Table 1. *Fractional atomic coordinates and equivalent isotropic displacement parameters* (Å^2)

$$U_{eq} = (1/3)\Sigma_i\Sigma_j U_{ij}a_i^* a_j^* \mathbf{a}_i.\mathbf{a}_j.$$

	x	y	z	U_{eq}
Mn	0.0720 (1)	0.2069 (1)	0.0516 (1)	0.041 (1)
O(1)	0.0103 (2)	0.0965 (2)	−0.1208 (2)	0.068 (1)
Cl(1)	0.1356 (1)	0.3568 (1)	0.2197 (1)	0.053 (1)
C(1')	0.3163 (3)	0.1078 (3)	0.0979 (3)	0.046 (1)
C(2')	0.2567 (3)	0.0518 (3)	0.1531 (3)	0.045 (1)
C(3')	0.3016 (3)	−0.0469 (3)	0.2193 (3)	0.051 (1)
C(4')	0.4025 (3)	−0.0869 (3)	0.2330 (3)	0.056 (1)
C(5')	0.4617 (3)	−0.0307 (3)	0.1814 (3)	0.055 (1)
C(6')	0.4197 (3)	0.0649 (3)	0.1140 (3)	0.054 (1)
N(1'a)	0.1888 (2)	0.2618 (2)	0.0079 (2)	0.042 (1)
C(1'a)	0.2797 (3)	0.2108 (3)	0.0300 (3)	0.050 (1)
C(2'a)	0.1621 (3)	0.3713 (3)	−0.0558 (3)	0.052 (1)
O(2')	0.1606 (2)	0.0879 (2)	0.1459 (2)	0.049 (1)
Cl(2)	0.5917 (1)	−0.0805 (1)	0.2039 (1)	0.072 (1)
C(1'')	−0.1812 (3)	0.3008 (3)	−0.0297 (3)	0.042 (1)
C(2'')	−0.1464 (3)	0.2044 (3)	0.0447 (3)	0.041 (1)
C(3'')	−0.2181 (3)	0.1564 (3)	0.0879 (3)	0.046 (1)
C(4'')	−0.3200 (3)	0.2030 (3)	0.0594 (3)	0.052 (1)
C(5'')	−0.3538 (3)	0.2979 (3)	−0.0140 (3)	0.051 (1)
C(6'')	−0.2868 (3)	0.3459 (3)	−0.0591 (3)	0.049 (1)
N(1''a)	−0.0167 (2)	0.3265 (2)	−0.0624 (2)	0.042 (1)
C(1''a)	−0.1158 (3)	0.3543 (3)	−0.0834 (3)	0.046 (1)
C(2''a)	0.0382 (3)	0.3767 (3)	−0.1315 (3)	0.052 (1)
O(2'')	−0.0493 (2)	0.1546 (2)	0.0748 (2)	0.045 (1)
Cl(3)	−0.4846 (1)	0.3561 (1)	−0.0516 (1)	0.072 (1)

Table 2. *Selected geometric parameters* (Å, °)

Mn—O(1)	2.319 (3)	Mn—O(2'')	1.874 (3)
Mn—N(1'a)	1.973 (3)	N(1'a)—C(1'a)	1.280 (5)
Mn—N(1''a)	1.986 (2)	N(1''a)—C(1''a)	1.285 (5)
Mn—Cl(1)	2.572 (1)	N(1''a)—C(2''a)	1.468 (5)
Mn—O(2')	1.883 (2)	N(1'a)—C(2'a)	1.472 (4)
O(1)—Mn—Cl(1)	170.1 (1)	O(1)—Mn—O(2')	91.7 (1)
Cl(1)—Mn—N(1'a)	88.1 (1)	N(1'a)—Mn—O(2')	92.6 (1)
Cl(1)—Mn—O(2')	96.4 (1)	Cl(1)—Mn—N(1''a)	88.5 (1)
O(1)—Mn—N(1''a)	83.1 (1)	O(2')—Mn—N(1''a)	173.4 (1)
N(1'a)—Mn—N(1''a)	83.1 (1)	Cl(1)—Mn—O(2'')	96.5 (1)
O(1)—Mn—O(2'')	87.9 (1)	O(2')—Mn—O(2'')	91.3 (1)
N(1'a)—Mn—O(2'')	173.6 (1)	O(1)—Mn—N(1'a)	87.0 (1)
N(1''a)—Mn—O(2'')	92.5 (1)		

The position of the Mn atom was identified in a Patterson vector map. Direct methods of phase determination lead to an electron-density map from which all the non-H atoms were identified.

Siemens standard procedures and programs were used for all data collection operations. *SHELXTL-Plus* (Sheldrick, 1990) was used for phase determination and structure refinement.

References

Ashmawy, F. M., Beagly, B., McAuliffe, C. A., Parish, R. V. & Pritchard, R. G. (1990). *J. Chem. Soc. Chem. Commun.* pp. 936–937.

Boucher, L. J. & Day, V. W. (1977). *Inorg. Chem.* **16**, 1360–1367.

Dailey, G. C., Horwitz, C. P. & Lisek, C. A. (1992). *Inorg. Chem.* **31**, 5325–5330.

Davies, J. E., Gatehouse, B. M. & Murray, K. S. (1973). *J. Chem. Soc. Dalton Trans.* pp. 2523–2527.

Gohdes, J. W. & Armstrong, W. H. (1988). *Inorg. Chem.* **27**, 1841–1842.

Horwitz, C. P., Ciringh, Y., Liu, C. & Park, S. (1993). *Inorg. Chem.* **32**, 5951–5956.

Johnson, C. K. (1965). *ORTEP*. Report ORNL-3794. Oak Ridge National Laboratory, Tennessee, USA.

Matsumoto, N., Takemoto, N., Ohyosi, A. & Okawa, H. (1988). *Bull. Chem. Soc. Jpn*, **61**, 2984–2986.

Pecoraro, V. L. & Butler, W. M. (1986). *Acta Cryst.* C42, 1151–1154.

Sheldrick, G. M. (1990). *SHELXTL-Plus*. Release 4.21. Siemens Analytical X-ray Instruments Inc., Madison, Wisconsin, USA.

cis,trans-(2,2'-Bipyridine-N,N')dibromobis(4-methylpyridine-N)tungsten(II)

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Abstract

The title compound, [WBr$_2$(C$_6$H$_7$N)$_2$(C$_{10}$H$_8$N$_2$)], is a neutral tungsten(II) mononuclear octahedral coordination complex. The two 4-methylpyridine molecules are in the *trans* staggered conformation with an interplanar angle of 86.5 (3)°. The bidentate bipyridine ligand is slightly twisted, the angle between separate planar pyridine moieties being 5.7 (5)°.

Comment

Although there are numerous organometallic compounds of divalent tungsten, only a few mononuclear coordination compounds of W^{II}, most of which are six-(Colquhoun & Williams, 1984) or seven-coordinate (Barrera, Sabat & Harman, 1991), have been structurally characterized by X-ray diffraction. WCl$_6$ and WBr$_5$ are well known starting substances for the syntheses of tungsten complexes with lower oxidation states, *i.e.* from four (Brenčič, Čeh & Šegedin, 1980) down to zero (Anderson & Richards, 1986). Using the same synthetic procedure known for obtaining mononuclear anionic complexes of W^{III} with the formula *trans*-(BaseH)[WX$_4$L$_2$] [Base = pyridine, 4-methylpyridine, NH$_3$; X = Br, Cl; L = pyridine, 4-methylpyridine (Brenčič, Čeh & Leban, 1979, 1990; Brenčič, Čeh &

Šegedin, 1980)], our aim was to synthesize the simi-
lar *cis* species starting from WBr₄(bipy). However, the
higher sensitivity of *cis* in comparison to *trans* W^{IV} neu-
tral complexes with regard to reduction with 4-picoline
resulted in the title compound, (I).

$$CH_3$$

(I)

[WBr₂(bipy)pic₂] (bipy = 2,2'-bipyridine, pic = 4-
methylpyridine) is an example of a neutral
octahedral complex of W^{II} with an equatorial
arrangement of the two Br atoms and bidentate bipyri-
dine ligand, and with two coordinated molecules of
4-methylpyridine in a *trans* staggered conformation.
The W—Br and W—N(pic) distances are close to
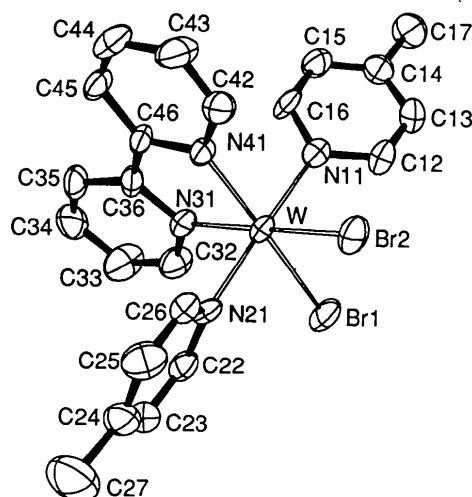those found, for example, in the anion $WBr_4pic_2^-$

Fig. 1. *ORTEP*II (Johnson, 1971) view of the molecule with atomic
numbering. Anisotropic displacement ellipsoids are at the 30%
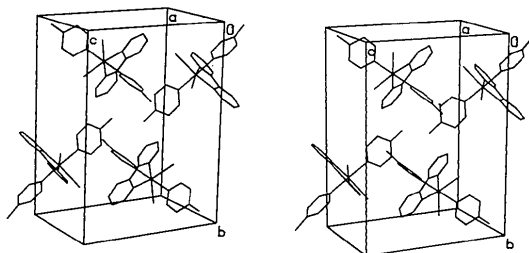probability level. H atoms are omitted for clarity.

Fig. 2. *PLUTON* stereodrawing (Spek, 1991) of the crystal packing.

(Brenčič, Čeh & Leban, 1979, 1990), in the compound
[WBr(Ph₂PCH₂CH₂PPh₂){N₂CN(Me)CH₂CH₂NMe}]-
PF₆ (Colquhoun & Williams, 1984) and in the
compound [W{C(Ph)CHCHMe}Br₂(CO)₂(pic)] (Mayr,
Asaro & Gilnes, 1987). The two W—N(bipy) distances
are almost the same, but are shorter than those found, for
example, in [W(bipy)(PMe₃)₂Cl(CH₃CN)]PF₆ (Barrera,
Sabat & Harman, 1991) or in [AsPh₄][WO(bipy)(CN)₃].-
0.5bipy.2H₂O (Szklarzewicz, Samotus, Alcock & Moll,
1990). The bipyridine ligand is slightly distorted. The
two pyridine moieties are twisted by 5.7 (5)° about the
C36—C46 bond. This value is close to the average value
of 8° found in the survey by Durham, Wilson, Hodg-
son & Meyer (1980) and earlier by McKenzie (1971).
All other distances and angles are generally as expected.
There are no unusual close intermolecular contacts.

Experimental

A mixture of 0.80 g of WBr₄(bipy) and 40 ml of 4-methyl-
pyridine was degassed *in vacuo* and stirred for 20 h at room
temperature. This was followed by filtration under an argon
atmosphere. The mixture of 10 ml of degassed water and 10 ml
of filtrate was left on ice for a week. From the crystalline
product, a well shaped dark red crystal of the compound
was selected and sealed into a glass capillary under argon
atmosphere. Crystals proved to be sensitive to air.

Crystal data

[WBr₂(C₆H₇N)₂(C₁₀H₈N₂)]	Mo $K\alpha$ radiation
$M_r = 686.11$	$\lambda = 0.7107$ Å
Monoclinic	Cell parameters from 25
$P2_1/n$	reflections
$a = 9.5690 (1)$ Å	$\theta = 9-12°$
$b = 17.651 (2)$ Å	$\mu = 8.695$ mm⁻¹
$c = 13.485 (2)$ Å	$T = 293 (1)$ K
$\beta = 94.26 (2)°$	Plate
$V = 2271.4 (5)$ Å³	0.42 × 0.32 × 0.06 mm
$Z = 4$	Dark red
$D_x = 2.006$ Mg m⁻³	

Data collection

Enraf–Nonius CAD-4	3071 observed reflections
diffractometer	[$I > 2\sigma(I)$]
Variable rate $\theta/2\theta$ scans	$R_{int} = 0.0823$
Absorption correction:	$\theta_{max} = 27.11°$
by integration from crystal	$h = -12 \rightarrow 12$
shape	$k = 0 \rightarrow 22$
$T_{min} = 0.100$, $T_{max} =$	$l = 0 \rightarrow 17$
0.596	3 standard reflections
9921 measured reflections	monitored every 600
4973 independent reflections	reflections
	intensity decay: 5.44%

Refinement

Refinement on F^2	$(\Delta/\sigma)_{max} = 0.257$
$R[F^2 > 2\sigma(F^2)] = 0.0447$	$\Delta\rho_{max} = 2.189$ e Å⁻³
$wR(F^2) = 0.0893$	$\Delta\rho_{min} = -1.584$ e Å⁻³
$S = 1.070$	Extinction correction: none

4973 reflections
266 parameters
Only H-atom U's refined
$w = 1/[\sigma^2(F_o^2) + (0.0528P)^2]$
where $P = (F_o^2 + 2F_c^2)/3$

Atomic scattering factors from *International Tables for Crystallography* (1992, Vol. C, Tables 4.2.6.8 and 6.1.1.4)

Table 1. *Fractional atomic coordinates and equivalent isotropic displacement parameters* (Å^2)

$U_{eq} = (1/3)\Sigma_i\Sigma_j U_{ij}a_i^* a_j^* \mathbf{a}_i.\mathbf{a}_j.$

	x	y	z	U_{eq}
W	0.24514 (3)	0.27437 (2)	0.09138 (2)	0.03370 (11)
Br1	0.43385 (9)	0.18450 (7)	0.17461 (6)	0.0541 (3)
Br2	0.43587 (8)	0.36401 (7)	0.03220 (6)	0.0553 (3)
N11	0.2485 (7)	0.2063 (4)	−0.0426 (5)	0.039 (2)
C12	0.3702 (8)	0.1826 (6)	−0.0799 (6)	0.048 (2)
C13	0.3719 (9)	0.1340 (6)	−0.1584 (6)	0.050 (2)
C14	0.2488 (9)	0.1049 (6)	−0.2040 (5)	0.050 (2)
C15	0.1274 (9)	0.1301 (6)	−0.1676 (6)	0.050 (2)
C16	0.1298 (8)	0.1795 (6)	−0.0898 (6)	0.048 (2)
C17	0.2514 (10)	0.0452 (6)	−0.2854 (6)	0.058 (3)
N21	0.2484 (6)	0.3420 (4)	0.2267 (4)	0.036 (2)
C22	0.2561 (8)	0.3122 (6)	0.3193 (5)	0.041 (2)
C23	0.2487 (9)	0.3534 (6)	0.4035 (6)	0.045 (2)
C24	0.2365 (9)	0.4312 (7)	0.3998 (6)	0.052 (2)
C25	0.2259 (10)	0.4635 (7)	0.3044 (6)	0.060 (3)
C26	0.2311 (8)	0.4161 (6)	0.2230 (6)	0.042 (2)
C27	0.2251 (15)	0.4788 (9)	0.4898 (8)	0.099 (5)
N31	0.0728 (6)	0.2193 (4)	0.1435 (4)	0.0345 (15)
C32	0.0807 (10)	0.1634 (6)	0.2112 (6)	0.052 (2)
C33	−0.0353 (10)	0.1347 (7)	0.2531 (7)	0.067 (3)
C34	−0.1681 (10)	0.1668 (8)	0.2268 (7)	0.065 (3)
C35	−0.1790 (9)	0.2230 (6)	0.1610 (6)	0.045 (2)
C36	−0.0597 (8)	0.2510 (5)	0.1179 (5)	0.036 (2)
N41	0.0748 (6)	0.3333 (4)	0.0250 (4)	0.034 (2)
C42	0.0828 (9)	0.3889 (6)	−0.0443 (5)	0.044 (2)
C43	−0.0307 (9)	0.4245 (6)	−0.0881 (6)	0.055 (3)
C44	−0.1666 (10)	0.4029 (6)	−0.0631 (6)	0.051 (2)
C45	−0.1779 (8)	0.3473 (6)	0.0042 (6)	0.047 (2)
C46	−0.0579 (7)	0.3106 (6)	0.0498 (5)	0.036 (2)

Table 2. *Selected geometric parameters* (Å, °)

W—N41	2.079 (6)	C24—C25	1.403 (12)
W—N31	2.082 (6)	C24—C27	1.486 (14)
W—N11	2.172 (7)	C25—C26	1.384 (13)
W—N21	2.179 (7)	N31—C32	1.342 (11)
W—Br2	2.5860 (10)	N31—C36	1.405 (10)
W—Br1	2.5953 (10)	C32—C33	1.379 (12)
N11—C16	1.346 (10)	C33—C34	1.412 (14)
N11—C12	1.368 (10)	C34—C35	1.331 (15)
C12—C13	1.364 (12)	C35—C36	1.407 (11)
C13—C14	1.386 (12)	C36—C46	1.398 (12)
C14—C15	1.368 (11)	N41—C42	1.361 (11)
C14—C17	1.524 (13)	N41—C46	1.395 (9)
C15—C16	1.362 (12)	C42—C43	1.352 (11)
N21—C26	1.318 (12)	C43—C44	1.419 (13)
N21—C22	1.352 (9)	C44—C45	1.346 (14)
C22—C23	1.354 (11)	C45—C46	1.419 (11)
C23—C24	1.379 (15)		
N41—W—N31	76.3 (3)	N21—C22—C23	124.3 (9)
N41—W—N11	88.8 (2)	C22—C23—C24	120.9 (8)
N31—W—N11	94.8 (2)	C23—C24—C25	115.9 (8)
N41—W—N21	92.8 (2)	C23—C24—C27	123.0 (9)
N31—W—N21	86.3 (2)	C25—C24—C27	121.0 (11)
N11—W—N21	178.3 (2)	C26—C25—C24	118.5 (10)
N41—W—Br2	96.3 (2)	N21—C26—C25	125.6 (8)
N31—W—Br2	170.1 (2)	C32—N31—C36	117.6 (7)
N11—W—Br2	91.6 (2)	C32—N31—W	124.5 (5)
N21—W—Br2	87.5 (2)	C36—N31—W	117.0 (6)
N41—W—Br1	171.9 (2)	N31—C32—C33	122.8 (9)
N31—W—Br1	96.4 (2)	C32—C33—C34	119.1 (10)
N11—W—Br1	88.2 (2)	C35—C34—C33	119.4 (9)
N21—W—Br1	90.4 (2)	C34—C35—C36	120.8 (9)
Br2—W—Br1	91.32 (3)	C46—C36—N31	113.9 (7)

C16—N11—C12	115.5 (7)	C46—C36—C35	125.8 (7)
C16—N11—W	121.6 (6)	N31—C36—C35	120.2 (8)
C12—N11—W	122.7 (5)	C42—N41—C46	118.0 (7)
C13—C12—N11	122.5 (8)	C42—N41—W	125.0 (5)
C12—C13—C14	121.2 (8)	C46—N41—W	116.8 (5)
C15—C14—C13	115.9 (9)	C43—C42—N41	123.4 (8)
C15—C14—C17	122.9 (8)	C42—C43—C44	119.5 (9)
C13—C14—C17	121.1 (8)	C45—C44—C43	118.5 (8)
C16—C15—C14	121.2 (8)	C44—C45—C46	121.4 (8)
N11—C16—C15	123.7 (8)	N41—C46—C36	115.4 (6)
C26—N21—C22	114.7 (7)	N41—C46—C45	119.1 (8)
C26—N21—W	121.2 (5)	C36—C46—C45	125.4 (7)
C22—N21—W	123.9 (6)		

The space group $P2_1/n$ was determined from the intensity statistics. H atoms were included in the refinement at calculated positions. Two common isotropic displacement parameters for H atoms were refined to 0.088 (16) Å^2 (for CH_3 groups) and to 0.055 (7) Å^2 for others.

Calculations were performed on the VAX 8550 cluster at the University Computer Centre, Ljubljana, under VMS 5.5–2 and partially on PC 486.

Data collection: *CAD-4 Software* (Enraf–Nonius, 1989). Cell refinement: *CAD-4 Software*. Data reduction: *NRCVAX* (Gabe, Le Page, Charland, Lee & White, 1989) and *GX* (Mallinson & Muir, 1985). Program(s) used to solve structure: *SHELXS86* (Sheldrick, 1985). Program(s) used to refine structure: *SHELXL93* (Sheldrick, 1993). Molecular graphics: *ORTEPII* (Johnson, 1971) and *PLUTON* (Spek, 1991). Software used to prepare material for publication: *SHELXL93*.

References

Anderson, S. N. & Richards, L. R. (1986). *J. Chem. Soc. Dalton Trans.* pp. 245–252.

Barrera, J., Sabat, M. & Harman, W. D. (1991). *J. Am. Chem. Soc.* **113**, 8178–8179.

Brenčič, J. V., Čeh, B. & Leban, I. (1979). *Acta Cryst.* B35, 3028–3030.

Brenčič, J. V., Čeh, B. & Leban, I. (1990). *Z. Anorg. Allg. Chem.* **582**, 190–196.

Brenčič, J. V., Čeh, B. & Šegedin, P. (1979). *Z. Anorg. Allg. Chem.* **454**, 181–186.

Brenčič, J. V., Čeh, B. & Šegedin, P. (1980). *J. Inorg. Nucl. Chem.* **42**, 1409–1412.

Colquhoun, H. M. & Williams, D. J. (1984). *J. Chem. Soc. Dalton Trans.* pp. 1675–1679.

Durham, B., Wilson, S. R., Hodgson, D. J. & Meyer, T. J. (1980). *J. Am. Chem. Soc.* **102**, 600–607.

Enraf–Nonius (1989). *CAD-4 Software*. Version 5.0. Enraf–Nonius, Delft, The Netherlands.

Gabe, E. J., Le Page, Y., Charland, J.-P., Lee, F. L. & White, J. (1989). *J. Appl. Cryst.* **22**, 384–387.

Johnson, C. K. (1971). *ORTEPII*. Report ORNL-3794, revised. Oak Ridge National Laboratory, Tennessee, USA.

Mallinson, P. R. & Muir, K. W. (1985). *J. Appl. Cryst.* **18**, 51–53.

McKenzie, E. D. (1971). *Coord. Chem. Rev.* **6**, 187–216.

Mayr, A., Asaro, M. F. & Gilnes, T. J. (1987). *J. Am. Chem. Soc.* **109**, 2215–2216.

Sheldrick, G. M. (1985). *SHELXS86. Program for the Solution of Crystal Structures.* Univ. of Göttingen, Germany.

Sheldrick, G. M. (1993). *SHELXL93. Program for Crystal Structure Refinement.* Univ. of Göttingen, Germany.

Spek, A. L. (1991). *PLUTON. Molecular Graphics Program.* Univ. of Utrecht, The Netherlands.

Szklarzewicz, J., Samotus, A., Alcock, N. W. & Moll, M. (1990). *J. Chem. Soc. Dalton Trans.* pp. 2959–2963.

Tris(2,2'-bipyridine)manganese(II) Perchlorate Hemihydrate

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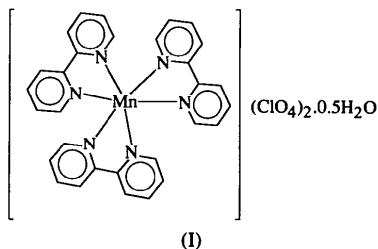
Abstract

The crystal structure of tris(2,2'-bipyridine)manganese(II) perchlorate hemihydrate, $[Mn(C_{10}H_8N_2)_3]$-$(ClO_4)_2.0.5H_2O$, has been established by X-ray crystallography. The metal atom is coordinated by three chelating 2,2'-bipyridine ligands in a highly distorted octahedral MnN_6 arrangement with Mn—N bond lengths ranging from 2.219 (4) to 2.294 (4) Å.

Comment

In an attempt to prepare a manganese(II) complex containing 2,2'-bipyridine (bpy) and betaine ligands, we obtained an unusual singly carboxylato-bridged dinuclear manganese(II) complex $[Mn_2(bpy)_4(Me_3NCH_2CO_2)$-$(H_2O)_2](ClO_4)_4.2H_2O$, together with golden needle-like crystals as a minor product (Chen & Mak, 1993). The latter complex has been characterized by IR spectral data and elemental analysis as the monomeric complex $[Mn(bpy)_3](ClO_4)_2.0.5H_2O$, (I). We report here the single-crystal structure of this complex.

$(ClO_4)_2.0.5H_2O$

(I)

The crystal structure of the title complex is composed of monomeric $[Mn(bpy)_3]^{2+}$ cations, perchlorate anions and lattice water molecules. As illustrated in Fig. 1, the metal atom is surrounded by six N atoms from three chelating bpy ligands in a highly distorted octahedral MnN_6 arrangement. The Mn—N bond lengths range from 2.219 (4) to 2.294 (4) Å with the most distorted N—Mn—N angle (*ca* 73°) resulting from a chelating bpy ligand. The Mn—N bond lengths are significantly longer than those (1.932–2.172 Å) found for the analogous cations $[Zn(bpy)_3]^{2+}$ (Chen, Wang & Yu, 1995), $[Co(bpy)_3]^{3+}$ (Yanagi, Ohashi, Sasada, Kaizu & Kobayashi, 1981), $[Fe(bpy)_3]^{3+}$ (Figgis, Skelton & White, 1978) and $[Ni(bpy)_3]^{2+}$ (Wada, Katayama & Tanaka, 1976). The Mn—N bond lengths are longer than the *M*—N bond lengths found for analogous $[M(bpy)_3]^{n+}$ complexes ($M = Zn^{2+}$, Co^{3+}, Fe^{3+}, Ni^{2+}); this may be attributed to the larger ionic radius of the Mn^{2+} cation. It is noteworthy that each pair of pyridine rings in the three bpy ligands are not coplanar, the dihedral angles between each pair ranging from 13 to 25°.
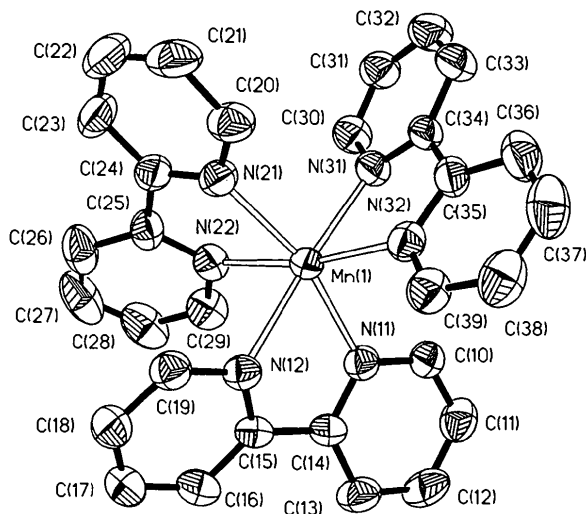

Fig. 1. *ORTEP* (Johnson, 1965) drawing of the $[Mn(bpy)_3]^{2+}$ cation showing 45% probability ellipsoids.

Experimental

Crystal data

$[Mn(C_{10}H_8N_2)_3](ClO_4)_2.$-$0.5H_2O$	Mo $K\alpha$ radiation
$M_r = 730.4$	$\lambda = 0.71073$ Å
Triclinic	Cell parameters from 25
$P\bar{1}$	reflections
	$\theta = 1.5$–$25°$