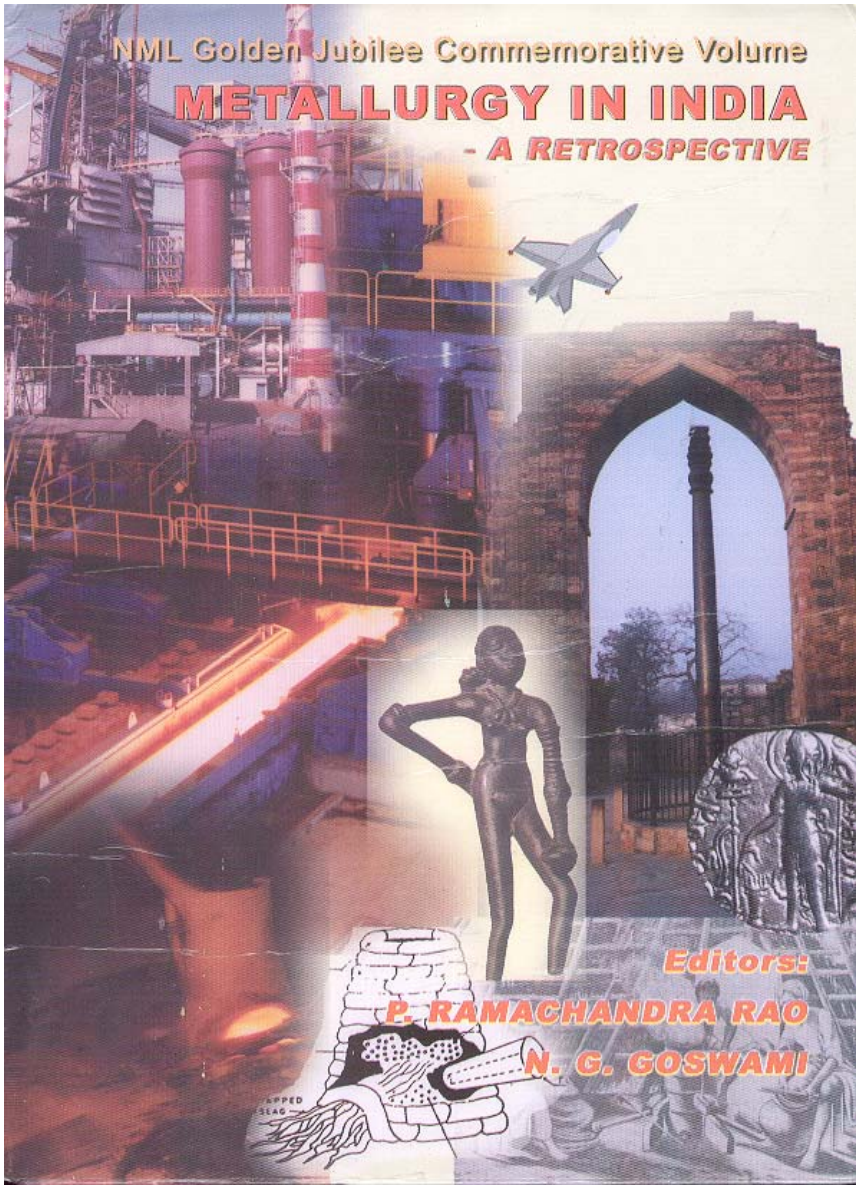
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New Insights on the Corrosion Resistant Delhi Iron Pillar

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ABSTRACT

The 1600-year old Delhi iron pillar (DIP) has attracted the attention of metallurgists and corrosion scientists for its excellent corrosion resistance. The present paper provides new insights on the Delhi iron pillar based on the researches of the author. The paper has first addressed the identity of Chandra and the original location of the pillar, Vishnupadagiri. Analysis of the archer-type gold coins of the Imperial Guptas provided that Chandra should be identified with Chandragupta II Vikramaditya. The original location of the pillar has been identified as Udayagiri in Central India based on archaeological evidences. The engineering details of the pillar have been described, including the decorative bell capital. The manufacturing method of the pillar by side way forge-welding small lumps of iron with the pillar resting in the horizontal position has been described. Finally, the corrosion resistance of the pillar has been addressed in detail. The earlier theories of corrosion resistance have been briefly reviewed. The microstructure of DIP iron has been explained. The role of slag particles in the matrix of the DIP iron in enhancing the passive film formation has been briefly discussed. Characterization of the DIP's rust by modern techniques has clearly established that the major constituents of the scale were crystalline iron hydrogen phosphate hydrate ($FePO_4.H_2PO_4.4H_2O$), α-, γ-, δ-FeOOH and magnetite. The iron oxide/oxyhydroxides were present in the amorphous form. The process of protective rust formation on DIP iron has been outlined based on the rust analysis. Initially, the corrosion rate of iron is high due to the presence of the slag particles. This results in enhancement of surface P content. In the presence of P, the formation of a protective amorphous compact layer of δ-FeOOH, next to the metal surface, is catalyzed and this confers the