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## Phosphorus, Sulfur, and Silicon and the Related Elements

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### New P,N-Cyclic Ligands

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## NEW P,N-CYCLIC LIGANDS

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The anions of P,N-cyclic metaphosphimic acids ( $\text{MPm}^{n-}$ ,  $n = 3, 4...$ ) interact with cations as conformationally labile multidentate ligands. They belong to the cyclophosphazane class and can be obtained from chloroderivatives  $(\text{NPCl}_2)_n$  associated with a related class of P,N-compounds (cyclophosphazenes. Besides halogens, a great variety of organic radicals can act as substituents in the cyclophosphazenes. An additional introduction of donating atoms or groups in these radicals results in new multidentate ligands. Like the  $\text{MPm}^{n-}$  they demonstrate a cation binding ability. Thus P,N-cyclic ligands can contain endocyclic functional groups

$\text{POO}^-$  which are inherent to common  $\text{MPm}^{n-}$  or various exocyclic groups. e.g.  $-\text{COO}^-$ ,  $-\text{PR}_2\text{O}^-$ ,  $-\text{PR}_2\text{O}^-$ ,  $-\text{PROO}^-$ ,  $-\text{NR}_2$  etc., linked to the cycle via side chains. Furthermore, miscellaneous phosphazane-phosphazene structures as well as those with an additional heteroatom can be designed. We have obtained the first examples of P,N-cyclic chelantes of some structural types. These are bicycles based on  $\text{MPm}^{n-}$  cross-linked by organic bridges. Such ligands can take a sandwich configuration. Neutral and acido-ligands of cyclopendante type involving groups  $-\text{COO}^-$ ,  $-\text{PPh}_2\text{O}$  and  $>\text{O}$  as well as a ligand with endocyclic sulfur have been obtained too. Selective or universal chelantes, extragents, coloured ligands and other reagents can be synthesized depending on a ligand structure design, the nature of organic fragments linked to the cycle and the type of functional groups.