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The Crystal and Molecular Structure of Di-μ-bis(diphenylarsino)methane-bis(*trans*-chlorocarbonylrhodium(I)), $Rh(CO)Cl((C_6H_5)_2AsCH_2As(C_6H_5)_2)_2Rh(CO)Cl$

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The structure of di-μ-bis(diphenylarsino)methane-bis(*trans*-chlorocarbonylrhodium(I)), $Rh(CO)Cl((C_6H_5)_2AsCH_2As(C_6H_5)_2)_2Rh(CO)Cl$, has been determined from three-dimensional X-ray data collected by counter methods. The final R factor obtained from a block-diagonal least-squares refinement for 2544 reflections is 0.068. The material crystallizes in the triclinic system with space group $P\bar{1}$ and a unit cell of dimensions a = 11.371 (2), b = 10.413 (2), c = 12.753 (3) Å and α = 100.35 (3), β = 103.60 (2), γ = 118.42 (2)°. The calculated density for two empirical formula units, $Rh(CO)Cl(C_6H_5)_2AsCH_2As(C_6H_5)_2$, is 1.747 g/cm^3 which agrees with the experimental value of 1.71 g/cm^3 determined by the flotation method. The crystal consists of discrete dimeric molecules of $\bar{1}$ symmetry held together by bridging diarsine molecules. The Rh–Rh distance within the dimer is 3.396 (1) Å and appears to be more the result of the steric requirements of the diarsine molecules than any significant metal–metal interaction. The approach is sufficiently close, however, that the coordination about each rhodium atom is best described as approximately square pyramidal. The centrosymmetrically related rhodium atom occupies the apical position while the "basal plane" consists of a terminal chlorine atom, a terminal carbonyl group, and two arsenic atoms, one from each of the two bridging diarsine molecules, in a *trans* configuration.

Introduction

Until recently, there have been only scattered reports of rhodium(I) complexes of chelating ditertiary phosphines and arsines.[1-3] Our discovery that bis(*cis*-1,2-bis(diphenylarsino)ethylene)rhodium(I) chloride, [Rh(*cis*-$(C_6H_5)_2AsCH{=}CHAs(C_6H_5)_2)_2$]Cl, would reversibly activate molecular hydrogen and undergo a variety of facile oxidative addition reactions[4] prompted a search for similar Rh(I) complexes which might behave in an analogous manner. In the course of this work, we prepared complexes of bis(diphenylarsino)methane and its phosphorus analog which were found to possess the empirical formula Rh(CO)Cl(L–L) (L–L = diphosphine or diarsine).[5] The two complexes are isomorphous from powder data but molecular weight studies produced conflicting results which, although indicating a dimer, prevented an unequivocal determination of the molecular formula. The similarity of their infrared spectra to that of *trans*-$Rh(CO)Cl(P(C_6H_5)_3)_2$ and related complexes[6] suggested a similar geometry about the metal and the likelihood of ligand bridges if the molecule were indeed dimeric. Such a formulation would be similar to the dimeric carboxylate complexes of Rh,[7] Ru,[8] Mo,[9] Re,[10] and Cu[11] where significant metal–metal interaction occurs in that in both cases a three-atom moiety links the two metals.

While this work was in progress, the preparation of a complex, also of empirical formula $Rh(CO)Cl(C_6H_5)_2PCH_2P(C_6H_5)_2$, was reported with a *polymeric* formulation being postulated.[3] We have shown this product to be identical with the phosphine complex which we have prepared and for which we had data indicating a dimeric formulation.[5] We therefore felt it necessary to know the exact structure of the complexes in order to determine unequivocally the molecular formula and to investigate the possibility of metal–metal interaction. We report here the results of that study of the diarsine complex.

Experimental Section[12]

Unit Cell Data and Collection of Intensities.—Bright orange crystals of $Rh(CO)Cl((C_6H_5)_2AsCH_2As(C_6H_5)_2)_2Rh(CO)Cl$[5] were grown by slow diffusion of diethyl ether into a dichloromethane solution of the complex. Equiinclination Weissenberg photographs taken with Ni-filtered, Cu Kα radiation indicated that the crystal belonged to the triclinic system and inspection of the 0*kl*–2*kl* and *hk*0–*hk*2 zones did not reveal any systematic absences. A least-squares refinement of the setting angles of 34 high-order reflections which had been carefully centered on a Picker four-circle diffractometer (Zr-filtered, Mo Kα radiation (λ 0.7107 Å)) gave the following unit cell parameters: a = 11.371 (2), b = 10.413 (2), c = 12.753 (2) Å and α = 100.35 (3), β = 103.60 (2), γ = 118.42 (2)°. The experimental density of 1.71 g/cm^3 as measured by flotation in aqueous zinc chloride is in agreement with the value of 1.747 g/cm^3 calculated on the basis of two empirical formula units ($Rh(CO)Cl(C_6H_5)_2AsCH_2As(C_6H_5)_2$) per unit cell. With Z = 2 and an indication from the molecular weight measurements that the molecule was probably dimeric[5] the most likely space group was $P\bar{1}$ (C_i^1, no. 2[13]). The subsequent successful refinement of the structure confirms this choice.

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(1) A. Sacco and R. Ugo, *J. Chem. Soc.*, 3274 (1964).

(2) R. J. Mawby and L. M. Venanzi, *Experientia, Suppl.*, No. 9, 240 (1964).

(3) W. Hieber and H. Lagally, *Chem. Ber.*, **100**, 148 (1967).

(4) J. T. Mague and J. P. Mitchener, *Chem. Commun.*, 911 (1968).

(5) J. T. Mague and J. P. Mitchener, *Inorg. Chem.*, **8**, 119 (1969).

(6) J. Chatt and B. L. Shaw, *J. Chem. Soc.*, *A*, 1437 (1966).

(7) M. A. Porai-Koshits and A. S. Antsyshkina, *Proc. Acad. Sci. USSR, Chem. Sect.*, **146**, 902 (1962).

(8) M. J. Bennett, K. G. Caulton, and F. A. Cotton, *Inorg. Chem.*, **8**, 1 (1969).

(9) D. Lawton and R. Mason, *J. Am. Chem. Soc.*, **87**, 921 (1965).

(10) M. J. Bennett, W. K. Bratton, F. A. Cotton, and W. R. Robinson, *Inorg. Chem.*, **7**, 1570 (1968).

(11) J. N. van Niekerk and F. R. L. Schoenig, *Acta Cryst.*, **6**, 227 (1953).

(12) All computations were performed on an IBM 7044 computer at the Tulane University Computer Laboratory. Local programs were used except for those noted here: GSET-4, C. T. Prewitt (diffractometer settings); LPIN (Lorentz and polarization corrections), FOUR (Fourier synthesis), BLSA (modification of the Gantzel–Sparks–Trueblood UCLALS-1, ACA Program No. 317 for block-diagonal least-squares refinement and distance–angle calculation), LSPL (least-squares planes), all by C. J. Fritchie, Jr.; ORABS, W. L. Busing (absorption corrections); ORTEP, C. K. Johnson (graphical illustrations); CELL, B. L. Trus (refinement of unit cell dimensions).

(13) "International Tables for X-Ray Crystallography," Vol. I, The Kynoch Press, Birmingham, England, 1962.

The crystal used for the collection of the intensity data was a plate with parallelogram faces measuring 0.1 × 0.3 × 0.5 mm, the largest face being identified as $\{001\}$. It was mounted on one end such that the crystallographic a axis was coincident with the ϕ axis of the goniostat. The latter was in turn approximately parallel to the minor diagonal of the $\{001\}$ face. The data were collected at room temperature on a card-controlled, Picker four-circle diffractometer using Zr-filtered, Mo Kα radiation (λ 0.7107 Å) and a takeoff angle of 5.3°. The integrated intensities were measured with a scintillation counter employing a pulse-height analyzer set to admit about 90% of the Mo Kα pulse distribution. Preliminary inspection of the stronger reflections showed noticeable tailing to higher 2θ. As this continued essentially undiminished for at least 3° in 2θ beyond the peak maximum, it did not appear feasible to employ an asymmetric scan range, particularly since the tailing did not produce more than a 2% error in the measured intensities. The moving-crystal, moving-counter scan technique[14] was employed in which the 2θ scan was from $2\theta_{\text{calcd}} - 1.25°$ to $2\theta_{\text{calcd}} + 1.25°$. The scan rate was 1°/min and background counts were made for 20 sec at each scan limit. Two standard reflections were monitored approximately every 4 hr throughout the course of the data collection and no significant variation in their intensities was noted. Coincidence losses were found to affect only the most intense reflections. Reflections for which the counting rate exceeded 10,000 cps were remeasured at reduced power and were scaled to the remaining data using the same standard reflections.

The unique hemisphere having $h \geq 0$ and $(\sin\theta)/\lambda \leq 0.55$ was scanned to yield 3589 independent reflections. Raw intensities, I, were obtained from the diffractometer output according to the formula $I = \text{CT} - 0.5(t_c/t_b)(B_1 + B_2)$ where CT is the total integrated count obtained in time t_c and B_1 and B_2 are the background counts, each obtained in time t_b. The standard deviation of the raw intensity, $\sigma(I)$, was estimated as $\sigma(I) = (\text{CT} + 0.25(t_c/t_b)^2(B_1 + B_2) + (pI)^2)^{1/2}$ with p[15] taken as 0.02. Using the criterion $I < 2\sigma(I)$, 602 reflections were rejected as statistically insignificant and were treated as unobserved. Each of these reflections was assigned a threshold value given by $I_{\text{th}} = 2\sigma(I)$. Owing to program limitations and the fact that many of these unobserved reflections occurred at high values of $(\sin\theta)/\lambda$, a smaller data set was chosen having $(\sin\theta)/\lambda \leq 0.525$. The resulting 2941 reflections of which 419 were unobserved were then corrected for Lorentz, polarization, and absorption effects. The linear absorption coefficient for the compound is 37.9 cm^{-1} for Mo Kα radiation.

Solution and Refinement of the Structure.—The structure was refined by a block-diagonal least-squares process. Scattering factors for neutral Rh, As, Cl, O, and C were obtained from ref 16, and those for Rh, As, and Cl included both the real and imaginary parts of the correction for the effects of anomalous dispersion.[17] The function minimized was $\Sigma w(K|F_o| - G|F_c|)^2$ where F_o and F_c are, respectively, the observed and calculated structure factors, K and G are scale factors ($G = 1.0$), and w is $1/\sigma^2(F_o)$. The standard deviation in F_o, $\sigma(F_o)$, was taken as $\sigma(F_o^2)/2F_o$. Unobserved reflections were included in the refinement if $|F_c|$ exceeded F_{th} where F_{th} is the threshold value for F_o obtained by correcting I_{th} for Lorentz, polarization, and absorption effects. In the final stages of refinement only 49 of the unobserved reflections met this criterion. The conventional residual, R, is defined as $R = \Sigma(||F_o| - |F_c||)/\Sigma|F_o|$.

A three-dimensional, unsharpened Patterson function which clearly showed the heavy-atom vectors was readily interpretable in terms of a centrosymmetric dimer thus further indicating P$\bar{1}$ as the correct space group. The remaining nonhydrogen atoms were found from successive cycles of least-squares refinement followed by a difference Fourier synthesis. After all 31 nonhydrogen atoms had been located and their positional and isotropic thermal parameters refined, a difference Fourier map was calculated which indicated anisotropic thermal motion about the heavy atoms. Refinement was therefore continued with anisotropic temperature factors of the form $\exp[-(B_{11}h^2 + B_{22}k^2 + B_{33}l^2 + B_{12}hk + B_{13}hl + B_{23}kl)]$ for these atoms, leading to an R of 0.071 and to an improvement in the appearance of the difference map in the immediate vicinity of these atoms. (However, see below.) Inspection of the list of observed and calculated structure factors showed some rather large discrepancies between $|F_o|$ and $|F_c|$ among the strongest and the weakest reflections. Since the latter receive relatively large weights but make only small contributions to the total electron density, it was thought that the large errors here might be impeding the refinement and 146 were omitted. Also omitted were the strong reflections 001 and 002 which appeared to be severely affected by either extinction or by overlap with the "tail" of the direct beam. Other than this, the effects of extinction were neglected. Three more cycles reduced R to 0.063 and improved the agreement among the strong reflections. The agreement among the weaker reflections was not noticeably affected so the 146 omitted data were returned and three more cycles of refinement were performed leading to a final R of 0.068. At this point no parameter was shifted by more than 0.1 of its estimated standard deviation and there were no significant changes in the molecular dimensions from those determined prior to the temporary removal of the 146 reflections. The final difference map indicated reasonable positions for most of the phenyl hydrogens but the peaks were very diffuse (<0.5 e$^-$/Å^3). In addition each heavy atom was surrounded by a pair of peaks (~1.6 e$^-$Å^3) and a pair of holes (~−2.0 e$^-$/Å^3) which resembled uncorrected anisotropic thermal motion but which occurred about 1.1 Å from the atoms. These anomalies were smaller here than on a map calculated after convergence had been reached on the data set which included no absorption corrections. The directions of the peaks and holes were, respectively, in the approximate directions of the minimum and maximum dimensions of the crystal. These observations, together with the fact that similar anomalies in another case[18] could not be removed by manual changes in the size and orientation of the thermal ellipsoid of the atom with which they were associated, suggest that they may be connected in some way with the absorption correction. Although there may be a somewhat larger uncertainty than desirable in the angular dimensions of the crystal since good reflections from the faces could not be obtained on an optical goniometer, all linear dimensions were accurately measured on a microscope fitted with a micrometer eyepiece. Thus it does not appear that any serious error has been made in applying the absorption correction. Another contributing factor may be the white radiation problem inherent with Mo Kα radiation[19] although, as mentioned earlier, this did not appear to be an appreciable effect either. The final standard deviation of an observation of unit weight is 2.98. This high value probably results from the anomalies noted above and to the neglect of the contributions of the hydrogen atoms to the scattering. It may possibly also indicate an underestimation of the value of p. Despite this, the molecular features of chemical interest are quite adequately established and further refinements in the treatment of the data such as inclusion of the hydrogens and a detailed analysis of the noise features in the final map do not appear to be economically feasible.

The final values of $|F_o|$ and F_c are presented in Table I. The positional and thermal parameters obtained from the last cycle of least-squares refinement are listed in Table II together with the associated standard deviations as estimated from the inverse least-squares matrix.

Description of the Structure

The structure consists of discrete dimeric molecules having $\bar{1}$ symmetry with the centers located at ($^1/_2$, 0, $^1/_2$). A perspective view of the dimer in given in Figure

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[14] T. C. Furnas, "Single Crystal Orienter Instruction Manual," General Electric Co., Milwaukee, Wis., 1957.

[15] W. R. Busing and H. A. Levy, *J. Chem. Phys.*, **26**, 563 (1957).

[16] "International Tables for X-Ray Crystallography," Vol. III, The Kynoch Press, Birmingham, England, 1962, p 200 ff.

[17] Reference 16, Table 3.3.2C.

[18] C. J. Fritchie, Jr. and J. L. Wells, private communication.

[19] R. Eisenberg and J. A. Ibers, *Inorg. Chem.*, **4**, 773 (1965).

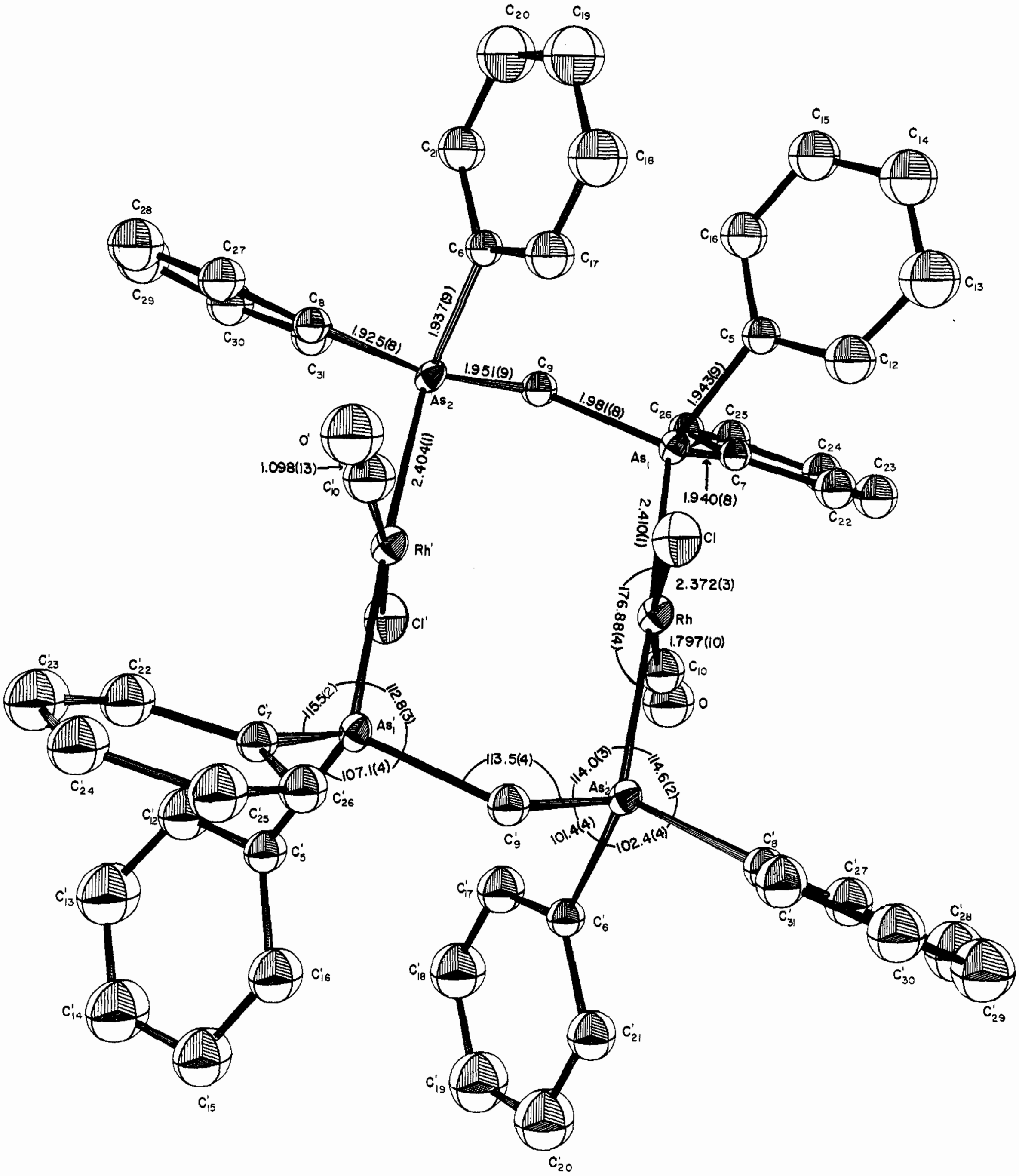

Figure 1.—A perspective view of the centrosymmetric dimeric molecule with pertinent dimensions. Additional angles which could not conveniently be included in the figure are: Cl–Rh–As_1, 93.73 (7)°; Cl–Rh–C_{10}, 171.4 (3)°; Rh–C_{10}–O, 177.1 (9)°; As_1–Rh–C_{10}, 88.3 (3)°; Cl–Rh–As_2', 87.22 (7)°; As_2'–Rh–C_{10}, 91.2 (3)°; C_5'–As_1–C_7', 99.4 (4)°; C_5'–As_1'–Rh', 119.3 (2)°; C_6'–As_2'–Rh, 120.8 (2)°.

1, together with selected interatomic distances and angles, while the molecular packing is depicted in Figure 2. The halves of the molecule are held together by bridging diarsine molecules. The coordination about each rhodium atom is effectively that of a square pyramid with the basal atoms consisting of an arsenic atom from each of the diarsine molecules, a terminal chlorine atom, and the carbon atom of a terminal carbonyl group. The arrangement of these four atoms is *trans*, and in this respect each half of the molecule is analogous to the known complexes *trans*-Rh(CO)ClL_2 (L = monotertiary phosphine or arsine).[20] The coordination about the rhodium is completed by the second rhodium which occupies the apical position at a distance of 3.396 (1) Å. This distance is significantly greater than the intramolecular Rh–Rh distances found in [Rh($CH_3COO)_2(H_2O)]_2$ (2.45 Å)[7] and $[Rh(CO)_2Cl]_2$ (3.21 Å)[21] where metal–metal bonding has been postulated (in rhodium metal theRh–Rh distance is 2.690 (12) Å[22]). On the other hand it has been suggested that weak

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(20) L. Vallarino, *J. Chem. Soc.*, 2473 (1957).

(21) L. F. Dahl, C. Martell, and D. S. Wampler, *J. Am. Chem. Soc.*, **83**, 1761 (1961).

(22) L. Pauling, "The Nature of the Chemical Bond," 3rd ed, Cornell University Press, Ithaca, N. Y., 1960, Table 11-2.

TABLE I

OBSERVED AND CALCULATED STRUCTURE AMPLITUDES (×10, IN ELECTRONS) FOR $Rh(CO)Cl((C_6H_5)_2AsCH_2As(C_6H_5)_2)_2Rh(CO)Cl$[a]

	0	0
3	88	-40
4	-54	76
5	-56	-20
6	298	-330
7	501	552
8	328	-332
9	246	-251
10	264	-212
11	274	330
12	615	-556
	0	1
11	424	377
10	234	-219
9	146	135
8	-69	-11
7	-65	-36
6	521	551
5	939	-1080
4	1152	1259
3	1118	-1176
2	276	-225
1	132	108
0	1009	971
-1	1170	-996
-2	94	-87
-3	241	228
-4	82	106
-5	102	136
-6	456	-431
-7	1252	1333
-8	1110	-1171
-9	339	350
-10	77	-62
-11	-79	35
-12	200	-160
	0	2
-12	127	113
-11	113	126
-10	198	-198
-9	568	564
-8	818	-863
-7	596	601
-6	63	51
-5	77	-67
-4	821	-731
-3	243	273
-2	1685	-1462
-1	220	-208
0	105	154
1	476	446
2	88	111
3	1134	-1141
4	942	966
5	63	-56
6	234	-244
7	326	335
8	341	354
9	410	-411
10	306	300
11	-81	-56
	0	3
10	257	236
9	450	-443
8	585	589
7	430	-437
6	216	-209
5	338	330
4	-56	-3
3	77	-71
2	527	-520
1	601	563
0	214	-192
-1	937	-893
-2	-48	18
-3	1655	1485
-4	1514	-1363
-5	507	454
-6	219	177
-7	-63	-40
-8	170	-176
-9	138	-111
-10	458	486
-11	230	-241
-12	107	64
-13	153	136
	0	4
-12	491	554
-11	798	-795
-10	500	510
-9	84	92
-8	269	-244
-7	131	-123
-6	370	329
-5	102	85
-4	158	-164
-3	286	-278
-2	823	741
-1	94	-67
0	763	-778
1	1255	1271
2	974	-958
3	391	391
4	131	-110
5	109	103
6	-68	3
7	195	-204
8	109	121
9	-78	-77
	0	5
8	117	-86
7	118	119
6	685	-661
5	753	754
4	200	-194
3	213	-203
2	100	74
1	403	409
0	770	-749
-1	585	564
-2	434	418
-3	203	170
-4	200	200
-5	616	-593
-6	1062	1014
-7	1052	-1033
-8	413	394
-9	206	178
-10	316	-305
-11	-80	-15
-12	98	94
	0	6
-12	100	-113
-11	89	103
-10	147	-154
-9	-79	-58
-8	703	668
-7	761	-765
-6	417	414
-5	119	122
-4	102	-57
-3	816	-807
-2	865	845
-1	335	-350
0	100	-81
1	86	-95
2	-66	-38
3	288	302
4	788	-763
5	778	783
6	241	-229
	0	7
5	121	118
4	84	-49
3	83	40
2	91	58
1	95	27
0	83	-62
-1	249	-245
-2	839	829
-3	1137	-1140
-4	605	617
-5	305	-307
-6	118	-134
-7	90	-46
-8	-77	-13
-9	230	236
-10	317	-341
-11	108	124
	0	8
-10	723	-788
-9	376	400
-8	-81	-57
-7	100	-74
-6	90	124
-5	80	-40
-4	279	313
-3	334	-329
-2	74	33
-1	195	214
0	-75	50
1	423	-431
2	605	639
3	377	-390
	0	9
0	203	226
-1	-78	-9
-2	-78	-80
-3	80	-10
-4	123	-126
-5	518	553
-6	526	-575
-7	182	194
-8	185	245
	1	9
-6	541	577
-5	177	-159
-4	-81	-52
-3	-80	61
	1	8
1	676	705
0	665	-707
-1	225	206
-2	-75	45
-3	161	146
-4	257	-269
-5	-77	51
-6	93	79
-7	150	-126
-8	88	89
-9	-82	28
	1	7
-11	403	-440
-10	428	452
-9	158	-169
-8	170	143
-7	218	-233
-6	126	-132
-5	707	726
-4	936	-946
-3	781	805
-2	152	-155
-1	107	-135
0	168	-180
1	229	238
2	131	-115
3	-76	-10
	1	6
5	168	-172
4	646	650
3	585	-567
2	195	196
1	151	131
0	214	-209
-1	167	162
-2	583	-576
-3	984	977
-4	603	-598
-5	115	-91
-6	163	131
-7	121	108
-8	440	-433
-9	404	407
-10	115	-59
-11	-83	-39
-12	-84	17
	1	5
-12	-83	-74
-11	154	-173
-10	95	83
-9	455	441
-8	1012	-966
-7	741	699
-6	196	-187
-5	149	150
-4	-62	64
-3	229	213
-2	-59	71
-1	390	-405
0	151	156
1	300	259
2	241	-216
3	306	-299
4	866	855
5	866	-839
6	258	244
7	-77	-36
	1	4
8	-76	22
7	156	158
6	102	-97
5	92	-74
4	122	132
3	137	122
2	108	70
1	536	-537
0	1353	1307
-1	1207	-1132
-2	500	452
-3	244	216
-4	392	-320
-5	435	-416
-6	77	55
-7	282	239
-8	269	-255
-9	232	-198
-10	160	161
-11	341	315
-12	611	-661
-13	594	641
	1	3
-13	207	183
-12	406	-418
-11	584	596
-10	225	-211
-9	117	-109
-8	223	209
-7	128	-158
-6	1169	1086
-5	1611	-1509
-4	1409	1235
-3	805	-661
-2	940	-819
-1	124	75
0	333	350
1	530	-509
2	-53	-23
3	-56	-24
4	-59	-31
5	141	124
6	412	-400
7	755	746
8	355	-371
9	-78	47
	1	2
10	-79	-37
9	229	230
8	544	-537
7	268	263
6	194	176
5	109	-66
4	652	-644
3	911	927
2	1267	-1302
1	620	626
0	50	65
-1	659	568
-2	905	721
-3	650	-601
-4	1336	1242
-5	1167	-1117
-6	337	320
-7	271	237
-8	323	336
-9	737	-742
-10	400	396
-11	184	-174
-12	158	-152
-13	-83	-12
	1	1
-12	117	-101
-11	-79	116
-10	253	266
-9	1015	-1054
-8	957	1019
-7	423	-427
-6	-58	31
-5	375	-343
-4	161	216
-3	292	240
-2	1205	-1059
-1	852	782
0	799	742
1	844	791
2	1450	-1555
3	1464	1639
4	937	-1003
5	453	471
6	172	162
7	174	-150
8	-72	-22
9	328	-309
10	376	358
11	334	-293
	1	0
11	745	-711
10	636	617
9	255	-224
8	148	-147
7	-66	-65
6	184	191
5	182	189
4	267	-293
3	59	-63
2	78	-75
1	537	-554
0	1050	-1102
-2	1229	-1268
-3	188	184
-4	226	268
-5	79	93
-6	123	-131
-7	257	-256
-8	580	601
-9	120	-76
-10	131	-115
-11	109	87
-12	232	200
	1	-1
-12	463	421
-11	-79	19
-10	81	-69
-9	-73	61
-8	74	-83
-7	401	425
-6	795	-887
-5	561	610
-4	755	793
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-11	349	348
-12	489	-483
7 -3		
-11	548	539
-10	359	-360
-9	-79	72
-8	-77	48
-7	-76	-89
-6	138	157
-5	590	-706
-4	567	653
-3	233	-305
-2	93	-84
-1	83	-101
0	486	606
1	718	-738
2	403	438
3	86	118
4	241	-264
5	307	349
6	263	-293
7	515	546
8	506	-501
7 -4		
8	482	-490
7	201	175
6	-84	69
5	103	-89
4	291	-313
3	554	623
2	81	-28
1	-76	19
0	199	-132
-1	150	187
-2	298	290
-3	971	-1013
-4	1154	1269
-5	478	-511
-6	175	-188
-7	-76	68
-8	-80	55
-9	-81	-90
-10	131	-124
-11	138	146
7 -5		
-10	172	168
-9	418	-457
-8	601	634
-7	303	-334
-6	91	-81
-5	234	239
-4	93	103
-3	349	-348
-2	233	217
-1	225	-204
0	-70	30
1	161	-178
2	120	-117
3	800	763
4	1045	-1031
5	552	560
6	-86	26
7	95	-101
8	-89	-76
7 -6		
8	-89	45
7	95	-32
6	285	-297
5	331	277
4	475	-449
3	-82	40
2	217	169
1	132	115
0	546	-518
-1	632	596
-2	475	-458
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-5	153	181
-6	121	132
-7	332	-347
-8	349	345
-9	-82	-46
7 -7		
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-7	149	163
-6	414	-418
-5	410	393
-4	-86	-163
-3	309	-298
-2	114	110
-1	553	529
0	717	-703
1	469	468
2	119	132
3	157	-170
4	127	123
5	134	-110
6	363	349
7	405	-339
8	138	121
7 -8		
8	656	680
7	598	-592
6	146	169
5	113	121
4	118	60
3	274	-267
2	297	230
1	172	-162
0	-76	-12
-1	218	-196
-2	163	141
-3	212	177
-4	637	-619
-5	660	655
-6	354	-352
-7	98	54
7 -9		
-5	173	176
-4	394	-400
-3	221	245
-2	133	121
-1	-76	-10
0	105	122
1	472	-471
2	630	648
3	782	-798
4	592	541
5	97	-49
6	266	-239
7	-93	81
7 -10		
5	177	-184
4	467	485
3	313	-349
2	111	68
1	102	82
0	-80	45
-1	446	-495
-2	517	544
-3	209	-211
8 -10		
-2	224	-215
-1	-81	-28
0	188	220
1	-83	37
2	420	-413
3	597	603
4	221	-248
8 -9		
6	185	-177
5	231	-249
4	118	128
3	427	370
2	717	-716
1	562	534
0	339	-350
-1	-77	-8
-2	-79	28
-3	85	49
-4	320	318
-5	347	-335
8 -8		
-6	605	607
-5	534	-534
-4	154	148
-3	133	143
-1	99	-129
0	-89	68
1	155	164
2	311	-315
3	177	175
4	-89	-29
5	396	373
6	756	-722
7	522	565
8 -7		
7	-92	70
6	447	-431
5	510	504
4	102	-134
3	213	219
2	298	-286
1	114	102
0	406	365
-1	835	-803
-2	658	606
-3	-74	-23
-4	-75	33
-5	284	-765
-6	232	225
-7	233	-240
-8	94	75
8 -6		
-9	430	461
-8	393	-411
-7	103	79
-6	185	189
-5	277	-300
-4	168	182
-3	701	-734
-2	739	741
-1	469	-459
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1	289	253
2	-84	43
3	434	-411
4	337	290
5	134	61
6	106	-15
7	-92	79
8 -5		
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5	111	48
4	385	392
3	925	-988
2	770	763
1	273	-255
0	97	41
-1	-73	-28
-2	103	92
-3	266	271
-4	367	-388
-5	139	191
-6	239	253
-7	203	-233
-8	144	-131
-9	444	499
-10	461	-504
8 -4		
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-9	101	97
-8	86	75
-7	118	102
-6	196	-214
-5	940	1101
-4	633	-709
-3	102	-32
-2	222	174
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1	152	177
2	-86	72
3	183	-216
4	237	-283
5	105	-125
6	461	478
7	623	-665
8 -3		
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5	153	-170
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3	-82	94
2	-81	70
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0	727	-770
-1	798	869
-2	366	-389
-3	298	-271
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-5	442	471
-6	419	-450
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-8	80	39
-9	-80	-42
-10	-81	16
-11	229	-242
8 -2		
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-9	376	-369
-8	475	502
-7	705	-690
-6	247	235
-5	81	100
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-3	222	188
-2	805	-776
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0	465	-453
2	211	235
3	136	129
1	101	149
4	329	-355
5	215	208
6	-83	51
8 -1		
5	205	202
4	459	-480
3	668	672
2	419	-398
1	98	-90
0	-71	-28
-1	195	154
-2	174	-158
-3	258	-224
-4	234	194
-5	155	161
-6	230	-214
-7	485	-463
-8	889	854
-9	695	-695
-10	377	360
-11	-84	-46
8 0		
-11	111	127
-10	154	98
-9	224	-201
-8	136	124
-7	167	210
-6	-74	63
-5	681	-639
-4	490	434
-3	574	-529
-2	103	-96
-1	232	235
0	87	-128
1	135	131
2	299	-321
3	133	135
4	-79	-29
8 1		
2	162	142
1	597	-606
0	473	458
-1	-73	18
-2	252	-250
-3	109	82
-4	328	309
-5	442	-452
-6	169	168
-7	-76	49
-8	249	235
-9	170	-143
-10	-82	-35
-11	368	373
8 2		
-10	-81	74
-9	257	-282
-8	109	-118
-7	370	395
-6	241	-248
-5	77	-20
-4	95	-99
-3	131	111
-2	112	122
-1	477	-463
0	720	745
1	246	-231
8 3		
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-3	179	168
-4	96	-91
-5	-77	-42
-6	178	-167
-7	641	663
-8	699	-717
9 2		
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-4	-79	5
-5	-79	9
-6	-80	-5
-7	234	-221
9 1		
-9	-81	65
-8	145	-131
-7	275	277
-6	440	-410
-5	295	275
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-3	78	-106
-2	239	-213
-1	393	387
0	474	-466
9 0		
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1	95	-108
0	101	40
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-2	143	152
-3	-78	-39
-4	487	-463
-5	949	934
-6	716	-676
-7	244	244
-8	-80	25
-9	146	121
-10	277	-262
9 -1		
-10	597	-613
-9	390	390
-8	243	-242
-7	218	-184
-6	-77	-54
-5	499	461
-4	444	-448
-3	122	90
-2	-73	-4
-1	-74	-53
0	276	289
1	327	-343
2	717	774
3	577	-621
9 -2		
4	327	340
3	484	-501
2	164	162
1	-76	42
0	113	128
-1	260	-268
-2	529	512
-3	673	-690
-4	233	228
-5	-77	-10
-6	-80	11
-7	278	249
-8	361	-390
-9	542	552
-10	254	-279
9 -3		
-10	161	167
-9	-83	10
-8	-82	63
-7	274	-257
-6	334	355
-5	298	278
-4	236	-209
-3	346	-314
-2	702	703
-1	647	-645
0	359	367
1	-80	-21
2	-81	-95
3	102	-124
4	137	-156
5	274	288
9 -4		
5	406	435
4	-86	-20
3	-86	-121
2	181	-210
1	175	168
0	-87	-13
-1	88	-79
-2	-84	-47
-3	198	226
-4	161	-175
-5	414	-447
-6	616	707
-7	447	-505
-8	131	150
-9	-84	77
-10	117	99
9 -5		
-9	109	-98
-8	201	-246
-7	107	-88
-6	310	312
-5	286	-286
-4	108	20
-3	204	203
-2	270	-265
-1	247	264
1	634	604
2	501	-463
3	117	120
4	265	297
5	206	-223
6	-90	-24
9 -6		
6	135	133
5	121	-83
4	-90	-20
3	477	494
2	483	-443
1	255	244
0	209	226
-1	230	-244
-2	257	-247
-3	645	608
-4	437	-429
-5	120	94
-6	260	-245
-7	116	138
-8	-81	-22
-9	417	-459
9 -7		
-7	86	60
-6	-80	101
-5	-78	57
-4	122	-101
-3	672	677
-2	882	-860
-1	417	376
0	79	-81
1	-82	-63
2	-87	28
3	-89	-100
4	307	317
5	427	-446
6	-94	61
9 -8		
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4	426	377
3	170	-169
2	-85	32
1	-81	-1
0	-80	-10
-1	187	204
-2	252	-250
-3	189	162
-4	178	175
-5	-80	89
-6	334	-334
9 -9		
-4	105	48
-3	166	-142
-2	145	-132
-1	166	-158
0	514	496
1	515	-505
2	189	180
3	178	190
4	-92	-118
9 -10		
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1	534	-549
0	133	150
-1	144	143
10 -9		
2	239	229
1	-86	57
0	385	-370
-1	405	396
-2	168	-189
-3	-82	95
10 -8		
-5	170	188
-4	-80	-27
-3	200	-173
-2	88	89
-1	-81	-7
0	95	32
1	97	-66
2	115	-114
3	421	401
10 -7		
4	289	-290
3	114	79
2	93	54
1	101	56
0	107	-123
-1	-80	71
-2	340	329
-3	700	-718
-4	601	627
-5	354	-328
-6	-81	114
-7	-82	53
10 -6		
-8	-83	27
-7	-81	16
-6	-79	62
-5	-78	-21
-4	374	351
-3	247	-240
-2	-77	-35
-1	93	-90
0	565	500
1	778	-734
2	572	558
3	147	-158
4	186	-194
10 -5		
4	-90	-66
3	164	196
2	135	153
1	417	-445
0	575	599
-1	404	-418
-2	90	55
-3	167	-181
-4	-77	37
-5	164	185
-6	330	-371
-7	407	459
-8	209	-249
10 -4		
-9	195	219
-8	631	-675
-7	452	525
-6	351	-375
-5	89	54
-4	227	728
-3	-78	-77
-2	140	-157
-1	-83	66
0	190	203
1	116	-128
2	-86	-22
3	-86	17
10 -3		
3	106	-75
2	-82	-36
1	134	-146
0	172	175
-1	164	165
-2	626	-593
-3	624	591
-4	268	-214
-5	-81	-26
-6	-83	106
-7	132	98
-8	140	-107
-9	-86	47
10 -2		
-9	195	-206
-8	100	-54
-7	98	86
-6	115	-49
-5	182	158
-4	305	-299
-3	279	263
-2	120	-34
-1	136	-165
0	112	121
1	255	248
2	494	-523
10 -1		
0	267	-266
-1	123	135
-2	119	-100
-3	-77	31
-4	221	183
-5	484	-477
-6	405	395
-7	-81	8
-8	118	-145
-9	-84	32
10 0		
-8	192	167
-7	548	-556
-6	701	708
-5	426	-445
-4	-79	-57
-3	-79	44
-2	110	96
-1	155	-136
11 -2		
-2	128	-130
-3	-80	-36
-4	332	322
-5	211	-193
-6	134	98
-7	-84	-52
11 -3		
-7	137	-104
-6	164	161
-5	408	-422
-4	714	690
-3	647	-638
-2	-79	36
11 -4		
1	-86	75
0	129	-137
-1	114	104
-2	-81	65
-3	350	-319
-4	187	118
-5	-86	91
-6	-85	45
-7	256	-262
11 -5		
-7	434	-477
-6	178	216
-5	-83	66
-4	-81	-94
-3	-79	5
-2	292	-304
-1	508	604
0	344	-391
1	-91	79
11 -6		
2	-91	23
1	405	402
0	678	-653
-1	450	432
-2	-81	15
-3	-79	-74
-4	120	-123
-5	216	239
-6	-83	-38
11 -7		
-5	434	408
-4	368	-367
-3	-80	50
-2	267	287
-1	200	-195
0	-88	-33
1	144	145
11 -8		
1	107	-127
0	-85	-25
-1	139	-137
-2	83	-21
-3	211	213

[a] The data are separated into groups having the common values of h and k listed above each one. Within each group the three columns list l, $|F_o|$, and F_c. Unobserved reflections are indicated by a negative F_o.

TABLE II

FINAL POSITIONAL AND THERMAL PARAMETERS[a] FOR $Rh(CO)Cl((C_6H_5)_2AsCH_2As(C_6H_5)_2)_2Rh(CO)Cl$

Atom[b]	x	y	z	B_{11}[c]	B_{22}	B_{33}	B_{12}	B_{13}	B_{23}
Rh	0.52789 (7)	0.86905 (8)	0.54428 (6)	5.85 (7)	5.64 (8)	4.32 (5)	5.0 (1)	3.8 (1)	5.1 (1)
As_1	0.31977 (9)	0.66271 (9)	0.38024 (8)	4.89 (9)	3.96 (9)	3.93 (7)	4.1 (1)	3.4 (1)	4.3 (1)
As_2	0.27118 (9)	0.91780 (9)	0.29176 (8)	4.97 (9)	4.69 (9)	3.38 (7)	4.5 (1)	2.4 (1)	4.6 (1)
Cl	0.6722 (3)	0.9569 (3)	0.4340 (2)	9.8 (2)	9.6 (3)	7.6 (2)	9.7 (4)	8.5 (4)	9.2 (4)

Atom	x	y	z	B, Å²	Atom	x	y	z	B, Å²
C_5	0.3467 (9)	0.5667 (10)	0.2502 (8)	2.4 (2)	C_{19}	0.3263 (12)	0.7599 (14)	−0.0535 (11)	5.1 (3)
C_6	0.2942 (9)	0.8577 (10)	0.1488 (8)	2.1 (2)	C_{20}	0.1877 (10)	0.7315 (13)	−0.0587 (11)	4.9 (3)
C_7	0.1952 (8)	0.4781 (9)	0.4098 (8)	2.0 (2)	C_{21}	0.1756 (10)	0.7841 (11)	0.0443 (9)	3.2 (2)
C_8	0.1089 (9)	0.9376 (10)	0.2425 (8)	2.3 (2)	C_{22}	0.2586 (11)	0.3999 (11)	0.4492 (9)	3.2 (2)
C_9	0.1818 (9)	0.7205 (10)	0.3188 (8)	2.2 (2)	C_{23}	0.1736 (10)	0.2664 (12)	0.4761 (10)	3.8 (3)
C_{10}	0.4335 (10)	0.7896 (12)	0.6343 (9)	3.5 (2)	C_{24}	0.0310 (10)	0.2134 (11)	0.4601 (9)	3.4 (2)
O	0.3741 (8)	0.7352 (9)	0.6867 (7)	4.9 (2)	C_{25}	−0.0330 (9)	0.2891 (11)	0.4187 (9)	3.3 (2)
C_{12}	0.4679 (11)	0.5627 (12)	0.2708 (10)	3.9 (3)	C_{26}	0.0523 (9)	0.4240 (10)	0.3942 (8)	2.5 (2)
C_{13}	0.4845 (13)	0.4779 (15)	0.1786 (12)	5.4 (3)	C_{27}	0.1221 (10)	1.0469 (11)	0.1880 (9)	3.4 (2)
C_{14}	0.3789 (13)	0.4037 (14)	0.0717 (11)	5.2 (3)	C_{28}	0.0128 (12)	1.0711 (14)	0.1517 (11)	5.0 (3)
C_{15}	0.2532 (12)	0.4093 (13)	0.0483 (11)	4.8 (3)	C_{29}	−0.1171 (12)	0.9821 (13)	0.1758 (11)	4.8 (3)
C_{16}	0.2362 (11)	0.4886 (12)	0.1394 (9)	3.6 (2)	C_{30}	−0.1308 (11)	0.8758 (12)	0.2317 (10)	3.9 (3)
C_{17}	0.4254 (10)	0.8815 (11)	0.1508 (9)	3.4 (2)	C_{31}	−0.0186 (10)	0.8513 (11)	0.2651 (9)	3.2 (2)
C_{18}	0.4396 (12)	0.8301 (13)	0.0469 (11)	4.6 (3)					

[a] The standard deviations of the least significant figure(s) are given in parentheses here, in other tables and figures, and in the text. [b] The atom labeling conforms to that shown in Figure 1. [c] Anisotropic thermal parameters (×10³). The form of the ellipsoid is that given in the text.

intermolecular metal–metal interactions occur in $[Rh(CO)_2Cl]_2$ (Rh–Rh = 3.31 Å),[21] $Rh(CO)_2(CH_3CO)_2CH$ (Rh–Rh = 3.27 (1), 3.26 (1) Å),[23] and $Rh(CO)_2(CF_3CO)_2CH$ (Rh–Rh = 3.34 (1) Å).[23] This last value is only marginally shorter than that found in this work so, while it is unlikely that there is significant metal–metal interaction here, it cannot be completely ruled out. Thus each rhodium atom should best be considered to be effectively five-coordinate. In view of the As_1–Rh–As_2' angle of 176.88 (4)° and particularly the As_1–C_9–As_2 angle of 113.5 (4)°, it appears that the relatively short "bite" of the diarsine ligand is the major factor responsible for the close approach of the rhodium atoms.

The Rh–Cl distance of 2.372 (3) Å is comparable to those found in similar complexes of elements in the

(23) N. A. Bailey, E. Coates, G. B. Robertson, F. Bonati, and R. Ugo, *Chem. Commun.*, 1041 (1967).

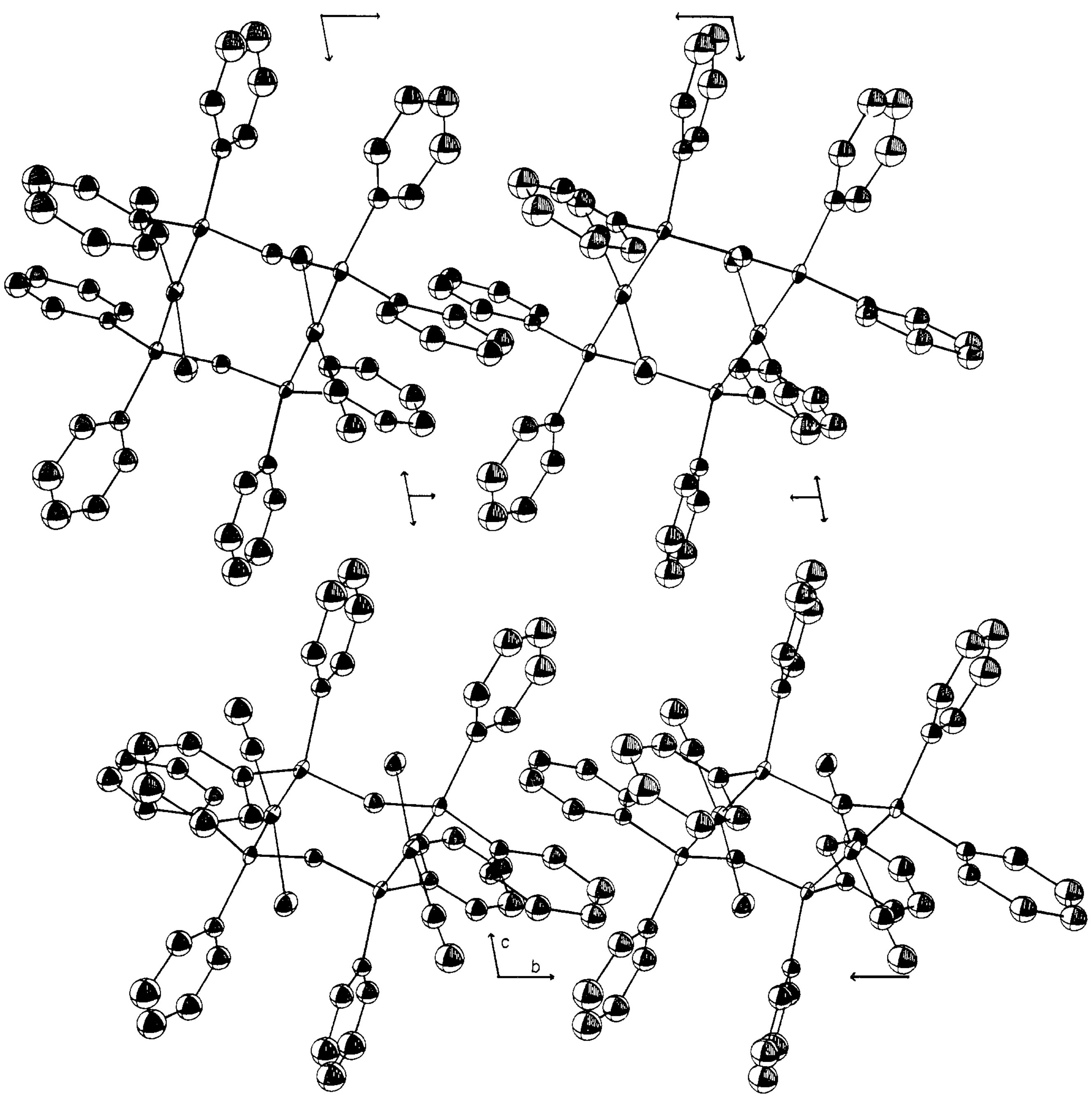

Figure 2.—A projection of four neighboring dimers upon {100} showing the molecular packing.

latter part of the second transition series, *viz.*, Rh–Cl (2.386 (3) Å) in $Rh(CS)Cl(P(C_6H_5)_3)_2$,[24] Pd–Cl (2.33 (4) Å) in $[Pd(TPAS)Cl]ClO_4$ (TPAS = *o*-phenylenebis(*o*-dimethylarsinophenylmethylarsine)),[25] and Ru–Cl (2.388 (8) Å) in $RuCl_2(P(C_6H_5)_3)_3$.[26] The two independent Rh–As distances (Figure 1) are different to an extent which is only barely significant and therefore probably not meaningful. They can be compared to those found in similar instances, *viz.*, Pd–As (2.408 (7), 2.375 (7) Å) in $[Pd(TPAS)Cl]ClO_4$[25] and Ru–As (2.308 (5), 2.398 (5), 2.468 (5) Å) in $Ru(QAS)Br_2$ (QAS = tris(*o*-diphenylarsinophenylarsine)).[27] The As_1–C_9 and As_2–C_9 distances (Figure 1) are also different to a barely significant extent ($\Delta/\sigma \sim 3$) but since C_9 lies in the vicinity of some of the anomalies about the arsenic atoms, its position may be somewhat affected by this so we do not attach any significance to this difference in bond lengths. Finally, the Rh–C_{10} and C_{10}–O distances (Figure 1) are in the ranges found previously for a variety of terminal carbonyl groups bound to transition metals.[23,24,28-30] The slight distortion of the Rh–C_{10}–O moiety from linearity is not significant but is in the direction expected from the intramolecular contacts (*vide infra*).

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[24] J. L. DeBoer, D. Rogers, A. C. Skapski, and P. G. H. Troughton, *Chem. Commun.*, 756 (1966).

[25] T. L. Blundell and H. M. Powell, *J. Chem. Soc.*, *A*, 1650 (1967).

[26] S. J. La Placa and J. A. Ibers, *Inorg. Chem.*, **4**, 778 (1965).

[27] R. H. B. Mais and H. M. Powell, *J. Chem. Soc.*, 7471 (1965).

[28] F. Calderazzo, R. Ercoli, and G. Natta in "Organic Syntheses *via* Metal Carbonyls," Vol. 1, I. Wender and P. Pino Ed., Interscience Publishers, New York, N. Y., 1968, p 47.

[29] S. J. La Placa and J. A. Ibers, *Acta Cryst.*, **18**, 511 (1965).

[30] R. Mason and A. I. M. Rae, *J. Chem. Soc.*, *A*, 778 (1968).

TABLE III

WEIGHTED LEAST-SQUARES PLANES THROUGH THE DIMER[a]

Atoms	Plane no.	A	B	C	D
Rh, As_1, As_2, Cl, C_{10}, O	1	−0.346	0.932	−0.109	2.954
Rh, Rh′, Cl, C_{10}, O	2	−0.492	−0.288	−0.821	−7.996
Rh, Rh′, As_1, As_1', As_2, As_2'	3	0.845	−0.140	−0.516	−1.665

	Distances of Atoms from Planes, Å		
	Plane no.		
Atom	1	2	3
Rh	0.011 (1)	0.009 (1)	0.022 (1)
Rh′		−0.001 (1)	−0.022 (1)
As_1	0.074 (1)		−0.015 (1)
As_1'			0.015 (1)
As_2			0.015 (1)
As_2'	0.077 (1)		−0.015 (1)
Cl	−0.166 (3)	−0.010 (3)	
C_{10}	−0.122 (14)	−0.022 (14)	
O	−0.235 (12)	−0.009 (12)	

[a] The equations of the planes are of the form $AX + BY + CZ - D = 0$ where X, Y, and Z are orthogonal coordinates (in Å). The transformations from the fractional triclinic coordinates (x, y, z) are: $X = ax \sin \gamma + cz (\cos \beta - \cos \alpha \cos \gamma)/\sin \gamma$; $Y = ax \cos \gamma + by + cz \cos \alpha$; $Z = cz (1 - \cos^2 \alpha - \cos^2 \beta - \cos^2 \gamma + 2 \cos \alpha \cos \beta \cos \gamma)^{1/2}$.

The C–C distances within the phenyl rings range from 1.465 (16) (C_{27}–C_{28}) to 1.350 (17) Å (C_{18}–C_{19}) with the average value being 1.404 (15) Å. The root-mean-square deviation of an individual value from the mean is 0.026 Å indicating a slight underestimation of the standard deviations by the least-squares refinement process. The average C–C–C angle is 120.0 (9)° with the individual values ranging from 117.3 to 122.0°. In addition the rings are planar within experimental error ($\sigma_{\text{plane}} = 0.02$ Å) no atom being more than 0.02 Å from the best plane through the ring.

Although there are no unusually short nonbonded contacts in this structure, there are sufficient interactions of the phenyl rings containing C_5 and C_6 with each other and with the adjacent chlorine atom and carbonyl group to render the major portion of the molecule quite rigid. Using the calculated positions of the hydrogen atoms on C_{17} and C_{12} (hereafter called H_{17} and H_{12}) assuming a C–H distance of 1.08 Å, the following intramolecular contacts are found: H_{17}---Cl, 2.7 Å; H_{17}---C_{10}', 2.8 Å; H_{17}---O′, 2.9 Å. In addition, the C_{16}---C_{17} contact is 3.57 Å and that for H_{12}---Cl is 3.5 Å. The only intermolecular contacts of possible significance are those between C_{24} and the atoms C_{29} and C_{30} in the adjacent molecule at ($1 - x$, $2 - y$, $-z$) which are found to be 3.4 Å.

An examination of the data in Table III shows that the coordination about the rhodium (excluding the apical metal atom) is not rigorously planar. The rhodium atom is approximately in the "basal plane" (no. 1) while the arsenic atoms are ~0.07 Å from this plane toward the center of the molecule and the chlorine atom and the carbonyl group are considerably bent away. A similar distortion of the coordinated atoms alternately above and below the best plane has been found in $Rh(CS)Cl(P(C_6H_5)_3)_2$ but in the latter it is not nearly as pronounced. The displacement of the arsenic atoms toward the center of the molecule provides further evidence for the short "bite" of the ligand being mainly responsible for the close approach of the rhodium atoms, while the marked bending back of the chlorine atom and the carbonyl groups is largely due to the close contacts with H_{17}. The heavy-atom skeleton is very nearly planar (plane 3) with the small displacements of the atoms (~0.02 Å) from this plane being in the direction of a "chair" conformation. This slight buckling is probably to relieve the strain occasioned by the above-mentioned contacts as well as the As_2---Cl contact of 3.3 Å. Finally, C_9 is ~0.6 Å from the plane of the heavy atoms as expected from the approximately tetrahedral coordination about the arsenic atoms.

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