

# Chinese blast furnaces from the 10th to the 14th century

Donald B Wagner

*ABSTRACT: The Chinese 'Commercial revolution' of the 11th century was accompanied by a number of important technical developments. In the iron industry, the last major advances in blast furnace design were made. Water power was widely used for the blast, and coal and coke began to take the place of charcoal for the fuel. New blast furnace structures came into use, in some cases foreshadowing early European designs and those known from the traditional Chinese iron industry of the 19th and 20th centuries. This article reviews the available evidence on the construction and operation of iron blast furnaces in the Song and Yuan periods (960–1279, 1279–1368), with special reference to the use of mineral fuel.*

**EDITORIAL NOTE:** The editors welcome the opportunity to publish this survey, with its valuable bibliography, despite its prior appearance in *East Asian Science, Technology, and Medicine*, 18 (2001), 41–74 (published 2002). The present version adds two illustrations and omits detail considered to be peripheral to the interests of the readership of *Historical Metallurgy*.

## Blast furnace excavations

Excavations of ironworks sites of the Song and Yuan periods have been reported in seven Chinese provinces (see Fig 1 for a map of the eastern China region).<sup>1</sup> Of these a few are reported in sufficient detail to give us some idea of how blast furnaces in this period were built, and how they differed from what is known from periods before and after.<sup>2</sup>

A very large blast furnace, 6 metres tall, from the Song period is still standing today near Handan, Hebei. The photograph (Fig 2) was published, with a short description, in a newspaper in 1959,<sup>3</sup> and has often been reproduced.<sup>4</sup> In the Song this was Cizhou, a major iron-producing prefecture; in AD 1078 Cizhou and the

adjacent prefecture Xingzhou between them supplied more than 75 per cent of all quota deliveries of iron to the state.<sup>5</sup>

I have heard that a major investigation of this furnace has recently been completed. Until a report is published we have very little to go on, but it seems to be rather like some of the traditional Chinese blast furnaces which are known from the 19th and 20th centuries. Perhaps we see in Figure 2 the internal stone shaft of a furnace like that shown in Figures 3–4, without its wooden frame and tamped-earth fill. Nearby, in Anyang and Lin Counties, Henan, several other large blast furnaces have been investigated, but the results have not yet been published in detail (Anon 1978b, 148–9; Li Jinghua 1992, 47, 48).

## Blast furnaces built into hillsides

Song and Yuan remains of a curious type of blast furnace, built directly into a hill to obviate the need for a strong outer construction, have been reported in the provinces of Henan, Jiangxi, and Heilongjiang.<sup>6</sup> The only ones which have so far been described in adequate detail are some 12th-century sites in Acheng County,