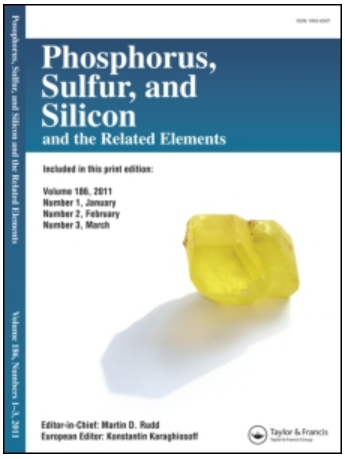

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THE CHEMICAL SHIFT OF TWO-COORDINATE PHOSPHORUS, II[1,2] HETEROCYCLES

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THE CHEMICAL SHIFT OF TWO-COORDINATE PHOSPHORUS, II[1,2]

HETEROCYCLES

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A compilation of the chemical shifts of two-coordinate phosphorus in fully unsaturated cyclic compounds is presented. (Acyclic as well as partly unsaturated cyclic compounds are covered in Part I). Data are arranged according to the ring size and to the neighbours to the phosphorus in the ring. $\delta^{31}P$ tends to lower field in the series C, N. P for the neighbouring ring members; the whole range extends roughly from $\delta^{31}P = 470$ to 0 with most of the shifts between 300 and 50. Parallels to $\delta^{13}C$ and $\delta^{15}N$ in heterocycles with CH and N, respectively, in place of P are shown.

Compounds of two-coordinate phosphorus(III) derive their stability from either one of two effects: Bulky substituents can prevent the formation of di- or oligomers with phosphorus of co-ordination number three. Or two-coordination can be made the intrinsically more stable alternative by including the phosphorus into a delocalized π-system.[3] The acyclic and not fully unsaturated cyclic compounds covered in Part I of this review belong to the one or other group. This second part covers two-coordinate phosphorus heterocycles of maximal unsaturation; they belong to the second group alone. As a consequence their ^{31}P chemical shift range (extending essentially from $\delta^{31}P = 470$ to 0) is considerably smaller than the range in Part I (extending essentially from $\delta^{31}P = 600$ to -300).[1] In the majority of the compounds of this part the two-coordinate phosphorus participates in a cyclic $(4n + 2)\pi$-system. In some cases the cyclic delocalization may be debated. Some borderline cases are included here although they are already contained in Part I.

Some ^{31}P chemical shifts of two-coordinate phosphorus in both acyclic and cyclic compounds have been collected in recently published books.[4,5]

ORGANIZATION OF THE $\delta^{31}P$ COMPILATION

The compilation (Table I) is meant to include all pertinent data reported up to summer 1987. The compounds are arranged according

(1) to the ring size,

(2) to the nature of the ring members adjacent to the phosphorus,

(3) to the remaining ring members,

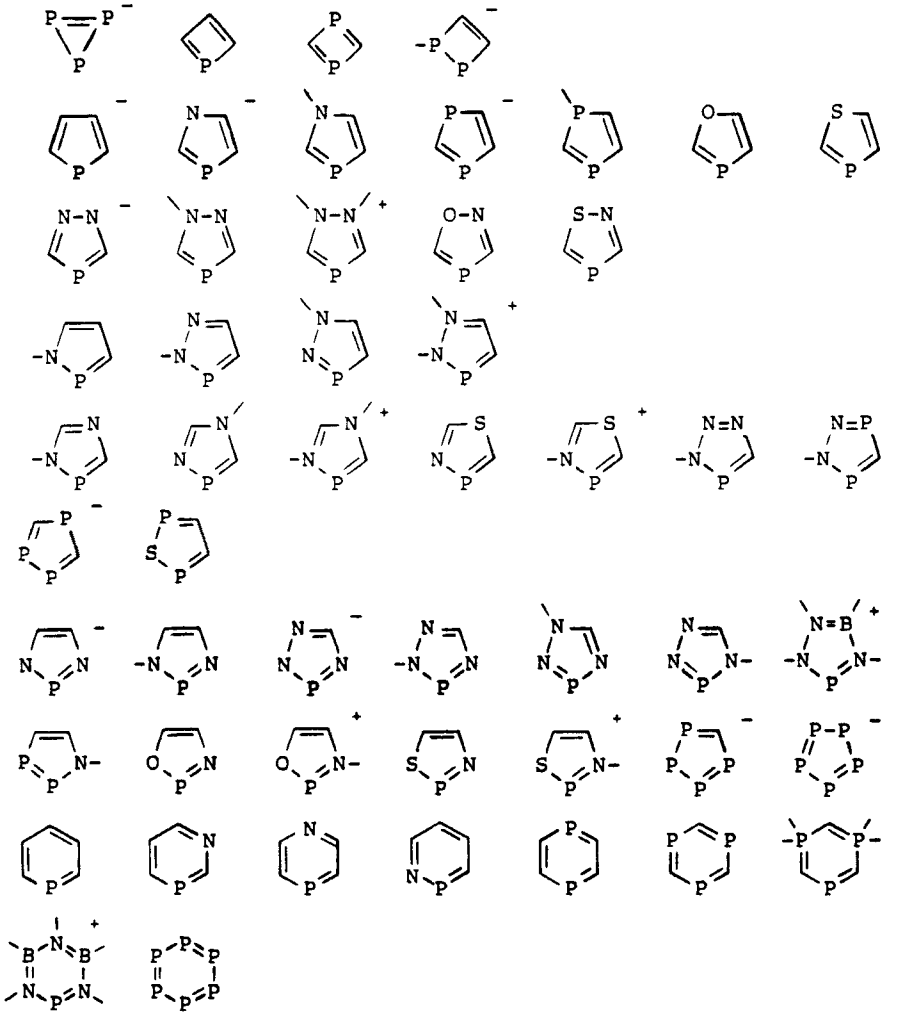
(4) to the number of the substituents at the ring,

(5) to the nature of these substituents.

For (2) and (3) the ring members are ordered according to the PSE: C, N, P, O, S. Two different locations may result for a ring containing two non-equivalent two-coordinate phosphorus members; in such a case the ring is found at the second location. The same principle of order as before applies to the α-atom of the substituents: H, C, Si, Ge, Sn, N, P, As, Sb, O, S, F, Cl, Br, I.

Condensed systems are treated together with the parent phosphorus heterocycle. σ- and π-complexes are also included (in contrast to Part I even if the phosphorus two-coordination is not preserved in the complex formation).

The scheme below shows the known delocalized monocyclic systems of two-coordinate phosphorus ordered as in Table I according to points (1) to (3). It starts with three- and four-membered rings which may be regarded as 4π-systems (triphosphirenide, phosphete and 1,3-diphosphete) and which are known only as η^3- and η^4-complexes, respectively. Almost all the five- and six-membered heterocycles can be considered as 6π-systems.[6] Two eight-membered rings already contained in Part I are not repeated here.



$\delta^{31}P$ RANGES

In Figure 1 the phosphorus chemical shifts of Table I are classified according to the immediate surrounding of phosphorus and to the ring size. The other ring members and the substituents prove to be of similar influence however; thus only broad and overlapping ranges result. Four of them are enough populated to allow some statements nevertheless: Phosphorus is less shielded in six-membered rings than in five-membered rings, as shown for the CPC case. A nitrogen instead of carbon as neighbour also causes a phosphorus shift to lower field, as shown by the five-membered rings with CPC, CPN, and NPN fragments; a much more pronounced downfield shift is caused by phosphorus neighbours.

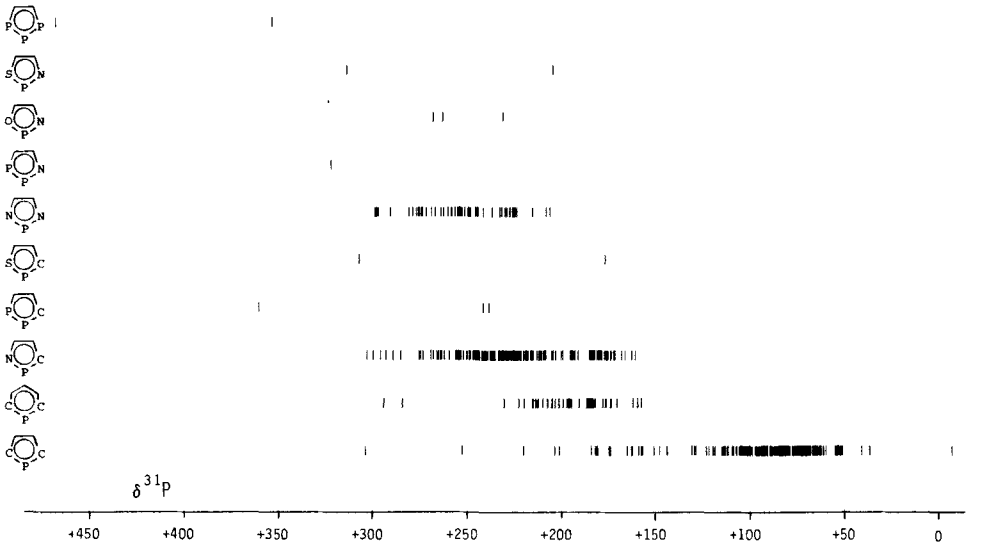
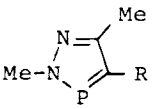


FIGURE 1 The chemical shifts $\delta^{31}P$ from Table I arranged according to the ring members adjacent to phosphorus and to the ring size.

The effect of an α-substituent on $\delta^{31}P$ is similar to that in the acyclic case[1]; the 2,5-dimethyl-1,2,3-diazaphospholes provide a representative example for it:[7]



R	$\delta^{31}P$	R	$\delta^{31}P$	R	$\delta^{31}P$	R	$\delta^{31}P$
PSF_2	275	$POPh_2$	252	$P(CN)_2$	257	$C(CF_3)_2OH$	237
PSFCl	269	$PO(OMe)_2$	247	PCl_2	249	SPh	236
$PSCl_2$	251			PBr_2	249	H	229
$PS(OMe)_2$	254			PPhCl	243	Me	226
$PSBr_2$	249			PPh_2	241	Br	217
PSClMe	249			PMeCl	240	Cl	212
PSClPh	248			$P(OMe)_2$	240	NHPh	172

$\delta^{13}C/^{31}P$ AND $\delta^{15}N/^{31}P$ CORRELATIONS

The properties of the phosphorus heterocycles discussed here suggest bonding situation comparable to that of the parent compounds in which a CH unit occupies the site of phosphorus. On this assumption the effects of the molecular environment on the chemical shift of this carbon and on $\delta^{31}P$ in the corresponding phospha derivative should parallel each other. For 37 pairs of compounds identical except for the CH/P replacement $\delta^{13}C$ and $\delta^{31}P$ data were found available.[8] They are plotted in Figure 2 and clearly demonstrate the expected parallel between the carbon and phosphorus chemical shift. $\delta^{31}P$ responds, however, much more sensitive (almost five times as strongly) to the effects than $\delta^{13}C$. The shown $\delta^{13}C/^{31}P$ correlation is closely related to the one found for methylene and phosphinidene compounds in Part I.[1]

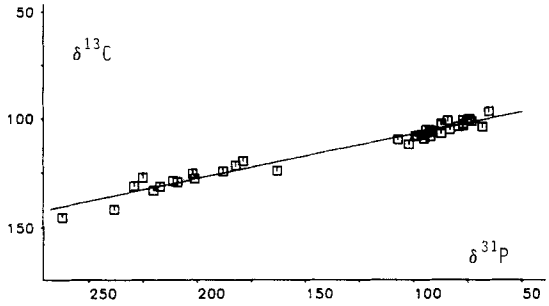
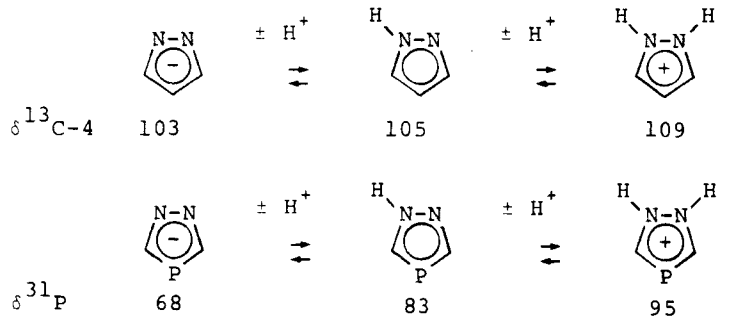


FIGURE 2 Correlation of $\delta^{31}P$ in two-coordinate phosphorus heterocycles (from Table I) with $\delta^{13}C$ of the CH unit replacing the phosphorus in otherwise identical heterocycles.[8] A linear dependency is found (correlation coefficient 0.980): $\delta^{13}C = 0.205\delta^{31}P - 86.5$.

A specific example for the parallel response of $\delta^{13}C$ and $\delta^{31}P$ is provided by the two-step protonation of the pyrazole and of the 1,2,4-diazaphosphole anion. The ^{13}C-4 as well as the ^{31}P resonance shifts to lower field in both steps. Here again the effect on the former is much smaller than on the latter:



The comparison between nitrogen and phosphorus chemical shifts in corresponding aza- and phospha-heterocycles is somewhat hampered by the lack of $\delta^{15}N$ data. The pairs available[9] are plotted in Figure 3.

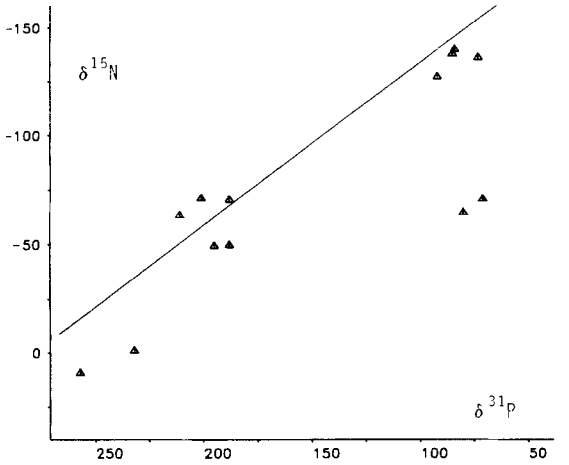


FIGURE 3 Correlation of $\delta^{31}P$ in two-coordinate phosphorus heterocycles (from Table I) with $\delta^{15}N$ of the specific nitrogen replacing the phosphorus in otherwise identical heterocycles.[9] The straight line is taken from a broader $\delta^{15}N/^{31}P$ correlation.[10] Its slope is much steeper than that of the $\delta^{13}C/^{31}P$ correlation: $\delta^{15}N = 0.75\delta^{31}P - 209$.

ACKNOWLEDGMENTS

We thank all colleagues who made unpublished data available to us. Thanks are also due to the Fonds der Chemischen Industrie for its support.

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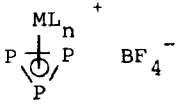
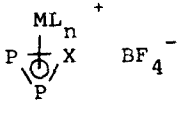
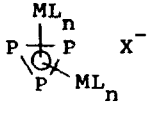
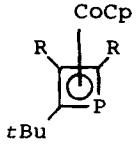
10. A. Schmidpeter and B. Wrackmeyer, *Z. Naturforsch.*, **B41,** 553 (1986).

TABLE I

Chemical shifts $\delta^{31}P$ of dicoordinate phosphorus heterocycles

			$\delta^{31}P_A$	$\delta^{31}P_{B,C}$	J_{PP}	Lit.
	$ML_n = Cr(C_5Me_5)(CO)_2$		−270			135
	$MoCp(CO)_2$		−352			133
	$Mo(C_5Me_5)(CO)_2$		−337			134
	$WCp(CO)_2$		−396			162
	$Co(Ph_2P_BCH_2)_3CMe$		−276	+38		149
	$Rh(Ph_2P_BCH_2)_3CMe$		−261	+19	12	149
	$Ir(Ph_2P_BCH_2)_3CMe$		−313	−12	13	149
	$ML_n = Ni(Ph_2P_BCH_2)_3CMe$		−156	+16	14	149
	$Pd(Ph_2P_BCH_2)_3CMe$		−133	+5	11	149
	$Pt(Ph_2P_BCH_2)_3CMe$		−217	−19	9	149
	$ML_n = Co(Ph_2P_BCH_2)_3CMe$	X = S	−211	+33	12	150
	$Co(Ph_2P_BCH_2)_3CMe$	Se	−146	+33	12	150
	$ML_n = Pd(Ph_2P_BCH_2)_3CMe$	$X = BPh_4$	−334	−13	20	163
	$Pd(Ph_2P_BCH_2CH_2)_3N$	$X = BF_4$	−283	−5	32	163
	$R = SiMe_3$		+3			157

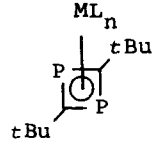
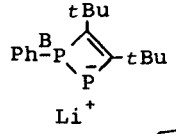
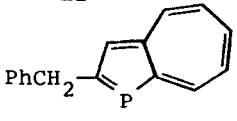
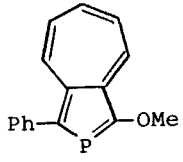
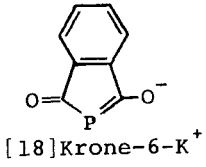
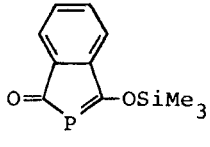
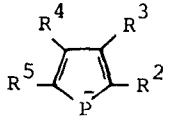
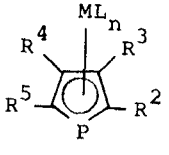
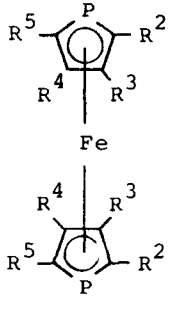
	ML_n = $Fe(C_6H_5Me)$	+21			161
	CoCp	+38			26
		+39			54
	P_B-$CoCp(CH_2{=}CH_2)$ complex	−32	+135		26
	P,P-$[CoCp(CH_2{=}CH_2)]_2$ complex	+86			26
	$Co(C_5Me_5)$	+27			54
	RhCp	+49			54
	$Rh(C_5Me_5)$	+39			54
	$Ir(C_5Me_5)$	+32			54
		−53	−18	81	34
		+168			89
		+178			89
		+43			78
		+72			6
		+77			99

TABLE I

(*contd.*)

							$\delta^{31}P_A$	$\delta^{31}P_{B,C}$	J_{PP}	Lit.
	R^2 = H	R^3 = H	R^4 = H	R^5 = H	M = Li		+77			33
	Ph	H	H	Ph	Li		+79			33
	H	Me	Me	H	Li		+59			33
		P-$Cr(CO)_5$ complex					−30			58
M^+		*P*-$W(CO)_5$ complex					−55			59, 148
		P-$[W(CO)_5]_2$ complex					−100			58, 59
		$Mn_3(CO)_{11}^+$ complex				—	+74			101
		$Mn_3(CO)_{12}^+$ complex				—	+42			101
		$Co_4(CO)_{10}^{2+}$ 2:1-complex				—	+56			57
	H	Me	Me	H	Na		+57			105
	H	Me	Me	H	$(Ph_3P_B)_2N$		+58	+21		60
	H	Ph	Ph	H	Li		+54			112
	Ph	Me	Me	H						
		P-$Mo_2(CO)_8^{2+}$ 2:1-complex				—	+207			106
							+208			106
		P-$W_2(CO)_8^{2+}$ 2:1-complex				—	+161			106
		P-$Fe_2(CO)_6^{2+}$ 2:1-complex				—	+90			57
	Ph	Ph	H	Ph	Li		+103			32
	Ph	Ph	Ph	Ph	Li		+98			33
	Ph	Ph	Ph	Ph	K		+99			33
	R^2 = H	R^3 = H	R^4 = H	R^5 = H	ML_n = $Mn(CO)_3$		−26			101
	Ph	H	H	H	FeCp		−70			106
	H	Me	H	H	$Mn(CO)_3$		−29			101
	H	Me	H	H	$Fe(C_5Me_5)$		−58			132
	Ph	H	H	Ph	$Mn(CO)_3$		−30			27
	H	Me	Me	H	$W(CO)_3I$		−32			59
		P-$W(CO)_5$ complex					−14			59
	H	Me	Me	H	$Mn(CO)_3$		−47			101
		P-$Fe(CO)_4$ complex					+52			27
	H	Me	Me	H	FeCp		−83			102
		P-BF_3 complex					+23			122
		P-$Fe(CO)_4$ complex					+26			102

H	Me	Me	H	Fe(1,2-Me_2-4-PhC_5H_2)	−75	41
H	Me	Me	H	Fe(C_5Me_5)	−69	132
H	Me	Me	H	$Fe(CO)_3$		
		P-$Fe_2(CO)_6$ 2:1-complex			+200	57
Et		Me	Me	H	$Mn(CO)_3$	−45	27
CH_2OH		Me	Me	H	FeCp	−80	75
CH(OH)Me		Me	Me	H	$Mn(CO)_3$	−7	27
CHO		Me	Me	H	FeCp	−62	75
COMe		Me	Me	H	$Mn(CO)_3$	−16	101
$COCH_2t$Bu		Me	Me	H	$Mn(CO)_3$	−21	27
CO*i*Pr		Me	Me	H	$Mn(CO)_3$	−20	27
COCH=CHMe		Me	Me	H	$Mn(CO)_3$	−21	27
COCH=CHPh		Me	Me	H	$Mn(CO)_3$	−21	27
COPh		Me	Me	H	$Mn(CO)_3$	−22	101
CO(4-FC_6H_4)		Me	Me	H	$Mn(CO)_3$	−26	27
Ph		Me	Me	H	FeCp	−72	100
Ph		Ph	Ph	Ph	Fe(C_5Me_5)	−50	132

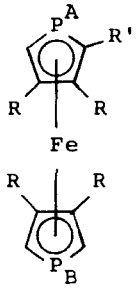


$R^2 = H$	$R^3 = H$	$R^4 = H$	$R^5 = H$	−58 ($CDCl_3$)	121
				−59	75
				−123 (CF_3SO_3H)	121
Me	H	H	H	−54 ($CDCl_3$)	121
				−55 ($CDCl_3$)	121
				−116 (CF_3SO_3H)	121
				−119 (CF_3SO_3H)	121
		$AgOSO_2CF_3$ complex		−145	122
				−149	122
H	Me	H	H	−58 ($CDCl_3$)	121
				−59 ($CDCl_3$)	121
				−128 (CF_3SO_3H)	121
				−129 (CF_3SO_3H)	121
				−72 (CF_3CO_2H)	121
		$AgOSO_2CF_3$ complex		−139	122
				−155	122

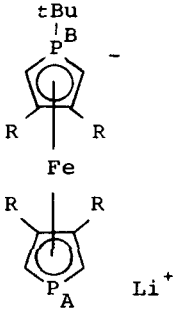
TABLE I

(*contd.*)

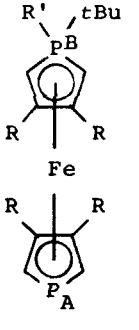
					$\delta^{31}P_A$	$\delta^{31}P_{B,C}$	J_{PP}	Lit.
	Ph	H	H	Ph	−61 ($CDCl_3$)			121
					−64			75
					−137 (CF_3SO_3H)			121
		$AlCl_3$ complex			−137			122
		$CuOSO_2CF_3$ complex			−109			122
		$AgOCOCF_3$ complex			−133			122
		$AgOSO_2CF_3$ complex			−146			122
	H	Me	Me	H	−72 ($CDCl_3$)			42
					−146 (CF_3SO_3H)			121
		P_B-BF_3 complex			−63	+31		122
		P_B-$Cr(CO)_5$ complex			−68	+12	5	42
		P,P-$[Cr(CO)_5]_2$ complex			+14			42
		P_B-$Mo(CO)_5$ complex			−67	−23	5	42
		P,P-$[Mo(CO)_5]_2$ complex			−22			42
		P_B-$W(CO)_5$ complex			−67	−48	5	42
		P,P-$[W(CO)_5]_2$ complex			−46			42
		P_A-$Cr(CO)_5$-P_B-$Mo(CO)_5$ complex			+14	−22	5	42
		P_A-$Cr(CO)_5$-P_B-$W(CO)_5$ complex			+14	−47	5	42
		P_A-$Mo(CO)_5$-P_B-$W(CO)_5$ complex			−21	−47	5	42
		P_B-$Mn_2(CO)_9$ complex			−67	+22		42
		P,P-$[Mn_2(CO)_9]_2$ complex			+29			42
		P_B-$Fe(CO)_4$ complex			−64	+32		74
		P,P-$[Fe(CO)_4]_2$ complex			+35			74
		P_B-$RuCl_2$ 4:1-complex			−73	+12	0	42
		P,P-$[Ru_2(P_BPh_3)_2Cl_4]$ 2:1-complex			+18	+56	42	42
		$CuOSO_2CF_3$ complex			−154			122
		CuI complex			−144			122
		$AgOSO_2CF_3$ complex			−141 (MeCN)			122
					−161 (DMF)			122
	COMe	Me	Me	H	−52			75
					−49			75



R = Me	R′ = CH_2OH	−67	−74	10	75
	CH(OH)Me	−80	−80		75
		−71	−72	10	75
	$C(OH)Me_2$	−66	−83	10	75
	CH=NOH	−47	−67	7	74
		−72	−67	7	74
	CHO	−51	−67	10	75
	COMe	−54	−72	*10*	75
	COPh	−50	−69	10	75
	CO_2H	−53	−67	7	74
	CO_2Et	−57	−68	7	74
	CN	−52	−65	7	74



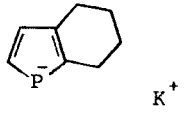
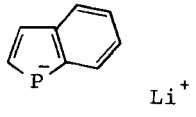
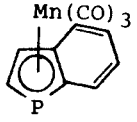
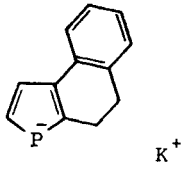
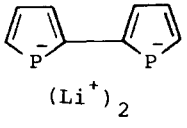
R = Me		−95	−22		40

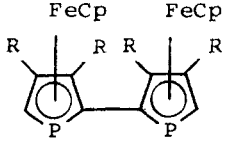


R = Me	R′ = COMe	−66	−2	0	41
	COPh	−64	−9	3	41

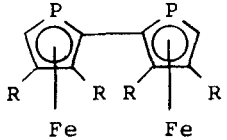
TABLE I

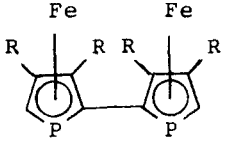
(*contd.*)

		$\delta^{31}P_A$	$\delta^{31}P_{B,C}$	J_{PP}	Lit.
		+73			116
	*P*-$Mn_2(CO)_8Br^+$ complex	+40 −36			112 112
		−55			112
		+82			116
		+57			107

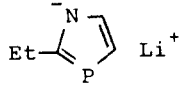


R = Me | −60 | 104

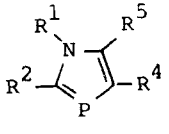




R = Me | −41 | 104



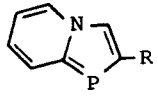
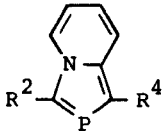
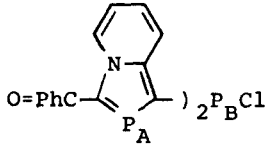
+78 | 52

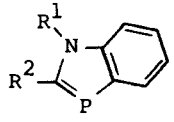


R^1	R^2	R^4	R^5		
H	H	H	H	+98	52
$SiMe_3$	H	H	H	+114	52
H	Me	H	H	+92	52
H	Et	H	H	+86	52
H	Ph	H	H	+96	52
$SiMe_3$	Me	H	H	+122	52
Et	H	H	Ph	+97	91
Me	Ph	H	Ph	+102	117
Me	H	Me	Ph	+99	91
Me	H	Et	Ph	+94	1
Me	Me	Ph	Ph	+94	91
Et	Me	Ph	Ph	+92	91
*n*Bu	Me	Ph	Ph	+96	91
Me	Ph	*t*Bu	Ph	+97	129

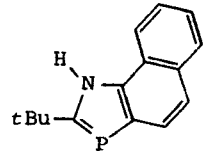
TABLE I

(*contd.*)

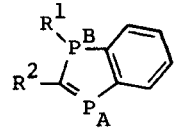
					$\delta^{31}P_A$	$\delta^{31}P_{B,C}$	J_{PP}	Lit.
	Me	Ph	Ph	Ph	+102			91
	Me	Ph	OH	Ph	+63			95
	Me	Ph	OH	4-$MeOC_6H_4$	+62			95
	Me	Ph	OCOMe	Ph	+73			95
	Me	Ph	OCOPh	Ph	+72			95
	Me	Ph	$OSiMe_3$	Ph	+72			95
	Me	Ph	$OSiMe_3$	4-$MeOC_6H_4$	+71			95
	Me	4-$MeOC_6H_4$	Ph	Ph	+101			91
	Ph	Ph	Ph	Ph	+105			91
	Ph	4-$MeOC_6H_4$	Ph	Ph	+102			91
	Ph	4-ClC_6H_4	Ph	Ph	+106			91
	R = Me				+76			94
	*t*Bu				+70			94
	Ph				+69			94
	R^2 = COPh			R^4 = H	+185			20
	COPh			Me	+184			20
	COPh			Ph	+179			20
	COPh			P_BCl_2	+201	+156	175	20
	CO_2Et			Me	+165			20
	CO_2Et			Ph	+160			20
	CN			Me	+165			20
	CN			Ph	+161			20
					+204	+66	48	20



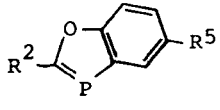
R^1 = H	R^2 = H	+77				62
Me	H	+73				49
P_BCl_2	H	+73	+160			62
H	Me	+70				62
H	*t*Bu	+66				128
H	Ph	+72				62
P-$Cr(CO)_5$ complex		+77				62
H	NMe_2	−5				62
Me	Li	+109				49
Me	Me	+69				49
Me	Ph	+76				49
Me	CO_2H	+127				49
Me	CO_2SiMe_3	+126				49
Me	$SiMe_3$	+121				49
Me	SMe	+109				50
COMe	Ph	+73				62
$S_x/2$	Ph	+74				62



	+74				128



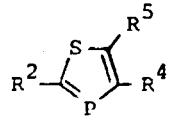
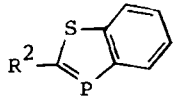
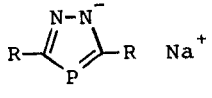
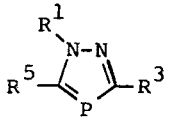
R^1 = Me	R^2 = NMe_2	+104	+2	27		147
$SiMe_3$	NPh$SiMe_3$	+178	−7	26		63
$SiMe_3$	O$SiMe_3$	+178	−7	34		63



R^2 = Me	R^5 = H	+85			51
Et	H	+81			51
*t*Bu	H	+76			51
Ph	H	+86			51
4-$MeOC_6H_4$	H	+78			51
4-ClC_6H_4	H	+88			51
*t*Bu	Me	+77			51

TABLE I

(*contd.*)

				$\delta^{31}P_A$	$\delta^{31}P_{B,C}$	J_{PP}	Lit.
	R^2 = Ph	R^4 = *t*Bu	R^5 = Ph	+221			129
	Ph	Ph	Me	+217			159
	Ph	Ph	Ph	+217			159
	Ph	Ph	$N(CH_2)_5$	+211			159
	Ph	Ph	$N[(CH_2)_2]_2O$	+212			159
	4-MeC_6H_4	Ph	Ph	+215			159
	4-$MeOC_6H_4$	Ph	Ph	+212			159
	4-BrC_6H_4	Ph	Ph	+220			159
	4-BrC_6H_4	$OSiMe_3$	Ph	+183			95
	R^2 = H			+80			61
	Me			+71			61
	Ph			+56			61
	R = H			+68			146
	*t*Bu			+68			146
	Ph			+66			146
	R^1 = H	R^3 = H	R^3 = H	+83 ($CHCl_3$)			177, 141, 146
				+84 (CH_2Cl_2)			146
				+86 (toluene)			146
	N(2)-BF_3 complex			+97			146
	Me	H	H	+92			146
	$CH(OMe)(NMe_2)$	H	H	+94			146
	C_4O_2Cl	H	H	+113			146
	Ph	H	H	+99			92, 141
	N(2)-BF_3 complex			+89			146
	N(2)-$AlCl_3$ complex			+103			146
	4-$NO_2C_6H_4$	H	H	+105 ($CHCl_3$)			146
				+104 (C_6H_6)			146
	C(Me)=NH	H	H	+82			146
	2-C_5H_4N	H	H	+98			146
	COMe	H	H	+107			146

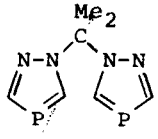
COPh	H	H	+102 (toluene)		146
			+104 (Me_2CO)		146
C(O)COCl	H	H	+119		146
CO(4-$MeOC_6H_4$)	H	H	+101		146
CO(4-$NO_2C_6H_4$)	H	H	+108		146
CONHMe	H	H	+101 (CH_2Cl_2)		146
			+104 ($CHCl_3$)		146
$SiMe_3$	H	H	+92		146
$P_B(S)Ph_2$	H	H	+98	+7	146
SO_4(4-MeC_6H_4)	H	H	+104		146
H	Me	H	+84		120
H	*i*Pr	H	+77		126
H	*t*Bu	H	+77		124, 127
H	CH_2*t*Bu	H	+87		126
H	CMe_2Et	H	+81		118
H	1-MeC_5H_8	H	+78		126
H	CMe_2*t*Bu	H	+88		118
H	1-MeC_6H_{10}	H	+80		126
H	Ph	H	+81		90
H	CO_2*t*Bu	H	+99		119
Me	*t*Bu	H	+83		129
Me	Ph	H	+87		92
Et	Ph	H	+85		92
Ph	*t*Bu	H	+91		129
Ph	Ph	H	+93		92
Me	H	Me	+94		69
Me	H	BMe_2	+104		146
Me	H	$SnMe_3$	+131		69
Me	H	$SnMe_2$(CMe=CEt)BEt_2	+132		69
Ph	H	D	+96		69
$SiMe_3$	H	*t*Bu	+86		127
H	Me	Me	+79		146
H	Me	*t*Bu	+75		127
H	*t*Bu	*t*Bu	+65		124, 141
H	*t*Bu	1-MeC_5H_8	+69		118
H	*t*Bu	1-Ad	+67		4
H	*t*Bu	$(CH_2)_3CO_2Me$	+74		127
H	*t*Bu	Ph	+74		127
H	*t*Bu	COPh	+106		127
H	*t*Bu	CONHPh	+87		127
H	*t*Bu	CO_2Me	+96		156
			+98		127

TABLE I

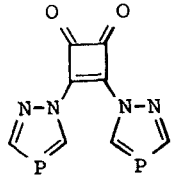
(*contd.*)

			$\delta^{31}P_A$	$\delta^{31}P_{B,C}$	J_{PP}	Lit.
H	*t*Bu	CO_2*t*Bu	+97			127
H	*t*Bu	$P_B(O)Ph_2$	+111	+23	54	127
H	*t*Bu	SO_2Ph	+90			127
H	C_6H_{11}	C_6H_{11}	+66			146
H	1-Ad	COPh	+104			4
H	1-Ad	CO_2Me	+95			4
H	Ph	Ph	+74			141
			+76			90
H	Ph	COPh	+105			90
H	Ph	CO_2Et	+99			90
H	Ph	$P_B(O)Ph_2$	+113	+23	54	90
H	Ph	$P_B(O)(OMe)Ph$	+111	+27	56	90
H	Ph	$P_B(O)(OMe)_2$	+111	+27	65	90
H	COPh	CO_2Et	+122			115
H	$CONMe_2$	CO_2Et	+113			115
H	CO_2Et	CO_2Et	+118			115
H	CO_2Me	$SiMe_3$	+134			90, 155
H	$SiMe_3$	$SiMe_3$	+151			25
H	$SiMe_3$	$P_B(S)(NiPr_2)_2$	+147	+56	61	25
Me	*t*Bu	Me	+84			127
Me	*t*Bu	*t*Bu	+83			141
Me	*t*Bu	Ph	+88			127
Me	C_6H_{11}	C_6H_{11}	+76			146
Me	Ph	Me	+87			92
Me	Ph	*t*Bu	+87			130
Me	Ph	Ph	+89			90, 141
Me	4-$MeOC_6H_4$	4-$MeOC_6H_4$	+85			146
Et	Ph	Me	+88			92
Ph	D	D	+96			69
Ph	Me	Me	+96			92
Ph	Me	*t*Bu	+95			92
			+92			130
Ph	*t*Bu	Me	+88			129
Ph	*t*Bu	*t*Bu	+83			141
Ph	*t*Bu	Ph	+97			124

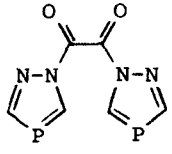
D	Ph	C_6H_{11}	C_6H_{11}	+78			146
	Ph	Ph	Me	+90			92
	Ph	Ph	*i*Pr	+80			92
	Ph	Ph	*t*Bu	+87			92, 130
	Ph	Ph	Ph	+95			92, 141
	Ph	4-$MeOC_6H_4$	4-$MeOC_6H_4$	+90			146
	COMe	Me	*t*Bu	+117			120
	COMe	*t*Bu	Me	+109			127
	COMe	*t*Bu	Ph	+117			127
	COMe	*t*Bu	CONHPh	+110			127
	COMe	*t*Bu	SO_2Ph	+149			127
	COMe	Ph	*t*Bu	+110			120
	COMe	Ph	Ph	+110			146
	COPh	*t*Bu	Ph	+106			127
	COPh	Ph	*t*Bu	+95			127
	$SiMe_3$	$SiMe_3$	$SiMe_3$	+178			25
	$SiMe_3$	$SiMe_3$	$P_B(S)(NiPr_2)_2$	+187	+56	83	25
	P_BCl_2	*t*Bu	*t*Bu	+100	+151		146
	$P_B(O)Ph_2$	*t*Bu	Ph	+107	+30		127
	$P_B(O)(OMe)_2$	*t*Bu	Me	+99	−6		127
	$P_B(O)(OMe)_2$	*t*Bu	Ph	+103	−5		127



+97 — 146



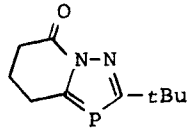
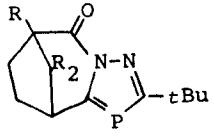
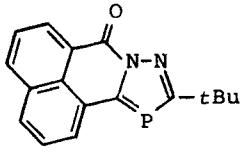
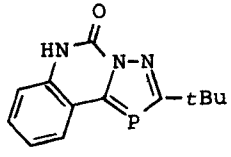
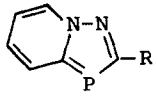
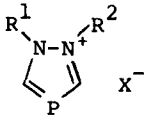
+114 — 146

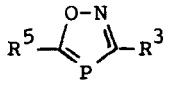


+117 ($CHCl_3$) — 146
+115 (C_6H_6) — 146

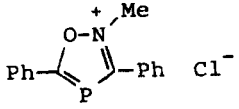
TABLE I

(*contd.*)

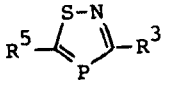
				$\delta^{31}P_A$	$\delta^{31}P_{B,C}$	J_{PP}	Lit.
				+96			127
	R = Me			+91			127
				+98			127
				+84			127
	R = Me			+63			94
	*i*Pr			+57			94
	*t*Bu			+55			94
	Ph			+58			94
	R^1 = H	R^2 = H	X = Cl	+95			146
	Me	Me	Cl	+87			146
	Me	Me	BF_4	+86			146
	Ph	H	BF_4	+102			146
	Ph	H	HSO_4	+92			146
	Ph	Me	$MeSO_4$	+92			146
	Ph	Ph	Cl	+79			146
	$CO(4\text{-}NO_2C_6H_4)$	H	Cl	+93			146



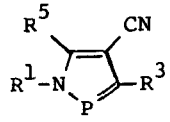
R^3 =	R^5 =		
H	H	+84	146
*t*Bu	*t*Bu	+69 ($CHCl_3$)	146
		+67 (*n*BuOH)	146
		+69 (Toluol)	146
		+68 (C_6D_6)	130
Ph	*i*Pr	+68	126
Ph	*t*Bu	+67	130
Ph	CH_2*t*Bu	+77	126
Ph	CMe_2Et	+72	118
Ph	1-MeC_5H_8	+69	126
Ph	CMe_2*t*Bu	+79	118
Ph	1-MeC_6H_{10}	+71	126
Ph	Ph	+70 (CH_2Cl_2)	146
		+72 ($CHCl_3$)	146
Ph	Mes	+83	118
Ph	2,4,6-*i*$Pr_3C_6H_2$	+87	118
4-ClC_6H_4	*t*Bu	+66	156
4-ClC_6H_4	$SiMe_3$	+127	155
Mes	*t*Bu	+77	124, 130
Mes	1-Ad	+74	4
2,4,6-$(MeO)_3C_6H_2$	*t*Bu	+82	130



+78 146



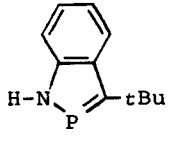
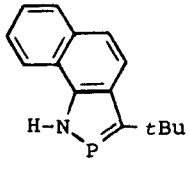
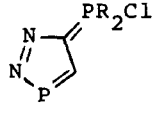
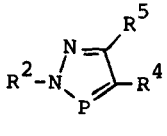
R^3 =	R^5 =		
*t*Bu	Ph	+178	129
Ph	*t*Bu	+183	129



R^1 =	R^3 =	R^5 =		
Me	H	Pr	+219	66
Me	H	Bu	+218	66
Me	H	CH_2NMe_2	+220	66
Me	H	Ph	+218	66
Me	H	CO_2Et	+221	66
Me	Me	Me	+227	66
Me	Pr	H	+227	66
Me	Bu	H	+226	66
Me	CH_2NMe_2	H	+217	66

TABLE I

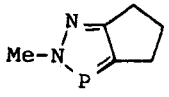
(*contd.*)

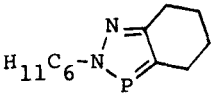
				$\delta^{31}P_A$	$\delta^{31}P_{B,C}$	J_{PP}	Lit.
	Me	Ph	CO_2Et	+226			66
	Me	Ph	OCOPh	+205			66
	Me	CO_2Et	H	+230			66
	Me	CO_2Me	Me	+230			66
	Me	CO_2Et	Ph	+231			66
	Me	CO_2Me	CO_2Me	+225			66
	Me	OCOPh	Ph	+227			66
	$SiMe_3$	CO_2Me	CO_2Me	+238			66
				+210			128
				+180			128
	R = *i*Pr						25
	R^2 = H	R^4 = H	R^5 = Me	+220			108
	H	H	CO_2tBu	+230			119
	Bu	Et	H	+226			44
	$SiMe_3$	CO_2Et	H	+258			140
	P_BPh_2	CO_2Et	H	+265	+64	72	140
	Me	H	Me	+229			152, 154

	P-$Cr(CO)_5$ complex		+242			153
	P-$W(CO)_5$ complex		+194			153
	P-$Mn(CO)_2C_5H_4Me$ complex		+275			153
	P-$Fe(CO)_4$ complex		+228			153
	N(1)-trans-$PdCl_2P_BEt_3$ complex		+237	+36		73
	P-$Pt(P_BPh_3)_3$ complex		+204	+12	57	71
	N(1)-trans-$PtBr_2P_BEt_3$ complex		+235	−2		73
	P-cis-$PtCl_2P_BEt_3$ complex		+166	+17	25	73
	P-cis-$PtBr_2P_BEt_3$ complex		+163	+15	16	73
	P-$Pt(P_BPh_3)_2$ 2:1-complex		+198	+13	57	71
	N(1)-$AuMe_2Cl$ complex		+229			36
CH_2CH_2CN	H	Me	+232			108
Ph	H	Me	+225			151
2-C_5H_4N	H	Me	+228			154
COMe	H	Me	+238			151
$SiMe_3$	H	CO_2Et	+253			140
P_BPh_2	H	CO_2Et	+260	+65	29	140
H	CO_2Me	CO_2Me	+255			140
H	$P_B(O)Ph_2$	Me	+245	+21	72	17
	BF_3 complex		+253	+46		17
			+238	+36		17
Me	Me	Me	+226			56
Me	*t*Bu	Ph	+224			130
Me	$C(OH)(CF_3)_2$	Me	+237			131
Me	CO_2Me	CO_2Me	+241			140
Me	NHPh	Me	+172			55
Me	P_BPh_2	Me	+241	−29		154
Me	$P_B(CN)_2$	Me	+257	−100	167	154
Me	P_BMeCl	Me	+240	+72	27	154
Me	P_BPhCl	Me	+243	+65	42	154
Me	$P_B(OMe)_2$	Me	+240	+157	21	154
	P_B-$Cr(CO)_5$ complex		+241	+196	38	154
Me	P_BCl_2	Me	+249	+158	79	154
	P_B-$Cr(CO)_5$ complex		+240	+186	74	154
Me	P_BCl_2	Et	+248	+157	61	80
Me	P_BBr_2	Me	+249	+142	65	154
Me	$P_B(O)Ph_2$	Me	+252	+22	71	18
Me	$P_B(S)MeCl$	Me	+249	+65	88	154
Me	$P_B(S)PhCl$	Me	+248	+64	83	154
Me	$P_B(O)(OMe)_2$	Me	+247	+71	67	154

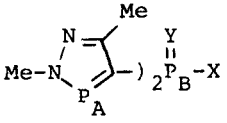
TABLE I

(*contd.*)

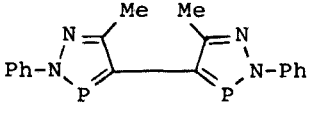
				$\delta^{31}P_A$	$\delta^{31}P_{B,C}$	J_{PP}	Lit.
	Me	$P_B(S)(OMe)_2$	Me	+254	+82	87	154
		P_A-$Cr(CO)_5$ complex		+266	+80	81	154
	Me	$P_B(S)F_2$	Me	+275	+93	112	154
	Me	$P_B(S)FCl$	Me	+269	+90	105	154
	Me	$P_B(S)Cl_2$	Me	+251	+56	95	154
	Me	$P_B(S)Br_2$	Me	+245	−11	85	154
	Me	$P_B(OMe)_2O_2C_2Me_2$	Me	+252	−36	75	154
	Me	$P_B(OMe)_2O_2C_2Ph_2$	Me	+255	−36	72	154
	Me	SMe	Me	+237			123
				+222			56
	Me	SPh	Me	+236			56
	Me	Cl	Me	+212			123
	Me	Br	Me	+217			56, 123
	*t*Bu	Me	Me	+212			53
	Ph	CH_2iPr	Me	+229			11
	Ph	*t*Bu	Me	+219			130
	Ph	CH_2tBu	Me	+220			11
	Ph	1-C_5H_9	Me	+228			10
	Ph	1-C_6H_{11}	Me	+231			10
	Ph	1-(2-HO)C_6H_{10}	Me	+223			10
	Ph	$P_B(O)Ph_2$	Me	+246	+21	74	18
	Ph	Cl	Me	+206			123
	Ph	Br	Me	+211			123
				+210			56
	COMe	$CONHCCl_3$	Me	+249			9
	COMe	CONHPh	Me	+246			12
	COMe	CONH(2-$C_{10}H_7$)	Me	+242			12
	$SiMe_3$	Ph	Ph	+247			145
	$SiMe_3$	CO_2Me	CO_2Me	+262			140
	P_BPh_2	CO_2Me	CO_2Me	+267	+66	68	140
				+204			152



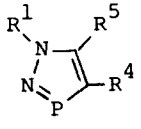
				+211			44



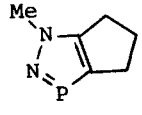
X = OMe	Y = —		+244	+89	21	154
Cl	—		+248	+53	28	154
Cl	S		+252	+47	88	154
Br	S		+247	+23	85	154



			+212			13



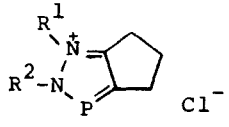
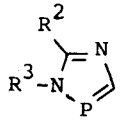
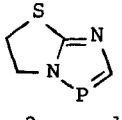
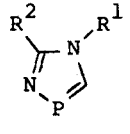
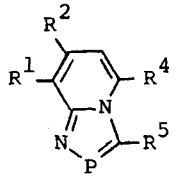
R^1 = Me	R^4 = *t*Bu	R^5 = H	+229			129
Me	H	Me	+223			152
	P-Cr(CO)$_5$ complex		+238			153
Me	P_BCl_2	Me	+231	+157	52	152



					+204			152
R^1 = Me	R^2 = H	R^4 = H	R^5 = Me	X = Cl	+221			152
H	Me	H	Me	Cl	+231			47
H	Me	H	Me	Br	+232			56
H	H	$P_B(O)Ph_2$	Me	Cl	+220	+30	43	18
Me	Me	H	Me	BF_4	+230			154
Me	Me	H	NEt_2	$MeBCl_3$	+231			114
Me	Me	H	NEt_2	$MeBBr_3$	+232			114
H	Me	Me	Me	Cl	+238			47
H	Me	Me	Me	Br	+229			56
H	Me	$P_B(O)Ph_2$	Me	Cl	+232	+32	45	18
H	Me	SMe	Me	Br	+220			56
H	Me	SPh	Me	Cl	+231			56
H	Me	SPh	Me	Br	+230			56

TABLE I

(*contd.*)

						$\delta^{31}P_A$	$\delta^{31}P_{B,C}$	J_{PP}	Lit.
	H	Ph	$P_B(O)Ph_2$	Me	Cl	+228	+33	45	18
	Me	Me	Me	NEt_2	$MeBCl_3$	+231			114
	Me	Me	Me	NEt_2	$MeBBr_3$	+232			114
 Cl^-	R^1 = Me	R^2 = H				+195			152
	H	Me				+209			47
	R^2 = Me	R^3 = H				+209			68
	Ph	H				+185			68
	Ph	Ph				+212			144
	SMe	Me				+213			68
						+194			68
	R^1 = H	R^2 = Me				+199			68
	Me	SMe				+183			68
	Ph	Ph				+182			144
	R^1 = H	R^2 = H	R^4 = H	R^5 = H		+195			68
	Me	H	H	H		+195			144
	H	Me	H	H		+194			144
	H	H	Me	H		+195			144
	H	H	H	P_BPh_2		+227	−38	2	144
	H	H	H	P_BCl_2		+244	+123	166	68
	H	Me	H	P_BPh_2		+228	−38	5	144
	H	H	H	CO_2Et		+233			144
	H	H	H	CO_2Et		+233			144
	Me	H	H	CO_2Et		+230			144
	H	Me	H	CO_2Et		+234			144

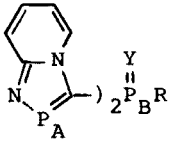
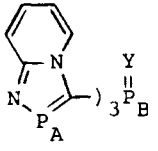
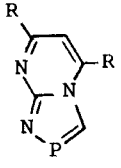
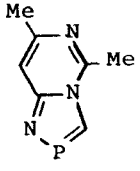
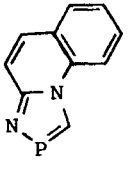
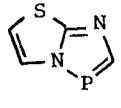
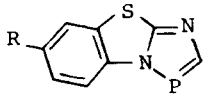
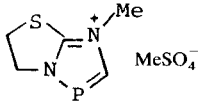
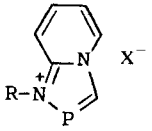
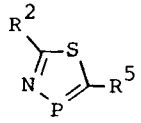
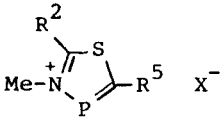
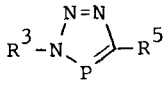
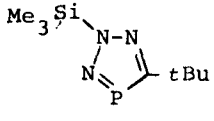
	R = CH_2Cl	Y = —	+232	−54	2	144
	Cl	—	+238	+24	70	68
	CH_2Cl	S	+238	+16	25	144
	Y = —		+235	−75	54	68
	O		+243	−2	45	68
	S		+241	−3	40	68
	Se		+240	−26	37	68
	R = H		+197			144
	Me		+197			68
			+200			144
			+187			144
			+192			144

TABLE I
(*contd.*)

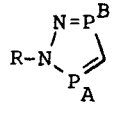
				$\delta^{31}P_A$	$\delta^{31}P_{B,C}$	J_{PP}	Lit.
	R = H			+184			144
	OMe			+184			144
				+178			68
	R = Me	X = $MeSO_4$		+187			68
	2-C_5H_4N	Cl		+178			144
	R^2 = Me	R^5 = CO_2Et		+302			144
	Ph	H		+276			68
	Ph	Ph		+250			143
	Ph	4-MeC_6H_4		+257			143
	Ph	4-$NO_2C_6H_4$		+270			143
	Ph	CO_2Et		+300			143
	CuBr complex			+293			144
	N(3)-BF_3 complex			+295			144
	NMe_2	Ph		+249			143
	NMe_2	4-CNC_6H_4		+262			143
	R^2 = Ph	R^5 = CO_2Et	X = BF_4	+290			144
	NMe_2	Ph	BF_4	+239			144
	NMe_2	Ph	$MeSO_4$	+240			144



R^3 =	R^5 =				
Me	H	+188			117
Ph	H	+182			119
H	*t*Bu	+161			124, 128
Me	*i*Pr	+176			126
Me	*s*Bu	+180			118
Me	*t*Bu	+173			124, 128
Me	CH_2*t*Bu	+181			126
Me	$CHEt_2$	+182			118
Me	CMe_2Et	+179			118
Me	C_5H_9	+178			118
Me	1-MeC_5H_8	+178			126
Me	C_6H_{11}	+178			118
Me	CMe_2*t*Bu	+185			228
Me	1-MeC_6H_{10}	+180			126
Me	1-Ad	+174			4
Me	Mes	+183			118
CH_2Ph	*t*Bu	+170			156
CH_2Ph	$SiMe_3$	+212			155
CH_2CN	*t*Bu	+176			124, 128
CH_2SiMe_3	*t*Bu	+173			128
*t*Bu	*t*Bu	+162			128
$CH{=}CH_2$	*t*Bu	+175			128
Ph	*t*Bu	+169			128, 156
4-$EtO_2CC_6H_4$	*t*Bu	+171			128
1-$C_{10}H_7$	*t*Bu	+181			128
CO_2Me	*t*Bu	+177			124, 128

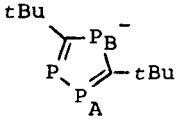
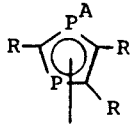
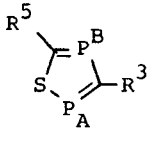
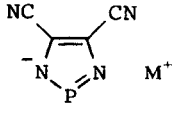
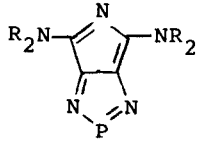


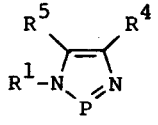
		+183			128



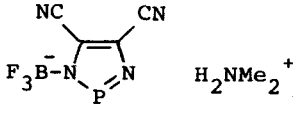
R =					
Me	+280	+265	23	142
Ph	+275	+266	25	142

TABLE I
(*contd.*)

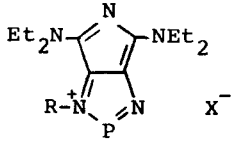
			$\delta^{31}P_A$	$\delta^{31}P_{B,C}$	J_{PP}	Lit.
	$Li(DME)_3^+$		+239	+252	51	24
	R = *t*Bu		+33	+46		161
	$R^3 = OSiMe_3$	$R^5 = OSiMe_3$	+180	+160	54	8
	$SSiMe_3$	$SiMe_3$	+310	+304	59	5
	$M = H_2NMe_2$		+262			65
	H_2NEt_2		+262			65
	K		+264			145
	$NR_2 = NMe_2$		+300			65
	$NMe(CH_2Ph)$		+301			67
			+300			67
			+300			67
	NEt_2		+301			67
	$N(CH_2)_5$		+299			67
	NMe_2, NEt_2		+301			67
	$NMe_2, N(CH_2)_5$		+300			67



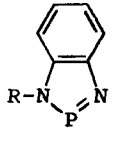
R^1 =	R^4 =	R^5 =		
Me	NMe_2	H	+210	144
H	CN	CN	+255	65
Me	CN	CN	+234	139
CH_2Ph	CN	CN	+230	144
CH_2COPh	CN	CN	+219	144
CH_2CO_2Et	CN	CN	+234	144
$SiMe_3$	CN	CN	+250	66



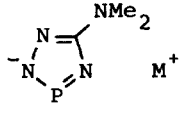
$H_2NMe_2^+$	+232	144



R = Me	X = $MeSO_4$	+278	67
Me	I	+280	67



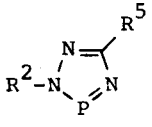
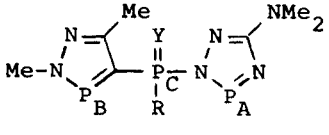
R = H		+238	98
	N(3)-BF_3 complex	+222	98
Et		+232	98
Pr		+236	98
	N(3)-BF_3 complex	+226	98
*i*Pr		+228	98
	N(3)-BF_3 complex	+226	98
*s*Bu		+226	98
	N(3)-BF_3 complex	+227	98
$(CH_2)_2CHMe_2$		+232	98
	N(3)-BF_3 complex	+226	98
CH_2Ph		+228	98
	N(3)-BF_3 complex	+225	98
Ph		+206	98



M = Na	+291	145
K	+263	145

TABLE I

(*contd.*)

			$\delta^{31}P_A$	$\delta^{31}P_{B,C}$	J_{PP}	Lit.
	R^3 = H	R^5 = Ph	+252			79
	H	NMe_2	+246			138
	H	SMe	+250			145
	Me	Me	+254			137
	Me	*i*Pr	+255			30
	Me	Bu	+256			30
	Me	CH_2Ph	+250			30
	Me	Ph	+256			96
		BF_3 complex	+251			30
		P-$Cr(CO)_5$ complex	+281			153
		P-$Mo(CO)_5$ complex	+258			153
		P-cis-$PtBr_2P_BEt_3$ complex	+191	+19	16	73
		N(4)-trans-$PdCl_2P_BEt_3$ complex	+245	+37		73
		N(4)-trans-$PtBr_2P_BEt_3$ complex	+242	+1		73
		P-$AuMe_2Cl$ complex	+223			36
	Ph	CH_2Ph	+245			30
	Ph	Ph	+245			30
	$SiMe_3$	Ph	+280			79
	$SiMe_3$	NMe_2	+275			138
	$SiMe_3$	SMe	+281			145
	$SnMe_3$	NMe_2	+279			138
	P_BMe_2	NMe_2	+272	+44	89	138
	P_BPh_2	NMe_2	+277	+49	69	138
	$P_B(S)Me_2$	NMe_2	+270	+68	23	138
	$P_B(S)Ph_2$	NMe_2	+275	+60	18	138
	R = Me	Y = —	+270	+244(B) +25(C)	92(AC) <1(BC)	138
	Ph	—	+270	+243(B) +30(C)	81(AC) <1(BC)	138
	Me	S	+268	+250(B) +51(C)	24(AC) 74(BC)	138

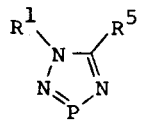
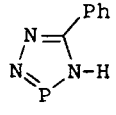
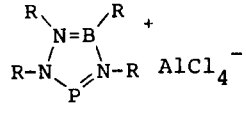
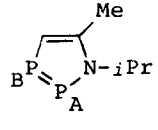
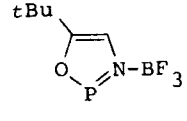
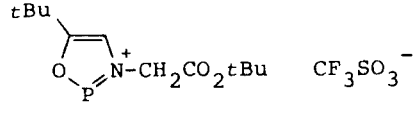
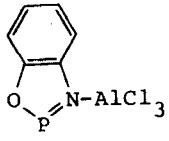
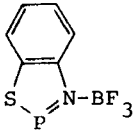
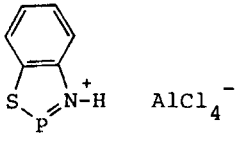
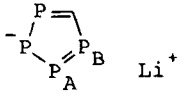
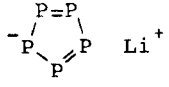
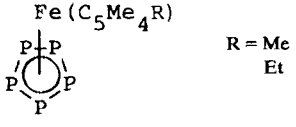
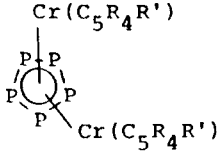
	R^1 = H	R^5 = Ph	+254			79
	Me	Me	+257			137
		P-$Cr(CO)_5$ complex	+315			153
		P-$Mo(CO)_5$ complex	+267			153
		N(4)-trans-$PdCl_2P_BEt_3$ complex	+246	+36		72
		P-cis-$PtBr_2P_BEt_3$ complex	+211	+17	20	73
		N(4)-trans-$PtBr_2P_BEt_3$ complex	+245	−3		73
		P-$Pt(P_BPh_3)_3$ complex	+234	+14	55	71
		P-$Pt(P_BPh_3)_2$ 2:1-complex	+231	+13	53	71
	Me	Bu	+260			30
	Me	CH_2Ph	+255			30
	Me	Ph	+261			30
	Ph	CH_2Ph	+257			30
			+249			79
		R = Me	+228			21
			+323	+244	480	48
			+270			19
			+234			14

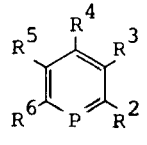
TABLE I

(*contd.*)

	$\delta^{31}P_A$	$\delta^{31}P_{B,C}$	J_{PP}		Lit.
	+262				97
	+160 +204				97 144
	+317				144
	+355	+362	−484 −4 −505 −53	(AB) (AB′) (AA′) (BB′)	23
	+470				23
 R = Me, Et	+153				136



R = H	R′ = H				−285	135
H	Me				−283	135
Me	Me				−291	135

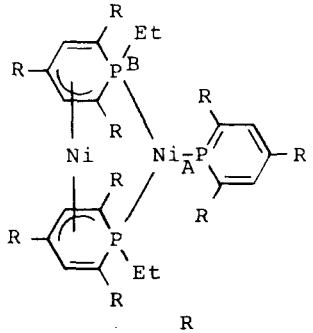


R^2 = H	R^3 = H	R^4 = H	R^5 = H	R^6 = H	+211	15, 16
*t*Bu	H	H	H	H	+202	125
Ph	H	H	H	H	+201	2
H	Ph	H	H	H	+209	87
Ph	H	H	Ph	H	+198	31
$CONMe_2$	H	H	OH	H	+225	115
CO_2H	H	H	OH	H	+231	115
CO_2Et	H	H	OH	H	+217	115
H	Me	Me	H	H	+188	3
H	Ph	CO*t*Bu	H	H	+207	86
H	4-MeC_6H_4	Me	H	H	+188	88
H	4-$MeOC_6H_4$	Me	H	H	+189	88
H	4-FC_6H_4	Me	H	H	+186	88
H	4-ClC_6H_4	Me	H	H	+187	88
H	Ph	H	OH	H	+213	85
H	Ph	H	Cl	H	+215	87
H	Ph	H	Br	H	+217	87
Me	Ph	H	H	Ph	+199	31
Et	Et	H	H	Ph	+198	31
Ph	Ph	H	H	Ph	+198	31
*t*Bu	H	Me	Me	H	+187	125
2-C_4H_3O	H	Me	Me	H	+173	2
2-C_4H_3S	H	Me	Me	H	+178	2
Ph	H	Me	Me	H	+189	2
					+181	103
	P-$W(CO)_5$ complex				+152	28
	P-$MnCp(CO)_2$ complex				+239	110
	P-$Mn(C_5H_4Me)(CO)_2$ complex				+234	110
2-C_5H_4N	H	Me	Me	H	+185	1
	hydrochloride				+197	28
	P-$Cr(CO)_5$ complex				+209	28
	P,N-$Cr(CO)_4$ complex				+248	28
	P,N-$Mo(CO)_4$ complex				+220	28

TABLE I
(*contd.*)

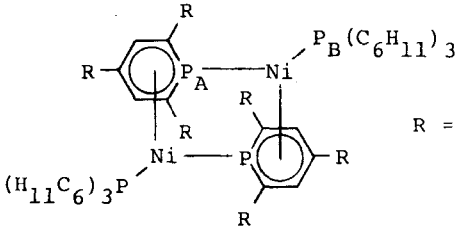
					$\delta^{31}P_A$	$\delta^{31}P_{B,C}$	J_{PP}	Lit.
	P-$W(CO)_5$ complex				+161			28
	P,N-$W(CO)_4$ complex				+205			28
$SiMe_3$	H	Me	Me	H	+215			155
*t*Bu	H	*t*Bu	H	*t*Bu	+179			29
*t*Bu	H	Ph	H	*t*Bu	+187			77
Ph	H	Me	H	Ph				
	P-$AgOCOCF_3$ complex				+133			64
Ph	H	CH_2Ph	H	Ph				
	P-$AgOCOCF_3$ complex				+138			64
Ph	H	CH_2/2	H	Ph	+178			160
Ph	H	CH_2CN	H	Ph	+191			160
Ph	H	*t*Bu	H	Ph	+179			77
	P-Ni(COD) 2:1-complex				+176			77
	P-Ni(CDT) complex				+176			77
Ph	H	Ph	H	Ph	+178			81
	P-$Cr(CO)_5$ complex				+198			39
	P-$Cr(CO)_4$ 2:1-complex				+217			39
	P-$Mo(CO)_5$ complex				+180			39
	P-$Mo(CO)_4$ 2:1-complex				+191			39
	P-$W(CO)_5$ complex				+156			39
	P-$W(CO)_4$ 2:1-complex				+170			39
	P-$MnCp(CO)_2$ complex				+243			110
	P-$Mn(C_5H_4Me)(CO)_2$ complex				+246			110
	P-Ni(CDT) complex				+179			77
	P-$Ni(CH_2{=}CH_2)P_B(C_6H_{11})_3$ complex				+205	+43	36	77
	P-$Ni(P_BPh_3)_2$ complex				+167	+28	90	77
	P-$Ni[P_B(O\text{-}2\text{-}MeC_6H_4)_3]_2$ complex				+160	+133	16	77
	P-Ni(COD) 2:1-complex				+179			77
	P-$Ni(COT)_{1/2}$ 2:1-complex				+179			77
	P-$AgOCOCF_3$ complex				+141			64
	P-AuCl complex				+167			35
	P-AuI complex				+166			35
Ph	H	CO_2Me	H	Ph	+215			160
Ph	H	CN	H	Ph	+216			160
CO_2Me	CO_2Me	Ph	H	Ph	+208			93
*t*Bu	*t*Bu	*t*Bu	CO_2Me-	*t*Bu	+189			117

*t*Bu	Ph	Ph	Ph	Ph	+202			125
Ph	Ph	Ph	Ph	Ph	+198			117, 164



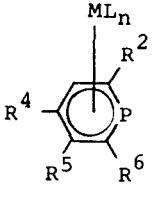
R = Ph

+186 −9 5 76



R = Ph

+108 +29 77



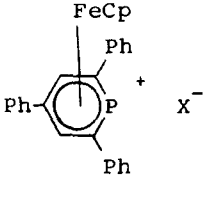
R^2 = Ph R^4 = Me R^5 = Me R^6 = H ML_n = $Mn(C_5H_4Me)$

P-$Mn(C_5H_4Me)(CO)_2$ complex +74 110

Ph	Me	Me	H	$Cr(CO)_3$	

P-$Cr(CO)_5$ complex +96 111

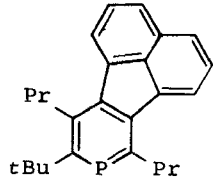
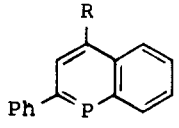
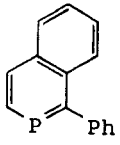
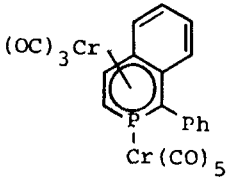
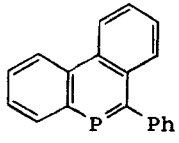
*t*Bu	*t*Bu	H	*t*Bu	$Cr(CO)_3$	+23	43
Ph	Ph	H	Ph	$Cr(CO)_3$	+4	37, 43
Ph	Ph	H	Ph	$Mo(CO)_3$	−3	38
Ph	Ph	H	Ph	MnCp	−50	110

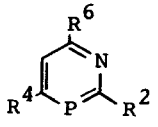


X = $AlCl_4$ −8 113

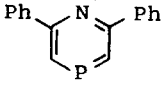
PF_6 −10 113

TABLE I
(*contd.*)

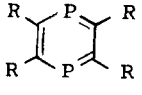
		$\delta^{31}P_A$	$\delta^{31}P_{B,C}$	J_{PP}	Lit.
		+206			117
	R = H	+197			82
	CO_2Et	+221			84
		+188			111
		+103			111
		+186			109



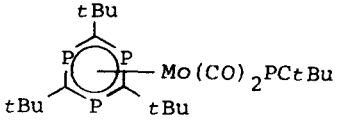
R^2	R^4	R			
CF_3	*t*Bu	Me	+163		7
CF_3	1-Ad	Me	+163		7
Ph	Ph	Ph	+163		93
Ph	Ph	4-MeC_6H_4	+161		93
4-MeC_6H_4	Ph	Ph	+161		93
4-MeC_6H_4	Ph	4-MeC_6H_4	+160		93
4-ClC_6H_4	Ph	Ph	+163		93
4-ClC_6H_4	Ph	4-MeC_6H_4	+161		93



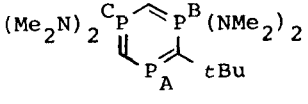
+245 83



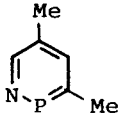
R = CF_3 +287 70



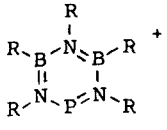
+25 22



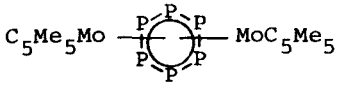
+296 +59 (B) 49 (AB) 46
+58 (C) 45 (AC)
30 (BC)



+263 158



$AlCl_4^-$ R = Me +302 21



−316 134

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