229 Item 9

# UNDERLINING STEEL

BASIC REFRACTORIES, INCORPORATED

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229 Item 9

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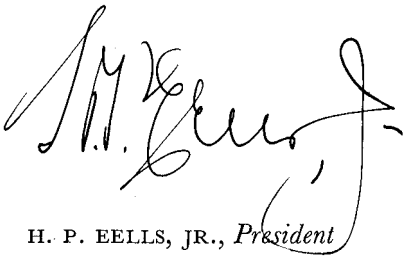
In point of time the completion of the accompanying booklet coincided with the purchase of a business that has given Basic Refractories a prominent position in the lime industry.

Rather than expand this publication just as it goes to press we have concluded it will be preferable to describe the lime industry and the significance of this development in a supplemental issue that will follow in due course.

BASIC REFRACTORIES, INCORPORATED

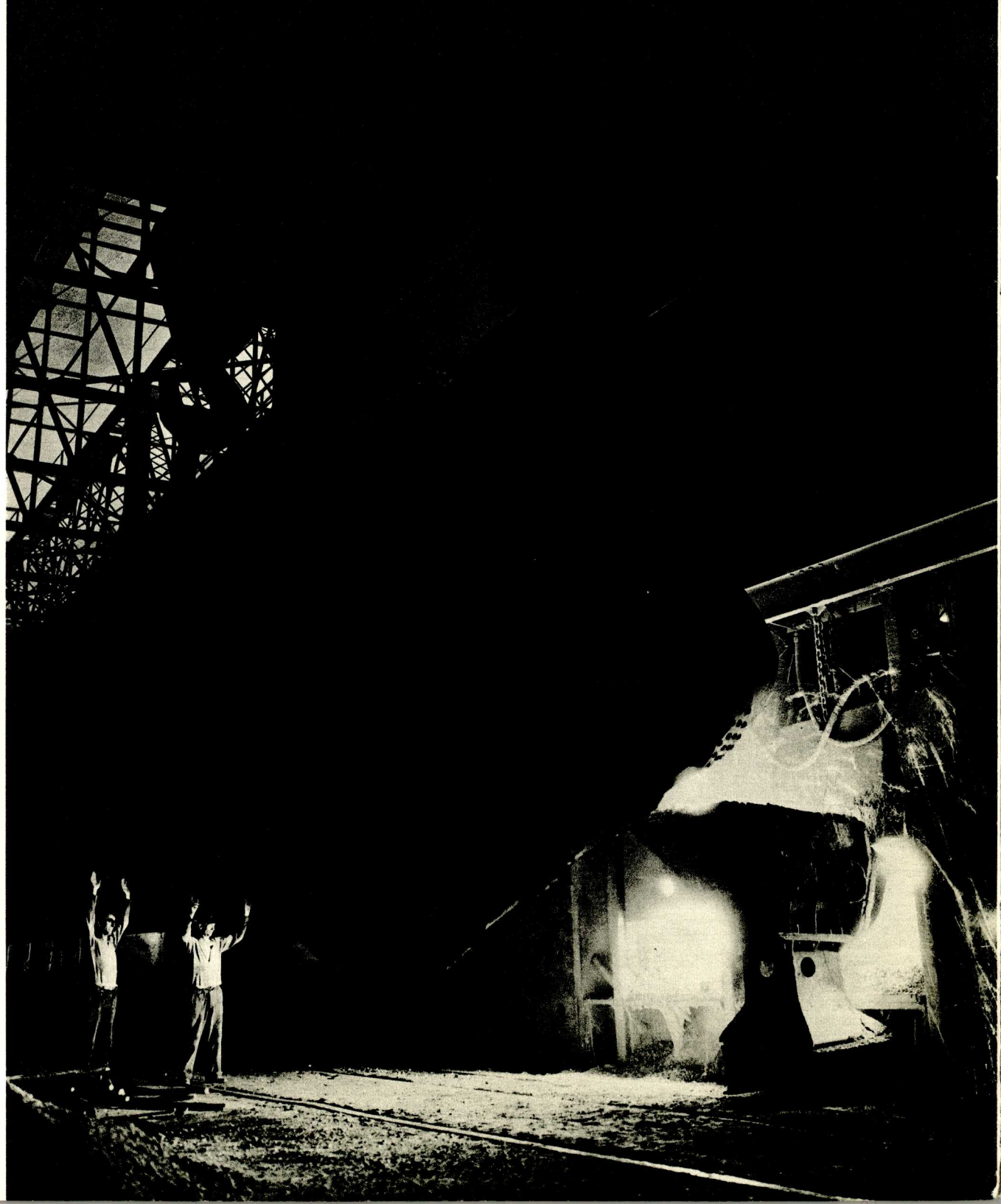


H. P. EELLS, JR., *President*

UNDERLINING STEEL . . .

*Basic*

*Grain Refractories*



*Charging steel furnace with molten iron*

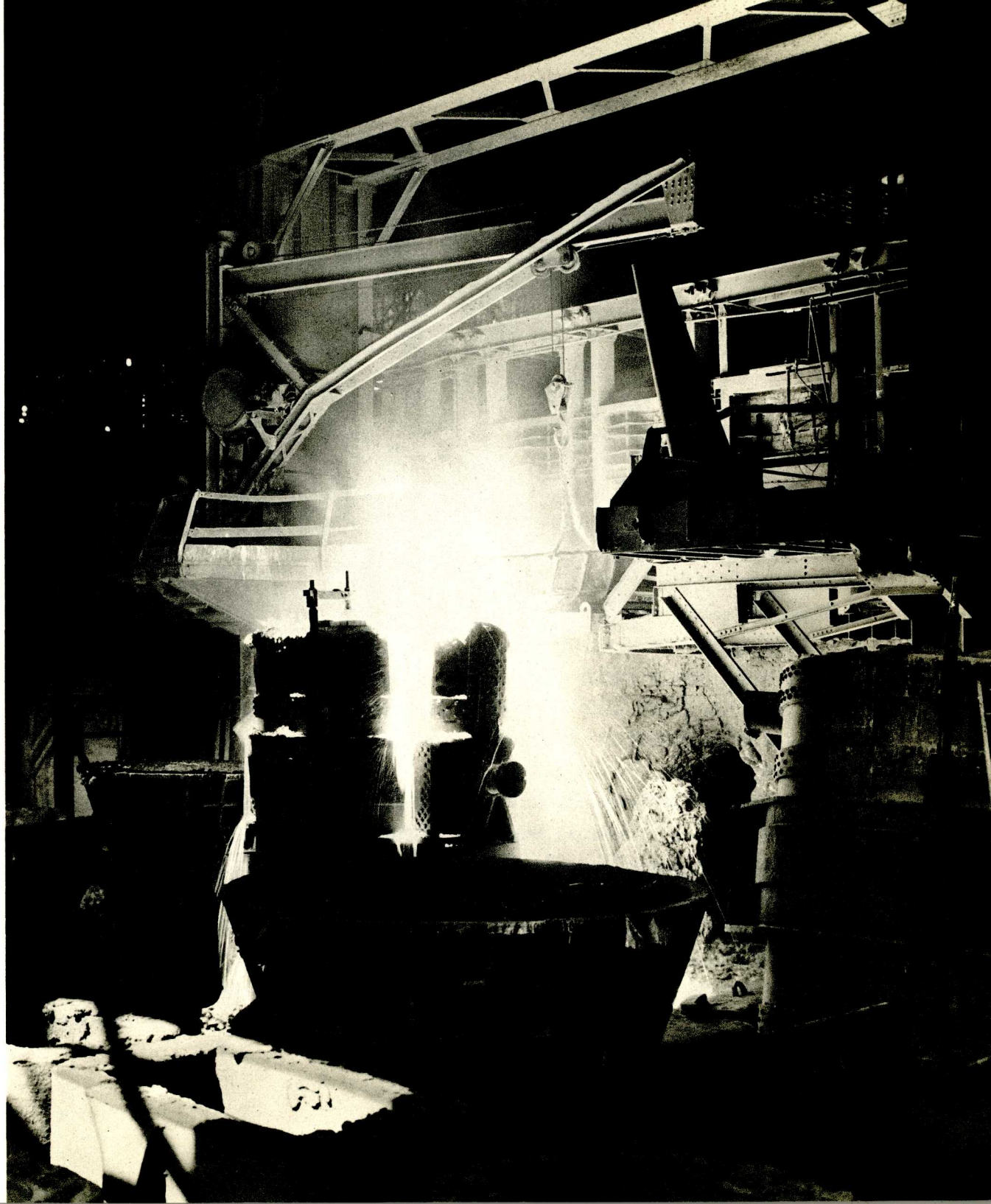
# FOREWORD

THE HISTORY of Basic Refractories, Incorporated is typical of American free enterprise. Forty years ago all but insolvent, its activities were limited to the operation of a "cross-roads stone quarry" in Northwestern Ohio. Today it is one of the foremost producers of basic grain refractories in the world.

When the earlier of two World Wars cut off imports to the United States from Central Europe, Basic Refractories began the manufacture of a substitute for Austrian magnesite the loss of which threatened to jeopardize the country's steel production and thus its war effort. This undertaking pioneered developments that have made the Americas self-sufficient in materials indispensable to the maintenance of basic steel producing furnaces.

Because the word "refractories" is infrequently encountered it may prove puzzling. One thinks first of a *refractory* boy *resisting* discipline or of *refractory* brick in a fireplace *withstanding* heat. The industrial refractories here discussed are manufactured to *resist* and *withstand* the forces set in motion by the basic steel refining process. These materials take the form not of brick but of loose, dry grains varying from pea size to powder that are shipped in bulk or in heavy paper bags.

The production of all steel is dependent upon such refractories. In their manufacture Basic Refractories, Incorporated plays a prominent part.



*Molten steel flowing from the open hearth furnace into receiving ladles*

## STEEL REFINING

STEEL IS PRIMARILY the product of thermal refining—the elimination of undesirable elements from molten compositions consisting mostly of iron.

The process by which it is manufactured is two-stage. First *iron ore* is refined and its oxides of iron reduced in blast furnaces to yield *iron* which in a second step is further refined to produce *steel*. Iron, it might be said, is semi-processed steel.

Whereas the blast furnace is employed universally to produce iron, steel is manufactured in three types of furnaces to wit—the converter, the reverberatory or open-hearth and the electric arc furnace.

A discussion of the operation and the refractory problems of converters—generally designated "Bessemer" or "Thomas"—falls outside the scope of this booklet. The omission alters little, however, broad observations relating to steel refining and refractory practices since the quantity of converter-produced steel is insignificant when related to total steel production.

Open-hearth and electric furnaces differ radically in design. However, both are essentially brick chambers against the floor and lower walls of which grain refractories are rammed to form thick dense mats in the shape of "basins" variously termed *linings*, *hearths* or *bottoms*.

It is this "basin" that receives the iron together with the materials which serve as the refining agents and that contains the molten bath as refining proceeds. Since it alone is in immediate contact with the charge and the bath the lining bears the brunt of attack from the physical forces that attend charging and the chemical forces brought into play by the process. Deep cutting results, the eroded portions of the lining passing into the slag.

Erosion is not, however, limited to the hearth. Unlined interior brickwork suffers from such conditions as the splatter and spray of the molten, boiling bath at temperatures approximating 3000° Fahrenheit.

To insure that the white-hot, liquid slag and steel will not break out of the furnace and that its walls or roof will not collapse, all damaged surfaces must be repaired

promptly. Consequently after refining is completed and the furnace is emptied, but while it remains close to operating temperatures, grain refractories are thrown by the "Man with the Shovel" or by mechanical means onto the surface needing repair. There the loose dry grains fuse together and become a monolithic part of the remaining structure to restore its original thickness and contour.

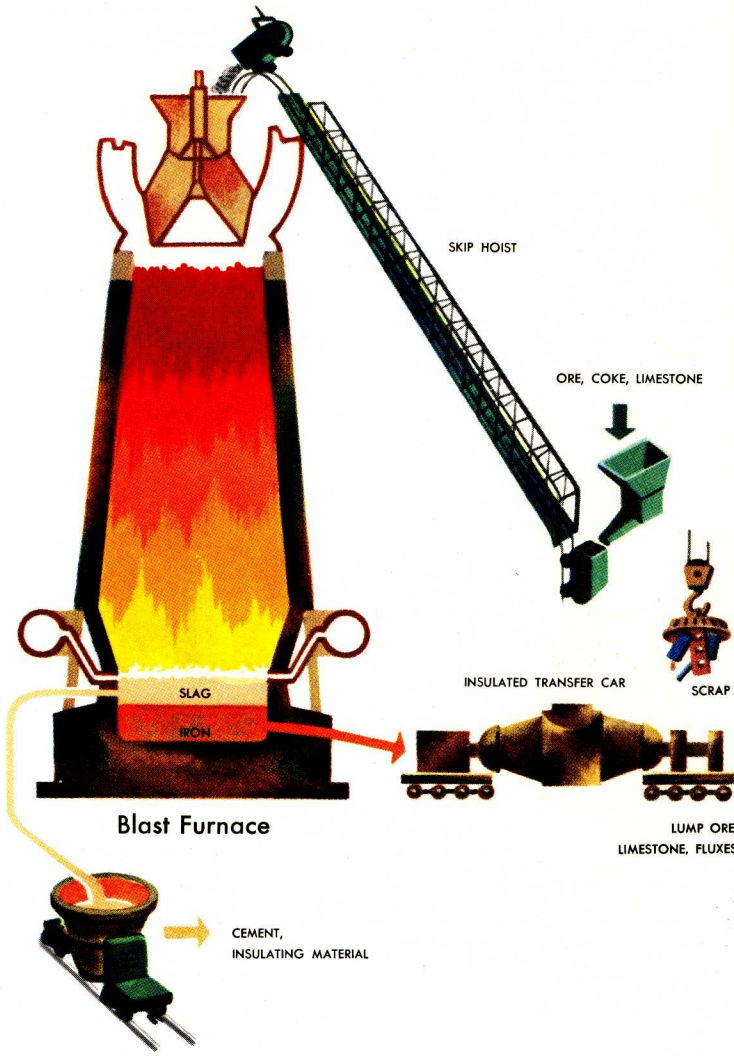
Since these repairs recur periodically at the end of every refining—charging—tapping cycle, day after day so long as the furnace operates, grain refractories used for maintenance are consumed in direct proportion to the production of steel.

## *Basic* vs *Acid Process*

Steel must be substantially free of phosphorus if it is to possess the strengths demanded of it. Early steel producers met this problem by selecting phosphorus-free iron ores out of which to produce iron and subsequently steel. This practice, however, put severe limitations upon steel production since the great iron ore deposits of the world are phosphorus bearing.

It was, therefore, highly significant when in 1878 the Englishman Sydney Gilchrist Thomas discovered that phosphorus could be disassociated from iron if a chemically *basic* (as contrasted with a chemically *acid*) environment is maintained within the furnace as refining proceeds.

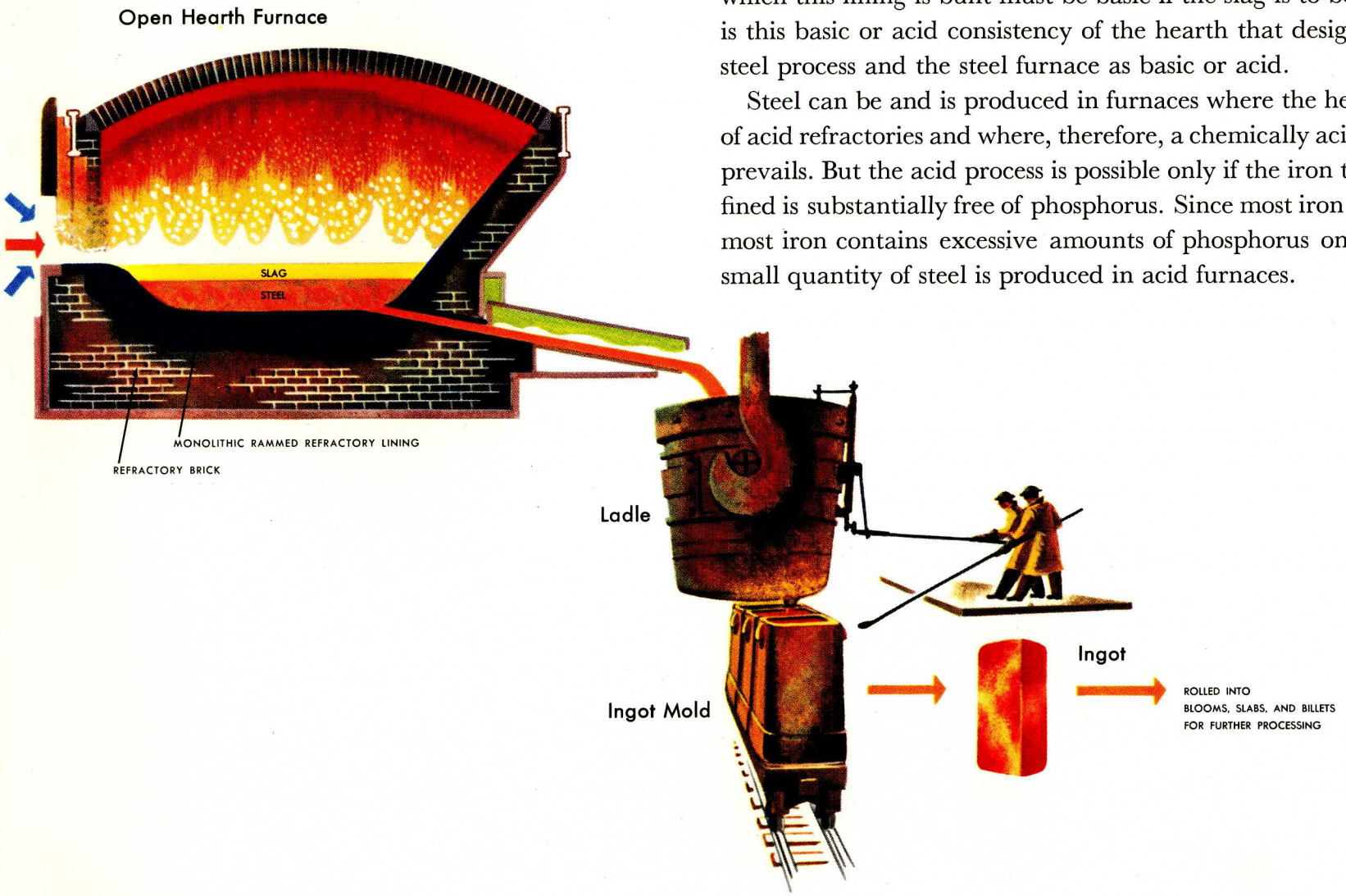
Since the maintenance of basic conditions in blast furnaces is impractical such phosphorus as is present in iron ore remains in the resulting iron. Its removal, therefore, falls to the refining that takes place in steel furnaces. And here the iron is rid of its phosphorus only if basic rather than acid conditions prevail. This is to say that the slag as it forms out of the undesirable elements in the iron and out of the materials eroded from

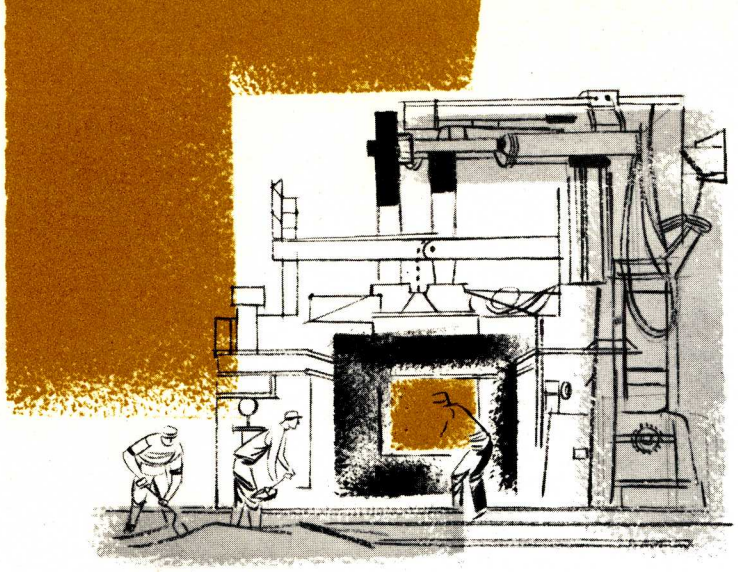


the interior furnace surfaces must be kept basic if phosphorus is to be removed. A basic slag has the further and important function of controlling sulphur, another of the elements adversely affecting the quality of steel.

The erosions of the furnace hearth have a predominant influence upon the character of the slag. It follows that the refractories from which this lining is built must be basic if the slag is to be kept basic. It is this basic or acid consistency of the hearth that designates both the steel process and the steel furnace as basic or acid.

Steel can be and is produced in furnaces where the hearths are built of acid refractories and where, therefore, a chemically acid environment prevails. But the acid process is possible only if the iron that is to be refined is substantially free of phosphorus. Since most iron ore and hence most iron contains excessive amounts of phosphorus only a relatively small quantity of steel is produced in acid furnaces.





*Manual repair of the furnace hearth*

## BASIC RAW MATERIALS

BASIC GRAIN REFRACTORIES are produced from the ores dolomite, magnesite, brucite and chromite and from artificial magnesite and brucite extracted by chemical processes from dolomite or from combinations of dolomite or calcite with the salt, magnesium chloride.

For the construction of basic furnace linings, products manufactured from magnesite and brucite—natural or artificial—are preferred due to their high concentrations of magnesia, the essential constituent of basic refractories.

The lowest concentration of magnesia is in dolomite. This mineral, however, is relatively abundant and often occurs in massive, uniformly pure and extensive deposits that lend themselves to low cost quarrying. Such economic as well as important metallurgical considerations have led to the adoption of dolomite, both in its natural state but preferably manufactured into so-called "dead-burned dolomite," for the maintenance of basic furnace linings to the virtual exclusion of other grain refractories.

Chromite is important in the manufacture of grain refractories used for repairing interior furnace surfaces other than that of the hearth. In these products it is employed in combination with semi-processed materials derived from the other basic ores and from synthetic brucite and magnesite.

From such ores and materials have been developed basic grain refractories, the products required to keep basic steel making furnaces in production. Lacking them there would be no basic process by which 90% of all steel is manufactured.


*Mechanical repair of interior furnace surfaces*

## BASIC REFRACTORIES, INCORPORATED

UNTIL 1914 the American steel industry relied upon "dead-burned" magnesite from Austria and domestic unprocessed or lightly burned dolomite for both basic furnace hearth construction and lining maintenance refractories. Then, to meet war-time shortages, the manufacture of dolomite into a scientifically prepared refractory was begun by three companies the business of which was consolidated later to form Basic Refractories, Incorporated.

Over the intervening years, retaining the leadership inherent in its early efforts, this company not only has kept its position abreast of a steadily growing market but has expanded the scope of its activities to include the production of a full complement of granular basic refractories.

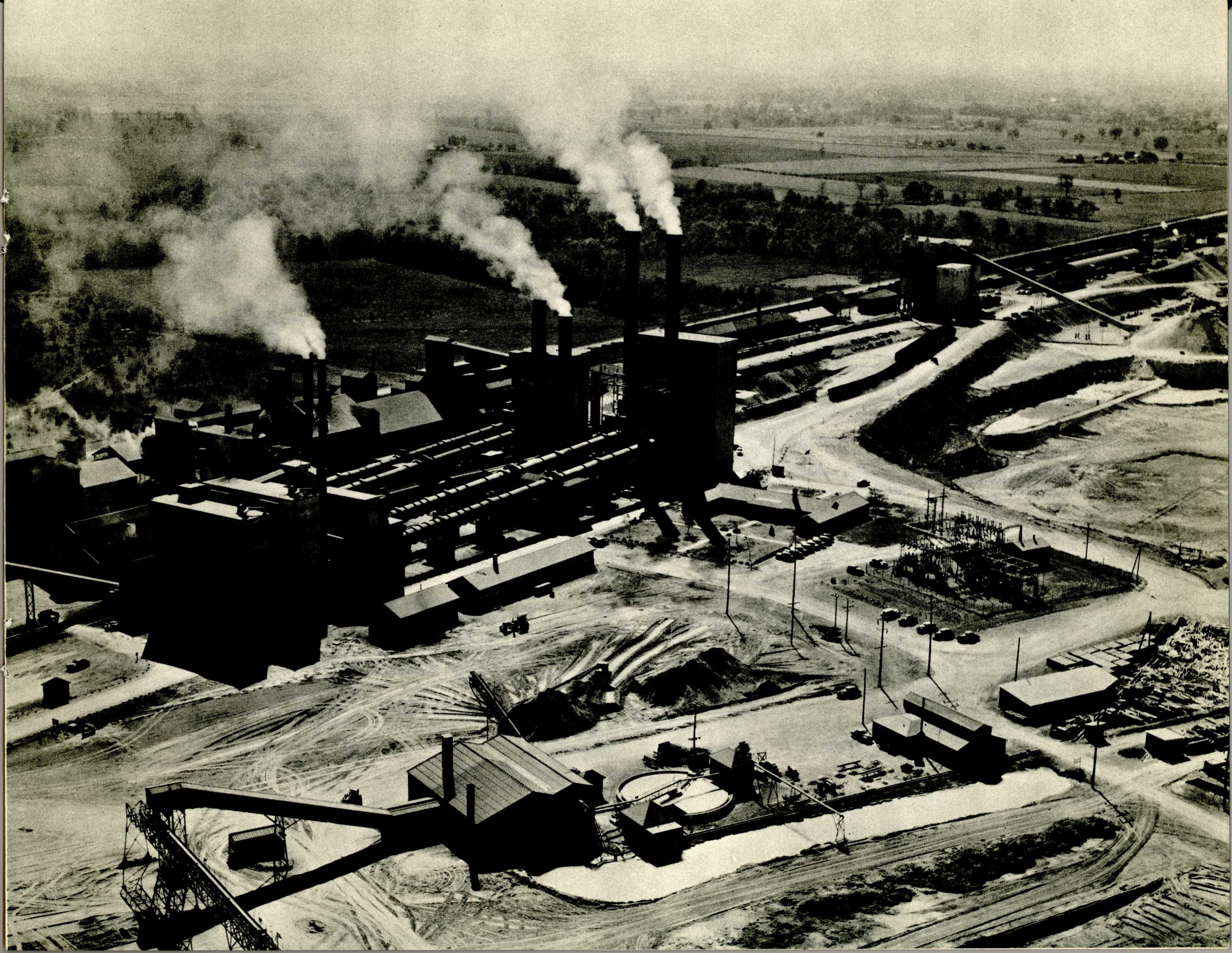
## ORE DEPOSITS

BASIC REFRACTORIES, INCORPORATED obtains dolomite from its extensive quarries in Northwestern Ohio. Here its reserves are sufficient to satisfy requirements at present rates of operation for well over one hundred years. The location of these dolomite resources and the company's adjoining principal manufacturing plants coincides almost exactly with the geographical center of steel production in the United States.

Basic's magnesite and brucite resources are located in the Paradise Mountains of West Central Nevada. These comprise the major part of one of the only two large known deposits of the kind in the United States. The refractories produced adjacent to these mines and shipped the country over are competitive in all steel refining centers and are accessible to foreign markets through export facilities on San Francisco Bay.

The company has discovered in Cuba and laid claim to deposits of chromite that give promise of rounding out its independent position in respect to all the raw materials essential to basic refractories' manufacture.

*Ohio Works of Basic Refractories, Incorporated*



## MINING

MINING AT the rate of more than two and a half million tons of ore a year, the company's field operations typify modern, large-scale, open-pit mechanical procedures that utilize blast hole and air drills, heavy power shovels, diesel trucks, crushers, screens and all essential complementary equipment.

## MANUFACTURING

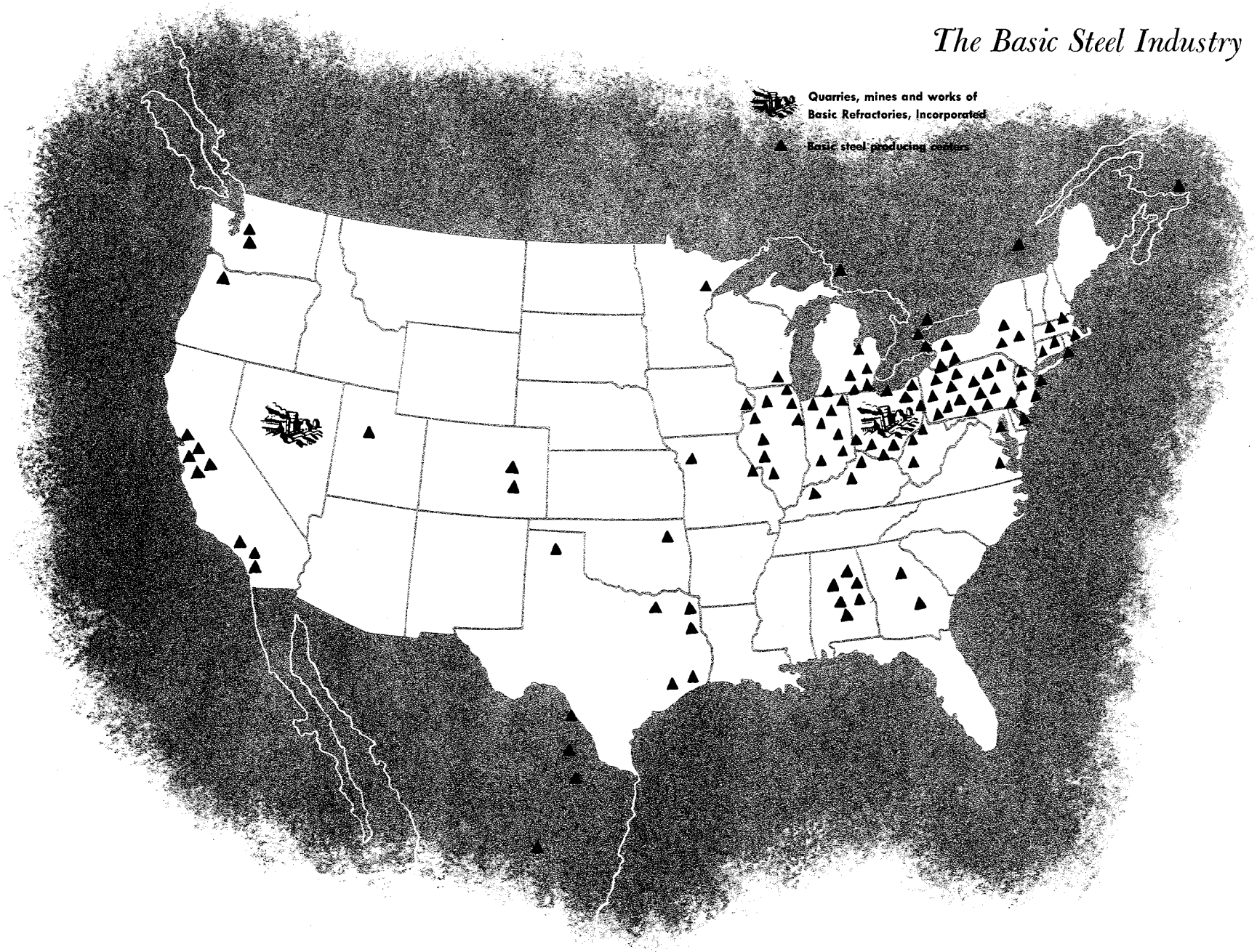
BEFORE THE three ores, dolomite, magnesite and brucite can be manufactured into refractories they must be fired at high temperatures in the presence of carefully selected and proportioned mineralizing agents such, for example, as iron oxide.

The preferred method of firing is in rotary kilns—large diameter, long, brick lined, nearly horizontal steel cylinders, sloping slightly downward. As raw materials are fed into the higher end, the revolution of the kiln around its inclined axis carries them slowly down its entire length while subjecting them, with gradually increasing intensity, to the heat of the flame applied at the lower discharge end. There the resulting white-hot granules are cooled and afterward processed into end products.

In respect to size, numbers and effectiveness Basic Refractories' rotary kiln plants are without parallel in the refractories industry. Leaving out of account two semi-commercial scale units that are reserved for new product development, the company operates a total of twelve kilns in its Ohio and Nevada works that range from three hundred and ninety to one hundred and fifteen feet in length.

From primary crushers to finishing departments, the plants of Basic Refractories, Incorporated are fully mechanized for continuous flow production, thus effecting maximum control over the quality and uniformity of its products. Extensive instrumentation combined with exacting laboratory analyses insure precise manufacturing.

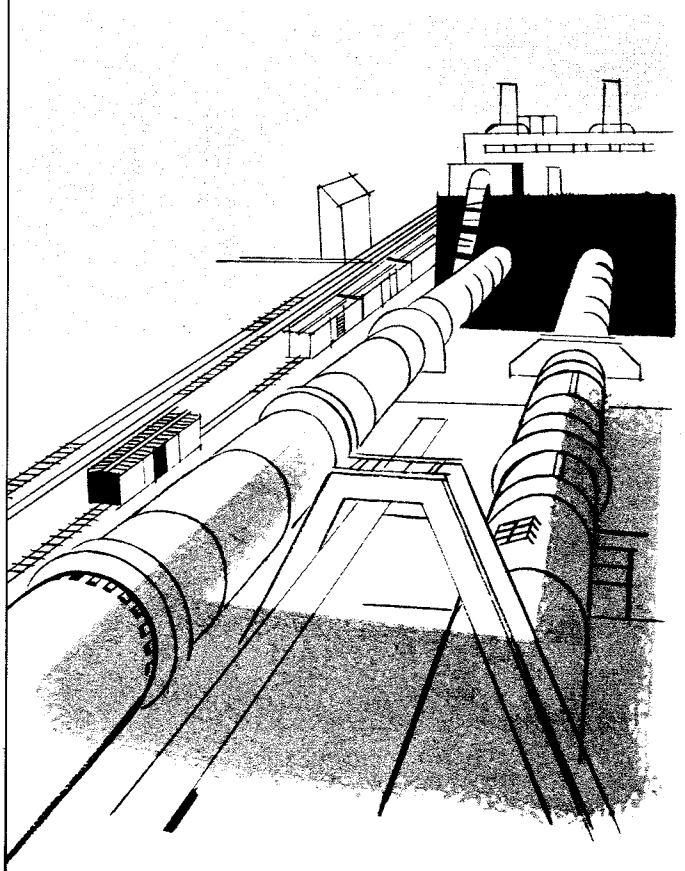
*Nevada Works of Basic Refractories, Incorporated*


Quarries, mines and works of
Basic Refractories, Incorporated
Basic steel producing centers

*Aceros Ecatepec S.A. ..... Mexico, D.F.
*Aceros Tlalnepantla ..... Monterrey, Mexico
*Adirondack Foundries ..... Watervliet, N. Y.
*Alan Wood Steel Company ..... Conshohocken, Pa.
*Algoma Steel Corp. Ltd., Sault Ste. Marie, Ont., Canada
*Allegheny Ludlum Steel Corporation, Brackenridge, Pa.
Allegheny Ludlum Steel Corporation ... Buffalo, N. Y.
*Allegheny Ludlum Steel Corporation ... Dunkirk, N. Y.
*Allegheny Ludlum Steel Corporation, Watervliet, N. Y.
*Altos Hornos de Mexico ..... Monclova, Mexico
*American Locomotive Company ..... Latrobe, Pa.
*American Brake Shoe Company ..... Calera, Ala.
*American Brake Shoe Company .. Chicago Heights, Ill.
American Brake Shoe Company ..... Denver, Colo.
American Brake Shoe Company ..... Elyria, Ohio
American Brake Shoe Company ..... Los Angeles, Cal.
*American Brake Shoe Company ..... Medina, N. Y.
American Brake Shoe Company ..... New Castle, Del.
*American Brake Shoe Company ..... Oakland, Cal.
*American Brake Shoe Company ..... St. Louis, Mo.
*American Steel Foundries ..... Alliance, Ohio
*American Steel Foundries ..... East Chicago, Ind.
*American Steel Foundries ..... East St. Louis, Ill.
*American Steel Foundries ..... Granite City, Ill.
*American Steel Foundries ..... Verona, Pa.
*Armco Steel Corporation ..... Ashland, Ky.
*Armco Steel Corporation ..... Baltimore, Md.
*Armco Steel Corporation ..... Butler, Pa.
*Armco Steel Corporation ..... Middletown, Ohio
*Atlantic Steel Company ..... Atlanta, Ga.
*Atlas Steels Ltd. ..... Welland, Ontario, Canada
*Auto Specialties Mfg. Co. ..... Benton Harbor, Mich.
*Babcock & Wilcox Company ..... Barberton, Ohio
*Babcock & Wilcox Company ..... Morado Station, Pa.
*Bethlehem Steel Company ..... Bethlehem, Pa.
*Bethlehem Steel Company ..... Johnstown, Pa.
*Bethlehem Steel Company ..... Lackawanna, N. Y.
*Bethlehem Steel Company ..... Los Angeles, Cal.
Bethlehem Steel Company ..... Seattle, Wash.
Bethlehem Steel Company ..... So. San Francisco, Cal.
*Bethlehem Steel Company ..... Sparrows Point, Md.
*Bethlehem Steel Company ..... Steelton, Pa.
*Birdsboro Steel Foundry ..... Birdsboro, Pa.
*Borg-Warner Corporation ..... New Castle, Ind.
*Braeburn Alloy Steel Corporation ..... Braeburn, Pa.
*Buckeye Steel Castings Company ..... Columbus, Ohio
*Bucyrus-Erie Company ..... So. Milwaukee, Wisc.
Burlington Steel Co. Ltd. .. Hamilton, Ontario, Canada
*Byers, A. M., Company ..... Economy, Pa.
*Cabot Shops, Incorporated ..... Kings Mills, Texas
Cameron Iron Works ..... Houston, Texas
*Camp Steel Works ..... Atlanta, Ga.
*Canada Electric Castings, Ltd. ..... Orillia, Ont., Canada
*Canadian Car & Foundry Ltd., Montreal, Quebec, Canada
*Canadian Tube & Steel, Ltd., Montreal, Quebec, Canada
*Carpenter Steel Company ..... Reading, Pa.
*Central Iron & Steel Company ..... Harrisburg, Pa.
*Chapman Valve Mfg. Company, Indian Orchard, Mass.
*Cia Fundidora de Fierro ..... Monterrey, Mexico
*Colorado Fuel & Iron Corporation ..... Claymont, Del.
*Colorado Fuel & Iron Corporation ..... Harriet, N. Y.
*Colorado Fuel & Iron Corporation ..... Minnequa, Col.
*Columbia Tool Steel Company .... Chicago Heights, Ill.
*Connors Steel Company ..... Birmingham, Ala.
*Continental Steel Company ..... Kokomo, Ind.
*Copperweld Steel Company ..... Warren, Ohio
*Crane Company ..... Chicago, Ill.
*Crucible Steel Company of America ..... Midland, Pa.
*Crucible Steel Company of America ... Syracuse, N. Y.
*Damascus Steel Casting Company .. New Brighton, Pa.
*Detroit Steel Corporation ..... Portsmouth, Ohio
*Disston & Sons Incorporated ..... Tacony, Pa.
*Dominion Engineering
Works, Ltd. ..... Lachine, Quebec, Canada
*Dominion Foundries & Steel, Ltd., Hamilton, Ont., Can.
*Dominion Iron & Steel, Ltd., Sydney, Nova Scotia, Can.
*Duraloy Company ..... Scottdale, Pa.
*Duriron Company ..... Dayton, Ohio
*Edgewater Steel Company ..... Verona, Pa.
*Electric Alloy Steel Corporation ..... Detroit, Mich.
*Empire Steel Corporation ..... Mansfield, Ohio
*Fairmount Steel Company ..... Philadelphia, Pa.
*Finkl & Sons Company ..... Chicago, Ill.
*Firth Sterling, Incorporated ..... McKeesport, Pa.
*Ford Motor Company ..... Detroit, Mich.
*Fundiciones de Hierro ..... Mexico, D.F.
*General Electric Company ..... Everett, Mass.
*General Electric Company ..... Schenectady, N. Y.
*General Steel Castings Corporation .... Eddystone, Pa.
*General Steel Castings Corporation .. Granite City, Ill.
*Glover Machine Works ..... Cordele, Ga.
*Granite City Steel Company ..... Granite City, Ill.
*Green River Steel Company ..... Owensboro, Ky.
*Griffin Wheel Company ..... Chicago, Ill.
Harrisburg Steel Corporation ..... Harrisburg, Pa.
*Harrison Steel Castings Company ..... Attica, Ind.
*Hojalata y Lamina ..... Monterrey, Mex.
*Industrial Forge & Steel Company ..... Canton, Ohio
*Inland Steel Company ..... East Chicago, Ind.
*Jessop Steel Company ..... Washington, Pa.
*Jones & Laughlin Steel Corporation ..... Aliquippa, Pa.
*Jones & Laughlin Steel Corporation .... Cleveland, Ohio
*Jones & Laughlin Steel Corporation ..... Pittsburgh, Pa.
*Joslyn Mfg. & Supply Company ..... Fort Wayne, Ind.
*Judson Steel Corporation ..... Emeryville, Cal.
Kaiser Steel Corporation ..... Fontana, Cal.
*Kensington Steel Company ..... Chicago, Ill.
*Keystone Steel & Wire Company ..... Peoria, Ill.
Kilby Steel Company ..... Anniston, Ala.
La Consolidada S. A. ..... Mexico, D. F. Mexico
*La Consolidada S. A. ..... Piedras Negras, Mex.
*Laclede Steel Company ..... Alton, Ill.
*Laminadora Kreimerman, S.A. ..... Pachuca, Mexico
*Latrobe Steel Company ..... Latrobe, Pa.
*Lebanon Steel Foundry ..... Lebanon, Pa.
*Le Tourneau Inc. ..... Longview, Texas
*Lone Star Steel Company ..... Lone Star, Texas
*Los Angeles Steel Castings Company, Los Angeles, Cal.
*Lukens Steel Company ..... Coatesville, Pa.
*McLouth Steel Company ..... Detroit, Mich.
*Mesta Machine Company ..... Homestead, Pa.
*Michigan-Standard Alloy Casting Co .. Detroit, Michigan
*Midvale Company ..... Nicetown, Pa.
*Milton Steel Products ..... Milton, Pa.
*National Forge & Ordinance Company ..... Irvine, Pa.
*National Roll & Foundry Co ..... Avonmore, Pa.
National Steel Company
*Great Lakes Steel Corporation ..... Detroit, Mich.
*Weirton Steel Company ..... Weirton, W.Va.
*Newport News Shipbuilding Co. .. Newport News, Va.
*Newport Steel Company ..... Newport, Ky.
*Northeastern Steel Corporation ..... Bridgeport, Conn.
*Northwestern Steel & Wire Company ..... Sterling, Ill.
*Ohio Steel Foundry Company ..... Lima, Ohio
*Ohio Steel Foundry Company ..... Springfield, Ohio
*Oregon Steel Mills ..... Portland, Ore.
*Pacific States Steel Company ..... Niles, Cal.
*Pettibone Mulliken Company ..... Chicago, Ill.
*Phoenix Iron & Steel Company ..... Phoenixville, Pa.
*Pittsburgh Steel Company ..... Monessen, Pa.
*Pittsburgh Steel Foundry Company ..... Glassport, Pa.
Pratt & Letchworth Company ..... Buffalo, N. Y.
*Republic Steel Corporation ..... Buffalo, N. Y.
*Republic Steel Corporation ..... Canton, Ohio
*Republic Steel Corporation ..... Cleveland, Ohio
*Republic Steel Corporation ..... Gadsden, Ala.
*Republic Steel Corporation ..... Massillon, Ohio
*Republic Steel Corporation ..... South Chicago, Ill.
*Republic Steel Corporation ..... Warren, Ohio
*Republic Steel Corporation ..... Youngstown, Ohio
*Riverside Foundry ..... Bettendorf, Iowa
*Roebling Sons Company ..... Roebling, N. J.
*Rotary Electric Steel Company ..... Detroit, Mich.
*Scullin Steel Company ..... St. Louis, Mo.
*Sharon Steel Corporation ..... Farrell, Pa.
*Sharon Steel Corporation ..... Lowellville, Ohio
*Sheffield Steel Corporation ..... Houston, Texas
*Sheffield Steel Corporation ..... Kansas City, Mo.
*Sheffield Steel Corporation ..... Sand Springs, Okla.
*Simonds Saw & Steel Company ..... Lockport, N. Y.
*Sorel Industries, Ltd. ..... Sorel, Quebec, Canada
*Sorel Steel Foundries, Ltd. ..... Sorel, Quebec, Canada
*Steel Company of Canada .. Hamilton, Ontario, Canada
*Symington Gould Corporation ..... Depew, N. Y.
*Taylor Wharton Iron & Steel Company, High Bridge, N.J.
*Texas Steel Company ..... Fort Worth, Texas
*Timken Roller Bearing Company ..... Canton, Ohio
*Union Electric Steel Company ..... Carnegie, Pa.
United States Steel Corporation
*American Steel & Wire Division ..... Donora, Pa.
*American Steel & Wire Division ..... Duluth, Minn.
*American Steel & Wire Division ... Worcester, Mass.
*Columbia-Geneva Steel ..... Geneva, Utah
*Columbia-Geneva Steel ..... Pittsburg, Cal.
*Columbia-Geneva Steel ..... Torrance, Cal.
*National Tube Division ..... Lorain, Ohio
*National Tube Division ..... McKeesport, Pa.
*Tennessee Coal & Iron & R. R. Division, Ensley, Ala.
*Tennessee Coal & Iron & R. R. Division, Fairfield, Ala.
*United States Steel Corporation ..... Bessemer, Pa.
*United States Steel Corporation ..... Clairton, Pa.
*United States Steel Corporation ..... Gary, Ind.
*United States Steel Corporation ..... Johnstown, Pa.
*United States Steel Corporation ..... Morrisville, Pa.
*United States Steel Corporation ..... Munhall, Pa.
*United States Steel Corporation .... So. Chicago, Ill.
*United States Steel Corporation .... So. Duquesne, Pa.
*United States Steel Corporation .... Youngstown, Ohio
*Universal Cyclops Steel Company ..... Bridgeville, Pa.
*Vanadium Alloys Steel Company ..... Latrobe, Pa.
*Vanadium Alloys Steel Company ..... Monaca, Pa.
*Vulcan Crucible Steel Company ..... Aliquippa, Pa.
*Washburn Wire Company ..... Phillipsdale, R. I.
*Washington Iron Works ..... Seattle, Wash.
*West Virginia Steel & Mfg. Company, Huntington, W.Va.
*Wheeling Steel Corporation ..... Steubenville, Ohio
*Wickwire Bros. ..... Cortland, N. Y.
*Wisconsin Steel Company ..... South Chicago, Ill.
*Youngstown Sheet & Tube Co. .. Indiana Harbor, Ind.
*Youngstown Sheet &Tube Company, Youngstown, Ohio

*Asterisks indicate plants producing steel by basic process which use lining refractories made by Basic Refractories, Incorporated.

## PRODUCTS AND TRADE NAMES



BASIC REFRACTORIES, INCORPORATED has adopted the use of trade names the more readily to identify its products and to associate them with the part the company has played in the development of the basic grain refractory science during the past forty years.

The company's "dead-burned" dolomite products, *Magnefer* and *Syndolag*, have long been regarded as standards for quality throughout the steel industry in the United States, Canada and Mexico.

Enjoying a comparable position in the trade is the company's "dead-burned" magnesite product, *Basifrit*, distinguished for its effectiveness in rapidly repairing serious damage to furnace hearths.

One of the principal products which the company manufactures at its Nevada Plant is *Basic Magnesite* a "dead-burned" magnesite designed to meet especially severe refractory requirements in the steel and ferro-alloy industries.

Prior to 1941—when Basic Refractories, Incorporated pioneered with *Ramset* for ramming hearths—the common practice in the steel industry was to install furnace linings by fusing, layer upon layer, a mixture of "dead-burned" magnesite and furnace slag. This proved a costly and time-consuming procedure. The rammed hearth has reduced construction costs and contributed hundreds of thousands of productive hours to the country's steel furnaces.

Subsequently a second magnesia ramming mix, *Ramiclase*, was added to the Basic line.

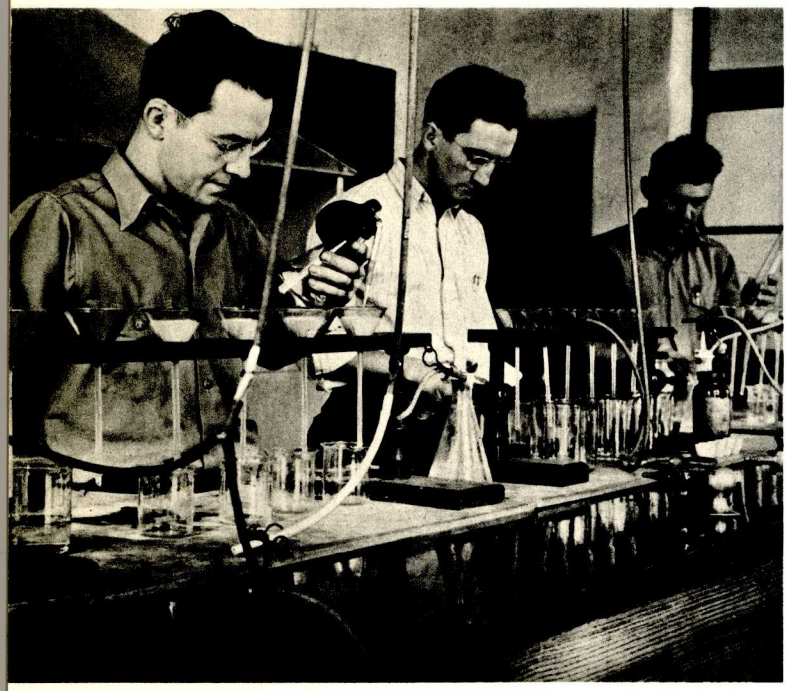
In the late 1930's a few enterprising furnace operators, realizing the need for an improved method of repairing furnace bank and wall sections, began to experiment with the air emplacement of grain refractories. These efforts failed owing to the fact that the refractories available and the variety of devices used for applying them, were inadequate to cope with a highly specialized undertaking.

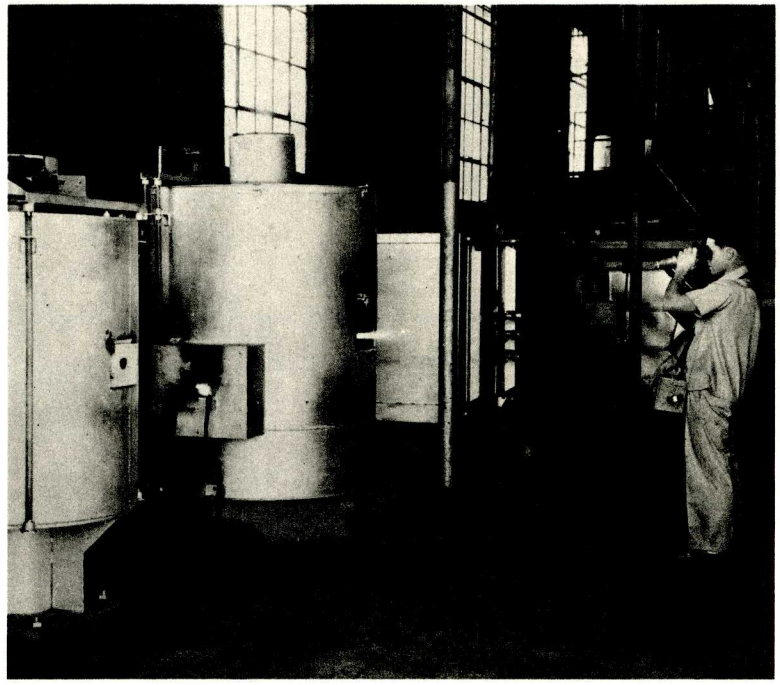
Against this background Basic Refractories developed and introduced a broad line of special refractories together with a pneumatic device—the *BRI Gun*—used for applying them to vertical furnace surfaces. This Gun is now employed in steel plants throughout the North and South American continents, as well as in Europe, Japan,

Africa and Australia. Refractories fed through it—*Gunmix*, *Gundol*, and *Gunchrome*—remain unique as basic lining maintenance materials.

Incident to this development, the *BRI Gun* and these special refractories have found favor for use in foundries where until recently cupolas melting iron for castings were operated exclusively on acid linings. Now it is acknowledged that by changing to a basic lining the quality of castings in many instances can be greatly improved without prejudice to production costs. As is the case with steel making furnaces, these cupola linings suffer constant erosion from the physical and chemical reactions accompanying the refining process. Their installation and repair provides an extensive new market for basic grain refractories.

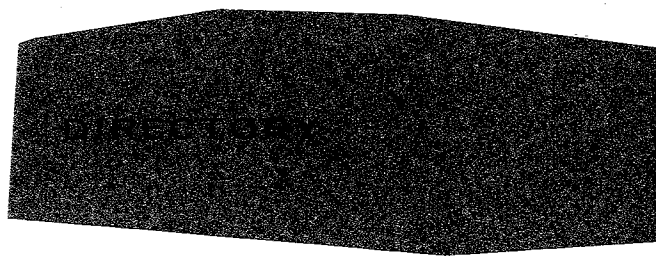
*Repairing basic arc electric furnace with BRI Gun and gun refractories*





## RESEARCH AND SERVICE

AS THE variety of products attest, the development and use of basic lining refractories is a highly specialized activity. The company, in addition to maintaining a large staff of ceramic, metallurgical and chemical engineers, retains men with broad steelmaking experience as sales and service engineers. Enjoying the confidence and "talking the language" of the nation's steelmakers and foundrymen, they are constantly in touch with practical refractory problems the solution of which, transferred to its laboratories, provides the company with the basis for its continuing progress and growth as a major supplier of basic grain refractories—Underlining Steel.



## *Directors*

JOHN H. BRIGGS, *President*, The Gabriel Company
HOWARD P. EELLS, JR., *President and Treasurer of the Company*
JOHN W. GARRETT, II, *Associate*, Hallgarten & Company
LORING L. GELBACH, *President*, The Central National Bank of Cleveland
RICHARD INGLIS, *Attorney*, Hauxhurst, Inglis, Sharp & Cull
HARLEY C. LEE, *Vice President of the Company*
JOHN C. WILSON, JR., *President*, Acro Welder Mfg. Company

## *Senior Officers*

HOWARD P. EELLS, JR., *President and Treasurer*
HARLEY C. LEE, *Vice President—Technical Services*
MATTHEW J. LUDWIG, *Vice President—Controller*
MAX MULLER, *Vice President—Operations and Engineering*
HARVEY N. BARRETT, JR., *Vice President—Refractory Sales*
FRANCIS J. COLLINS, *Vice President—Lime Sales*
WILLIAM A. MELVILLE, *Secretary*

## *Honorary Officers*

DAN P. EELLS, *Chairman*
SAMUEL EELLS, *Vice President*
WILLIAM P. KELLY, *Treasurer*

## *General Offices*

845 Hanna Building, Cleveland 15, Ohio

## *Sales Offices*

Farmers Bank Building, Pittsburgh, Pennsylvania
Gary National Bank Building, Gary, Indiana
Haverford, Philadelphia, Pennsylvania
Clayton, St. Louis, Missouri

## *Sales Agencies*

H. J. Kumer & Company, Los Angeles, California
Refractories Engineering & Supplies, Ltd.,
Hamilton, Ontario and Montreal, Quebec

## *Works and Laboratories*

Narlo, Ohio
Bettsville, Ohio
Gabbs, Nevada

BASIC REFRACTORIES, INCORPORATED