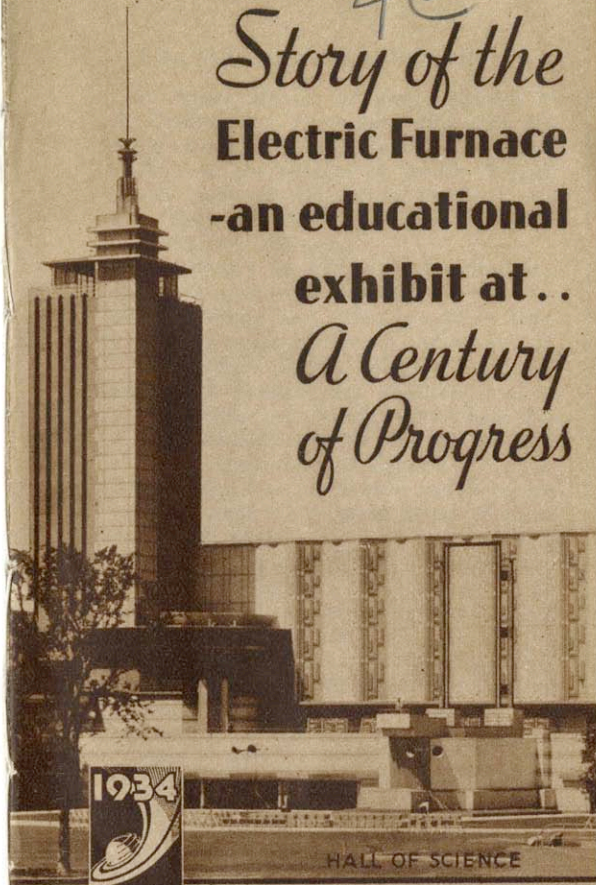
4c

Story of the Electric Furnace -an educational exhibit at.. A Century of Progress



1934
A CENTURY OF PROGRESS CHICAGO

HALL OF SCIENCE

Sponsored by

UNION CARBIDE AND CARBON CORPORATION

Two Miracles of Modern Science

In these Basic Science Exhibits of A Century of Progress, you will see many wonderful records of man's conquest over the secrets of nature. Yet, of these, perhaps the most amazing are the "Story of Air" and the "Story of the Electric Furnace".

The "Story of Air" explains how science has been able to make the familiar air do things and yield products that, a hundred years ago, were undreamed of.

The "Story of the Electric Furnace" tells how science has enabled man to use invisible forces and produce heat that is rivalled only by the heat of the sun.

Union Carbide and Carbon Corporation, which has sponsored much of the research that made these discoveries industrially useful, is proud to have been invited to cooperate with the management of A Century of Progress in arranging these exhibits for your enjoyment and information.

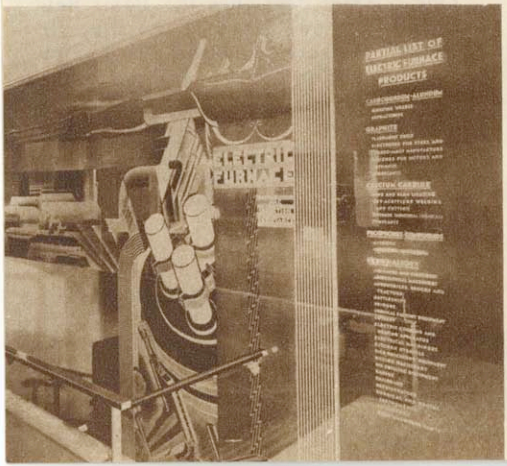
This booklet describes the Basic Science Exhibits on "Story of the Electric Furnace." Be sure to obtain also a copy of the companion booklet describing the "Story of Air." If you did not obtain this during your visit at the Hall of Science a copy will be mailed to you if you address a request to Union Carbide and Carbon Corporation, 30 East 42nd Street, New York, N. Y.

The Electric Furnace

Electric furnaces are devices for generating terrific heat from electricity. This heat is needed for producing or refining dozens of raw materials that are used in industry and science. Many chemicals and metals that are now widely used in industrial processes would be impossible to obtain if there were no electric furnaces.

This art of producing chemicals with electric heat is a part of the science of electrochemistry. The exhibits comprising the "Story of the Electric Furnace" explain the principles of electrochemistry that are involved in electric resistance furnaces, electric induction furnaces, and electric arc furnaces.

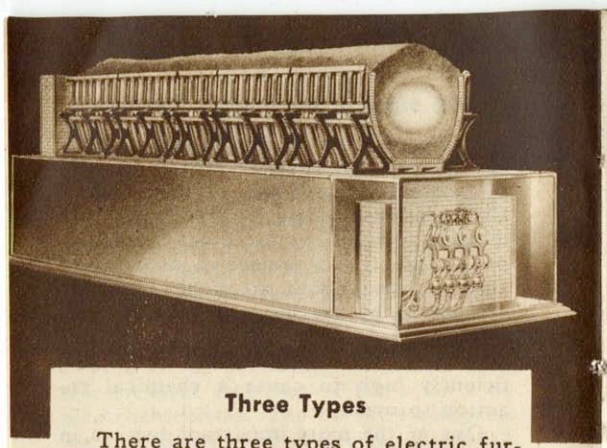
The following pages describe each of these exhibits in a way that will help you to understand and appreciate one of the greatest marvels of modern science—the electric furnace.



The Story of the Electric Furnace

During the past hundred years, electrical science and chemistry have become increasingly important to each other. Chemical reactions are used to generate electricity in all types of cells and batteries. Electricity is used in a variety of ways to bring about chemical reactions; sometimes by passing a current through a solution (electrolysis); in other instances, by producing a temperature sufficiently high to cause a chemical reaction to occur.

One of the most important factors in the production of many of the new marvels that are displayed in A Century of Progress has been the Electric Furnace. It has enabled metallurgists to get twice as high temperatures as were possible previous to its development. Until quite recently, the highest furnace temperature available commercially was about 2,500 degrees Fahrenheit. This was obtained in a combustion furnace operating under forced draft. Since the beginning of the present century, the development of the electric furnace has made temperatures of over 6,500 degrees Fahrenheit available for industrial use. This is the reason that the electric furnace has made possible the manufacture of products hitherto unknown.



Three Types

There are three types of electric furnaces: Resistance, Induction, and Arc. They all work on the principle of changing electrical energy into heat energy. In these exhibits, a model of each type of furnace and the principles of its operation are demonstrated.

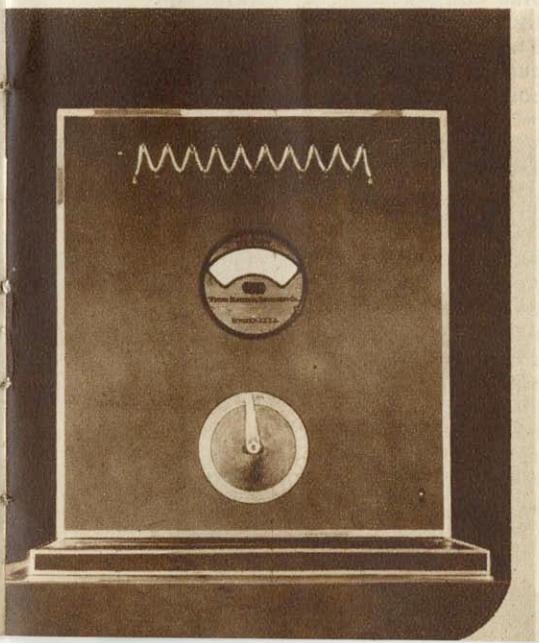
Carborundum Furnace*

The manufacture of silicon carbide (Carborundum) is one practical application of the resistance type of electric furnace. The end of the model shown here was made to expose the cross-section of the furnace when it is fully charged and in operation. A central core of coke is used as a conductor for the electricity. When the current flows through, this core becomes extremely hot, due to the resistance of the core to the current of electricity. As the heat continues, the sand and coke mixture around the central core reacts to form the iridescent crystals of silicon carbide.

*This exhibit was made possible by the cooperation of The Carborundum Company.

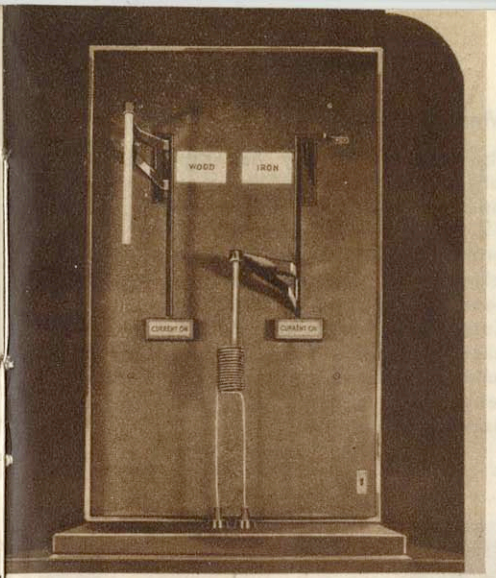
Principles of a Resistance Furnace

Heat is generated when an electric current passes through a conductor such as a wire. The more resistance there is in the wire, the more heat there will be generated. The transfer of electrical energy into heat energy by overcoming resistance is the basic principle of the resistance type of furnace. In this exhibit, the amount of current passing through the wire is indicated. As the amount of current increases, heat is generated more rapidly. As a result, the wire becomes hot and bright.



Principle of Induction

A later developed type of electric furnace is known as the induction furnace. The name is derived from the fact that the heating current is an induced current. The great scientist Faraday discovered that when a conductor or wire cut through lines of force surrounding a magnet or a wire in which a current was flowing, a current would be set up in the secondary wire or conductor. The outer red coil, called the primary, is carrying a rapidly alternating current. This alternating current produces an alternating magnetic field or moving lines of force, which move through the inner blue coil, inducing a current in it and lighting the small lamp in the center. There is absolutely no other source of current connected with the secondary coil and lamp.



Principle of Induction Furnace

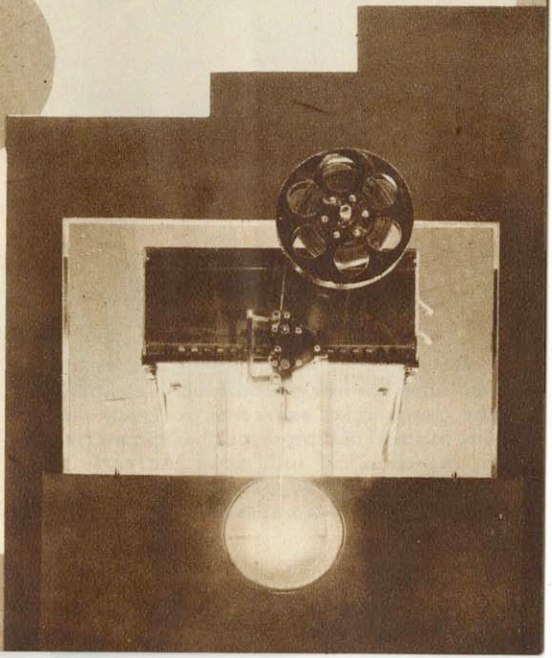
This exhibit demonstrates a combination of induced currents and resistance heating to form a simple induction furnace. The primary conductor is composed of copper tubing wound in a spiral. It is carrying a rapidly alternating current which is producing an alternating magnetic field or moving lines of force within the coil. When the iron rod is placed in the center of the coil, it takes the position of a secondary conductor, and induced currents are set up. As the iron has some resistance to the flow of these induced currents, it is heated by them. When a wooden rod is placed in the coil, there is no heating, because the wood is a non-conductor and there is no flow of induced current.

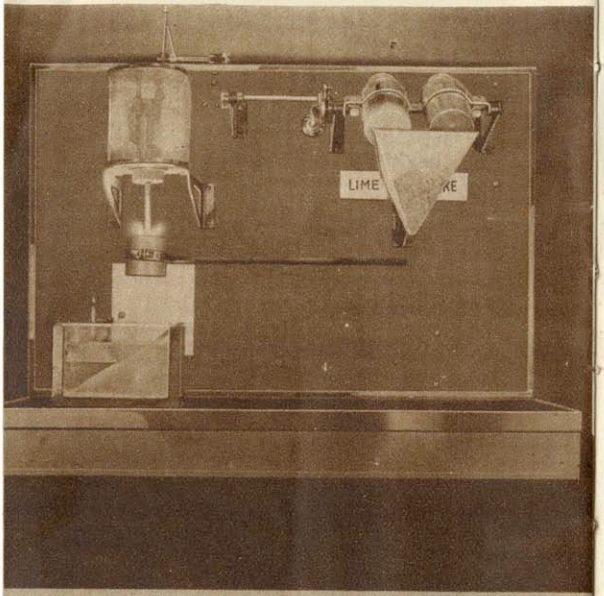
Men Behind the Electric Furnace

The history of any development is generally the history of the men behind it; and here, etched in stainless steel, itself a product of electric furnaces, are portraits of the more prominent men who developed the principles of the electric furnaces—Davy and his early experiments in electric melting, Siemens' first melting furnace, Moissan's furnace applications, Acheson's carborundum (silicon carbide) furnace, and Heroult and his steel-furnace developments.

The Electric Arc

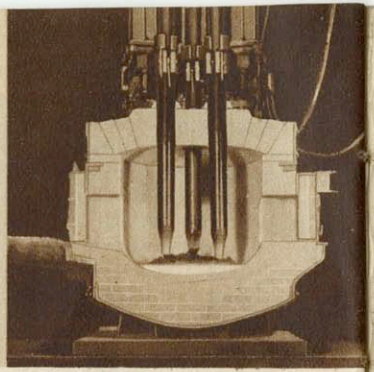
The fact that considerable heat is liberated when an electric current arcs or jumps is common knowledge. The arc furnace simply consists of an installation that provides a convenient method of sustaining an arc and confining its heat to a definite area. A properly sustained arc of electricity will develop temperatures higher than 6,500 degrees. In this exhibit, the arc between the carbon electrodes is liberating enough heat to melt the iron wire rapidly. If a crucible were placed around these electrodes, the set-up would be that of a complete small electric arc furnace.





The Manufacture of Calcium Carbide by the Arc Furnace

This exhibit is a simulation of the manufacture of calcium carbide, which is the commercial source of acetylene and one of the most important basic materials in the chemical industries. As early as 1836, Edmund Davy, an English chemist, produced, by decomposing water with a by-product of one of his experiments, a gas which we now know as acetylene. Calcium carbide itself was produced in 1862 by Woehler, the most famous chemist of his day. Commercial production of calcium carbide began in 1892 when it was accidentally produced at Spray, North Carolina, while experiments for the production of metallic calcium in an electric furnace were being made. The great utility of calcium carbide comes from the fact that when it comes in contact with water, a gas called acetylene is liberated. Acetylene is extensively used for lighting in country homes, light houses, harbor buoys and air beacons, for heating in the oxy-acetylene process for cutting and welding of metals, and in the manufacture of synthetic organic chemicals.



Model of an Arc Furnace

This is a model of the type of arc furnace used extensively for the manufacture of steels of many varieties. It is what is called a three-phase installation; and, at any time, the electric current is coming down two of the electrodes, going through the slag, into the metal underneath, and out through the third electrode. This furnace has great efficiency with simple construction and is extremely adaptable.

On the Ground Floor of the Hall of Science are many examples of electric furnace products and their uses. They show very clearly the great advances in the science of metals and materials that have been possible since the advent of the electric furnace.

The Periodic Table of Chemical Elements

For the first time in history, every or of the earth's 92 chemical elements ha been gathered into a single exhibit. Thi exhibit is the Periodic Table of Chemica Elements—the huge central feature in th Great Hall of the Hall of Science.

Of these 92 elements, about half hav been contributed by Union Carbide an Carbon Corporation.