

S4'—Ag2—S3	125.85 (6)	C31—S4—Ag2'	108.8 (2)
S4'—Ag2···Ag2'	109.90 (5)	Ag1—S3—Ag2	122.82 (7)
S2—Ag2···Ag2'	75.22 (5)	Ag2'—S4—Ag1	94.77 (6)
S3—Ag2···Ag2'	73.30 (4)		

Symmetry code: (i)  $1 - x, 1 - y, -z$ .

For complex (I), a positional disorder was resolved for two Hthcl moieties; atoms C22, C23, C25, C26, C32, C33, C35 and C36 are disordered and were refined with fixed site-occupation factors of 0.5. In the last least-squares cycles, distances involving one or two disordered atoms were restrained to target values of 1.52 Å with an s.u. of 0.02 Å for C—C bonds (20 restraints), and 1.48 Å with an s.u. of 0.02 Å for N—C bonds (four restraints). In the case of complex (II), a minor positional disorder was encountered for an O atom of one of the nitrate ions; O41 is disordered and was refined with a fixed site-occupation factor of 0.5. Moreover, in the last cycles of refinement for (II), reflection  $\bar{1}01$  was omitted because it presented a very large discrepancy between  $F_o^2$  and  $F_c^2$  ( $\Delta F^2/s.u. = 25.8$ ) due to a tube surge during the measurement of this reflection. Omitting this reflection reduced the  $wR_2$  value for all data from 14.06 to 12.95%. For both compounds, H atoms were placed on idealized positions (N—H = 0.86 and C—H = 0.97 Å) with an isotropic displacement parameter  $1.2U_{eq}$  of the bonded atom.

For both compounds, data collection: XSCANS (Fait, 1991); cell refinement: XSCANS; data reduction: XSCANS. Program(s) used to solve structures: SIR92 (Altomare *et al.*, 1992) for (I); SHELXTL-Plus (Sheldrick, 1995) for (II). For both compounds, program(s) used to refine structures: SHELX97 (Sheldrick, 1997); molecular graphics: SHELXTL-Plus; software used to prepare material for publication: SHELX97.

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Supplementary data for this paper are available from the IUCr electronic archives (Reference: FR1179). Services for accessing these data are described at the back of the journal.

## References

- Altomare, A., Cascarano, G., Giacovazzo, C., Guagliardi, A., Burla, M. C., Polidori, G. & Camalli, M. (1992). *SIR92 User's Manual*. University of Bari, Italy.
- Bau, R. (1998). *J. Am. Chem. Soc.* **120**, 9380–9381.
- Fait, J. (1991). *XSCANS User's Manual*. Siemens Analytical X-ray Instruments Inc., Madison, Wisconsin, USA.
- Griffith, E. A. H., Charles, N. G., Rodesiler, P. F. & Amma, E. L. (1983). *Acta Cryst.* **C39**, 331–333.
- Howard-Lock, H. E., LeBlanc, D. J., Lock, C. J. L., Smith, R. W. & Wang, Z. (1996). *J. Chem. Soc. Chem. Commun.* pp. 1391–1392.
- Huheey, F. E., Keiter, E. A. & Keiter, R. L. (1993). *Inorganic Chemistry. Principles of Structure and Reactivity*, pp. 344–355. New York: Harper Collins College Publishers.
- Inoue, K., Yasukawa, R., Miura, N., Baba, Y. & Yoshizuka, K. (1992). *Solvent Extr. Ion Exch.* **10**, 769–785.
- Mozzhukhin, A. O., Ovchinnikov, Yu. E., Antipin, M. Yu., Struchkov, Yu. T., Shipov, A. G., Sergeev, V. N., Artamkin, S. A. & Baukov, Yu. I. (1993). *Izv. Akad. Nauk SSSR Ser. Khim.* pp. 198–202.
- Núñez, M. E. (1997). Masters thesis, Facultad de Química, UNAM, Mexico.
- Núñez, M. E., Bernès, S., Rodríguez de San Miguel Guerrero, E., Bernal, J. P. & de Gyves, J. (1998). *Acta Cryst.* **C54**, 49–51.

- Sato, T., Ishikawa, I. & Sato, K. (1986). *Proc. ISEC II*, pp. 159–163.
- Sheldrick, G. M. (1995). *SHELXTL-Plus*. Release 5.03. Siemens Analytical X-ray Instruments Inc., Madison, Wisconsin, USA.
- Sheldrick, G. M. (1997). *SHELX97 User's Manual*. University of Göttingen, Germany.
- Xiong, R.-G., Zuo, J.-L. & You, X.-Z. (1997). *Inorg. Chem.* **36**, 2472–2474.

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## Bis[(2-chloroethyl)diisopropylammonium] tetrachlorocobaltate(II)

AMIR H. MAHMOUDKHANI<sup>a\*</sup> AND VRATISLAV LANGER<sup>b</sup>

<sup>a</sup>Department of Inorganic Chemistry, Göteborg University, SE-41296 Göteborg, Sweden, and <sup>b</sup>Department of Environmental Inorganic Chemistry, Chalmers University of Technology, SE-41296 Göteborg, Sweden. E-mail: amir@inoc.chalmers.se

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## Abstract

The crystal structure of the title compound, (C<sub>8</sub>H<sub>19</sub>ClN)<sub>2</sub>[CoCl<sub>4</sub>], has been determined at 203 K. It is built up from alternating layers of organic cations and inorganic [CoCl<sub>4</sub>]<sup>2-</sup> anions. The asymmetric unit consists of two cations with different conformations, one cation being disordered. The structure exhibits both N—H···Cl and C—H···Cl hydrogen bonds.

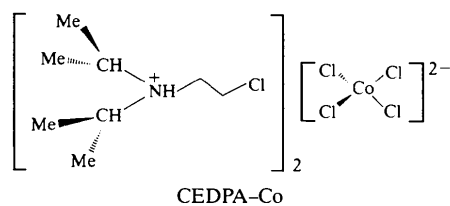
## Comment

Mixed organic–inorganic salts with the general formula [R<sub>n</sub>NH<sub>4-n</sub>]<sub>2</sub>[MX<sub>4</sub>] (where R is an alkyl group, M is a divalent metal ion, X is Cl<sup>-</sup>, Br<sup>-</sup> or I<sup>-</sup>, and n = 1, 2, 3, 4) have been widely investigated due to their structural diversity, ferroelectric and ferroelastic properties, and the presence of different phase transitions, including incommensurate ones. These structures are built up from discrete organic cations and inorganic anions and are often dominated by the presence of disordered organic cations (Bloomqvist & Willett, 1981; Hasebe *et al.*, 1990a,b; Madariaga *et al.*, 1987; Mahoui *et al.*, 1996a,b; Nishihata *et al.*, 1993; Willett, 1991; Zaleski, 1997). This behaviour is more pronounced in the absence of hydrogen bonds linking the organic and inorganic species. Indeed, the compounds with more alkyl groups on the N atom or with a long-chain alkyl group exhibit disorder in both the organic and inorganic species (Mahoui *et al.*, 1996a,b; Madariaga *et al.*, 1987). The presence of hydrogen bonds results in directional cation–anion interactions within the layers and adoption

of a well behaved three-dimensional structure. The structural phase transitions for these compounds have been attributed to the order-disorder transition of the alkylammonium group (Mahoui *et al.*, 1996a; Ning *et al.*, 1992) and/or changing of the hydrogen-bond network (Ning *et al.*, 1992; Williams *et al.*, 1992a).

Hydrogen bonding plays an important role in the crystal engineering of organic and organometallic solids (Desiraju, 1989; Braga *et al.*, 1998). The N—H...X and C—H...X (X = Cl or Br) hydrogen-bonding ability of  $MX_4^{2-}$  anions has been described previously (Feist *et al.*, 1995; Hitchcock *et al.*, 1993; Mahmoudkhani & Langer, 1999a; Waškowska, 1994), and is important for stabilization of the crystal structure, though the medium-strong N—H...X hydrogen bonds (Gilli, 1995) have a more significant contribution than the C—H...X bonds. This can be seen in the structure of  $[(CH_3)_2NH_2]_2[CuCl_4]$ , with more hydrogen bonds and no disorder, while the structure of  $[(CH_3)_3NH]_2[ZnCl_4]$  with less hydrogen bonds suffers from disorder (Williams *et al.*, 1992b). Recently, we have shown that the hydrogen-bonding network in the crystal structure of  $[(CH_3)_2NH_2]_2[CoCl_4]$  remains unchanged and thereby the structure behaves well even at temperatures up to 366 K (Mahmoudkhani & Langer, 1999a). It is of interest to investigate the effect of hydrogen bonding on the structure and properties of these compounds with respect to the size and nature of the alkyl groups on the N atom.

Bis[(2-chloroethyl)diisopropylammonium] tetrachlorocobaltate(II), CEDPA-Co, crystallizes in the monoclinic space group  $P2_1/n$ . The structure determination at room



temperature results in a unit cell with  $a = 8.1263(1)$ ,  $b = 26.1325(4)$ ,  $c = 12.1909(1)$  Å and  $\beta = 93.918(1)^\circ$  [8192 reflections with  $I > 10\sigma(I)$ ]. Nevertheless, the high atomic displacement parameters (ADPs) of one of the organic cations hampered the structure refinement process. Cooling to 173 K failed as the crystals cracked. A more satisfactory result was obtained at 203 K. Disorder persists even at low temperature and this is reflected in high ADPs for substituents on the N1 atom. One isopropyl group was disordered over two positions with site occupancies of 0.64 (1) and 0.36 (1), and the other isopropyl group had an artificially short C13—C14 bond of 1.410(6) Å. The  $[CoCl_4]^{2-}$  anion behaves normally as a tetrahedron, while the ammonium cations exhibit different conformations. The di-

edral angle C11—C11—C12—N1 is  $-162.8(2)^\circ$ , which corresponds to a *trans* conformation similar to that found for (2-chloroethyl)diisopropylammonium chloride (Mahmoudkhani & Langer, 1999b), while the dihedral angle C12—C21—C22—N2 is  $-78.7(3)^\circ$  and presents a *gauche* conformation for the corresponding N and Cl atoms. The conformations of the isopropyl groups on the N1 and N2 atoms (with relevance for the corresponding H—N—C—H dihedral angles) are *gauche-gauche* and *gauche-trans*, respectively. The hydrogen-bonding scheme is shown in Fig. 2. Although all the Cl atoms

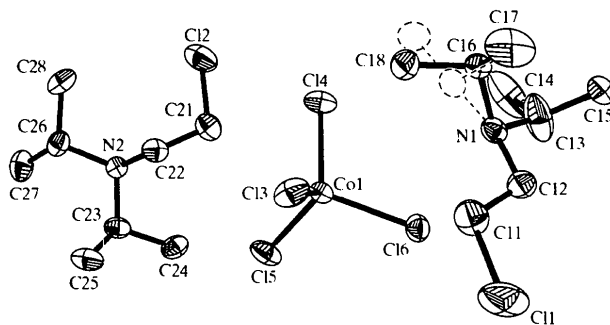


Fig. 1. The molecular structure of CEDPA-Co. Displacement ellipsoids are shown at the 50% probability level and H atoms have been omitted for clarity. The disordered isopropyl group is shown with dotted ellipsoids. The C17 and C7 atoms have almost the same coordinates.

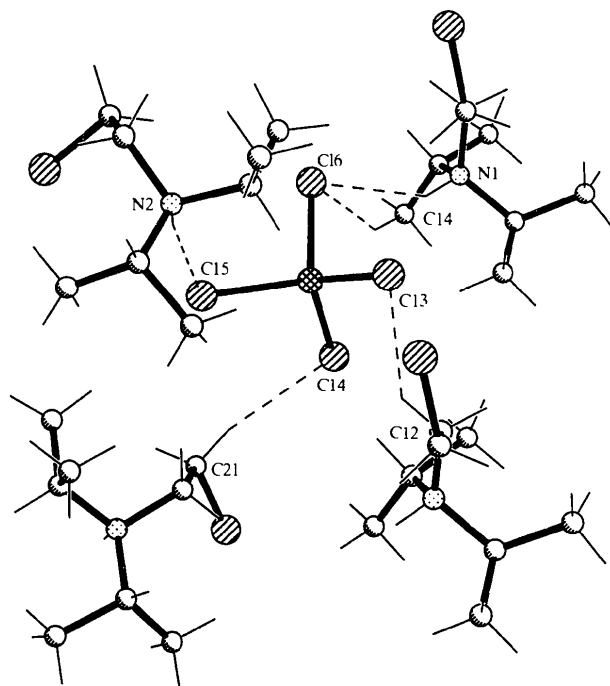


Fig. 2. The hydrogen-bonding scheme for a  $[CoCl_4]^{2-}$  anion. The H atoms are represented with thin lines.

of the  $[\text{CoCl}_4]^{2-}$  anion are involved in hydrogen bonds either of the  $\text{N}-\text{H}\cdots\text{Cl}$  or  $\text{C}-\text{H}\cdots\text{Cl}$  type (Table 2), there are less hydrogen-bond contacts compared with the structure of  $[(\text{CH}_3)_2\text{NH}_2]_2[\text{CoCl}_4]$  (Mahmoudkhani & Langer, 1999a). The structure of CEPDA-Co consists of organic-inorganic layers which are perpendicular to the  $b$  axis. Each layer of  $[\text{CoCl}_4]^{2-}$  anions is 'sandwiched' between ordered and disordered organic layers. Similar behaviour has been reported by Bloomqvist & Willett (1981) for  $[\text{Et}_2\text{NH}_2]_2[\text{ZnCl}_4]\cdot x\text{H}_2\text{O}$ .

## Experimental

The title compound was prepared by the reaction of (2-chloroethyl)diisopropylammonium chloride with  $\text{CoCl}_2\cdot 6\text{H}_2\text{O}$  in ethanol at 323 K. The solvent was removed by azeotropic distillation with toluene. Crystals suitable for X-ray diffraction analysis were obtained by slow evaporation from a solution in acetone-ethyl acetate when allowed to stand over silica gel in a desiccator. The crystal chosen was stable enough for data collection under normal conditions.

### Crystal data

$(\text{C}_8\text{H}_{19}\text{ClN})_2[\text{CoCl}_4]$	Mo $K\alpha$ radiation
$M_r = 530.11$	$\lambda = 0.71073 \text{ \AA}$
Monoclinic	Cell parameters from 6564 reflections
$P2_1/n$	$\theta = 1-32^\circ$
$a = 8.0257 (1) \text{ \AA}$	$\mu = 1.328 \text{ mm}^{-1}$
$b = 25.8793 (3) \text{ \AA}$	$T = 203 (2) \text{ K}$
$c = 12.1196 (1) \text{ \AA}$	Thin plate
$\beta = 94.7901 (2)^\circ$	$0.50 \times 0.40 \times 0.01 \text{ mm}$
$V = 2508.44 (5) \text{ \AA}^3$	Blue
$Z = 4$	
$D_x = 1.404 \text{ Mg m}^{-3}$	
$D_m$ not measured	

### Data collection

Siemens SMART CCD diffractometer	4601 reflections with $I > 2\sigma(I)$
$\omega$ scans	$R_{\text{int}} = 0.051$
Absorption correction: multi-scan (SADABS; Sheldrick, 1996; Blessing, 1995)	$\theta_{\text{max}} = 28.3^\circ$
$T_{\text{min}} = 0.557$ , $T_{\text{max}} = 0.987$	$h = -10 \rightarrow 10$
29 643 measured reflections	$k = -34 \rightarrow 34$
6231 independent reflections	$l = -16 \rightarrow 16$
	Intensity decay: none

### Refinement

Refinement on $F^2$	$(\Delta/\sigma)_{\text{max}} = 0.002$
$R[F^2 > 2\sigma(F^2)] = 0.045$	$\Delta\rho_{\text{max}} = 1.062 \text{ e \AA}^{-3}$
$wR(F^2) = 0.111$	$\Delta\rho_{\text{min}} = -0.770 \text{ e \AA}^{-3}$
$S = 1.021$	Extinction correction: none
6231 reflections	Scattering factors from <i>International Tables for Crystallography</i> (Vol. C)
256 parameters	
H atoms: see below	
$w = 1/[\sigma^2(F_o^2) + (0.0413P)^2 + 3.3222P]$	
where $P = (F_o^2 + 2F_c^2)/3$	

Table 1. Selected geometric parameters ( $\text{\AA}$ ,  $^\circ$ )

Co1—Cl4	2.2688 (8)	Co1—Cl5	2.2881 (8)
Co1—Cl3	2.2689 (8)	Co1—Cl6	2.2886 (8)
Cl4—Co1—Cl3	112.96 (3)	Cl4—Co1—Cl6	107.66 (3)
Cl4—Co1—Cl5	109.28 (3)	Cl3—Co1—Cl6	107.49 (3)
Cl3—Co1—Cl5	112.38 (4)	Cl5—Co1—Cl6	106.76 (3)
Cl1—Cl11—Cl12—N1	-162.8 (2)	H1—N1—Cl13—H13	72.9
Cl2—Cl21—Cl22—N2	-78.7 (3)	H1—N1—Cl16—H16	97.4
H2—N2—C23—H23	56.1	H1—N1—C6—H6	-62.8
H2—N2—C26—H26	169.6		

Table 2. Hydrogen-bonding geometry ( $\text{\AA}$ ,  $^\circ$ )

$D-\text{H}\cdots A$	$D-\text{H}$	$\text{H}\cdots A$	$D\cdots A$	$D-\text{H}\cdots A$
N1—H1 $\cdots$ Cl6	0.92	2.45	3.222 (2)	142
N2—H2 $\cdots$ Cl5 <sup>i</sup>	0.92	2.37	3.253 (2)	160
C21—H21A $\cdots$ Cl4 <sup>ii</sup>	0.98	2.70	3.656 (4)	165
Cl2—H12B $\cdots$ Cl3 <sup>ii</sup>	0.98	2.87	3.648 (3)	136
Cl4—H14C $\cdots$ Cl6	0.97	2.87	3.633 (4)	137

Symmetry codes: (i)  $x - \frac{1}{2}, \frac{1}{2} - y, \frac{1}{2} + z$ ; (ii)  $x - 1, y, z$ .

The disordered parts of the cations were restrained to have the same geometry. The H atoms on the N atoms were refined isotropically using an appropriate riding model, whereas the other H atoms were constrained to idealized geometries and assigned isotropic displacement parameters 1.5 times (for  $\text{CH}_3$  groups) or 1.2 times (for  $\text{CH}_2$  and  $\text{CH}$  groups) the  $U_{\text{iso}}$  value of their respective pivot atom.

Data collection: SMART (Siemens, 1995). Cell refinement: SAINT (Siemens, 1995). Data reduction: SAINT and SADABS (Sheldrick, 1996). Program(s) used to solve structure: SHELXTL (Bruker, 1997). Program(s) used to refine structure: SHELXTL. Molecular graphics: SHELXTL.

Supplementary data for this paper are available from the IUCr electronic archives (Reference: OS1065). Services for accessing these data are described at the back of the journal.

## References

- Blessing, R. H. (1995). *Acta Cryst.* **A51**, 33–38.
- Bloomqvist, D. R. & Willett, R. D. (1981). *Acta Cryst.* **B37**, 1353–1356.
- Braga, D., Grepioni, F. & Desiraju, G. R. (1998). *Chem. Rev.* **98**, 1375–1405.
- Bruker (1997). *SHELXTL*. Version 5.10. Bruker AXS Inc., Madison, Wisconsin, USA.
- Desiraju, G. R. (1989). In *Crystal Engineering: The Design of Organic Solids*. Amsterdam: Elsevier.
- Feist, M., Trojanov, S. & Kemnitz, E. (1995). *Z. Anorg. Allg. Chem.* **621**, 1775–1778.
- Gilli, G. (1995). *Fundamentals of Crystallography*, edited by C. Giacovazzo, pp. 465–534. New York: Oxford.
- Hasebe, K., Asahi, T. & Gesi, K. (1990a). *Acta Cryst.* **C46**, 218–229.
- Hasebe, K., Asahi, T. & Gesi, K. (1990b). *Acta Cryst.* **C46**, 759–762.
- Hitchcock, P. B., Seddon, K. R. & Welton, T. (1993). *J. Chem. Soc. Dalton Trans.* pp. 2639–2643.
- Madariaga, G., Zuniga, F. J., Perez-Mato, J. M. & Tello, M. J. (1987). *Acta Cryst.* **B43**, 356–368.
- Mahmoudkhani, A. H. & Langer, V. (1999a). *Acta Cryst.* **B55**. In the press.
- Mahmoudkhani, A. H. & Langer, V. (1999b). *Acta Cryst.* **C55**, 1163–1167.
- Mahoui, A., Lapasset, J., Moret, J. & Saint Grégoire, P. (1996a). *Acta Cryst.* **C52**, 2671–2674.
- Mahoui, A., Lapasset, J., Moret, J. & Saint Grégoire, P. (1996b). *Acta Cryst.* **C52**, 2674–2676.

- Ning, G., Guangfu, Z. & Shiquan, X. (1992). *J. Mol. Struct.* **275**, 85–94.
- Nishihata, Y., Sawada, A., Kasatani, H. & Terauchi, H. (1993). *Acta Cryst.* **C49**, 1939–1941.
- Sheldrick, G. M. (1996). *SADABS. Program for Empirical Absorption Correction of Area Detector Data*. University of Göttingen, Germany.
- Siemens (1995). *SMART and SAINT. Area Detector Control and Integration Software*. Siemens Analytical X-ray Instruments Inc., Madison, Wisconsin, USA.
- Waškowska, A. (1994). *Z. Kristallogr.* **209**, 752–754.
- Willet, R. D. (1991). *Acta Cryst.* **C47**, 1083–1084.
- Williams, I. D., Brown, P. W. & Taylor, N. J. (1992a). *Acta Cryst.* **C48**, 263–266.
- Williams, I. D., Brown, P. W. & Taylor, N. J. (1992b). *Acta Cryst.* **C48**, 259–263.
- Zaleski, J. (1997). *Ferroelectrics*, **192**, 71–79.

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### Bis( $\mu$ -acetato){ $\mu$ -2,6-bis[(2-hydroxybenzyl)-(2-pyridylmethyl)aminomethyl]-4-methylphenolato}diindium(III) nitrate dihydrate

ADAILTON J. BORTOLUZZI,<sup>a</sup> ADEMIR NEVES,<sup>a</sup> IVO VENCATO,<sup>a</sup> CESAR ZUCCO<sup>a</sup> AND MANFREDO HÖRNER<sup>b</sup>

<sup>a</sup>Departamento de Química—UFSC, 88040-900 Florianópolis, SC, Brazil, and <sup>b</sup>Departamento de Química—UFMS, 88040-900 Santa Maria, RS, Brazil. E-mail: adajb@alpha2.qmc.ufsc.br

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#### Abstract

In the title compound, [In<sub>2</sub>(C<sub>35</sub>H<sub>33</sub>N<sub>4</sub>O<sub>3</sub>)(C<sub>2</sub>H<sub>3</sub>O<sub>2</sub>)<sub>2</sub>]-NO<sub>3</sub>·2H<sub>2</sub>O, a new binuclear In<sup>III</sup> complex, the metal centers are linked by one phenolate and two acetate bridging groups. The In<sup>III</sup> ions are in a distorted octahedral environment and they are related by imposed crystallographic C<sub>2</sub> symmetry.

#### Comment

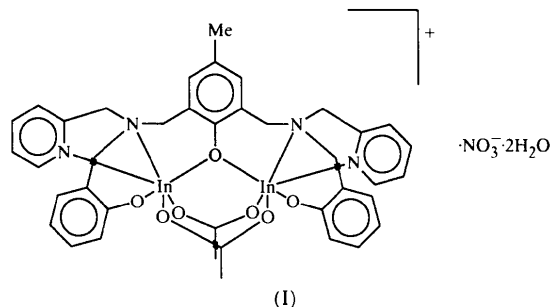
<sup>111</sup>In and <sup>113</sup>In are useful radionuclides for some diagnostic imaging procedures in nuclear medicine (Remy *et al.*, 1995; Jamar *et al.*, 1995). These isotopes are appropriate  $\gamma$ -emitters for imaging using techniques such as single-photon emission computed tomography.

Special conditions in the physiological environment (*e.g.* pH), and the high affinity between serum proteins in human blood (*e.g.* transferrin) and trivalent metal ions requires the development of indium complexes with high stability for radiopharmaceutical applications. They must be thermodynamically stable to avoid hydrolysis processes in the organism, as well as being kinetically

inert to prevent demetalation by transferrin (Jurisson *et al.*, 1993).

A number of complexes with linear and tripodal polydentate amine–phenol ligands have been reported previously (Wong, Liu, Lügger *et al.*, 1995; Wong, Liu, Rettig & Orvig, 1995; Liu *et al.*, 1993). These ligands have been considered as effective chelating agents capable of producing highly stable mononuclear complexes with group 13 metal ions.

We report here for the first time the homodinuclear complex [In<sub>2</sub>(BBPMP)(OAc)<sub>2</sub>]NO<sub>3</sub>·2H<sub>2</sub>O, (I), with an N<sub>4</sub>O<sub>3</sub>-donor dinucleating ligand which contains phenolate and pyridyl pendant arms {H<sub>3</sub>BBPMP is 2,6-bis[(2-hydroxybenzyl)(2-pyridylmethyl)aminomethyl]-4-methylphenol and OAc is acetate}. H<sub>3</sub>BBPMP is a symmetric and non-linear amine–phenol ligand. It has a molecular structure suitable for the formation of binuclear phenolate-bridged complexes (Neves *et al.*, 1993, 1996; de Brito *et al.*, 1997). In this work, we have used the H<sub>3</sub>BBPMP ligand to synthesize the first example of a binuclear indium complex with two bridging acetate groups.



The [In<sub>2</sub>(BBPMP)(OAc)<sub>2</sub>]<sup>+</sup> cation has C<sub>2</sub> symmetry, with atoms O10, C11, C14 and C17 of the BBPMP<sup>3-</sup> ligand lying on the crystallographic twofold axis (Fig. 1). Each In<sup>III</sup> ion is coordinated by one O (phenolate) and two N (amine and pyridyl) atoms of the main ligand in the external face, while three O atoms of one phenolate and two carboxylate bridging groups in the internal face complete the coordination sphere. The O atom of the terminal phenolate arm is coordinated in a *trans* position to the phenolate bridging group. A similar arrangement of the BBPMP<sup>3-</sup> ligand around a metal ion was also observed in the [Fe<sub>2</sub>(BBPMP)(OAc)<sub>2</sub>]ClO<sub>4</sub>·H<sub>2</sub>O (Neves *et al.*, 1993), NH<sub>4</sub>[Fe<sub>2</sub>(BBPMP)(SO<sub>4</sub>)<sub>2</sub>] (de Brito *et al.*, 1997) and [Fe<sub>2</sub>(BBPMP){O<sub>2</sub>P(OPh)<sub>2</sub>}]<sub>2</sub>ClO<sub>4</sub>·H<sub>2</sub>O (Krebs *et al.*, 1994) complexes. As in the iron complexes, the greatest distortion in the coordination sphere of the metal is the acute N<sub>amine</sub>—In—N<sub>pyridyl</sub> angle of 75.7(1)°, imposed by formation of the five-membered chelate ring. The M—O—M angle varies according to the rigidity of the bridging groups. In the complexes [In<sub>2</sub>(BBPMP)(OAc)<sub>2</sub>]NO<sub>3</sub>·2H<sub>2</sub>O and [Fe<sub>2</sub>(BBPMP)(OAc)<sub>2</sub>]ClO<sub>4</sub>·H<sub>2</sub>O, which are