Tableau 3. *Angles inter-plans*

Plan–Plan		Angle (±1°)
I	II	139
I	III	80
I	IV	135
II	III	61
II	IV	17
III	IV	55

L'azote le plus basique de la molécule est l'azote N(10) du cycle pipérazine; ce sera donc lui qui sera protoné dans les sels. Sa position spatiale est définie par les deux angles de torsion C(20)–C(14)–C(13)–N(10) $\simeq 67°$ et C(15)–C(14)–C(13)–N(10) $\simeq -80°$. L'hypothèse qui a généralement cours pour le mode de fixation des antagonistes α sur leurs récepteurs met en jeu au moins deux sites: un atome d'azote protoné distant d'environ 5,5 Å d'une zone riche en électrons délocalisés (généralement un système aromatique) (McGrath, 1982). Un troisième site, représenté par un autre nuage électronique distant lui aussi de 5,5 Å de l'azote protoné, semble également intervenir dans le processus de fixation de certains antagonistes comme les alcaloïdes pentacycliques (Dubost, Léger, Goursolle, Colleter & Carpy, 1984) ou de certaines molécules de synthèse flexibles (Carpy, Léger & Colleter, 1984). Dans le cas présent, seule la distance N(10)–π_1 (π_1 milieu du groupement méthoxyphényl) = 5,66 (1) Å possède la valeur attendue; les distances N(10)–π_2 = 4,60 (1) Å (π_2 milieu du cycle aniline) et N(10)–π_3 = 4,57 (1) Å (π_3 milieu du cycle φ du groupement benzofurannone) s'écartant d'environ 1 Å de la valeur proposée. La position de l'azote protonable N(10) par rapport au groupement méthoxyphényl est comparable à celle trouvée dans d'autres antagonistes α_1-sélectifs tels le WB-4101 (Carpy, Colleter & Léger, 1981) et l'AR-C239 (Carpy, Goursolle & Léger, 1983).

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Structure of 4′-Amino-2,2,3′-trichloroacetophenone, $C_8H_6Cl_3NO$

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Abstract. $M_r = 238{\cdot}51$, monoclinic, $P2_1/a$, $a = 7{\cdot}425$ (4), $b = 9{\cdot}089$ (5), $c = 14{\cdot}202$ (4) Å, $\beta = 92{\cdot}27$ (3)°, $V = 950{\cdot}78$ Å^3, $Z = 4$, $D_m = 1{\cdot}69$, $D_x = 1{\cdot}67$ Mg m^{-3}, λ(Cu $K\alpha$) = 1·5418 Å, $\mu = 8{\cdot}35$ mm^{-1}, $F(000) = 480$, $T = 297$ K. Final $R = 0{\cdot}065$ for 1279 observed reflections. The expected distortion in the benzene nucleus consequent to the substitution of electron-releasing (amino) and electron-withdrawing (chloro) groups has been observed. The acetyl group and the phenyl ring are strongly conjugated, the corresponding dihedral angle being 1·09°. The structure is stabilized by intermolecular N(1)–H(N)1···O(1) hydrogen bonds of 2·959 (7) Å.

Introduction. Since the first isolation of the widely used broad-spectrum antibiotic chloramphenicol, D-(−)-*threo*-2,2-dichloro-*N*-[2-hydroxy-1-(hydroxymethyl)-2-(*p*-nitrophenyl)ethyl]acetamide, a large number of related compounds have been synthesized and studied in order to gain some insight into the structure–activity relationship of the drug. Although these studies have so far failed to provide any definite idea about the exact structural component responsible for the activity, the dichloroacetamide (–NHCOCHCl$_2$) group appears to play an important role in the biological activity of the antibiotic. The replacement of the dichloroacetyl group (–COCHCl$_2$) with various acyl or aryl groups leads to

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some interesting findings (Rebstock, 1950). The present paper deals with the structure of 4′-amino-2,2,3′-trichloroacetophenone, a structural analogue of chloramphenicol.

Experimental. Transparent needle-shaped crystals from ethanol, initial cell parameters and symmetry from oscillation and Weissenberg photographs, systematic absences: $0k0$, k odd and $h0l$, h odd, crystal size: $0{\cdot}23 \times 0{\cdot}20 \times 0{\cdot}18$ mm, accurate cell parameters from 25 reflections ($15 \leq \theta \leq 20°$), intensity data measured on an Enraf–Nonius CAD-4 diffractometer using graphite-monochromatized Cu $K\alpha$ radiation, 1517 unique reflections measured ($h = -8$ to 8, $k = 0$ to 10, $l = 0$ to 15; $2 \leq \theta \leq 60°$), 1279 observed reflections with $I \geq 3\sigma(I)$, correction for Lp, absorption ignored, intensity variation (<1·5%) corrected for, Cl position located from Patterson synthesis, location of other non-H atoms from Cl-phased Fourier synthesis, block-diagonal least-squares refinement on F for non-H atoms, H (located from ΔF synthesis) not refined, $R = 0{\cdot}065$ (observed reflections), $R_w = 0{\cdot}063$, $w = 1/\sigma^2(|F_o|)$, R (all reflections) = 0·07, max. shift/error <0·01, peak heights in range −0·31 to +0·33 e Å^{-3} in final ΔF synthesis, scattering factors for non-H atoms from Cromer & Waber (1965), for H from Stewart, Davidson & Simpson (1965).

Discussion. A projection of the structure along the a axis and the atomic-labeling scheme are presented in Fig. 1. Table 1 lists the final atomic parameters while the molecular dimensions are listed in Table 2.* The structure of the present compound was compared with those of *p*-aminoacetophenone (Haisa, Kashino, Yuasa & Akigawa, 1976), *p*-nitroacetophenone (Kim, Boyko & Carpenter, 1973) and chloramphenicol (Ravindra Acharya, Sake Gowda & Post, 1979; Chatterjee, Duttagupta, Saha, Saenger & Muller, 1979). The expected deformation of the endocyclic angle due to an electron-releasing (amino) or electron-withdrawing (nitro) group substituted in the phenyl ring is observed in the cases of all these structures (Domenicano, Vaciago & Coulson, 1975; Domenicano, Mazzeo & Vaciago, 1976; Domenicano & Vaciago, 1979). In the present structure the lengthening of the C(1)–C(2) and C(1)–C(6) bond distances compared to C(2)–C(3) and C(6)–C(5) bond distances is also as expected.

Owing to the amino substitution on C(1), atom C(6), which is *ortho* to C(1), is comparatively electron-rich; the chlorine Cl(3) substituent on C(6) then behaves as an electron-withdrawing group, resulting in the widening of the C(1)–C(6)–C(5) angle relative to C(1)–C(2)–C(3). This is in conformity with the observation that the effects of multiple substitution in the phenyl ring are independent and superimposable (Domenicano & Murray-Rust, 1979).

The amino substitution also results in electron enrichment at the *para* position, C(4). The π-electron cloud of the C(7)–O(1) bond together with this electron enrichment at C(4) results in a conjugation of the C(4)–C(7) bond with the phenyl ring and a consequent shortening of this bond from that observed in acetophenone (Tanimoto, Kobayashi, Nagakura & Saito, 1973).

Table 1. *Fractional atomic coordinates with e.s.d.'s in parentheses and equivalent isotropic temperature factors (Hamilton, 1959) for non-H atoms*

	x	y	z	B_{eq}(Å^2)
Cl(1)	0·9981 (3)	0·1833 (2)	0·8786 (2)	4·74
Cl(2)	0·2828 (3)	−0·0172 (2)	0·9546 (1)	4·50
Cl(3)	0·2565 (4)	−0·3963 (2)	0·5136 (1)	5·49
N(1)	0·1798 (9)	−0·6220 (6)	0·6526 (4)	4·71
O(1)	0·1634 (7)	0·0712 (5)	0·7207 (3)	5·20
C(1)	0·1687 (9)	−0·4831 (8)	0·6839 (5)	3·97
C(2)	0·1273 (9)	−0·4462 (7)	0·7749 (5)	3·49
C(3)	0·1148 (9)	−0·3017 (7)	0·8058 (5)	3·16
C(4)	0·1441 (8)	−0·1867 (7)	0·7454 (4)	2·90
C(5)	0·1882 (9)	−0·2161 (7)	0·6545 (4)	3·17
C(6)	0·1988 (9)	−0·3599 (8)	0·6266 (5)	3·63
C(7)	0·1339 (9)	−0·0317 (8)	0·7733 (5)	3·45
C(8)	0·0842 (9)	0·0040 (7)	0·8720 (5)	3·32

Table 2. *Bond distances* (Å) *and angles* (°)

Cl(1)–C(8)	1·757 (7)	C(2)–C(3)	1·392 (9)
Cl(2)–C(8)	1·774 (7)	C(3)–C(4)	1·386 (9)
Cl(3)–C(6)	1·744 (7)	C(4)–C(5)	1·397 (9)
N(1)–C(1)	1·345 (9)	C(4)–C(7)	1·468 (9)
O(1)–C(7)	1·234 (8)	C(5)–C(6)	1·371 (10)
C(1)–C(2)	1·406 (10)	C(7)–C(8)	1·529 (9)
C(1)–C(6)	1·419 (10)		

N(1)–C(1)–C(2)	123·9 (6)	Cl(3)–C(6)–C(1)	116·9 (5)
N(1)–C(1)–C(6)	122·0 (6)	Cl(3)–C(6)–C(5)	118·5 (5)
C(2)–C(1)–C(6)	114·1 (6)	C(1)–C(6)–C(5)	124·6 (6)
C(1)–C(2)–C(3)	123·1 (6)	O(1)–C(7)–C(4)	123·1 (6)
C(2)–C(3)–C(4)	119·6 (6)	O(1)–C(7)–C(8)	118·4 (6)
C(3)–C(4)–C(5)	120·1 (6)	C(4)–C(7)–C(8)	118·5 (6)
C(3)–C(4)–C(7)	122·6 (6)	Cl(1)–C(8)–Cl(2)	110·0 (4)
C(5)–C(4)–C(7)	117·3 (6)	Cl(1)–C(8)–C(7)	112·2 (5)
C(4)–C(5)–C(6)	118·6 (6)	Cl(2)–C(8)–C(7)	107·8 (5)

* Lists of structure factors, anisotropic thermal parameters, H-atom parameters, selected torsion angles and least-squares-planes' data have been deposited with the British Library Lending Division as Supplementary Publication No. SUP 39639 (15 pp.). Copies may be obtained through The Executive Secretary, International Union of Crystallography, 5 Abbey Square, Chester CH1 2HU, England.

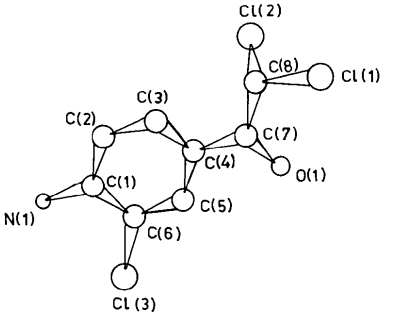

Fig. 1. View of the molecule down the a axis.

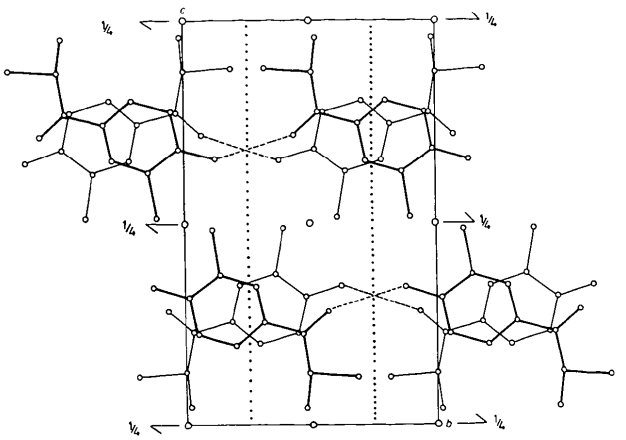

Fig. 2. Projection of the crystal structure of 4′-amino-2,2,3′-trichloroacetophenone down the *a* axis.

The small dihedral angle (1·091°) between the least-squares planes of the phenyl ring and the acetyl group [C(4), C(7), O(1), C(8)] also indicates a strong conjugation.

The increase in the C(7)–C(8) bond distance in the present structure compared to that in *p*-aminoacetophenone [1·498 (6) Å] can be explained as the effect of substitution at C(8). This lengthening is also observed in the structure of chloramphenicol which has similar substitution (Chatterjee *et al.*, 1979; Ravindra Acharya *et al.*, 1979).

The coplanarity of the acetyl group with the phenyl ring results in a short C(5)–H(5)···O(1) contact [C(5)···O(1) = 2·790 (8), H(5)···O(1) = 2·47 Å, ∠C(5)–H(5)···O(1) = 94·96°].

Of the two amino H atoms only one, H(N)1, takes part in an intermolecular N(amino)–H···O(carboxyl) hydrogen bond [N(1)–H(N)1 = 0·98, N(1)–O(1) = 2·959 (7), H(N)1···O(1) = 2·12 Å, ∠N(1)–H(N)1···O(1) = 143°].

In packing (Fig. 2) a partial overlapping of the phenyl ring is observed. The dichloroacetyl group and the chlorine substituent at C(6) form bands extending along the *b* axis.

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Cyclic Dipeptides Containing Proline. Structure and Conformation of *cyclo*(L-Phe-L-Pro-), $C_{14}H_{16}N_2O_2$

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Abstract. $M_r = 244·3$, monoclinic, $P2_1$, $a = 10·789$ (2), $b = 10·061$ (2), $c = 5·668$ (3) Å, $\beta = 92·70$ (3)°, $V = 614·6$ (4) Å^3, $Z = 2$, $D_x = 1·32$ Mg m^{-3}, λ(Mo $K\alpha$) = 0·71069 Å, $\mu = 0·1$ mm^{-1}, $F(000) = 260$, room temperature, final $R = 0·038$ for 1739 independent observed reflections. The diketopiperazine ring has a pronounced boat conformation with equatorial C^β atoms. The degree of folding along the line joining the two C^α

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