ends of the air channels next to the periphery were sometimes formed with inverted cast-iron troughs with holes in them; their ends next to the chimneys with the largest blocks of coal, and their intermediate parts with "dry" bricks.

The chimneys had cast-iron lids with handles for closing them air-tight when required. Ignition was effected at the bottom of the chimneys, or vertical holes, by dropping burning coal and pieces of wood down through them; and the fire gradually spread from the centre towards the periphery, or in the opposite direction to the air-currents. Care was taken to keep the mantle of damp coke-dust as air-tight as possible while this was going on, and when smoke ceased to issue from the chimneys or holes all openings were sealed up and the heaps allowed to cool.

Ovens for coking are first mentioned in the latter half of the eighteenth century. In 1773 Horne and in 1782 the Earl of Dundonald obtained patents for the recovery of the by-products obtainable from coal coked in closed vessels or chambers. The Dundonald patent provided for the admission of a restricted and regulated supply of air to the interior of the chamber for the purpose of creating sufficient heat to carry on the process of distillation by the partial combustion of the gases. From that time forward, ovens worked upon the Dundonald principle (but, except in rare cases, without arrangements for the recovery of the by-products) have been in constant use. The more ancient ovens were circular, elliptical, or ovoid in plan, with a dome or cupola for a roof, the more recent, square or trapezoidal, with a cylindrical arch for a roof.

One of the fomer was provided with an air passage, which entered the masonry on each side of the doorway, passed all round about the chamber, and was connected with its interior by branches; a circular outlet for the products of combustion, which was probably also used for introducing part of the charge; and a cast-iron door. Its vertical walls were from 2½ to 3½ feet high, in some cases more; and its diameter or other dimensions varied from those required to accommodate a charge of 1½ tons up to those required for several tons.

Each oven was provided with a doorway at one side or one end, with an outlet for the gases in the top, and with one or more inlets for air. The charge was introduced through the doorway, or partly through the dooway, partly through a hole in the roof, and both of these openings were afterwards more or less completely closed.

The escaping gases passed into a short chimney and thence into the atmosphere. Circular ovens of this class, known as Beehive, have persisted up to the present day. The coke was drawn out through the doorway by means of a long iron rod bent into the form of a ring at one end to serve as a handle, and at right angles to itself at the other to serve as a hook.

The time required for coking varied from 48 to 72 hours, according to the magnitude of the charge; and the yield of coke varied from 50 to 65 per cent., according to the quality of coal and other circumstances. Many of these ovens produced a very fine, much-prized quality of coke. After a charge had been drawn out, the walls, as a rule, retained sufficient heat to ignite the following charge.

The work of drawing the hot coke out through a narrow doorway, in an oven of any shape whose diameter, or width, is greater than that of the doorway, is, as can be imagined, a most laborious and exhausting operation. This consideration led to the construction of rectangular ovens of greater length than width, with a doorway of the full width of the oven at one end, and later, as will be seen further on, with a doorway at each end. When ovens of this shape with a doorway at one end—some of which are still in use—are about to be charged, an iron frame—frequently made of two pieces of old permanent-way rail, one as long, the other nearly as wide, as the oven, one end of the longer bar fixed at right angles to the middle of the shorter bar, and its other end provided with a strong link—is pushed in along the floor until the cross-bar touches the back wall.

The charge is then introduced and coked in the ordinary way. When the coke is ready to be drawn out, the door is removed, the charge is cooled with water inside the oven, a hook, at the end of a chain which extends from a windlass at the opposite side of the coke-bank, is passed through the link at the outer end of the long bar, and the charge is drawn out on to the coke-bank in one block. With long rectangular or trapezoidal ovens, which have a door at each end, the charge is pushed out by means of a ram with a shield at one end, and cooled with water, partly as it emerges from the oven, partly after it has fallen in pieces on the coke-bank.

Up to the year 1840 no attempt appears to have been made to apply heat generated by the combustion of the gases to the outside of the oven walls, with the object of coking the charge in its interior. At that date Cox obtained a patent for an oblong rectangular oven, with two cylindrical arches over the coking chamber, one above the other, with an empty space between them. The lower arch extended from the back to near the front, where it terminated, leaving a communicating passage between the space below it and the space above it, and air was admitted through holes in the back walls into the space between it and the top of the charge.

The products of combustion thus passed from back to front under the lower arch, then up into the space between the two arches, then back over the lower arch into the flue, and so up the chimney. This appears to have been the first attempt made to increase the heat of the chamber by circulating the hot gases on the outer side of one of its walls.

It would be difficult to trace the exact course of events during the next twenty years, but the following extract, translated from the writings of a contemporary writer, will serve the purpose of throwing some light upon it.

Writing in 1858, Hartmann says: "Improvements in the process of coking have, during recent years, been the object of many experiments and investigations, in Belgium and Rheinland, which are not yet terminated. . . . The object of these improvements has been to produce better coke, to reduce the time required in coking it, and to obtain a better yield, so as to be able to compete with English coke, which is made of the best materials, and is of exceptionally good quality.

"In the whole of these investigations one principle, whose practical application has been sought for in many different ways, has been steadily kept in view—namely, to employ the waste heat in order to effect the distillation of the charge. . . . It stands to reason that this object can be effected only by means of more or less complicated apparatus.

"In all these improvements the main problem has been to prevent the consumption of coal through contact with air outside the oven, and to subject every part of the oven to a uniform temperature. . . . This object