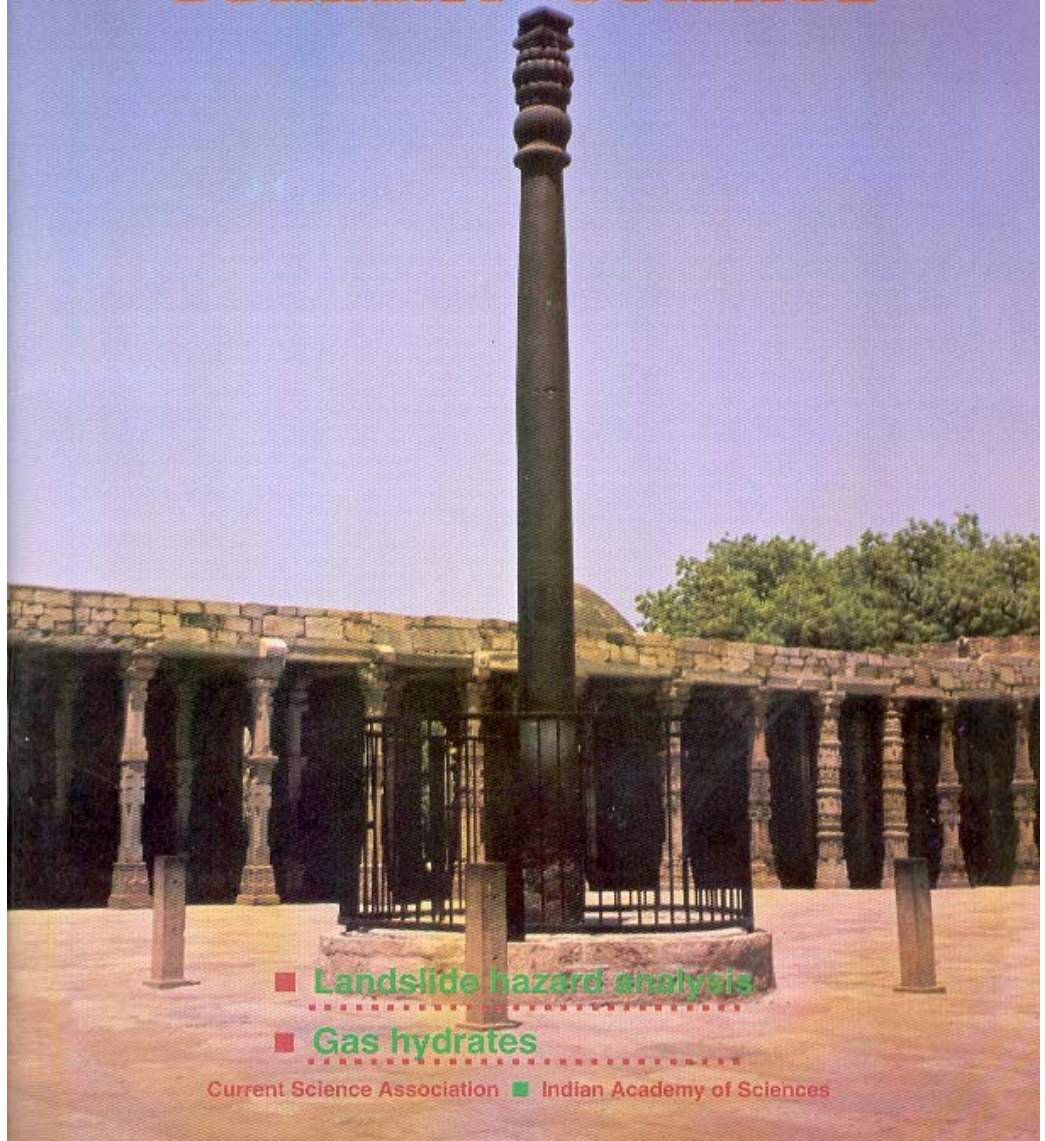


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## New insights on the corrosion of the Delhi iron pillar based on historical and dimensional analysis

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*The history of the Delhi iron pillar has been critically reviewed to show that the pillar has been exposed to the environment of Delhi for only the last 800 years. Dimensional and historical analysis of the pillar indicates that it was originally buried up to the start of the smooth surface section. The changes in the burial level of the pillar over the centuries has been explained. Reasons for the severe soil-line corrosion occurring at a distance of 1.5' from the bottom of the pillar have been addressed.*

The iron pillar currently situated in the Qawwat-ul-Islam mosque (Figure 1) near the Qutub Minar at New Delhi has attracted the attention of metallurgists and archaeologists for its excellent resistance to corrosion. The theories which have been proposed to explain its superior corrosion resistance can broadly be classified into two categories: the environmental<sup>1-3</sup> and material<sup>4-7</sup> theories. According to the proponents of the environment theory, the mild climate of Delhi is responsible for the corrosion resistance of the Delhi iron pillar as it is known that the relative humidity at Delhi does not exceed 70% for significant periods of time in the year<sup>1</sup>, which therefore results in very mild corrosion of the pillar. On the other hand, several investigators have stressed the importance of the material of construction as the primary cause for its corrosion resistance. The ideas proposed in this regard are the relatively pure composition of the iron used<sup>2</sup>, presence of phosphorus and absence of S/Mn in the iron<sup>3</sup>, its slag enveloped metal grain structure<sup>3</sup>, and passivity enhancement in the presence of slag particles<sup>6,7</sup>. Other theories to explain the corrosion resistance are also to be found in the literature like the mass metal effect<sup>1</sup>, initial exposure to an alkaline and ammonical environment<sup>2</sup>, and surface coatings provided to the pillar after manufacture (barfing<sup>8</sup> and slag coating<sup>9</sup>) and during use (coating with clarified butter<sup>5</sup>). That the material of construction may be the important factor in determining the corrosion resistance of ancient Indian iron is attested by the presence of ancient massive iron objects located in areas where the relative humidity is high for significant periods in the year (for example, the iron pillar at Dhar in Madhya Pradesh, the iron beams in the Surya temple at Konarak in coastal Orissa and the iron pillar at the Mookambika Temple at Kollur situated in the Kodachadri Hills in the Western Ghats).

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The Delhi iron pillar is a classic product of the forge welding technique that was employed by ancient Indians to manufacture large iron objects<sup>10</sup>. The iron required for fabrication was received in the form of lumps

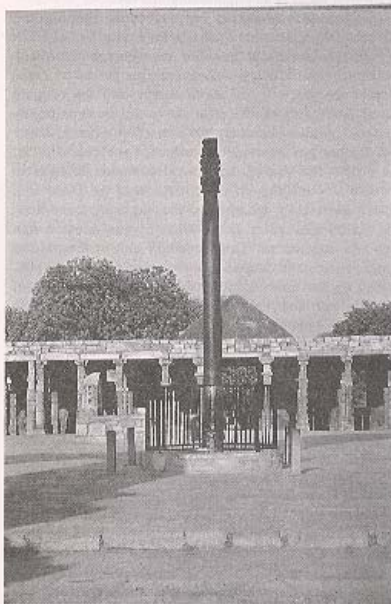


Figure 1. The Delhi iron pillar located at the Qutub Minar complex in New Delhi.

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