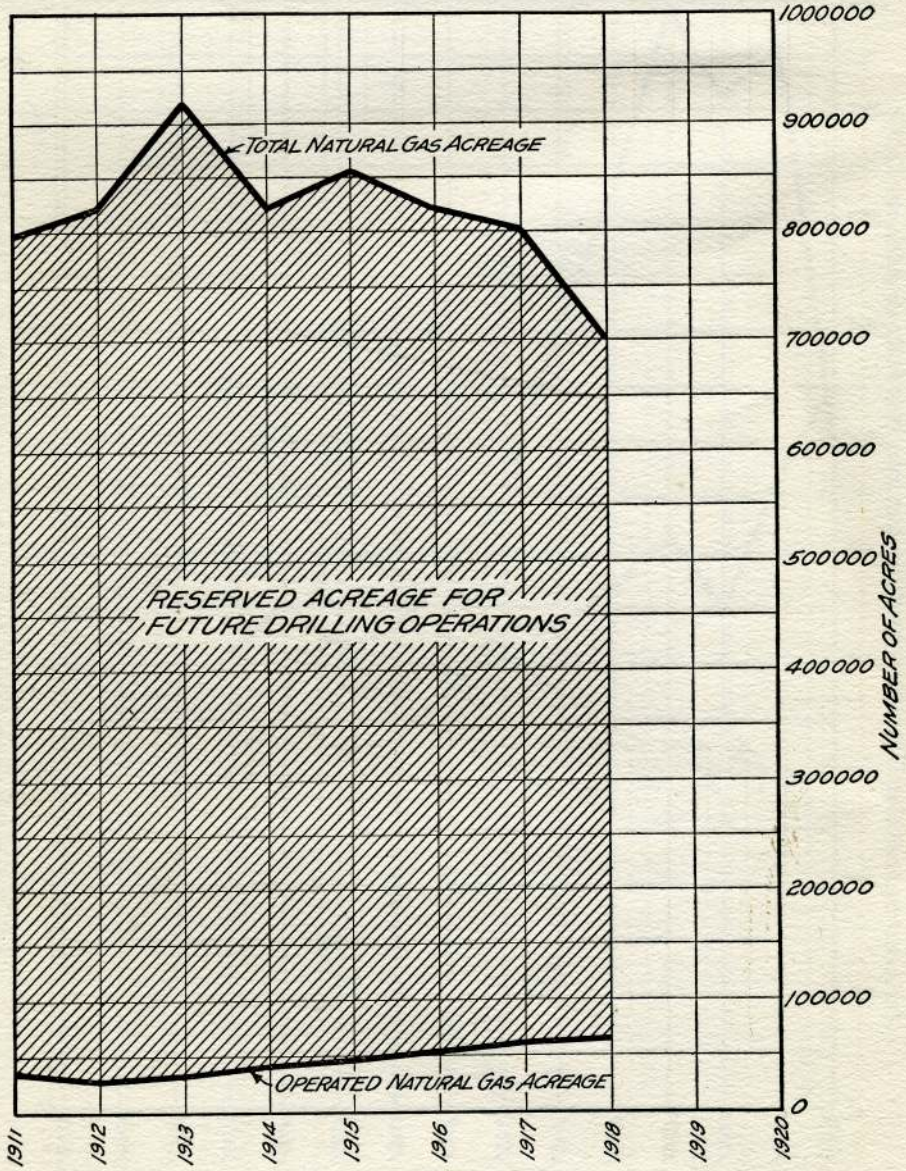
The following comparisons are based on data compiled by the United States Geological Survey. The average number of acres land held for each natural gas well in 1906 was 586 acres, and this increased to 994 acres in 1909 and then declined to 406 acres by 1917. The annual average delivering capacities of natural gas wells in 1906 was 65 million cu. ft. and this declined to 32 million cu. ft. by 1917; that is, in 11 years the average delivering capacity was halved.



# PLATE 13

## OPERATED, RESERVE AND TOTAL NATURAL GAS ACREAGE OF THE UNITED FUEL GAS COMPANY, IN W. VA. AND KY.

The shaded area, which is the difference between the total and operated acreage, represents the reserve acreage. While the operated acreage has about doubled, the number of producing wells has more than trebled so that the average per well has declined, as shown on Plate 11.



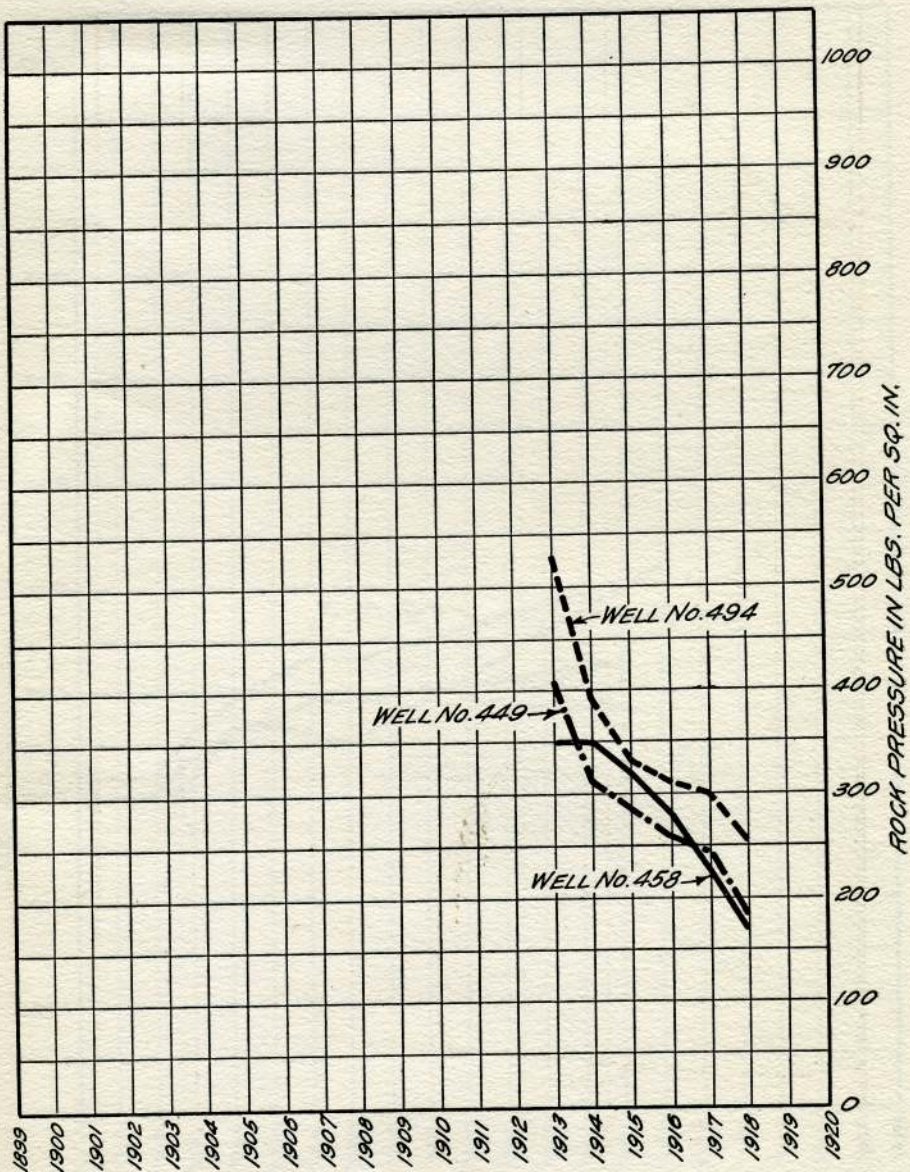
# PLATE 14

## ROCK PRESSURE DECLINE
OF
## TYPICAL NATURAL GAS WELLS IN WEIR SAND
OF
## THE UNITED FUEL GAS COMPANY
## IN BIG SANDY DIST., KANAWHA CO., W. VA.

Well No. 494, drilled in 1913, had an original rock pressure of 530 pounds; by 1918 this declined to 255 pounds.

Well No. 449, drilled in 1913, had an original rock pressure of 410 pounds; by 1918 this declined to 185 pounds.

Well No. 458, drilled in 1913, had an original rock pressure of 350 pounds; by 1918 this declined to 170 pounds.



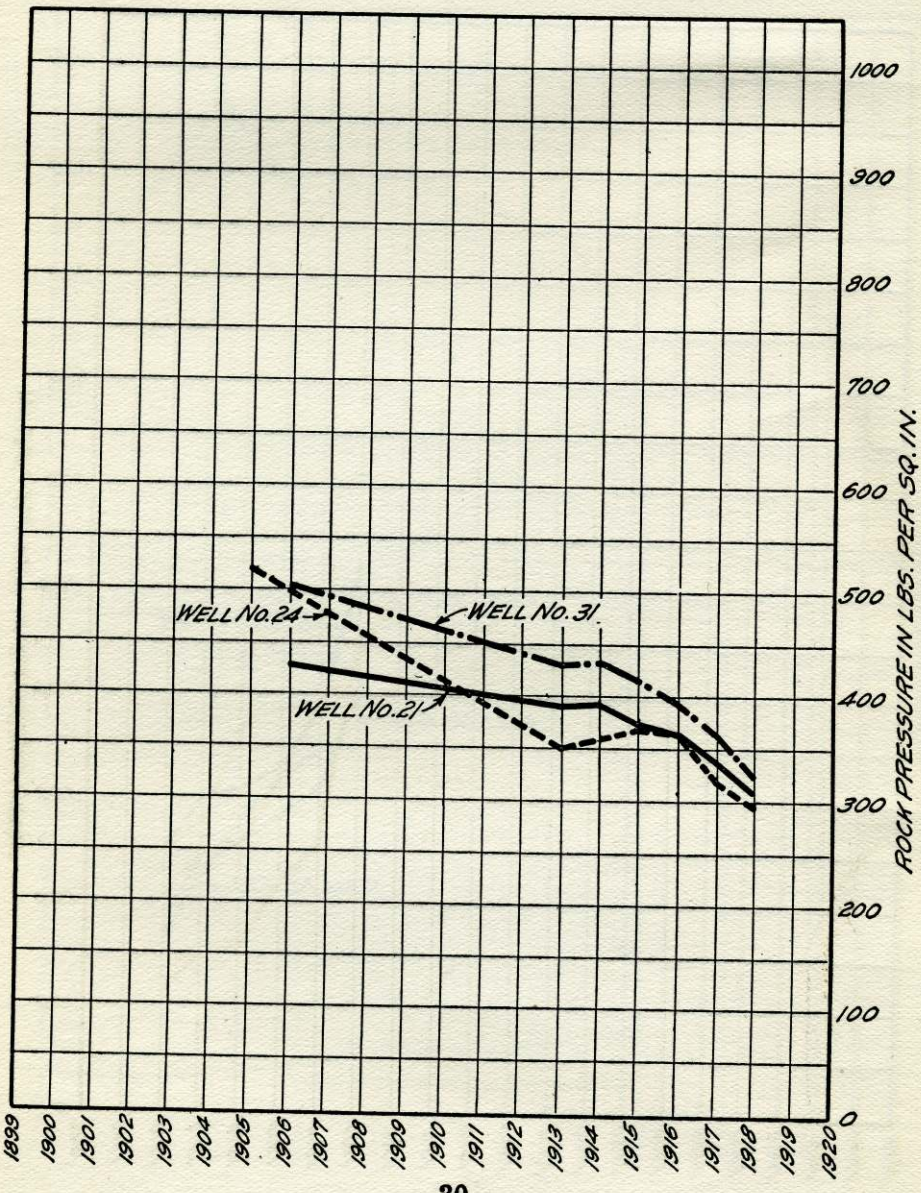
# PLATE 15

## ROCK PRESSURE DECLINE
OF
## TYPICAL NATURAL GAS WELLS IN BIG INJUN SAND
OF
## THE UNITED FUEL GAS COMPANY
IN BIG SANDY DIST., KANAWHA CO., W. VA.

Well No. 21, drilled in 1906, had an original rock pressure of 430 pounds; by 1918 this declined to 310 pounds.

Well No. 24, drilled in 1905, had an original rock pressure of 520 pounds; by 1918 this declined to 295 pounds.

Well No. 31, drilled in 1906, had an original rock pressure of 505 pounds; by 1918 this declined to 325 pounds.



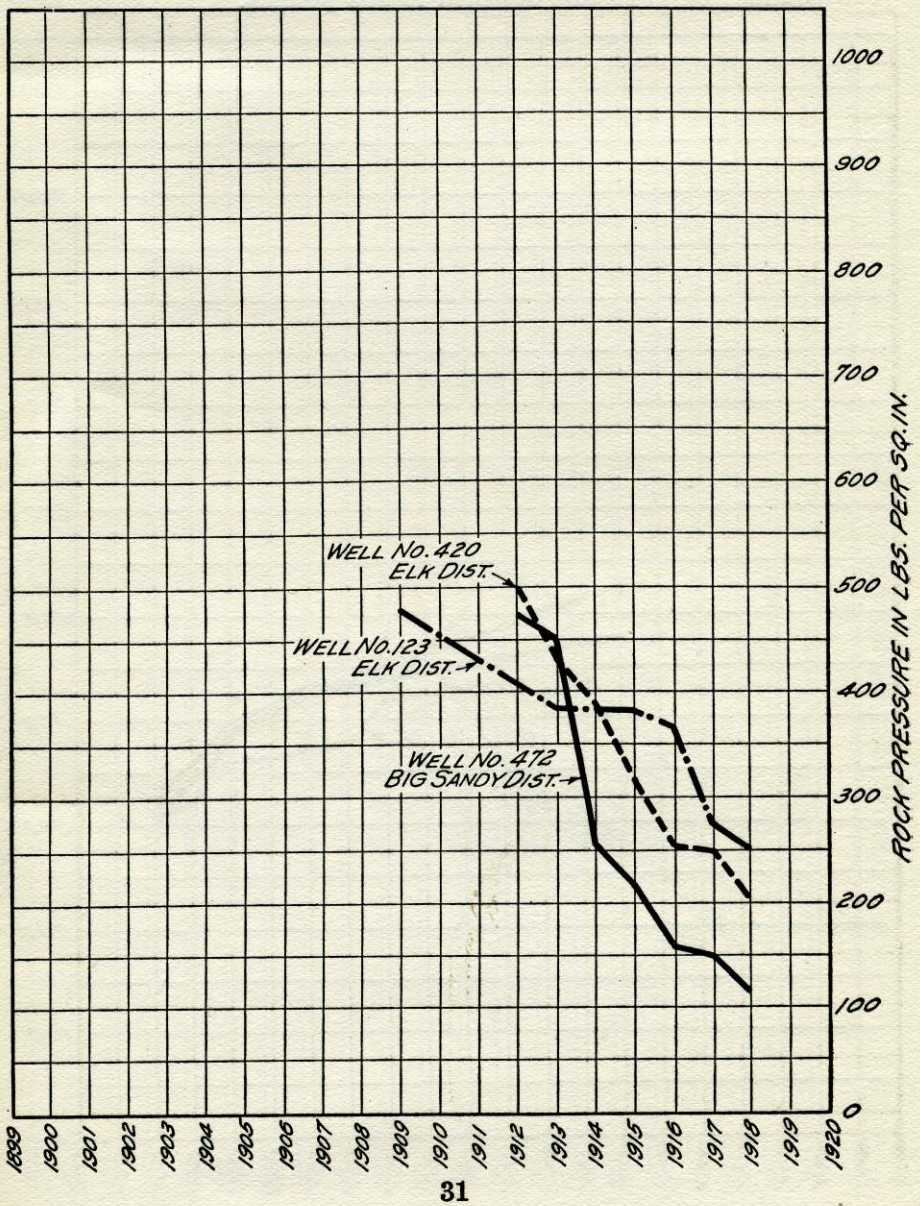
# PLATE 16

## ROCK PRESSURE DECLINE OF TYPICAL NATURAL GAS WELLS IN SQUAW SAND OF THE UNITED FUEL GAS COMPANY IN KANAWHA CO., W. VA.

Well No. 472, drilled in 1912, had an original rock pressure of 475 pounds; by 1918 this declined to 115 pounds.

Well No. 123, drilled in 1909, had an original rock pressure of 480 pounds; by 1918 this declined to 252 pounds.

Well No. 420, drilled in 1912, had an original rock pressure of 500 pounds; by 1918 this declined to 205 pounds.



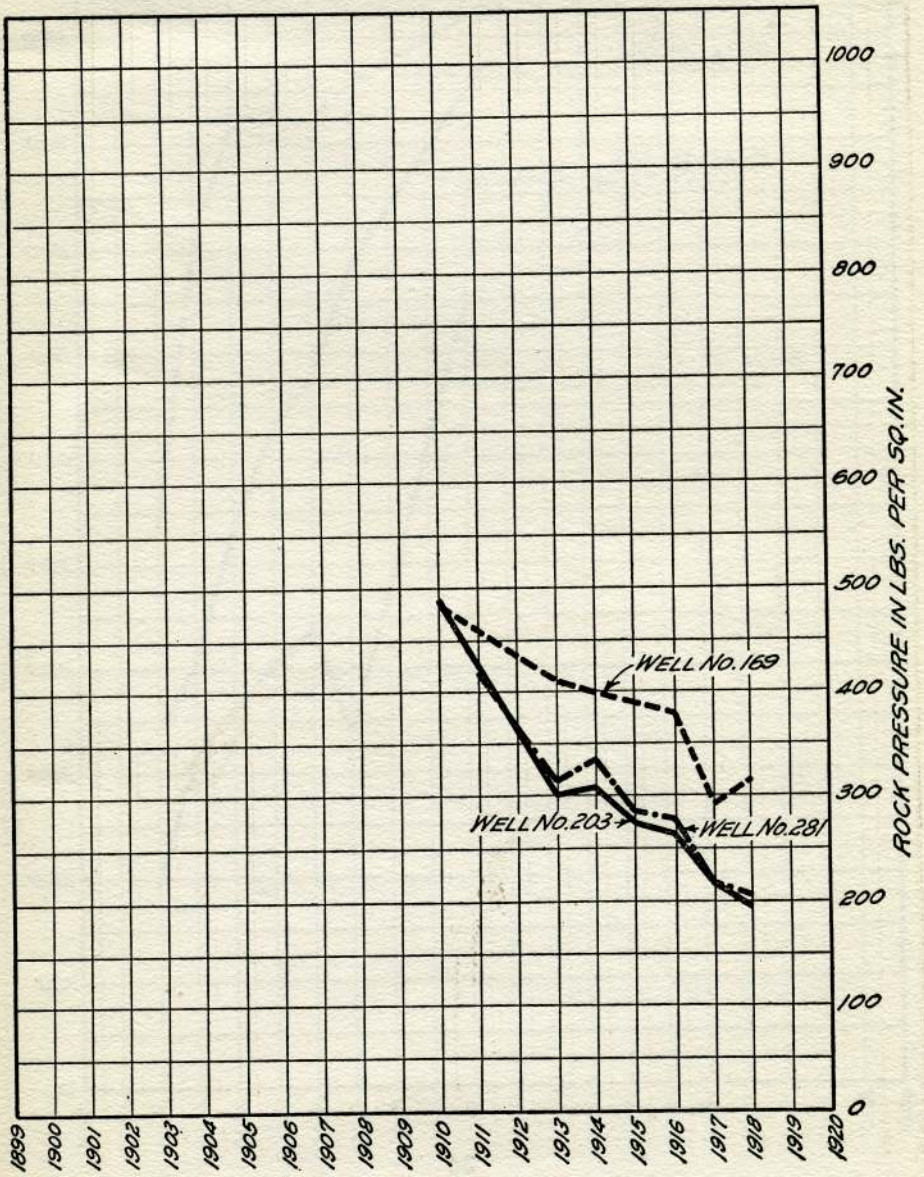
# PLATE 18

## ROCK PRESSURE DECLINE OF TYPICAL NATURAL GAS WELLS IN BIG INJUN SAND OF THE UNITED FUEL GAS COMPANY IN UNION DIST., CLAY COUNTY, W. VA.

Well No. 169, drilled in 1910, had an original rock pressure of 485 pounds; by 1918 this declined to 315 pounds.

Well No. 281, drilled in 1911, had an original rock pressure of 420 pounds; by 1918 this declined to 205 pounds.

Well No. 203, drilled in 1910, had an original rock pressure of 490 pounds; by 1918 this declined to 195 pounds.



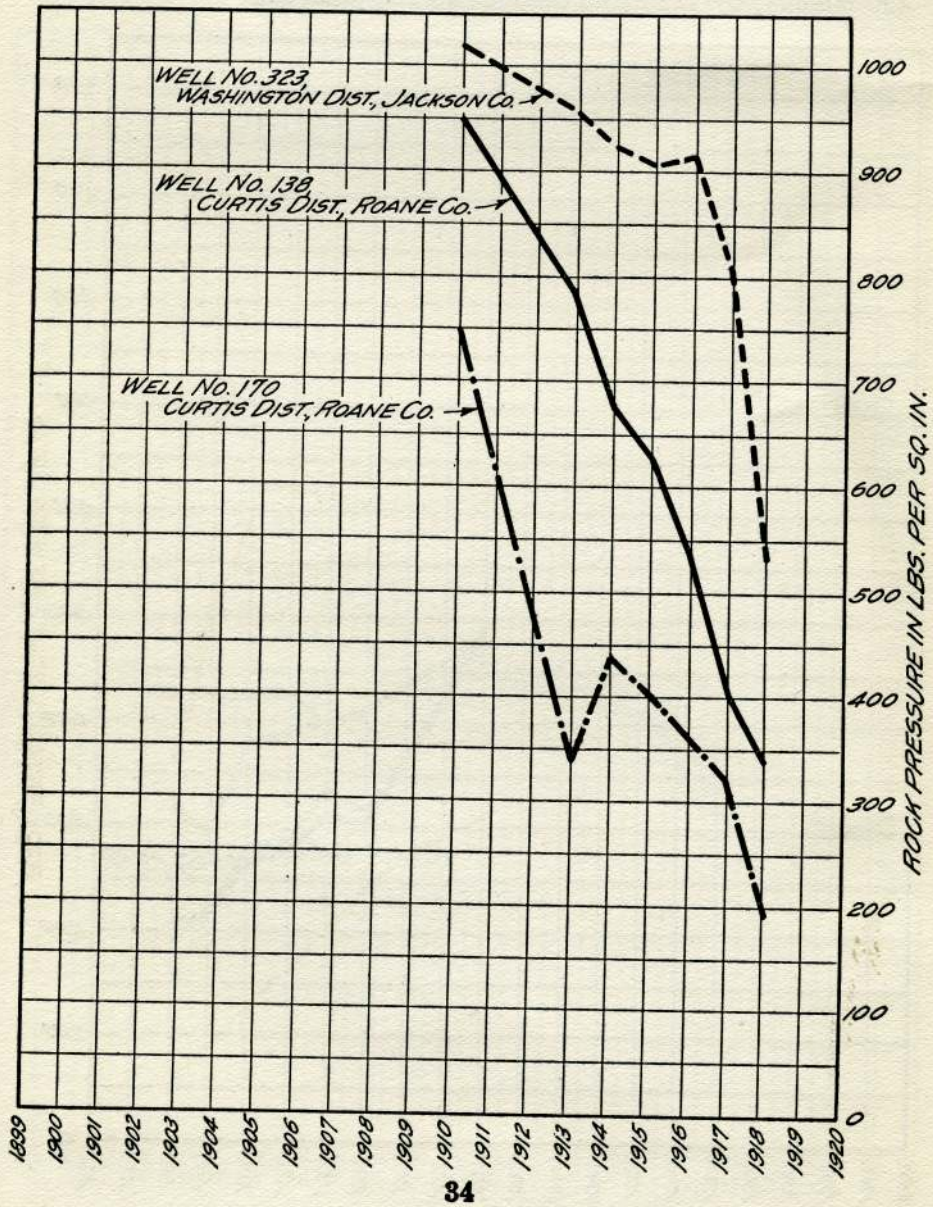
# PLATE 19

## ROCK PRESSURE DECLINE
OF
## TYPICAL NATURAL GAS WELLS IN BEREA SAND
OF
## THE UNITED FUEL GAS COMPANY
## IN JACKSON AND ROANE COUNTIES, W. VA.

Well No. 323, drilled in 1910, had an original rock pressure of 1020 pounds; by 1918 this declined to 535 pounds.

Well No. 138, drilled in 1910, had an original rock pressure of 950 pounds; by 1918 this declined to 338 pounds.

Well No. 170, drilled in 1910, had an original rock pressure of 750 pounds; by 1918 this declined to 195 pounds.



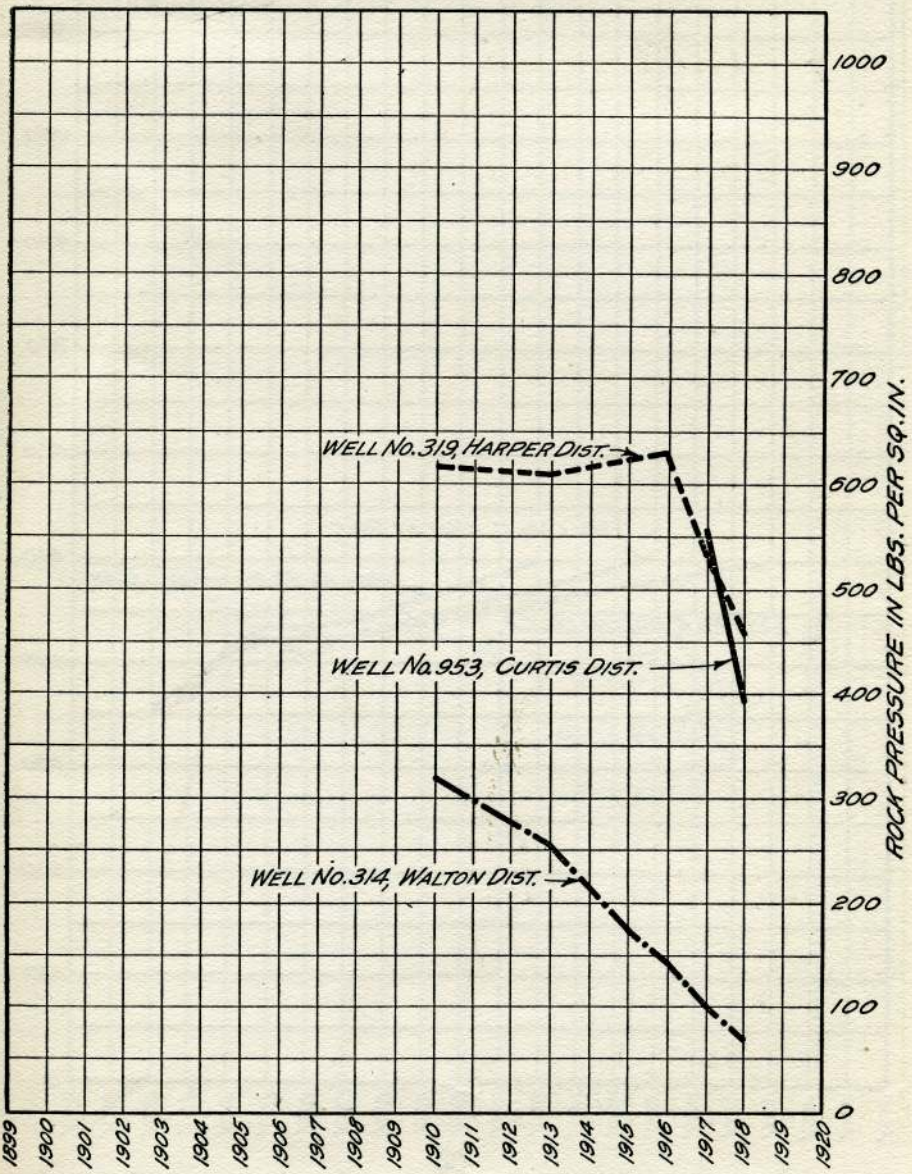
# PLATE 20

## ROCK PRESSURE DECLINE
OF
## TYPICAL NATURAL GAS WELLS IN SALT SAND
OF
## THE UNITED FUEL GAS COMPANY
## IN ROANE COUNTY, W. VA.

Well No. 953, drilled in 1917, had an original rock pressure of 560 pounds; by 1918 this declined to 392 pounds.

Well No. 319, drilled in 1910, had an original rock pressure of 615 pounds; by 1918 this declined to 455 pounds.

Well No. 314, drilled in 1910, had an original rock pressure of 320 pounds; by 1918 this declined to 70 pounds.



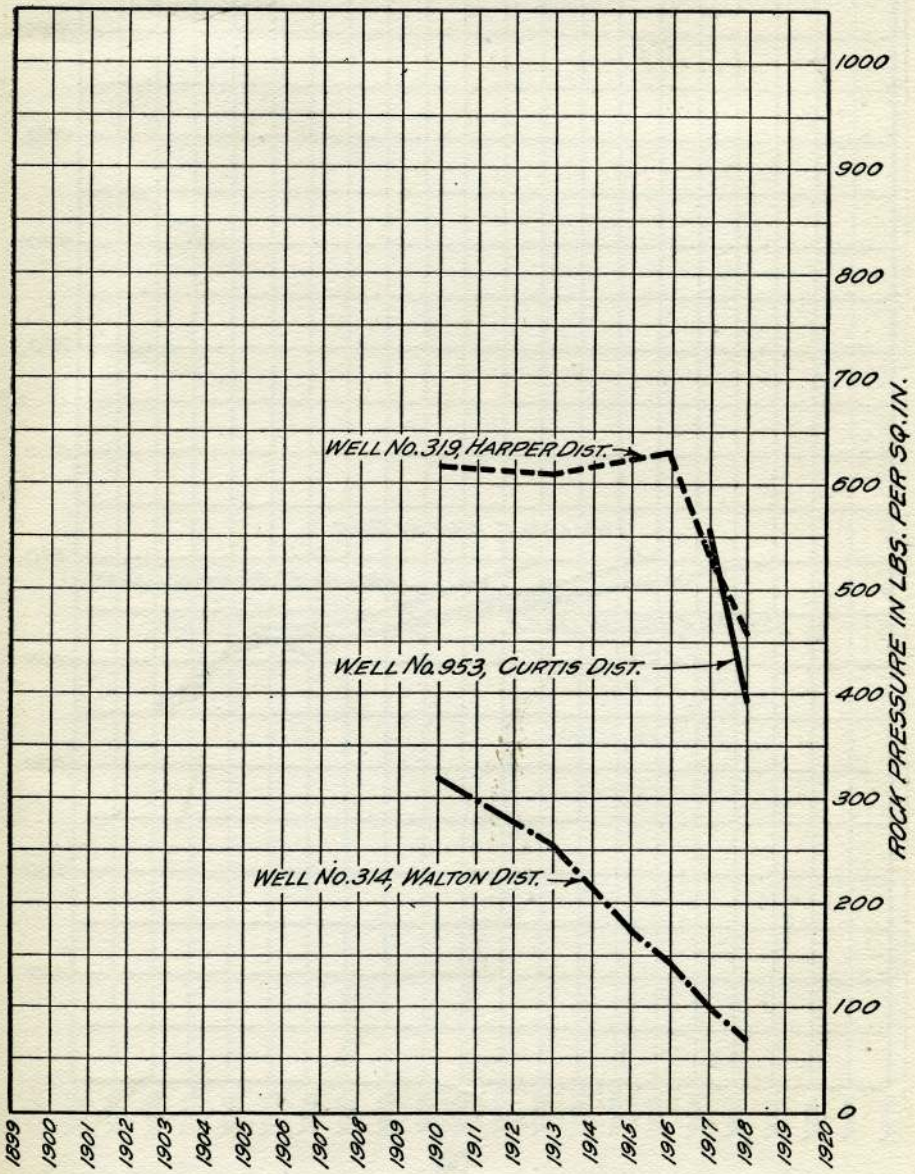
# PLATE 20

## ROCK PRESSURE DECLINE OF TYPICAL NATURAL GAS WELLS IN SALT SAND OF THE UNITED FUEL GAS COMPANY IN ROANE COUNTY, W. VA.

Well No. 953, drilled in 1917, had an original rock pressure of 560 pounds; by 1918 this declined to 392 pounds.

Well No. 319, drilled in 1910, had an original rock pressure of 615 pounds; by 1918 this declined to 455 pounds.

Well No. 314, drilled in 1910, had an original rock pressure of 320 pounds; by 1918 this declined to 70 pounds.



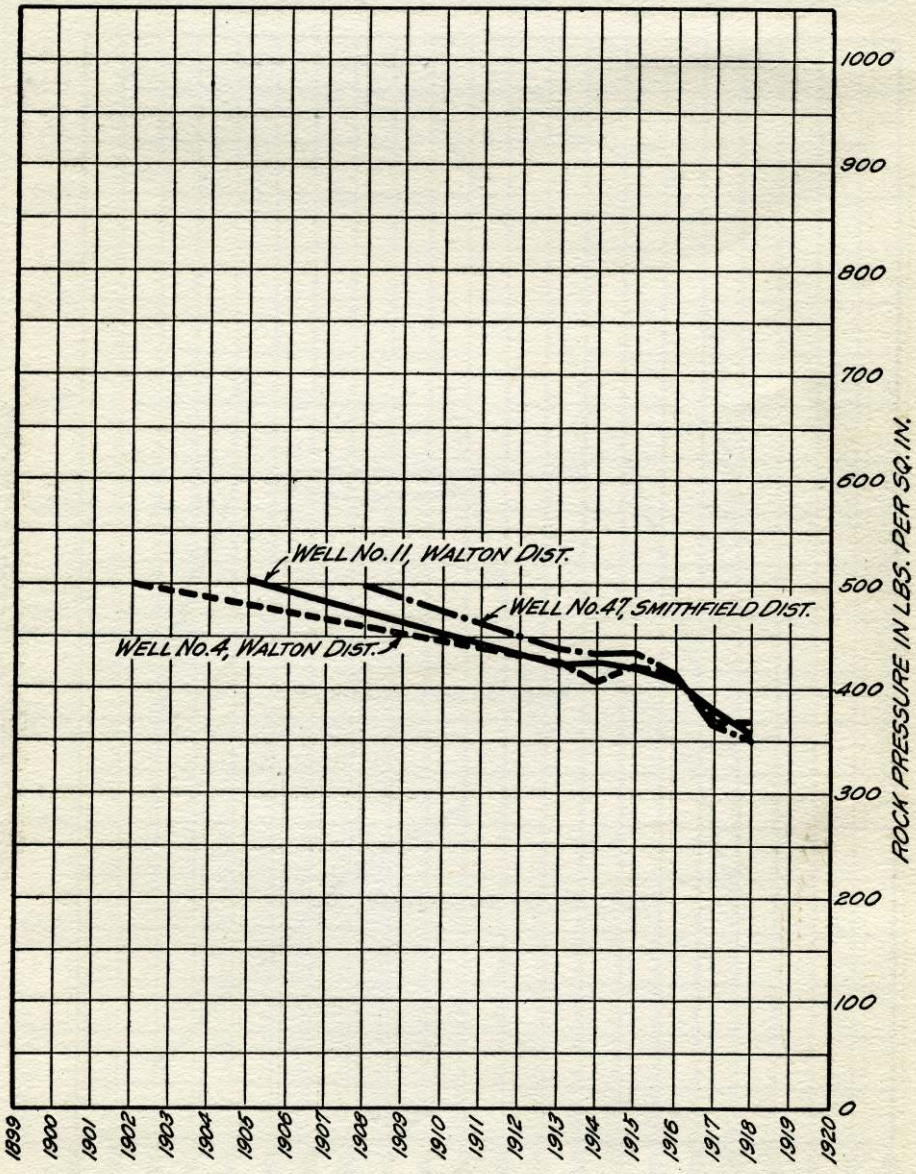
# PLATE 21

## ROCK PRESSURE DECLINE
OF
## TYPICAL NATURAL GAS WELLS IN BIG INJUN SAND
OF
## THE UNITED FUEL GAS COMPANY
## IN ROANE COUNTY, W. VA.

Well No. 47, drilled in 1908, had an original rock pressure of 500 pounds; by 1918 this declined to 350 pounds.

Well No. 4, drilled in 1902, had an original rock pressure of 500 pounds; by 1918 this declined to 370 pounds.

Well No. 11, drilled in 1905, had an original rock pressure of 505 pounds; by 1918 this declined to 360 pounds.



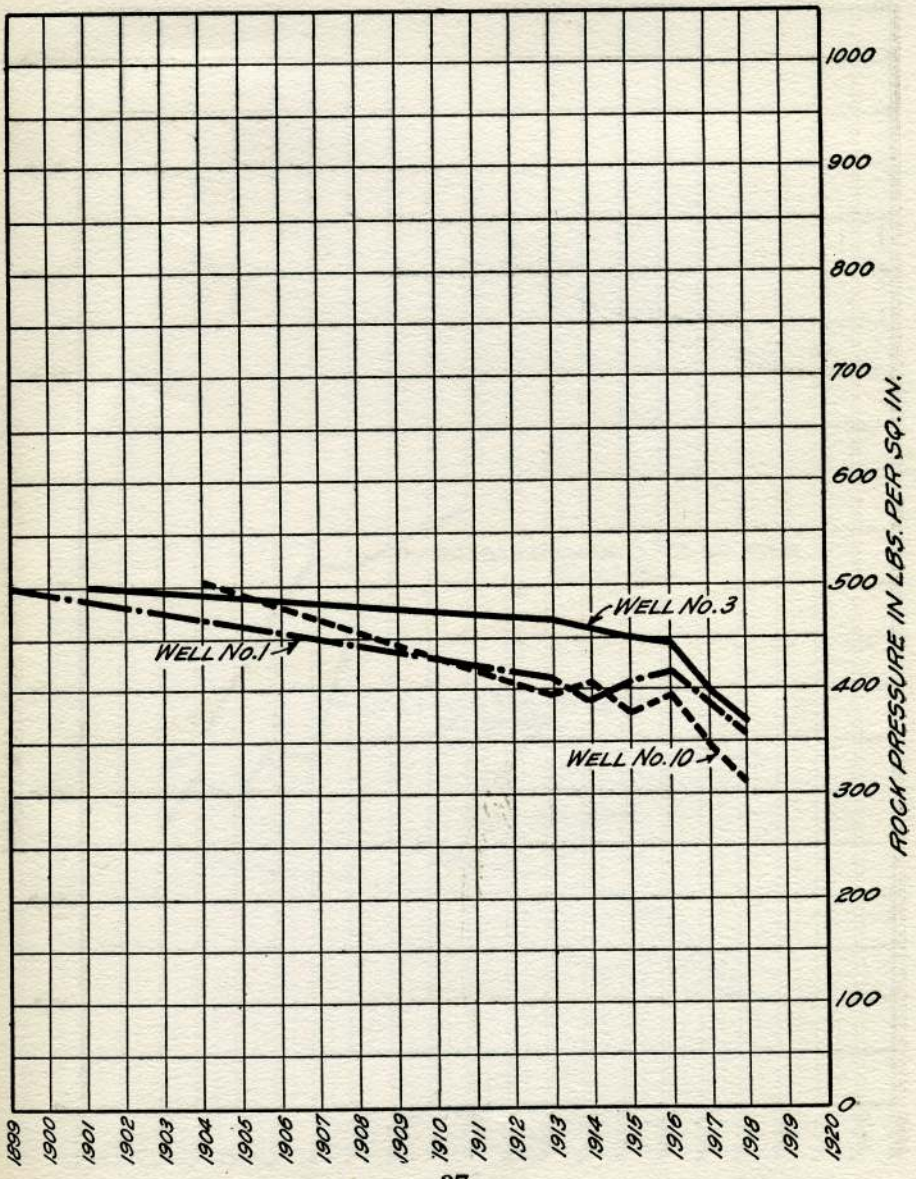
# PLATE 22

## ROCK PRESSURE DECLINE
OF
## TYPICAL NATURAL GAS WELLS IN BIG INJUN SAND
OF
## THE UNITED FUEL GAS COMPANY
## IN GEARY DIST., ROANE CO., W. VA.

Well No. 1, drilled in 1899, had an original rock pressure of 500 pounds; by 1918 this declined to 360 pounds.

Well No. 3, drilled in 1901, had an original rock pressure of 500 pounds; by 1918 this declined to 370 pounds.

Well No. 10, drilled in 1904, had an original rock pressure of 505 pounds; by 1918 this declined to 310 pounds.

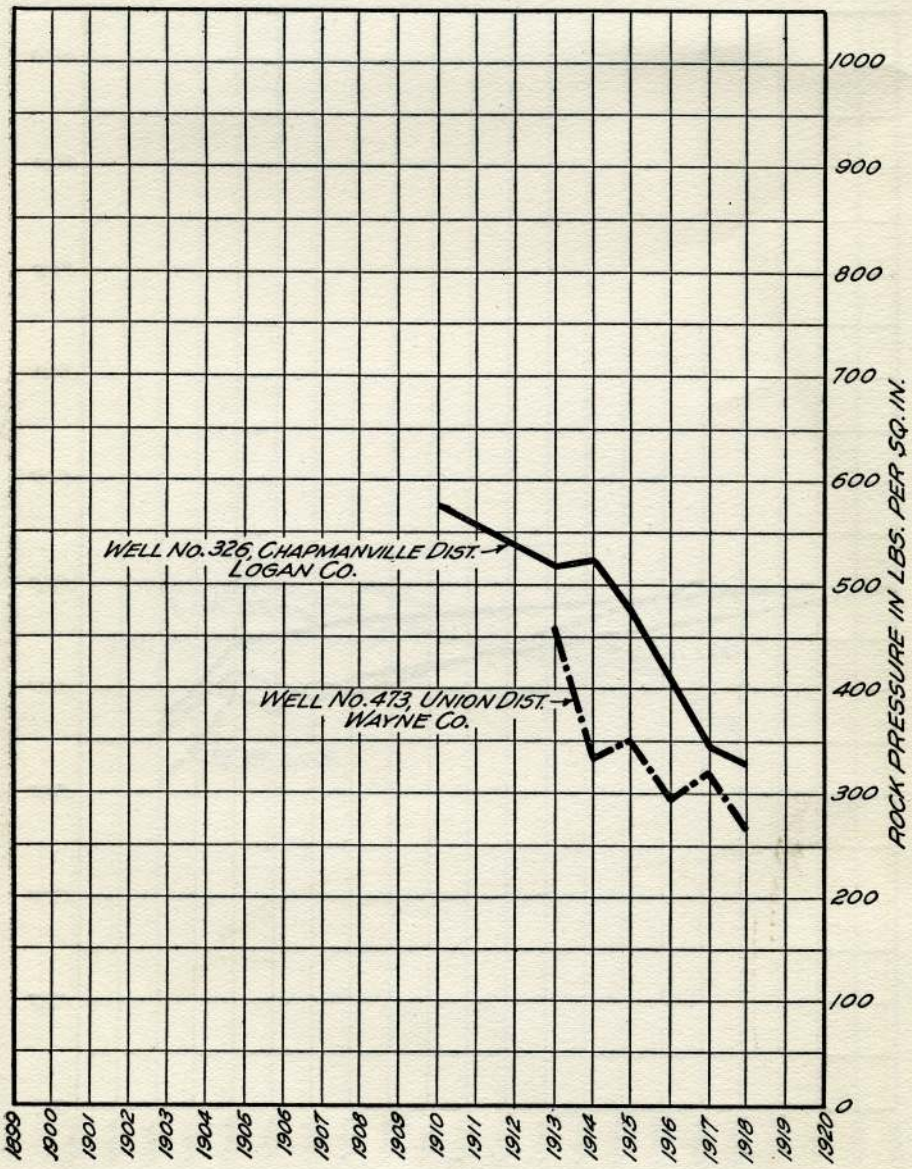


# PLATE 23

## ROCK PRESSURE DECLINE
## OF
## TYPICAL NATURAL GAS WELLS IN LIME SAND
## OF
## THE UNITED FUEL GAS COMPANY
## IN LOGAN AND WAYNE COUNTIES, W. VA.

Well No. 326, drilled in 1910, had an original rock pressure of 578 pounds; by 1918 this declined to 325 pounds.

Well No. 473, drilled in 1913, had an original rock pressure of 460 pounds; by 1918 this declined to 263 pounds.



# PLATE 24

## ROCK PRESSURE DECLINE
OF

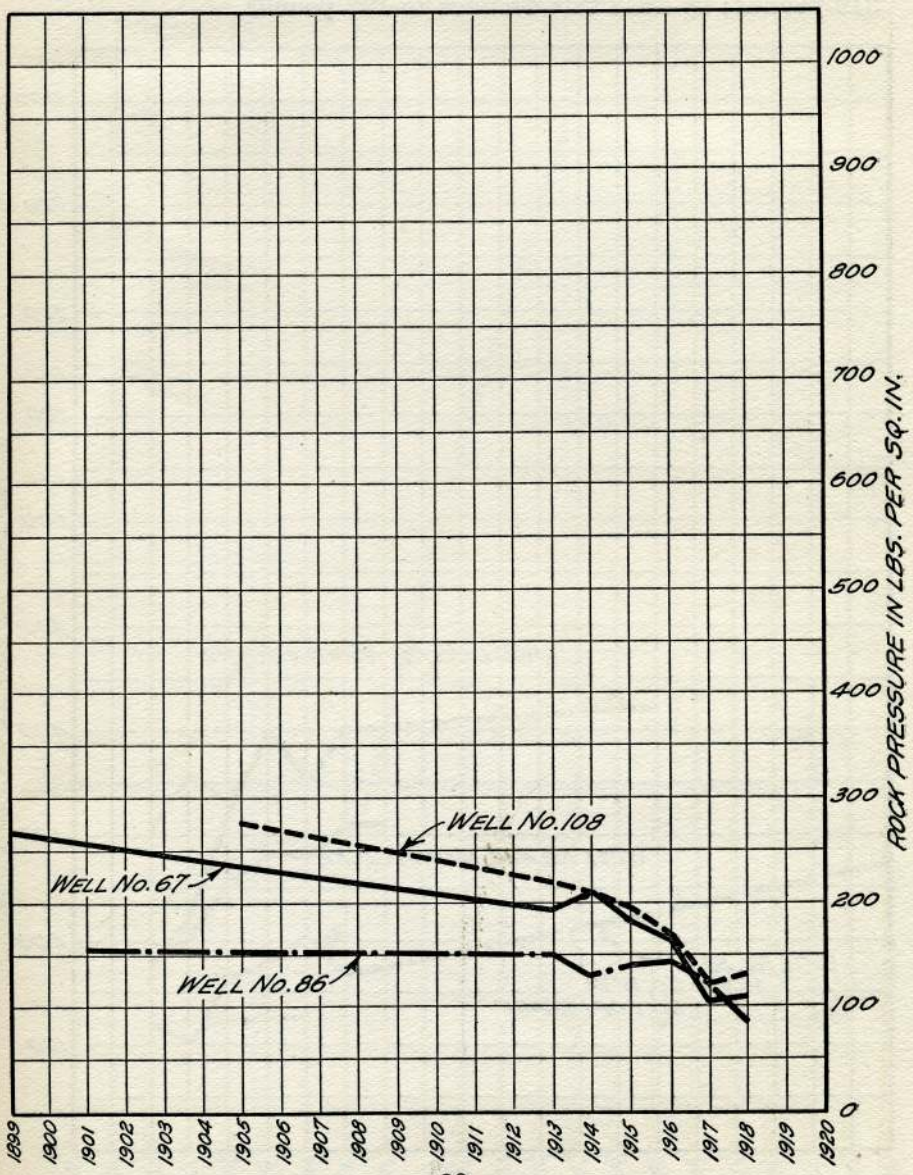
## TYPICAL NATURAL GAS WELLS IN MAXON SAND
OF

## THE UNITED FUEL GAS COMPANY
IN MARTIN COUNTY, KY.

Well No. 67, drilled in 1899, had an original rock pressure of 270 pounds; by 1918 this declined to 108 pounds.

Well No. 86, drilled in 1901, had an original rock pressure of 155 pounds; by 1918 this declined to 85 pounds.

Well No. 108, drilled in 1905, had an original rock pressure of 275 pounds; by 1918 this declined to 130 pounds.



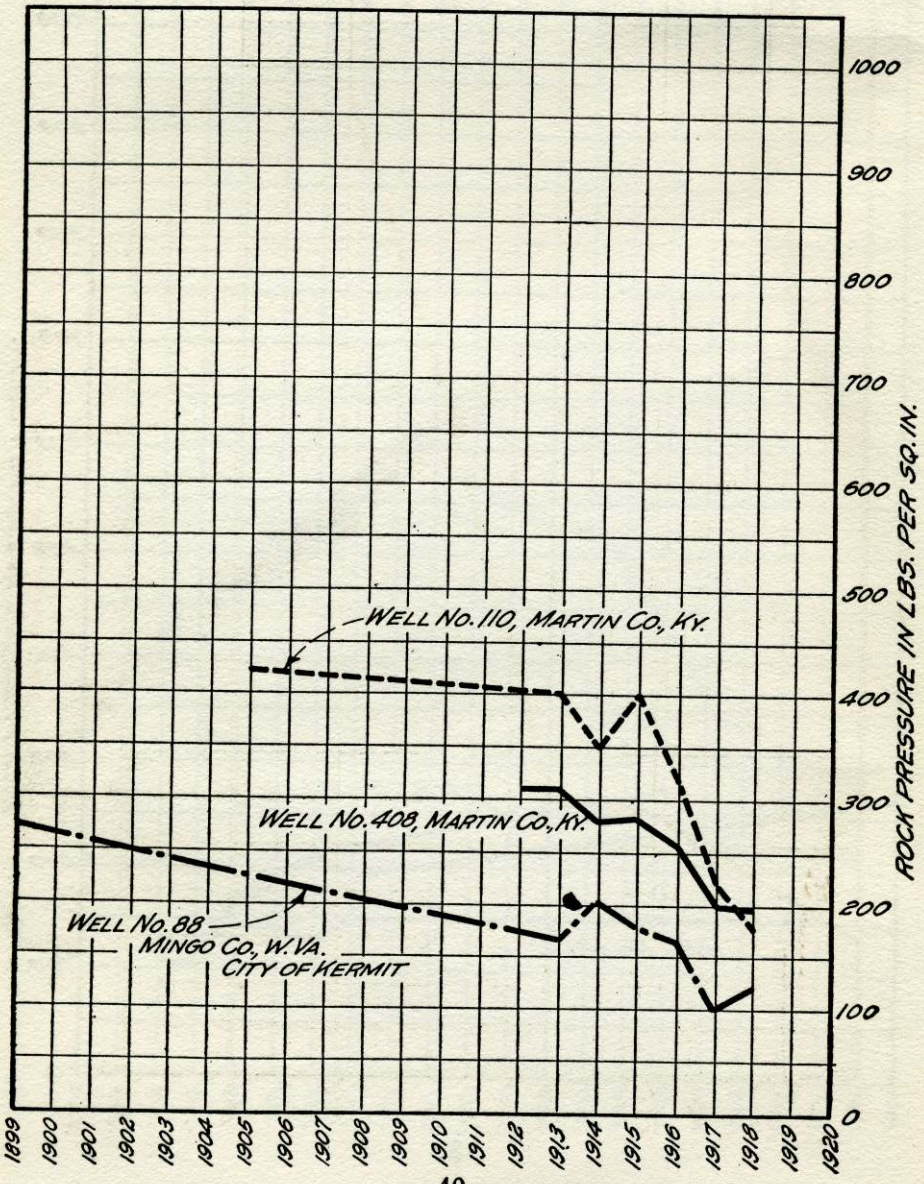
# PLATE 25

## ROCK PRESSURE DECLINE OF TYPICAL NATURAL GAS WELLS IN MAXON AND LIME SANDS OF THE UNITED FUEL GAS COMPANY IN MINGO CO., W. VA., AND MARTIN CO., KY.

Well No. 88, drilled in 1899, had an original rock pressure of 275 pounds; by 1918 this declined to 120 pounds.

Well No. 110, drilled in 1905, had an original rock pressure of 421 pounds; by 1918 this declined to 180 pounds.

Well No. 408, drilled in 1912, had an original rock pressure of 310 pounds; by 1918 this declined to 197 pounds.



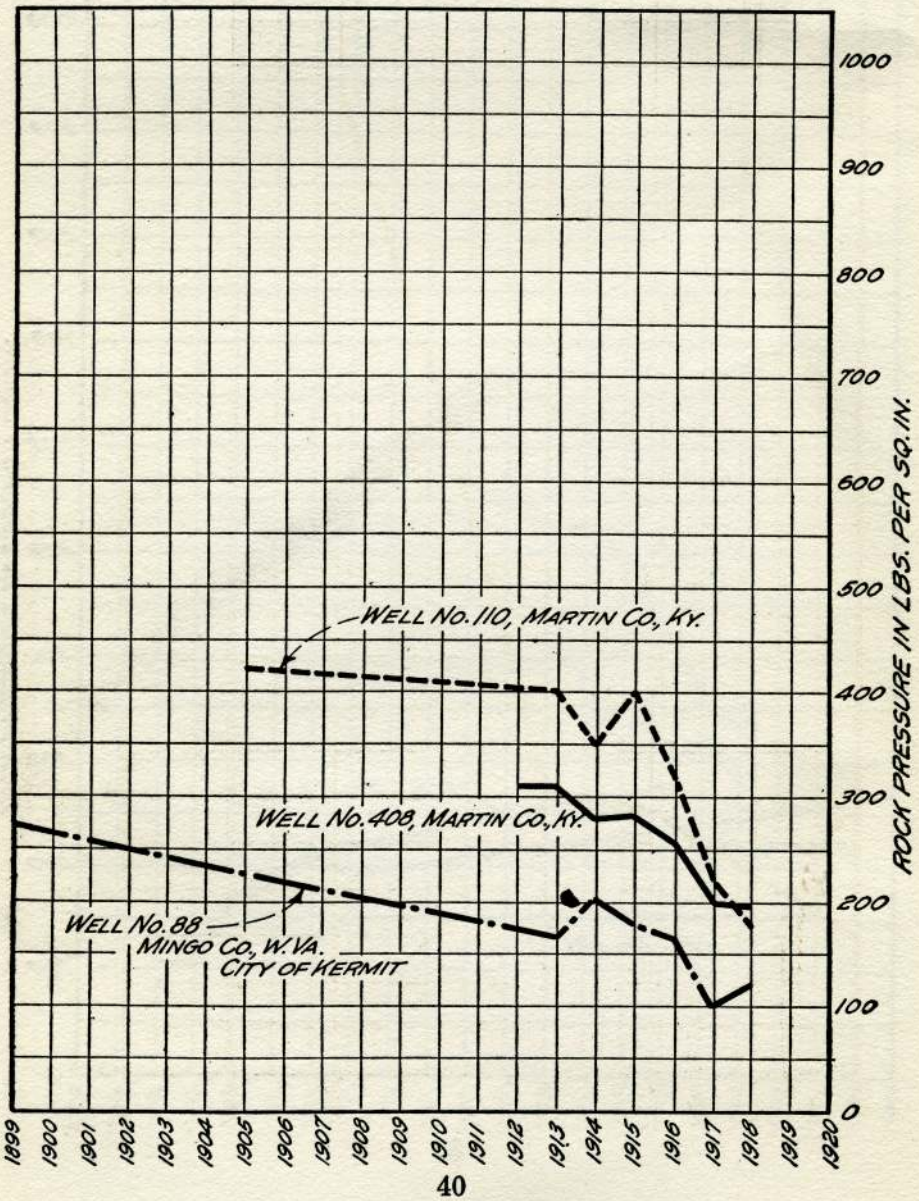
# PLATE 25

## ROCK PRESSURE DECLINE OF TYPICAL NATURAL GAS WELLS IN MAXON AND LIME SANDS OF THE UNITED FUEL GAS COMPANY IN MINGO CO., W. VA., AND MARTIN CO., KY.

Well No. 88, drilled in 1899, had an original rock pressure of 275 pounds; by 1918 this declined to 120 pounds.

Well No. 110, drilled in 1905, had an original rock pressure of 421 pounds; by 1918 this declined to 180 pounds.

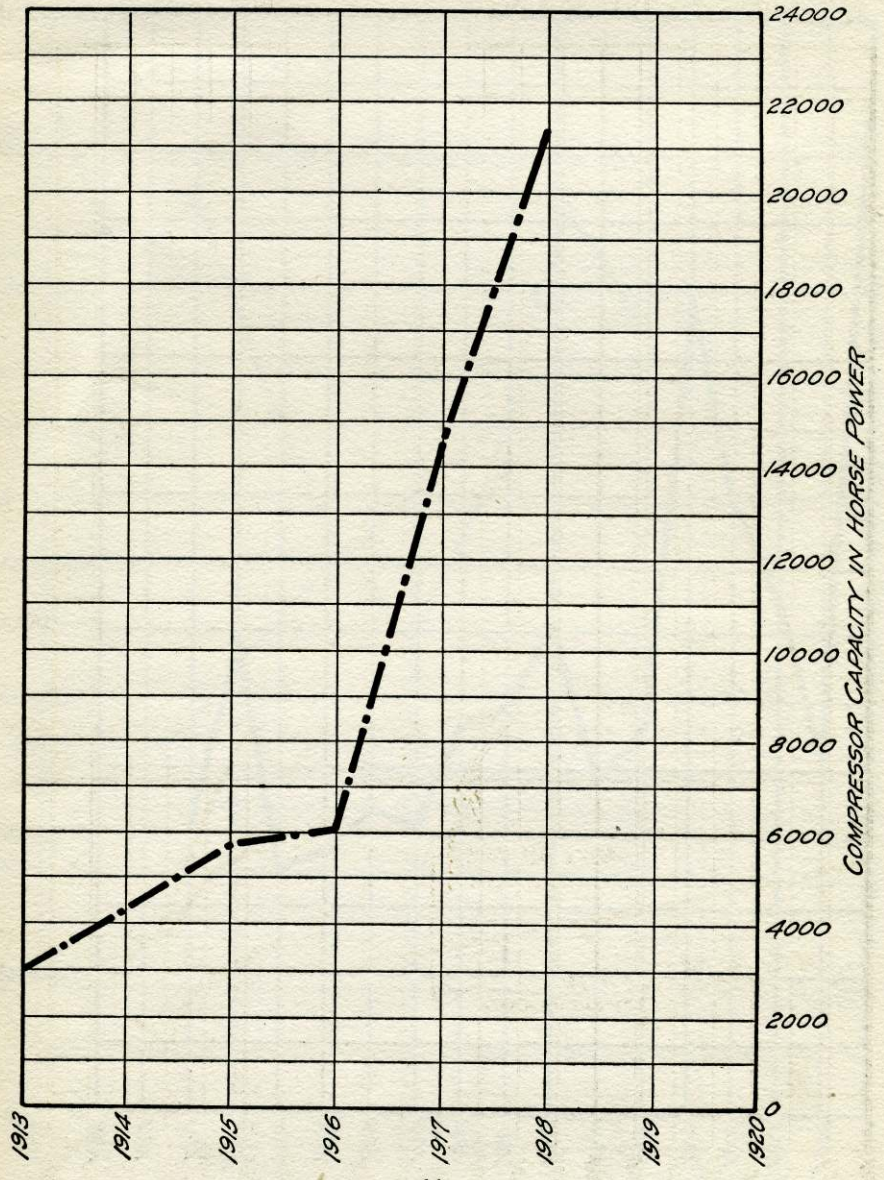
Well No. 408, drilled in 1912, had an original rock pressure of 310 pounds; by 1918 this declined to 197 pounds.



# PLATE 26

## INCREASE IN HORSE POWER CAPACITY OF COMPRESSORS NECESSARY FOR NATURAL GAS TRANSMISSION OF THE UNITED FUEL GAS COMPANY IN WEST VIRGINIA AND KENTUCKY

The compressor capacity in horse power in 1913 was 2,980, and this was increased to 21,530 by 1918, on account of the rapidly declining rock pressure.



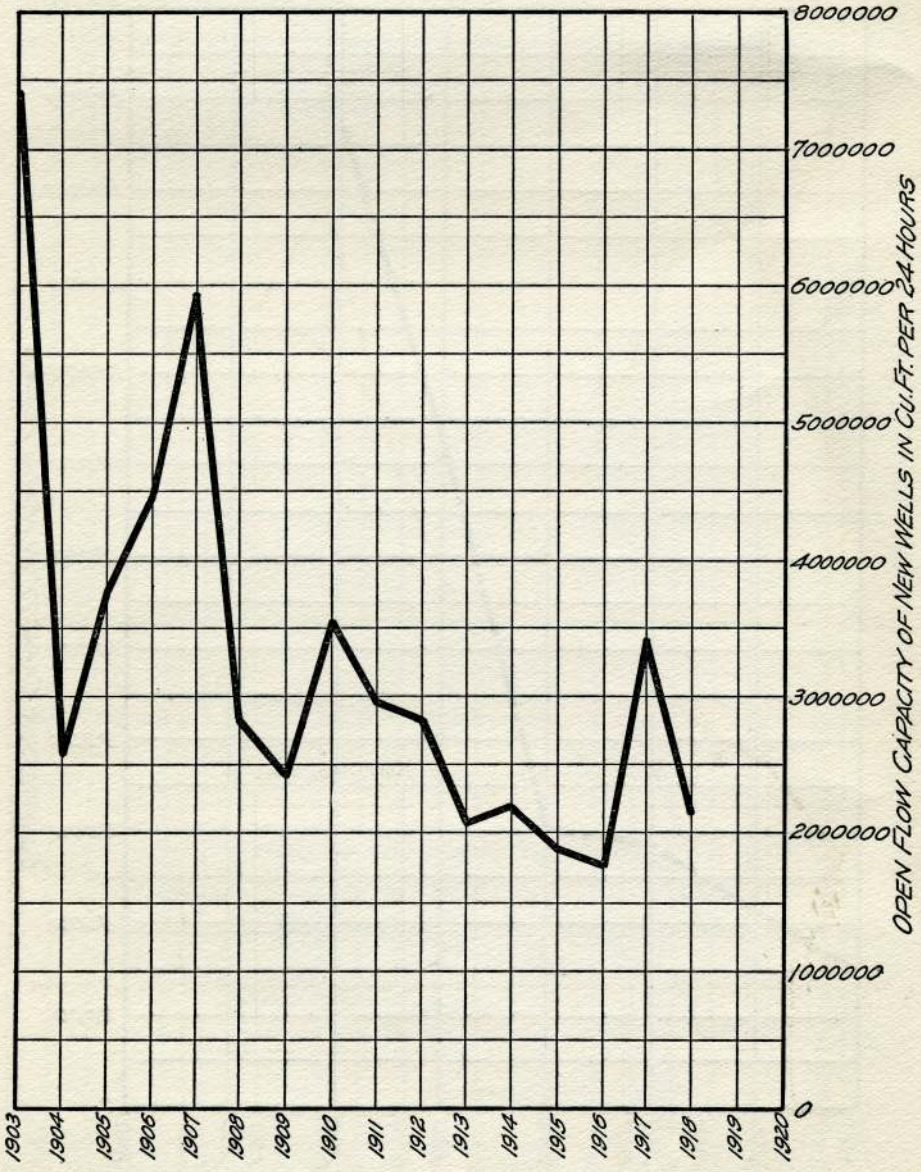
# PLATE 27

## DECLINE IN AVERAGE OPEN FLOW CAPACITY OF NEW NATURAL GAS WELLS OF THE UNITED FUEL GAS COMPANY IN W. VA. AND KY.

In 1903 the average open flow capacity was 7,422,000 cu. ft.; by 1918 this declined to 2,118,000 cu. ft.

This is the average open flow capacity of all wells drilled, the dry holes having been averaged in with the producing wells.

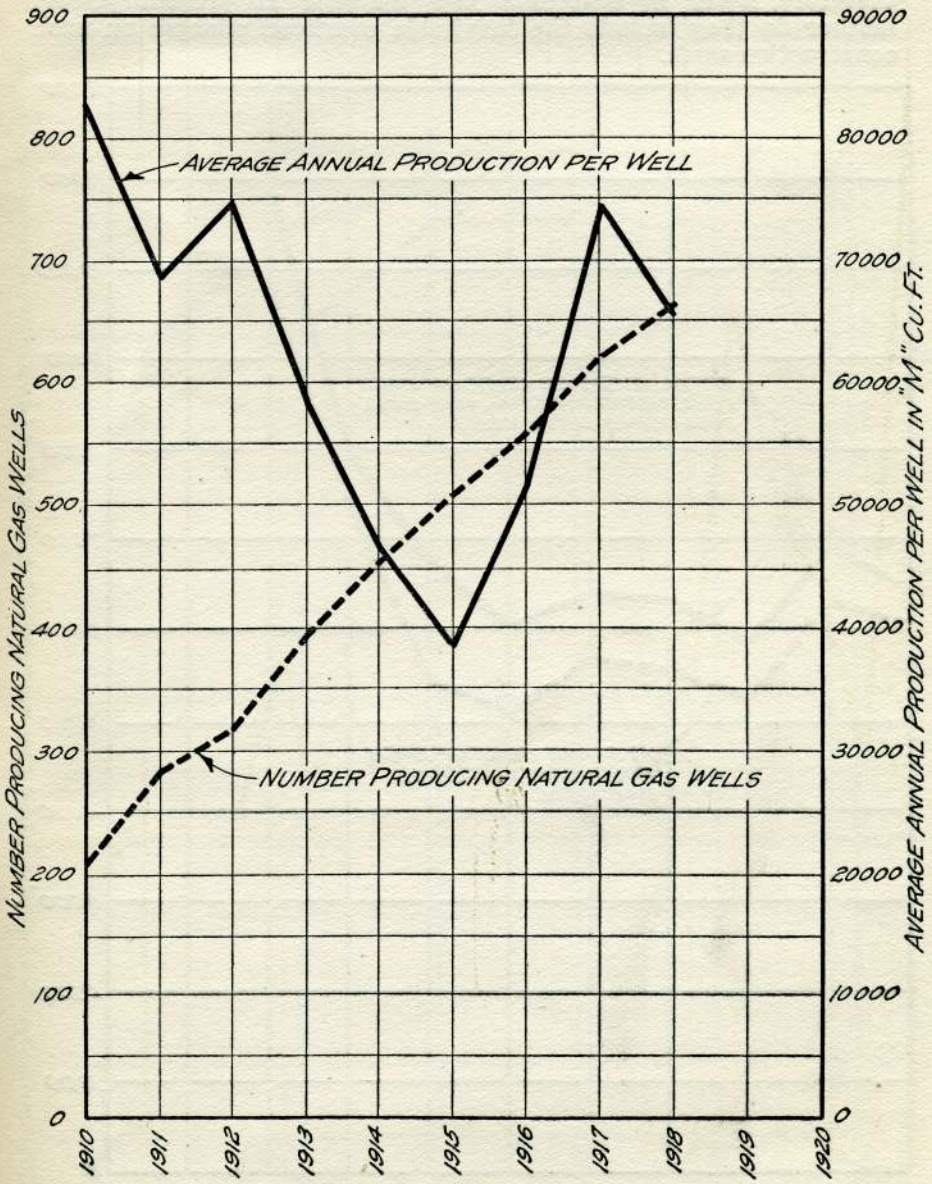
The marked increase in 1917 was due to the drilling in of five unusually large wells.



# PLATE 28

## DECLINE IN AVERAGE ANNUAL PRODUCTION OF NATURAL GAS WELLS AND INCREASE IN NUMBER OF NATURAL GAS WELLS OF THE UNITED FUEL GAS COMPANY IN W. VA. AND KY.

In 1910 the average annual production per well was 82,650 "M" cu. ft. By 1918 this declined to 65,531 "M" cu. ft. The marked increase in production in 1916 and 1917 was due to the abnormal demands made on wells on account of war conditions, and the unprecedented cold weather. In 1910 there were 204 producing natural gas wells and by 1918 this increased to 656.

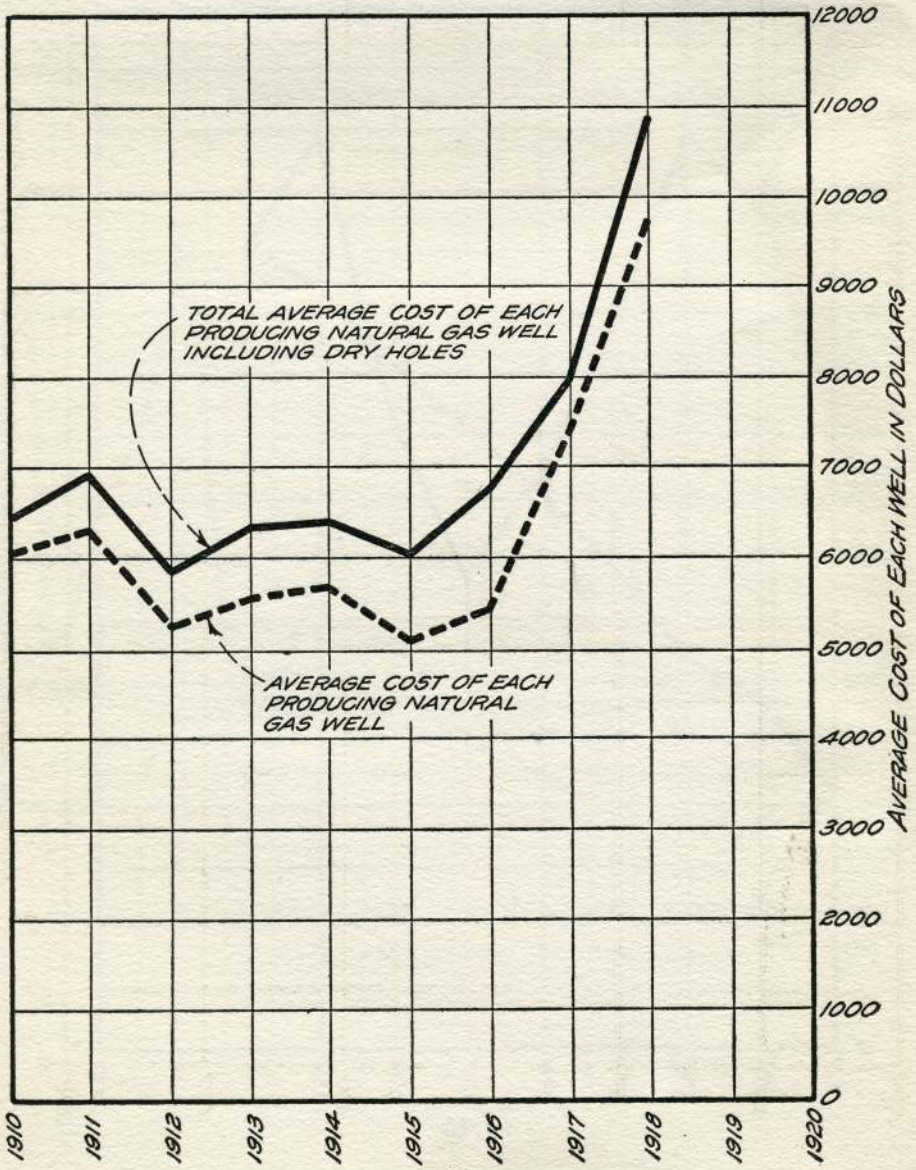


# PLATE 29

## INCREASING COST OF PRODUCING NATURAL GAS WELLS OF THE UNITED FUEL GAS COMPANY IN W. VA. AND KY.

In 1910 the average cost of each producing well was $6,057, and this increased to $9,731 by 1918. The dry holes that must be drilled in order to get the producing wells, of course, increase the total cost of the producing wells and on the basis of adding the dry hole cost to the producing wells the average cost of each producing well, including the dry holes, in 1910 was $6,462, and this increased to $10,902 by 1918.

These figures are based on re-used well material, which was, therefore, lower in cost than new material at present prices; neither do they include the inevitable overhead charges on such construction work.



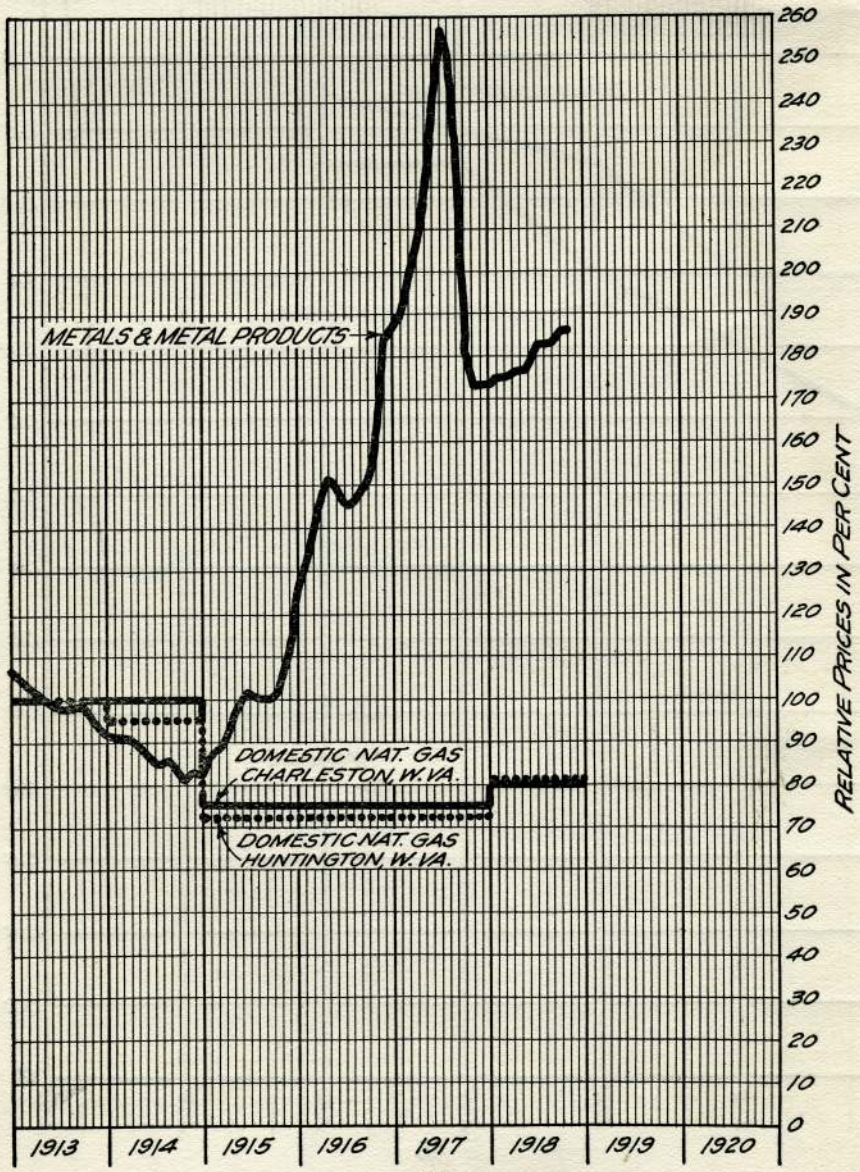
# PLATE 31

## RELATIVE PRICES
## WHOLESALE METALS AND METAL PRODUCTS
## AND
## DOMESTIC NATURAL GAS RATES
## OF
## THE UNITED FUEL GAS COMPANY
## AT CHARLESTON AND HUNTINGTON, W. VA.

The commodity prices are taken from page 102, Vol. 8, January, 1919, No. 1 Monthly Review of the United States Bureau of Labor Statistics.

The decrease in domestic natural gas rates in the 6 years from 1913 to 1918 was 20 per cent, as contrasted with an increase of 86 per cent in metals.

The retail prices for finished steel products, like pipe, have increased much more, as is shown in Sec. 25.

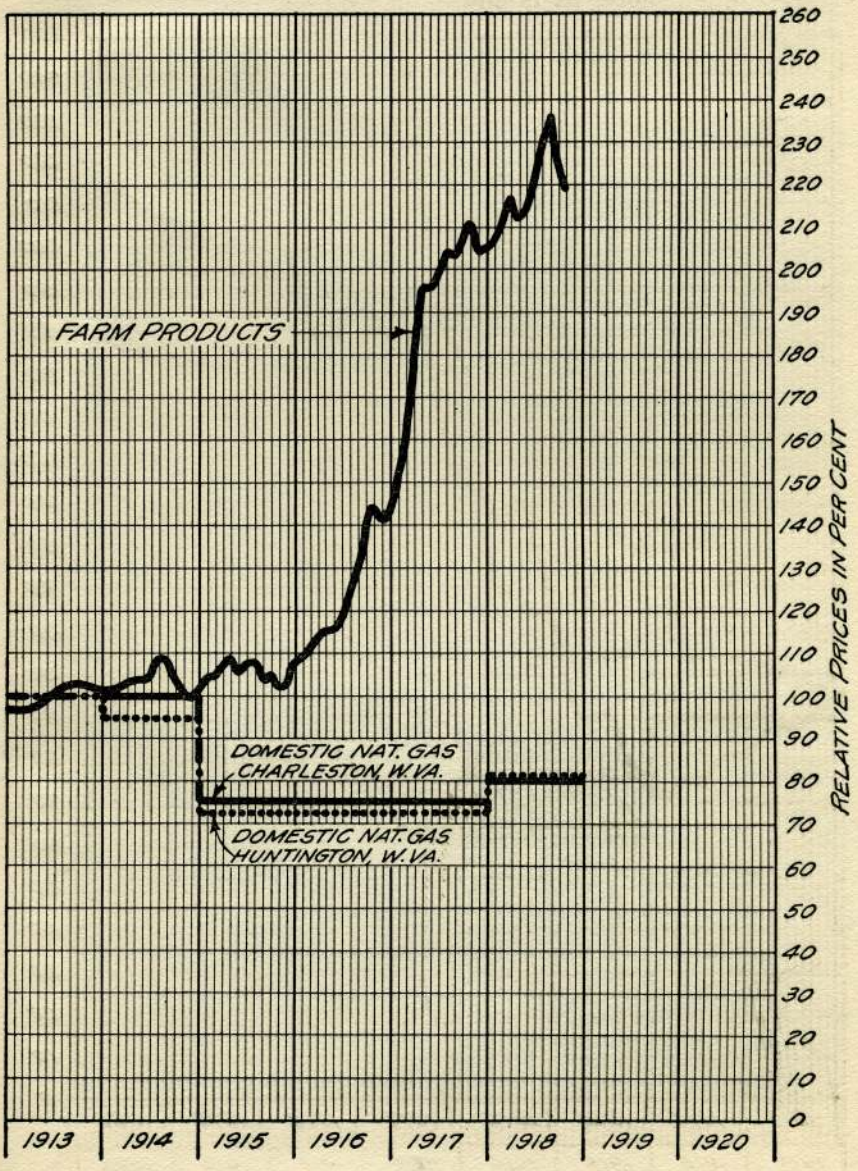


# PLATE 32

## RELATIVE PRICES
## WHOLESALE FARM PRODUCTS IN THE UNITED STATES
AND
## DOMESTIC NATURAL GAS RATES
OF
## THE UNITED FUEL GAS COMPANY
## AT CHARLESTON AND HUNTINGTON, W. VA.

The commodity prices are taken from page 102, Vol. 8, January, 1919, No. 1 Monthly Review of the United States Bureau of Labor Statistics.

The decrease in domestic natural gas rates in the 6 years from 1913 to 1918, was 20 per cent, as contrasted with an increase of 120 per cent in farm products.



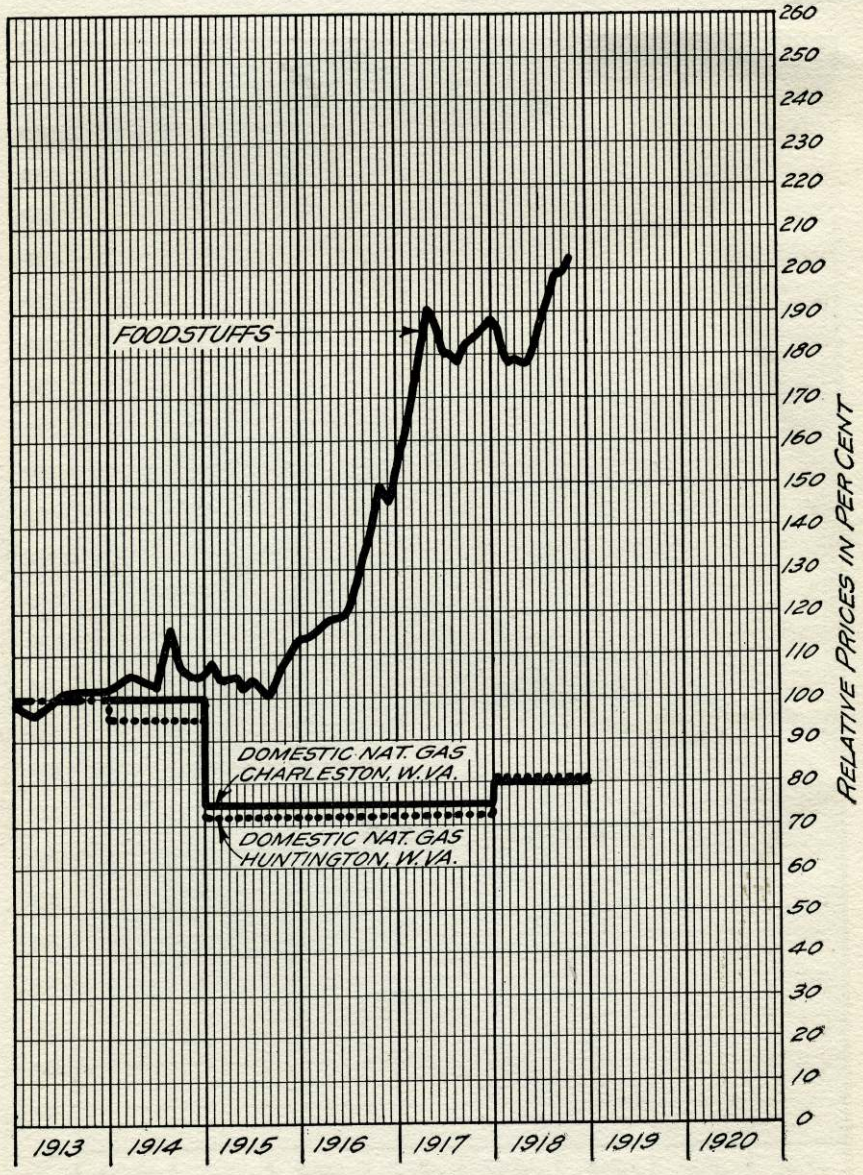
# PLATE 33

## RELATIVE PRICES

## WHOLESALE FOOD PRODUCTS IN THE UNITED STATES AND DOMESTIC NATURAL GAS RATES OF THE UNITED FUEL GAS COMPANY AT CHARLESTON AND HUNTINGTON, W. VA.

The commodity prices are taken from page 102, Vol. 8, January, 1919, No. 1 Monthly Review of the United States Bureau of Labor Statistics.

The decrease in domestic natural gas rates in the 6 years from 1913 to 1918, was 20 per cent, as contrasted with an increase of 102 per cent in food stuffs.

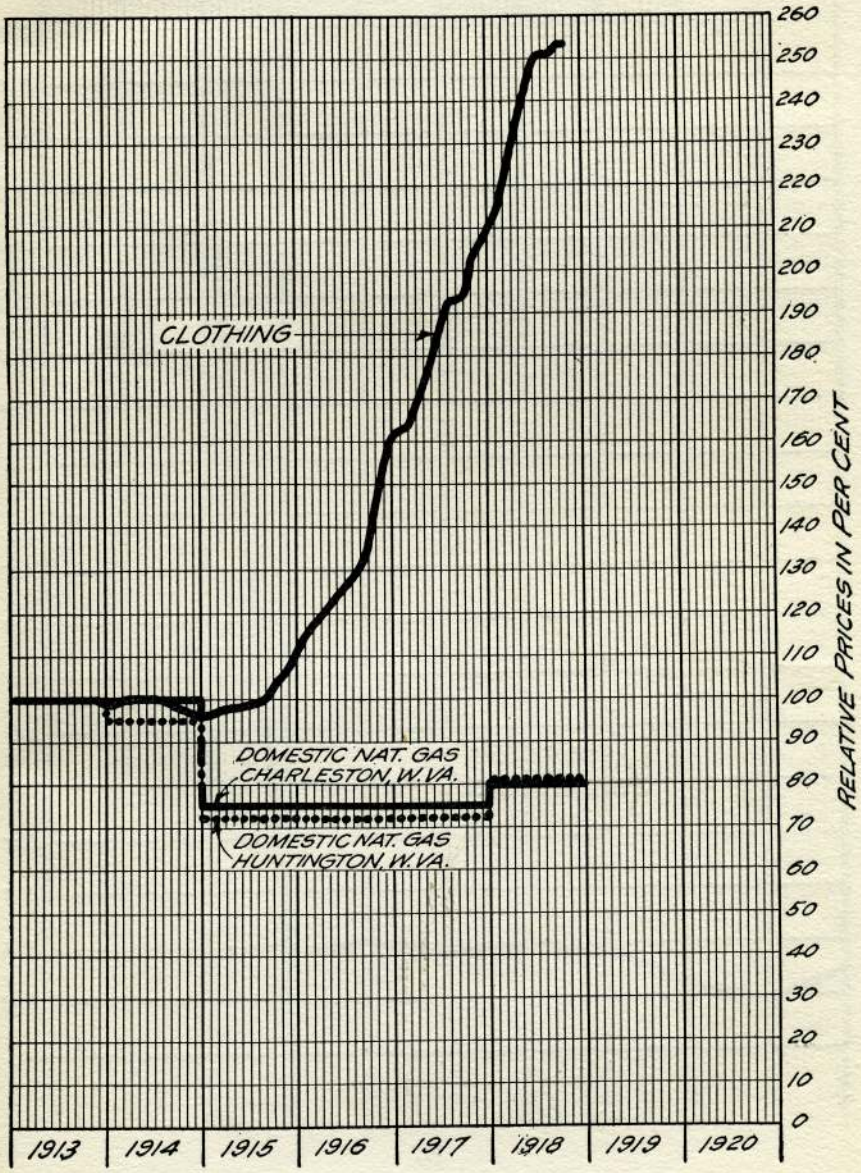


# PLATE 34

## RELATIVE PRICES
## WHOLESALE CLOTHING IN THE UNITED STATES
## AND
## DOMESTIC NATURAL GAS RATES
## OF
## THE UNITED FUEL GAS COMPANY
## AT CHARLESTON AND HUNTINGTON, W. VA.

The commodity prices are taken from page 102, Vol. 8, January, 1919, No. 1 Monthly Review of the United States Bureau of Labor Statistics.

The decrease in domestic natural gas rates in the 6 years from 1913 to 1918, was 20 per cent, as contrasted with an increase of 152 per cent in clothing.



# PLATE 35

## INCREASING COST OF TAXES
IN
## CENTS PER "M" CU. FT. OF GAS
OF
## THE UNITED FUEL GAS COMPANY
IN
## WEST VIRGINIA, KENTUCKY, AND OHIO

In 1910 the total taxes amounted to .29c per "M" cu. ft. and this increased to 3.5c by 1918.