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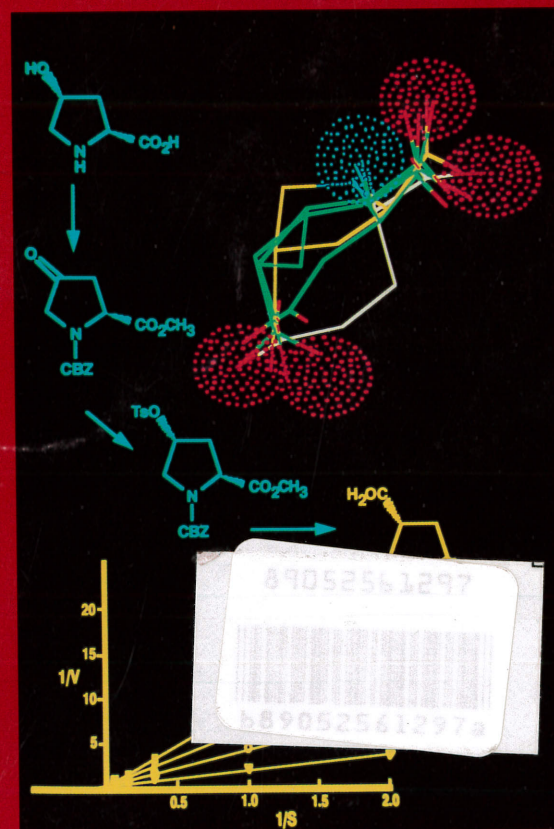
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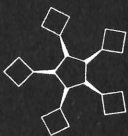
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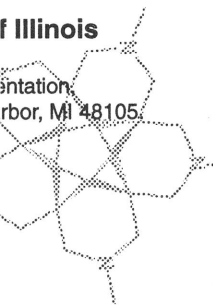
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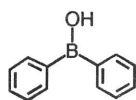
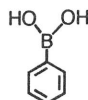
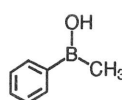
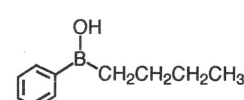
**DIPHENYLBORINIC ACID IS A STRONG INHIBITOR OF SERINE  
PROTEASES<sup>‡</sup>**Steven J. Steiner,<sup>‡</sup> Jeffrey T. Bien, Bradley D. Smith\*

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**Abstract.** Diphenylborinic acid, a commercially available and reasonably air stable compound, was found to be a strong competitive inhibitor of three serine proteases. Compared to phenylborinic acid, it was a thirty-fold better inhibitor of  $\alpha$ -chymotrypsin, a fifteen-fold better inhibitor of subtilisin BPN', and a sixty-fold better inhibitor of bovine trypsin. The  $pK_a$  and inhibitory ability of methylphenylborinic acid was also determined.

Boronic acids have been studied as competitive inhibitors of serine proteases for more than twenty-five years.<sup>1</sup> Nonetheless, interest in these compounds remains high due to their potential clinical uses,<sup>2</sup> and their ability to act as structural probes of enzyme binding sites.<sup>3</sup> Despite numerous X-ray and NMR studies, some of the details concerning the structures of the enzyme/inhibitor complexes remain controversial, particularly when the inhibitors are simple, "non substrate-like" boronic acids.<sup>4</sup> In some cases there is clear evidence for a covalent tetrahedral adduct with the active-site serine hydroxyl.<sup>4,5</sup> In other cases there is no doubt that the boron is coordinated to the active-site histidine.<sup>6</sup>

Our interest in this area stems from our recent efforts to develop molecular transport devices using boron acids.<sup>7</sup> While conducting experiments with diphenylborinic acid, **1**, we became curious about its ability to inhibit serine proteases. Inhibition with asymmetric boronic acids has been reported before,<sup>8</sup> the most recent study by the Jones research group.<sup>9</sup> In general, borinic acids are better inhibitors than boronic acids. The major detraction with borinic acids is their susceptibility to air oxidation. Diarylborinic acids, however, are reasonably air stable compounds. For example, a solution of **1** in phosphate buffer, at pH 7.4, was found to be > 90 % pure after standing on the bench top for 24 hours. Compound **1** has a  $pK_a$  of 6.2.<sup>10</sup> At neutral pH it readily combines with vicinal diols to form anionic, tetrahedral "ate" complexes.<sup>7</sup> The expected inhibitory ability of **1** was hard to predict, *a priori*, since it was difficult to estimate the relative importance of various opposing factors such as increased acidity, enzyme binding site specificity, inhibitor hydrophobicity, loss of a potential active-site hydrogen, etc. We felt that if **1** were a good protease binder then it may have utility in clarifying some of the structural and mechanistic ambiguities concerning this class of transition-state-analogue inhibitors.

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