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The Structure of a Dinuclear Complex of Osmium(I) with a Metal-to-Metal Single Bond: Bis-(μ-acetato)hexacarbonyldiosmium

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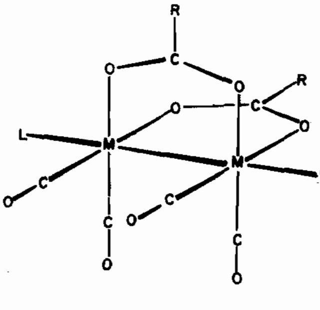
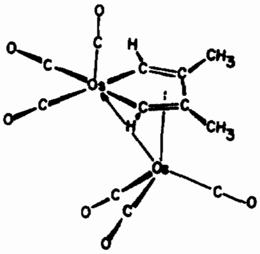
The crystal and molecular structure of bis–(μ–acetato)-hexacarbonyldiosmium, $(CH_3CO_2)_2Os_2(CO)_6$, has been determined from the intensities of 3919 independent reflections measured with a counter diffractometer. The compound crystallizes in the monoclinic space group $P2_1/c$ with eight molecules in a unit cell of dimensions $a = 7.767(6)$, $b = 28.347(14)$, $c = 14.600(6)$ A and $\beta = 103.16(2)$; $\rho_{obs} = 2.83$ and $\rho_{calcd} = 2.816$ g/ml. The structure was solved by Patterson and Fourier methods and refined by least squares to a conventional R factor of 9.2% and a weighted R of 8.9%. The crystal structure is composed of dinuclear molecular units with no crystallographically imposed symmetry. The two independent molecules are identical within their estimated standard deviations and each has approximately C_{2v} symmetry with cisoid bridging acetate groups. The coordination about each osmium atom is roughly octahedral and the Os–Os distance is 2.731(2) A.

Introduction

Crooks, *et al.*,[1] have recently published the synthesis of a series of polynuclear carboxylate complexes of ruthenium and osmium carbonyls. On the basis of mass spectral, NMR and IR evidence, they have postulated dinuclear molecules, I and II, of C_{2v} symmetry. The crystal structure of one of these compounds, $(CH_3CO)_2Ru_2(CO)_4(C_5H_5N)_2$, has been determined by B. T. Kilbourn.[2] It has the postulated C_{2v} structure, II. The planes of the pyridine rings are found to be perpendicular to the mirror plane containing the Ru atoms. We report here the crystal structure of bis–(μ–acetato)hexacarbonyldiosmium, the molecules of which have a structure of type I.



I, L=CO
II, L=py



III

The only structures published to date that contain osmium-osmium single bonds are $Os_3(CO)_{12}$[3] and $C_6H_8Os_2(CO)_6$[4] (with the structure III), although it has been reported[5] that $(h^5\text{–}C_5H_5)_2Os_2(CO)_4$ is under study. On the basis of the inert gas formalism, $(CH_3CO_2)_2Os_2(CO)_6$, which contains osmium(I) would be expected to have an osmium-osmium single bond. One objective of this investigation was to determine accurately the length of that bond, thereby making a contribution to the store of information on the lengths of metal-metal bonds of various orders. Another reason for our interest in this structure was to use it in a broader study of the interpretation of intra- and intermolecular vibrational coupling constants in metal carbonyl molecules.

Experimental Section

Well formed, clear, white crystals of $(CH_3CO_2)_2Os_2(CO)_6$ were kindly supplied by Professor J. Lewis and Dr. B.F.G. Johnson. Precession films of the $h0\ell$ and $h1\ell$ levels and Weissenberg films of the $0k\ell$ and $1k\ell$ levels showed the crystal to be monoclinic with systematic absences along $0k0$ for $k = 2n+1$ and in the $h0\ell$ zone for $\ell = 2n+1$ conforming to the space group $P2_1/c$ (C^5_{2h}, No. 14). Unit cell dimensions were determined using Mo Kα radiation ($\lambda = 0.7107$ A) on a General Electric XRD-6 automated diffractometer by least squares refinement[6] of the accurately measured angular settings of 36 reflec-

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(1) G.R. Crooks, B.F.G. Johnson, J. Lewis, I.G. Williams, and G. Gamlen, *J. Chem. Soc.* (A), 2761 (1969).
(2) B.T. Kilbourn, unpublished results, privately communicated.
(3) E.R. Corey and L. F. Dahl, *Inorg. Chem.*, 1, 251 (1962).
(4) R.P. Dodge, O.S. Mills, and V. Schomaker, *Proc. Chem. Soc.*, 380 (1963).
(5) R.D. Fisher, A. Vogler, and K. Noack, *J. Organometal. Chem.*, 7, 135 (1967).

tions. The dimensions are: a=7.767(6), b=28.347 (14), c=14.600(6) A, and $\beta=103.16(2)°$.[7] The density was measured by flotation in a thallous formate to be $\rho_o=2.83(3)$ g/ml. The calculated density, ρ_o, is 2.816 g/ml for Z=8. With Z=8 there are two independent dinuclear molecules in the asymmetric unit and no crystallographic symmetry is imposed on either.

A capped prismatic crystal of approximate dimensions 0.125 mm by 0.16 mm by 0.12 mm was mounted on a General Electric XRD-6 automated diffractometer with the $4\ 12\ \bar{1}$ vector coincident with the Φ axis. Intensities were measured with a scintillation counter using Ni-filtered Cu Kα radiation with a take off angle of 2°. The pulse height discriminator was set to receive 95% of the Cu Kα peak. Scans were of the θ–2θ type with a scan rate of 2°/min. The angular width of the scans varied as a function of the separation between the α_1 and α_2 reflections and included the region from 0.6° below the Kα_1 peak to 0.6° above the Kα_2 peak for each reflection. Backgrounds were estimated by counting for 20 seconds at each end of the scan. The intensities of 4508 independent reflections within the sphere bounded by $2\theta=110°$ were collected. Of these, 59 of the last 500 reflections collected were rejected because of an instrumental malfunction. There were 547 reflections which had an intensity, $I = P - B_1 - B_2$ where P is the peak count and B_1 and B_2 are the scaled background counts, less than $\frac{1}{2}\sigma_I$, $\sigma_I = (P+B_1+B_2)^{1/2}$ Their intensities were set equal to $\frac{1}{2}\sigma_I$. Four reflections were remeasured at intervals of 75 reflections throughout the data collection as a check on instrumental and crystal stability. A slight decrease in intensity with time was linear and did not differ statistically for the four reflections within the limits of counting statistics, σ_I, and a five percent machine error, derived from the scatter of the standard reflections about the least squares line through them. The crystal alignment was checked midway through the data collection process and it had not shifted significantly. The most probable cause of this decrease is slow crystal decomposition, a supposition supported by the observation of clouding in the crystal after the completion of data collection.

The corrected intensities were used to calculate structure factor amplitudes, $|F_o|$, and their standard deviations, σ_F. The quantities are defined by the expressions

$$|F_o| = (I/Lp)^{1/2}$$

$$\sigma_F = [\sigma_I^2 + (0.05I)^2]^{1/2}/(2Lp|F_o|)$$

in which Lp represents the Lorentz-polarization correction. Because of the large linear absorption coefficient, $\mu=309.6$ cm^{-1}, the ten crystal faces were measured both on the diffractometer and under a stereoscopic microscope with a calibrated eye piece (max. resolution 0.01 mm) and an absorption correction applied. Transmission factors varied from 0.057 to 0.157.

Atomic scattering factors for osmium(I) were those of Thomas and Umeda[8] and for carbon and oxygen were those of Cromer and Waber.[9] All were corrected for the real and imaginary part of the anomalous dispersion using the values of Cromer and Liberman.[10]

The positions of the four independent osmium atoms were located from a three-dimensional map of the Patterson function. Least squares refinement of the osmium atoms gave $R_1=\Sigma\,||F_o|-|F_c||/\Sigma\,|F_o| = 0.331$ and $R_2=[\Sigma w_F ||F_o|-|F_c||^2/\Sigma w_F |F_o|^2]^{1/2}=0.305$ where the weights $w_F=\sigma_F^{-2}$. Anisotropic thermal parameters were refined for the osmium atoms, a difference Fourier was computed and the positions of the remaining 40 non-hydrogen atoms were determined. Diagonal refinement of these 44 atoms gave $R_1=0.116$ and $R_2=0.119$. Zachariasen's betas[11] were calculated for the 362 most intense reflections and the last 530 reflections measured were rejected because of an intermittent machine error. Full matrix least squares refinement was then continued using the 3919 remaining reflections and assigning anisotropic thermal parameters to the osmium atoms only, until all parameter shifts were less than half their e.s.d.'s except for the secondary extinction parameter which was just slightly less than its e.s.d. The magnitude of the structure factor of the most intense reflection was reduced by a factor of 0.47 by secondary extinction.

The final R values were: $R_1=0.092$ and $R_2=0.089$. The factors limiting this refinement are probably the accuracy of the absorption correction or the possibility of anisotropic secondary extinction. It also seems likely that if refinement were to be continued with anisotropic thermal parameters for all non-hydrogen atoms much lower R values could be reached, without any real change in the structure or improvement in accuracy. The e.s.d. of an observation of unit weight is 2.218 and the quantity $w_F\,||F_o|-|F_c||^2$ did not vary systematically with either $|F_o|$ or $\sin\theta/\lambda$. A difference Fourier synthesis was computed using the final parameters. The largest peak, in the vicinity of one of the osmium atoms, was 1.39 electrons/A^3. The standard deviation in electron density was 0.3 e/A^3. Distances and angles were calculated and their e.s.d.'s include all correlations between unit cell constants and all correlations between atomic positions greater than 0.1.

Results

Table I is a list of the final values of $|F_c|$ and $|F|_o$ scaled to F_c. Fractional atomic coordinates and thermal parameters are given in Table II. Significant intramolecular distances and angles and their averages are given in Tables III-V. Figures 1 and 2 show two perspective views of the molecule and Figure 3 illu-

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(6) Computer programs used in the structure determination include: PICK2 (J. A. Ibers), for refining cell constants and generating diffractometer settings; DIFDAR (A.S. Parks), for data reduction; ABSCOR (N.W. Alcock, B. Lee, and V. Day), for the absorption correction (with secondary extinction corrections added locally); FORDAP (A. Zalkin) for Patterson and Fourier syntheses; SFIX (a local revision of C.T. Prewitt's SFLS-5) for full-matrix least squares refinement minimizing $w_F||F_o|-|F_c||^2$; SDIAG (a locally modified version of SFLS-5) for diagonal least squares refinement; ORTEP (C.K. Johnson), for figures; STANI (B.G. DeBoer) for computing distances and angles.

(7) The values in parentheses are the estimated standard deviations in units of the last significant figure.

(8) L.H. Thomas and K. Umeda, *J. Chem. Phys.*, *26*, 239 (1957).

(9) D.T. Cromer and J.T. Waber, *Acta Cryst.*, *18*, 104 (1965).

(10) D.T. Cromer and D. Liberman, *J. Chem. Phys.*, *53*, 1891 (1970).

(11) W.R. Zachariasen, *Acta Cryst.*, *16*, 1139 (1963).

Table I. Calculated and Observed Structure Factors (× 5).

K	L	FOBS	FCAL
H = 0*			
0	2	3749	4343
0	4	446	444
0	6	926	963
0	8	1329	1413
0	10	731	799
0	12	145	169
0	14	22	11
1	1	36	5
1	2	742	760
1	3	83	51
1	4	74	36
1	5	84	48
1	6	554	579
1	7	19	48
1	8	1272	1264
1	9	148	119
1	10	859	909
1	11	71	80
1	12	215	226
1	13	67	32
1	14	188	172
1	15	22	28
2	0	72	7
2	1	1012	1040
2	2	146	149
2	3	667	587
2	4	112	22
2	5	155	122
2	6	253	266
2	7	402	411
2	8	1009	1014
2	9	272	241
2	10	1060	1128
2	11	101	74
2	12	442	414
2	13	22	33
2	14	283	294
2	15	22	2
3	1	86	38
3	2	704	707
3	3	57	60
3	4	60	34
3	5	54	25
3	6	662	663
3	7	395	366
3	8	1236	1215
3	9	349	373
3	10	887	891
3	11	73	113
3	12	200	194
3	13	22	21
3	14	151	133
3	15	58	50
4	0	5209	5765
4	1	16	24
4	2	3749	3435
4	3	99	69
4	4	314	294
4	5	131	122
4	6	1318	1343
4	7	350	344
4	8	1417	1391
4	9	405	449
4	10	670	662
4	11	209	198
4	12	119	150
4	13	22	53
4	14	23	23
4	15	195	198
5	1	69	47
5	2	550	517
5	3	18	42
5	4	205	170
5	5	168	184
5	6	726	709
5	7	407	464
5	8	1082	1099
5	9	477	461
5	10	754	750
5	11	234	225
5	12	126	149
5	13	68	39
5	14	188	163
6	0	21	19
6	1	1700	1559
6	2	193	165
6	3	1213	1161
6	4	240	215
6	5	86	20
6	6	287	278
6	7	706	685
6	8	734	755
6	9	609	643
6	10	880	914
6	11	244	250
6	12	371	411
6	13	22	46
6	14	241	234
7	1	61	34
7	2	519	495
7	3	132	111
7	4	309	316
7	5	366	348
7	6	443	631
7	7	462	442
7	8	1073	1061
7	9	538	538
7	10	690	721
7	11	232	256
7	12	130	112
7	13	32	8
7	14	195	199
8	0	2744	2675
8	1	63	27
8	2	1729	1527
8	3	82	84
8	4	120	26
8	5	288	283
12	8	1025	957
12	9	744	767
12	10	212	222
12	11	377	435
12	12	94	106
12	13	58	13
13	1	53	41
13	2	413	406
13	3	133	158
13	4	339	314
13	5	413	357
13	6	246	225
13	7	886	835
13	8	582	560
13	9	695	707
13	10	247	250
13	11	307	337
13	12	92	39
13	13	63	39
14	0	69	47
14	1	2632	2847
14	2	102	123
14	3	1318	1254
14	4	283	233
14	5	470	446
14	6	166	171
14	7	1007	1027
14	8	261	219
14	9	721	749
14	10	339	392
14	11	241	304
14	12	178	204
14	13	52	60
15	1	144	136
15	2	527	534
15	3	158	149
15	4	419	379
15	5	317	299
15	6	134	84
15	7	742	725
15	8	326	319
15	9	619	651
15	10	146	175
15	11	253	312
15	12	58	71
15	13	45	14
16	0	694	753
16	1	158	167
16	2	483	439
16	3	65	64
16	4	320	292
16	5	167	157
16	6	613	631
16	7	553	518
16	8	284	333
16	9	673	715
16	10	24	40
16	11	408	469
16	12	161	145
17	1	166	150
17	2	393	359
17	3	140	171
17	4	295	296
17	5	234	226
17	6	94	3
17	7	614	603
17	8	93	89
17	9	565	609
17	10	22	28
17	11	289	314
17	12	131	108
18	0	48	7
18	1	2175	2354
18	2	78	70
18	3	930	984
18	4	268	277
18	5	415	401
18	6	269	282
18	7	781	755
18	8	138	130
18	9	584	616
18	10	24	101
18	11	253	247
18	12	111	142
19	1	190	90
19	2	369	405
19	3	171	185
19	4	398	417
19	5	114	131
19	6	168	130
19	7	418	440
19	8	23	10
19	9	413	429
19	10	23	7
19	11	227	219
20	0	234	290
20	1	132	159
20	2	132	109
20	3	146	157
20	4	398	399
20	5	65	10
20	6	125	137
20	7	256	269
20	8	71	9
20	9	448	487
20	10	114	113
20	11	375	408
21	1	77	114
21	2	239	259
21	3	255	254
21	4	225	231
21	5	23	7
21	6	133	126
21	7	349	345
21	8	102	69
21	9	416	439
21	10	22	45
22	0	98	46
22	1	1355	1486
30	0	129	121
30	1	310	340
H = 1*			
0	-14	1019	1041
0	-12	532	521
0	-10	599	609
0	-8	1329	1366
0	-6	1176	1225
0	-4	722	733
0	-2	147	115
0	0	199	234
0	2	67	11
0	4	79	102
0	6	145	124
0	8	141	151
0	10	528	559
0	12	675	682
0	12	664	682
0	14	238	285
1	-15	22	68
1	-14	211	170
1	-13	24	91
1	-12	175	222
1	-11	22	8
1	-10	209	213
1	-9	217	201
1	-8	950	966
1	-7	245	254
1	-6	1559	1587
1	-5	181	206
1	-4	1122	1167
1	-3	308	303
1	-2	395	579
1	-1	236	218
1	0	922	1212
1	1	288	545
1	2	293	346
1	3	276	264
1	4	135	177
1	5	40	75
1	6	51	73
1	7	44	29
1	8	513	518
1	9	78	16
1	10	876	918
1	11	91	66
1	12	642	642
1	12	635	642
1	13	25	41
1	14	141	123
2	-15	153	137
2	-14	54	18
2	-13	113	123
2	-12	23	17
2	-11	83	8
2	-10	114	100
2	-9	269	285
2	-8	646	640
2	-7	18	43
2	-6	1710	1740
2	-5	44	29
2	-4	1642	1548
2	-3	285	313
2	-2	776	769
2	-1	68	49
2	0	3285	4137
2	1	15	14
2	2	3955	4564
2	3	61	35
2	4	1652	1770
2	5	17	19
2	6	158	167
2	7	49	23
2	8	1014	1047
2	9	126	95
2	10	1407	1328
2	11	92	66
2	12	649	654
2	12	642	634
2	13	25	73
2	14	23	111
3	-15	91	99
3	-14	142	116
3	-13	144	103
3	-12	216	222
3	-11	119	95
3	-10	140	154
3	-9	239	211
3	-8	961	1002
3	-7	19	32
3	-6	1700	1757
3	-5	165	124
3	-4	868	981
3	-3	452	494
3	-2	303	312
3	-1	208	187
3	0	786	947
3	1	221	258
3	2	249	272
3	3	77	90
3	4	299	302
3	5	100	91
3	6	106	69
3	7	148	130
3	8	488	462
3	9	278	263
3	10	901	899
3	11	246	243
3	12	569	614
3	12	566	614
3	13	77	134
3	14	73	104
4	-15	68	8
4	-14	939	936
4	-13	74	36
4	-12	459	449
4	-11	93	92
4	-10	578	568
4	-9	360	362
6	-10	106	81
6	-9	533	519
6	-8	777	731
6	-7	760	785
6	-6	1628	1650
6	-5	789	832
6	-4	1184	1247
6	-3	239	267
6	-2	321	370
6	-1	35	65
6	0	2350	2223
6	1	17	18
6	2	5156	5555
6	3	58	61
6	4	2478	2598
6	5	84	65
6	6	49	25
6	7	77	78
6	8	957	950
6	9	242	265
6	10	1075	1053
6	11	284	303
6	12	397	426
6	12	424	426
6	13	181	177
6	14	22	20
7	-14	99	65
7	-13	84	64
7	-12	209	189
7	-11	139	117
7	-10	222	145
7	-9	416	429
7	-8	850	890
7	-7	638	673
7	-6	1365	1413
7	-5	687	708
7	-4	551	591
7	-3	253	286
7	-2	83	30
7	-1	112	31
7	0	637	597
7	1	306	279
7	2	321	280
7	3	82	62
7	4	615	603
7	5	77	55
7	6	229	193
7	7	240	224
7	8	437	410
7	9	423	436
7	10	678	680
7	11	397	410
7	12	571	415
7	13	204	216
7	14	99	73
8	-14	655	650
8	-13	67	31
8	-12	326	331
8	-11	138	138
8	-10	606	606
8	-9	438	422
8	-8	1407	1461
8	-7	909	939
8	-6	1256	1303
8	-5	974	1011
8	-4	218	211
8	-3	182	225
8	-2	83	55
8	-1	788	625
8	0	151	142
8	1	2431	2264
8	2	134	77
8	3	3261	3018
8	4	135	138
8	5	1385	1283
8	6	172	123
8	7	316	299
8	8	46	39
8	9	597	590
8	10	358	327
8	11	415	399
8	12	373	394
8	13	176	190
9	-14	144	185
9	-13	137	92
9	-12	275	240
9	-11	121	89
9	-10	177	174
9	-9	591	667
9	-8	997	1006
9	-7	1212	1223
9	-6	1392	1412
9	-5	1153	1167
9	-4	607	655
9	-3	278	309
9	-2	138	118
9	-1	134	146
9	0	686	662
9	1	377	352
9	2	515	490
9	3	396	396
9	4	288	313
9	5	204	202
9	6	240	243
9	7	236	214
9	8	301	269
9	9	390	395
9	10	469	471
9	11	346	354
9	12	244	275
9	13	158	143
10	-14	66	21
10	-13	528	509
10	-12	24	30
10	-11	95	79
10	-10	22	10
10	-9	726	728
10	-8	502	496
10	-7	1356	1349
12	-2	243	251
12	-1	1362	1362
12	0	126	123
12	1	2433	2519
12	2	85	58
12	3	2554	2335
12	4	93	77
12	5	1222	1167
12	6	259	254
12	7	272	220
12	8	118	88
12	9	697	702
12	10	182	133
12	11	542	560
12	12	258	242
12	13	253	250
13	-13	141	124
13	-12	268	272
13	-11	93	33
13	-10	24	17
13	-9	531	535
13	-8	649	660
13	-7	1000	968
13	-6	695	744
13	-5	884	907
13	-4	219	241
13	-3	303	313
13	-2	360	370
13	-1	320	305
13	0	573	602
13	1	555	318
13	2	255	269
13	3	260	277
13	4	289	263
13	5	54	37
13	6	348	354
13	7	276	229
13	8	23	37
13	9	407	438
13	10	187	190
13	11	412	373
13	12	121	129
13	13	182	179
14	-13	468	487
14	-12	144	115
14	-11	125	91
14	-10	151	129
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Table I. (Continued)

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2	-9	23	18
2	-8	61	48
2	-7	25	61
2	-6	130	95
2	-5	115	82
2	-4	115	30
2	-3	125	84
2	-2	115	51
2	-1	49	81
2	0	117	12
2	1	24	37
2	2	100	132
2	3	23	45
2	4	136	129
3	-10	294	374
3	-9	176	203
3	-8	25	20
3	-7	172	168
3	-6	362	403
3	-5	416	447
3	-4	519	585
3	-3	540	581
3	-2	404	421
3	-1	392	418
3	0	113	135
3	1	96	43
3	2	25	5
3	3	165	202
3	4	131	40
4	-10	25	30
4	-9	110	133
4	-8	25	44
4	-7	25	5
4	-6	174	189
4	-5	72	24
4	-4	479	564
4	-3	24	24
4	-2	643	673
4	-1	87	9
4	0	282	260
4	1	61	13
4	2	263	284
4	3	113	46
4	4	475	497
5	-10	167	149
5	-9	113	136
5	-8	79	74
5	-7	55	52
5	-6	115	143
5	-5	114	149
5	-4	229	269
5	-3	231	259
5	-2	135	131
5	-1	152	141
5	0	127	41
5	1	77	49
5	2	[illegible]	32
5	3	193	216
5	4	177	145
6	-10	327	239
6	-9	24	37
6	-8	25	53
6	-7	151	141
6	-6	145	60
6	-5	225	244
6	-4	132	39
6	-3	265	224
6	-2	86	55
6	-1	237	236
6	0	25	16
6	1	139	115
6	2	25	90
6	3	183	165
6	4	157	76
7	-10	413	419
7	-9	209	212
7	-8	24	44
7	-7	157	218
7	-6	424	463
7	-5	492	548
7	-4	569	622
7	-3	433	615
7	-2	435	438
7	-1	443	445
7	0	163	167
7	1	126	108
7	2	72	56
7	3	149	117
7	4	135	63
8	-9	165	231
8	-8	134	64
8	-7	93	64
8	-6	139	152
8	-5	77	52
8	-4	414	463
8	-3	92	50
8	-2	552	527
8	-1	91	5
8	0	226	231
8	1	91	15
8	2	191	167
8	3	131	66
9	-9	25	25
9	-8	24	11
9	-7	85	6
9	-6	73	54
9	-5	131	16
9	-4	91	53
9	-3	75	22
9	-2	87	63
9	-1	24	15
9	0	192	173
9	1	76	44
9	2	23	12
9	3	167	171
10	-9	152	47
10	-8	59	47
10	-7	113	105
10	-6	169	96
10	-5	278	288
10	-4	94	18
10	-3	366	450
10	-2	115	56
10	-1	295	306
10	0	48	45
10	1	58	41
10	2	23	53
10	3	281	245
11	-8	23	59
11	-7	152	169
11	-6	331	370
11	-5	449	507
11	-4	477	579
11	-3	493	556
11	-2	375	391
11	-1	327	355
11	0	23	41
11	1	105	84
11	2	161	133
12	-8	114	108
12	-7	24	42
12	-6	123	66
12	-5	25	60
12	-4	248	279
12	-3	23	42
12	-2	335	373
12	-1	73	22
12	0	174	179
12	1	22	32
12	2	131	100
13	-7	23	15
13	-6	75	7
13	-5	163	137
13	-4	146	153
13	-3	165	152
13	-2	217	249
13	-1	73	41
13	0	178	162
13	1	23	21
14	-6	109	121
14	-5	233	234
14	-4	23	3
14	-3	382	441
14	-2	23	98
14	-1	289	314
14	0	112	49
15	-5	323	347
15	-4	346	401
15	-3	307	392
15	-2	221	246
15	-1	238	226
16	-3	70	35
H = 8***			
0	-6	137	68
0	-4	80	62
0	-2	71	42
0	0	23	19
1	-7	139	176
1	-6	21	14
1	-5	158	84
1	-4	251	284
1	-3	265	329
1	-2	341	402
1	-1	343	382
1	0	251	280
2	-7	66	25
2	-6	22	21
2	-5	23	14
2	-4	106	111
2	-3	63	18
2	-2	263	309
2	-1	23	17
2	0	337	354
3	-6	55	24
3	-5	70	63
3	-4	197	221
3	-3	176	214
3	-2	226	279
3	-1	233	219
3	0	159	127
4	-6	78	48
4	-5	82	40
4	-4	115	74
4	-3	61	46
4	-2	23	43
4	-1	127	106
5	-6	57	13
5	-5	175	125
5	-4	246	286
5	-3	334	355
5	-2	390	443
5	-1	493	449
6	-5	96	7
6	-4	57	76
6	-3	33	38
6	-2	239	247
6	-1	66	28
7	-5	21	3
7	-4	99	99
7	-3	95	64
7	-2	108	98

Table II. A. Fractional Coordinates and Isotropic Temperature Factors[a]

Atom	x	y	z	B(A²)[b]
OsA1	0.6939(1)	—0.24141(3)	0.16418(7)	4.6
OsA2	0.4662(1)	—0.23329(4)	0.28082(8)	5.7
CA01	0.851 (4)	—0.2587 (10)	0.081 (2)	8.6(7)
OA01	0.947 (3)	—0.2681 (8)	0.038 (2)	11.3(7)
CA02	0.294 (5)	—0.2393 (11)	0.364 (3)	9.8(9)
OA02	0.212 (4)	—0.2466 (11)	0.411 (2)	15.5(9)
CA03	0.584 (3)	—0.1991 (8)	0.084 (2)	5.5(5)
OA03	0.516 (3)	—0.1702 (8)	0.033 (2)	10.9(6)
CA04	0.582 (3)	—0.1844 (8)	0.347 (2)	5.4(5)
OA04	0.655 (3)	—0.1520 (7)	0.385 (1)	9.0(5)
CA05	0.837 (3)	—0.1972 (8)	0.227 (2)	5.4(5)
OA05	0.935 (3)	—0.1706 (8)	0.269 (1)	9.6(5)
CA06	0.336 (3)	—0.1924 (8)	0.208 (2)	5.9(5)
OA06	0.243 (3)	—0.1667 (8)	0.157 (2)	10.8(6)
OA07	0.523 (2)	—0.2943 (5)	0.188 (1)	5.7(3)
OA10	0.353 (2)	—0.12916(6)	0.207 (1)	7.0(4)
CA07	0.394 (4)	—0.3095 (9)	0.138 (2)	6.7(6)
CA09	0.292 (4)	—0.3537 (12)	0.093 (2)	10.5(9)
OA09	0.809 (2)	—0.2941 (5)	0.256 (1)	5.8(3)
OA08	0.633 (2)	—0.2839 (6)	0.360 (1)	6.3(4)
CA08	0.755 (3)	—0.3055 (9)	0.330 (2)	7.0(5)
OA10	0.838 (4)	—0.3456 (11)	0.395 (2)	10.2(8)
OsB1	0.0956(1)	—0.01283(4)	0.19319(7)	4.9
OsB2	—0.1381(1)	—0.01324(3)	0.30759(7)	4.6
CB01	0.261 (4)	—0.0021 (9)	0.115 (2)	7.1(6)
OB01	0.354 (3)	0.0053 (7)	0.070 (1)	10.6(6)
CB02	—0.306 (4)	—0.0016 (10)	0.385 (2)	7.4(6)
OB02	—0.388 (3)	0.0080 (8)	0.436 (2)	12.2(7)
CB03	—0.010 (3)	—0.0608 (9)	0.119 (2)	6.5(6)
OB03	—0.079 (3)	—0.0936 (8)	0.076 (2)	10.5(6)
CB04	—0.027 (3)	—0.0588 (7)	0.383 (1)	4.3(4)
OB04	0.039 (3)	—0.0893 (7)	0.428 (1)	8.2(5)
CB05	0.233 (3)	—0.0539 (8)	0.268 (2)	5.6(5)
OB05	0.325 (3)	—0.0814 (8)	0.318 (2)	10.7(6)
CB06	—0.281 (3)	—0.0579 (8)	0.236 (2)	6.0(5)
OB06	—0.377 (2)	—0.0847 (7)	0.189 (1)	9.3(5)
OB09	—0.072 (2)	0.0382 (6)	0.116 (1)	6.9(4)
OB08	—0.246 (2)	0.0423 (6)	0.222 (1)	6.8(4)
CB08	—0.205 (3)	0.0564 (8)	0.148 (2)	6.2(5)
CB10	—0.320 (4)	0.0960 (11)	0.089 (2)	9.5(8)
OB10	0.024 (2)	0.0394 (5)	0.379 (4)	5.4(3)
OB07	0.199 (2)	0.0444 (5)	0.275 (1)	5.7(3)
CB07	0.156 (3)	0.0590 (8)	0.351 (2)	6.5(5)
CB09	0.249 (3)	0.1023 (9)	0.400 (2)	8.0(6)

B. Anisotropic Temperature Factors[c]

Atom	B_{11}	B_{22}	B_{33}	B_{12}	B_{13}	B_{23}
OsA1	5.231(54)	4.566(52)	4.133(48)	0.932(39)	1.340(38)	0.164(36)
OsA2	5.057(54)	5.576(58)	4.849(53)	0.426(41)	1.686(41)	—0.612(40)
OsB1	5.093(54)	5.390(57)	4.430(51)	—0.125(40)	1.302(40)	—0.555(38)
OsB2	4.967(53)	4.194(50)	4.957(52)	0.055(37)	1.532(40)	0.171(37)

[a] Numbers in parentheses are e.s.d.'s in the last figure. [b] Effective isotropic B's are given for the anisotropically refined atoms. [c] The form of the temperature-factor expression is: $\exp[-\frac{1}{4}(B_{11}h^2a^{*2}+B_{22}k^2b^{*2}+B_{33}l^2c^{*2}+2B_{12}hka^*b^*+2B_{13}hla^*c^*+2B_{23}klb^*c^*)]$.

strates the packing of the molecules in the unit cell. The two crystallographically independent molecules and all atoms therein are distinghished by the labels A and B.

Discussion

The molecular structure of $(CH_3CO_2)_2Os_2(CO)_6$ is that which Crooks, *et al.*[1] anticipated. Each of the two independent molecules has approximate C_{2v} symmetry but this is not crystallographically imposed. The various bond lengths and angles may be sorted into sets, each set containing those which would be identical if the two molecules were, rigorously, (a) identical, and (b) of perfect C_{2v} symmetry. It is then found that there is very little variance within each set. Specifically, the values in each set are within 3 e.s.d.'s or less of the average value for the set, with the exception of three types of angle: Os—Os—CO(eq), Os—Os—O(acetate) and Os—O—C(acetate). Although these deviations are statistically significant, there appears to be no pattern of distortion and the average values of these as well as all other dimensions will be used for discussion of the structure.

The overall C_{2v} molecular structure incorporates six-fold coordination about the osmium atoms with cisoid bridging acetate groups. The axial carbonyl groups are not colinear with the Os—Os bond but are

Table III. Individual Bond Distances A [a].

OsA1-OsA2	2.730(02)	CA02-OA02	1.055(46)
OsB1-OsB2	2.732(02)	CB01-OB01	1.106(31)
OsA1-CA01	1.970(32)	CB02-OB02	1.115(33)
OsA2-CA02	2.006(40)	CA03-OA03	1.148(26)
OsB1-CB01	1.926(28)	CA04-OA04	1.159(24)
OsB2-CB02	1.939(29)	CA05-OA05	1.146(26)
OsA1-CA03	1.759(23)	CA06-OA06	1.167(25)
OsA1-CA05	1.781(22)	CB03-OB03	1.179(27)
OsA2-CA04	1.804(23)	CB04-OB04	1.143(23)
OsA2-CA06	1.738(23)	CB05-OB05	1.186(26)
OsB1-CB03	1.818(26)	CB06-OB06	1.170(25)
OsB1-CB05	1.776(23)	OA07-CA07	1.330(29)
OsB2-CB04	1.782(20)	OA10-CA07	1.229(30)
OsB2-CB06	1.844(23)	OA08-CA08	1.284(27)
OsA1-OA07	2.080(14)	OA09-CA08	1.286(28)
OsA1-OA09	2.069(15)	OB07-CB07	1.291(28)
OsA2-OA08	2.097(15)	OB10-SB07	1.313(28)
OsA2-OA10	2.060(16)	OB08-CB08	1.256(26)
OsB1-OB07	2.066(15)	OB09-CB08	1.336(28)
OsB1-OB09	2.094(16)	CA07-CA09	1.550(38)
OsB2-OB08	2.066(16)	CA08-CA10	1.527(37)
OsB2-OB10	2.076(14)	CB07-CB09	1.518(33)
CA01-OA01	1.109(34)	CB08-CB10	1.562(37)

[a] Numbers in parentheses are e.s.d.'s occurring in the last significant digit.

Table IV. Selected Bond Angles.

OsA2-OsA1-CA01	170.6(9)	OB09-CB08-CB10	118(2)
OsA1-OsA2-CA02	170.2(10)	OB08-CB08-CB10	119(2)
OsB2-OsB1-CB01	171.2(8)	CA05-OsA1-OA09	92.8(8)
OsB1-OsB2-CB02	169.9(9)	CA03-OsA1-OA07	91.5(8)
OsA2-OsA1-CA03	94.4(8)	CA06-OsA2-OA10	95.3(9)
OsA2-OsA1-CA05	92.3(7)	CA04-OsA2-OA08	93.5(8)
OsA1-OsA2-CA04	94.8(7)	CB03-OsB1-OB09	93.1(9)
OsA1-OsA2-CA06	92.3(8)	CB05-OsB1-OB07	93.4(8)
OsB2-OsB1-CB03	95.2(8)	CB04-OsB2-OB10	93.4(7)
OsB2-OsB1-CB05	90.6(8)	CB06-OsB2-OB08	94.0(8)
OsB1-OsB2-CB04	94.7(7)	OA07-OsA1-OA09	84.9(6)
OsB1-OsB2-CB06	93.1(7)	OA08-OsA2-OA10	83.0(6)
OsA1-CA01-OA01	177(2)	OB07-OsB1-OB09	83.2(6)
OsA2-CA02-OA02	173(7)	OB08-OsB2-OB10	82.8(6)
OsB1-CB01-OB01	178(2)	OsA1-OA07-CA07	120(1)
OsB2-CB02-OB02	172(4)	OsA1-OA09-CA08	123(1)
OsA1-CA03-OA03	177(2)	OsA2-OA08-CA08	123(2)
OsA1-CA05-OA05	177(2)	OsA2-OA10-CA07	127(2)
OsA2-CA04-OB04	177(2)	OsB1-OB07-CB07	127(1)
OsA2-CA06-OB06	177(2)	OsB1-OB09-CB08	121(1)
OsB1-CB03-OB03	176(2)	OsB2-OB08-CB08	128(2)
OsB1-CB05-OB05	180(1)	OsB2-OB10-CB07	125(1)
OsB2-CB04-OB04	177(2)	CA01-OsA1-CA03	92(1)
OsB2-CB06-OB06	177(2)	CA01-OsA1-CA05	95(1)
OsA2-OsA1-OA07	84.6(6)	CA02-OsA2-CA04	94(1)
OsA2-OsA1-OA09	84.4(4)	CA02-OsA2-CA06	93(1)
OsA1-OsA2-OA08	83.0(5)	CB01-OsB1-CB03	92(1)
OsA1-OsA2-OA10	82.3(5)	CB01-OsB1-CB05	95(1)
OsB2-OsB1-OB07	82.7(4)	CB02-OsB2-CB04	93(1)
OsB2-OsB1-OB09	85.0(5)	CB02-OsB2-CB06	93(1)
OsB1-OsB2-OB08	82.2(5)	CA01-OsA1-OA07	88(1)
OsB1-OsB2-OB10	83.9(4)	CA01-OsA1-OA09	89(1)
OA07-CA07-OA10	125(2)	CA02-OsA2-OA08	91(1)
OA07-CA07-CA09	116(2)	CA02-OsA2-OA10	89(1)
OA10-CA07-CA09	118(2)	CB01-OsB1-OB07	90(1)
OA09-CA08-OA08	125(2)	CB01-OsB1-OB09	89(1)
OA09-CA08-CA10	112(2)	CB02-OsB2-OB08	89(1)
OA08-CA08-CA10	113(2)	CB02-OsB2-OB10	90(1)
OB07-CB07-OB10	121(2)	CA03-OsA1-CA05	91(1)
OB07-CB07-CB09	118(2)	CA04-OsA2-CA06	88(1)
OB10-CB07-CB09	121(2)	CB03-OsB1-CB05	90(1)
OB09-CB08-OB08	123(2)	CB04-OsB2-CB06	90(1)

tilted along the mirror plane toward the acetate groups.

Table V. Average Interatomic Distances and Angles [a].

Os-Os	2.731(2)	O-Os-O(acetate)	83.5(4)
Os-C(ax)	1.96(2)	C(eq)-Os-O(acetate)	93.0(5)
Os-C(eq)	1.79(1)	C(eq)-Os-C(eq)	89.7(7)
Os-O	2.076(6)	C(ax)-Os-C(eq)	93.5)
C-O(ax)	1.10(2)	C(ax)-Os-O(acetate)	89.5(4)
C-O(eq)	1.16(1)	Os-C-O(ax)	175(3)
O-C(acetate)	1.29(1)	Os-C-O(eq)	177(1)
C-CH$_3$	1.54(2)	O-C-O(acetate)	124(1)
Os-Os-C(ax)	170.5(6)	O-C-CH$_3$(acetate)	118(1)
Os-Os-C(eq)	93.4(3)	Os-O-C(acetate)	124(1)
Os-Os-O(acetate)	83.5(2)		

[a] Numbers in parentheses are rms e.s.d.'s occurring in the last significant digit.

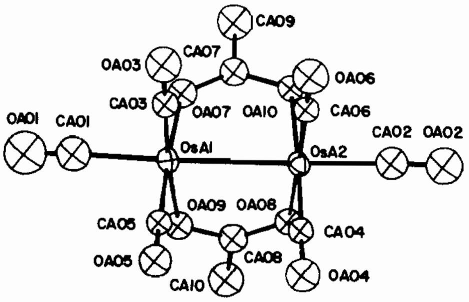

Figure 1. A view of molecule A down the C_2 axis.

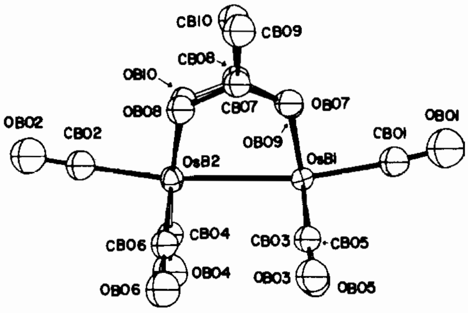

Figure 2. A view of molecule B perpendicular to the mirror plane containing the osmium atoms.

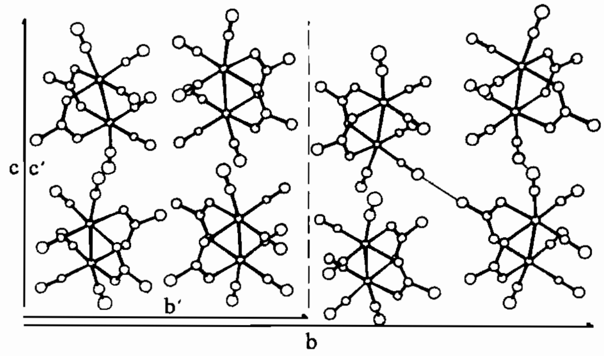

Figure 3. A projection of the contents of the unit cell on the bc plane. b and c are the lengths of the b and c axes. b' and c' are the lengths of the b and c axes in the higher space group C2/c.

The Os–Os distance of 2.731 A is consistent with a description of the bonding in this molecule which assigns 18 electrons to the valence orbitals (5d, 6s, 6p) of each osmium atom and requires an Os–Os

Table VI. Significant Dimensions in two $[M(RCO_2)(CO)_2L]_2$ Compounds.

Ru-Ru	2.678 A	Os-Os	2.731 A
Ru-C(eq)	1.84 A	Os-C(eq)	1.96 A
C-O(eq)	1.15 A	C-O(eq)	1.16 A
Normal to $Ru(CO)_2$ and Ru-Ru	6.9°	Normal to $Os(Co)_2$ and Os-Os	4.8°
OC-Ru-CO	88.56°	OC-Os-CO	89.7°
O-Ru-O	83.57°	O-Os-O	83.5°

single bond. This distance is close to that reported[4] for $C_6H_8Os_2(CO)_6$ (2.74 A) and significantly shorter than the value of 2.88 A reported[3] for $Os_3(CO)_{12}$.

The bridging acetate groups are planar and the O - - - O distance within the acetate group is 2.28 A, almost 0.5 A shorter than the Os–Os bond. This necessarily causes distortions from 90° angles in the six-fold coordination about, the osmium. The average angle between the Os–Os bond and the normals to the planes defined by O7–Os1–O9 and O8–Os2–O10 is 8.7(5)°. Similarly, the angles between the normals to the planes defined by each osmium atom and its equatorial carbonyl groups and the Os–Os bond have an average value of 4.8(5)°. The axial carbonyl groups are bent towards the acetate groups, with a mean Os–Os–C angle of 170.5°.

As expected from their chemical reactivity, the axial carbonyl groups are more weakly bound to the metal than are the equatorial ones. The average Os–C distance to equatorial carbonyl groups is 1.79 A, while that to the axial carbonyl groups is 1.96 A. The Os–C distance to the equatorial carbonyls is shorter than those found in the Os^0 compounds $Os_3(CO)_{12}$ (1.95 A)[3] and $Os(CO)_3(P(C_6H_5)_3)_2$ (1.90 and 1.93 A).[12]

This structure is very similar to that of $(CH_3CO_2)_2$-$Ru_2(CO)_4(C_5H_5N)_2$.[2] A comparison of certain dimensions is given in Table VI. There appear to be no significant differences that are not ascribable to the difference in metal and in the axial substituent. However, consequences of these two changes cannot be identified independently at this time.

The packing of the molecules in the unit cell, Figure 3, exhibits pseudosymmetry. It is as if the b axis were 14 A long instead of 28 A. If this were true, with the two-fold screw axis reducing to a simple two-fold axis, the molecule would have crystallographic C_2 symmetry. Similarly, on a glide at $y=-1/8$ or, equivalently, an inversion center at $x=1/4$, $y=-1/8$ and $z=1/4$ would relate the coordinates of molecule A to those of molecule B in Table II. The space group which would be formed if this pseudosymmetry were rigorous is I2/a, a nonstandard setting of C2/c, with a half molecule instead of two molecules as the asymmetric unit. The deviations from this more ordered array cause the closest intermolecular contacts. For example, the distances between the oxygen atoms of the axial carbonyls are 2.87 A for OB02-OB02, 3.38 A for OB01-OB01 and 3.10 A for OA01-OA02. The deviations from the C_{2v} averaged values for the three angles Os–Os–CO(eq), Os–Os–O(acetate) and Os–O–C(acetate) are not entirely due to the deviations from the more ordered structure. They result also, in part, from a C_{2v} to C_2 distortion, which reduces the contacts between the equatorial carbonyls and the methyl groups as in the CA03-CB10 close contact.

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(12) J.K. Stalick and J.A. Ibers, *Inorg. Chem.*, *8*, 419 (1969).