Acta Cryst. (1978). B**34**, 2890–2891

3-Amino-6-bromo-1-methyl-2,4(1*H*,3*H*)-quinazolinedione

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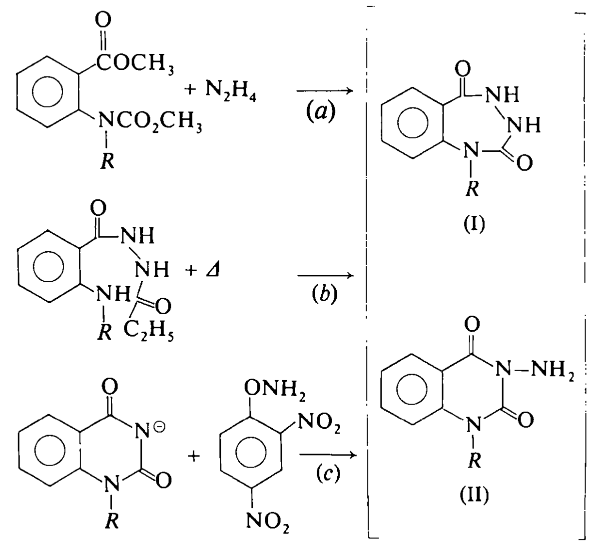
(*Received* 21 *March* 1978; *accepted* 24 *April* 1978)

Abstract. $C_9H_8BrN_3O_2$, triclinic, $P\bar{1}$, $a = 6{\cdot}826\,(1)$, $b = 8{\cdot}091\,(1)$, $c = 9{\cdot}538\,(2)$ Å, $\alpha = 93{\cdot}88\,(2)$, $\beta = 109{\cdot}60\,(2)$, $\gamma = 104{\cdot}02\,(2)°$, $V = 475{\cdot}1$ Å^3, $Z = 2$, $D_x = 1{\cdot}89$, $D_m = 1{\cdot}8$ g cm^{-3} (flotation in CCl_4–CH_3I at 25 °C). The crystal structure has been determined and block-diagonal least-squares refinement led to $R = 0{\cdot}041$, $R_w = 0{\cdot}042$ for the 1762 observed reflections. The structure found is chemically derived from quinazoline and not from benzotriazepine as originally suggested.

Introduction. More than 77 compounds of pharmaceutical interest were synthesized (Bailey, 1971) and reported initially as derivatives of 3,4-dihydro-1*H*-1,3,4-benzotriazepine (I, R = H). The general method of preparation was the condensation of alkyl *N*-carboxyanthrilates with hydrazines as shown in equation (*a*) below. Ambiguity concerning the chemical structure arose from the fact that two other reactions, shown in equations (*b*) and (*c*), resulted in identical products, although reaction (*c*) favored a quinazolinedione formula (II). An X-ray crystal structure determination was undertaken to decide between the two possibilities. The compound chosen, which has sedative and anti-inflammatory properties (Bailey, 1971) had R = CH_3 and a Br atom substituted in the benzene ring.



While the X-ray determination was in progress further chemical work was reported (Peet & Sunder, 1975) which supported the quinazolinedione structure and these authors argued that the greater thermodynamic stability of the six- over the seven-membered hetero-ring could result in the formation of quinazolines even in syntheses designed to produce benzotriazepines.

The crystals were colorless, transparent, prisms elongated along **a**. The X-ray data were measured on an Enraf–Nonius CAD-4 automated diffractometer using Ni-filtered Cu $K\alpha$ radiation and a crystal measuring $0{\cdot}07 \times 0{\cdot}07 \times 0{\cdot}132$ mm. The unit-cell parameters were determined by a least-squares fit of the angular settings for 15 high-angle reflections. The ω–2θ scanning mode was used with $\theta < 75°$. The intensities were corrected for Lorentz–polarization and absorption effects [μ(Cu $K\alpha$) = $63{\cdot}98$ cm^{-1}]. The absorption corrections to the intensities were calculated by *ORABS* 2 (Busing, 1972), using the six faces ±(100), (010), (001), and were in the range 1·44–2·18. Of 1882 possible independent reflections 1762 were accepted as observed on the criterion $I \geq 1{\cdot}5\sigma(I)$.

The structure was solved by the heavy-atom method and after refinement of all the C, N and O parameters the H atom positions were found from a difference electron density map. Refinement by the block-diagonal least-squares method was then carried out on all posi-

Table 1. *Fractional atomic coordinates* (× 10^4) *for the non-hydrogen atoms*

	x	*y*	*z*
Br	−999 (1)	−2972 (1)	−20 (1)
N(1)	3337 (4)	−452 (3)	6716 (3)
C(2)	4041 (4)	1281 (4)	7302 (3)
N(3)	3667 (4)	2407 (3)	6258 (3)
C(4)	2707 (4)	1976 (3)	4724 (3)
C(5)	1009 (4)	−463 (3)	2625 (3)
C(6)	371 (4)	−2200 (4)	2092 (3)
C(7)	746 (5)	−3383 (4)	3068 (3)
C(8)	1727 (5)	−2825 (3)	4601 (3)
C(9)	2370 (4)	−1055 (3)	5182 (3)
C(10)	2010 (4)	114 (3)	4172 (3)
C(11)	3667 (6)	−1652 (4)	7806 (4)
O(12)	4917 (4)	1842 (3)	8638 (2)
N(13)	4282 (4)	4187 (3)	6867 (3)
O(14)	2504 (4)	3075 (1)	3911 (2)

Table 2. *Fractional coordinates* ($\times 10^3$) *and isotropic thermal parameters*

The temperature factors used were of the form $\exp(-B \sin^2 \theta/\lambda^2)$.

	x	y	z	B (Å^2)
H(5)	76 (5)	43 (4)	198 (4)	0·9 (6)
H(7)	21 (6)	−469 (5)	268 (4)	1·4 (7)
H(8)	196 (5)	−359 (4)	526 (4)	1·1 (6)
H(11,1)	450 (11)	−240 (9)	763 (8)	7·2 (17)
H(11,2)	222 (9)	−261 (8)	760 (7)	5·2 (13)
H(11,3)	435 (9)	−97 (7)	874 (7)	4·8 (12)
H(13,1)	491 (7)	421 (5)	783 (5)	2·4 (8)
H(13,2)	526 (7)	467 (5)	655 (5)	2·4 (8)

Table 3. *Bond angles* (°) *involving non-hydrogen atoms*

C(9)–N(1)–C(2)	122·4 (2)	C(10)–C(4)–O(14)	124·3 (3)
C(9)–N(1)–C(11)	121·0 (2)	C(4)–C(10)–C(9)	120·5 (2)
C(11)–N(1)–C(2)	116·6 (2)	C(10)–C(9)–N(1)	119·7 (2)
N(1)–C(2)–N(3)	116·1 (2)	C(10)–C(5)–C(6)	119·3 (3)
N(1)–C(2)–O(12)	123·7 (3)	C(5)–C(6)–C(7)	121·0 (3)
O(12)–C(2)–N(3)	120·2 (3)	C(6)–C(7)–C(8)	120·1 (3)
C(2)–N(3)–C(4)	127·1 (2)	C(7)–C(8)–C(9)	120·1 (3)
C(2)–N(3)–N(13)	116·1 (2)	C(8)–C(9)–C(10)	118·6 (3)
C(4)–N(3)–N(13)	116·7 (2)	C(9)–C(10)–C(5)	120·8 (3)
N(3)–C(4)–C(10)	114·1 (2)	C(5)–C(6)–Br	118·9 (2)
N(3)–C(4)–O(14)	121·6 (3)	C(7)–C(6)–Br	120·1 (2)

tional parameters, isotropic thermal parameters for the H atoms and anisotropic thermal parameters for the other atoms. The function minimized was $\sum w(|F_o| - |F_c|)^2$ where w was obtained from the counting statistics for the observed reflections. During the last cycles the 53 unobserved reflections for which $|F_c|$ was greater than the threshold value of F_o were included at their most probable values, with a constant weight such that the mean values of $w|\Delta F_o|^2$ were equal for the observed and unobserved reflections. The other unobserved reflections were assigned a weight of zero. In the final cycle R_w = 0·042 and R = 0·041 (observed reflections only) and 0·043 (all reflections); the mean and maximum shift/e.s.d. = 0·023 and 0·094 and $[\sum w(\Delta F)^2/(m-n)]^{1/2}$ = 1·75. The coordinates of the non-hydrogen atoms are given in Table 1 and the coordinates and isotropic thermal parameters of the H atoms in Table 2.* The scattering factors used, including anomalous dispersion corrections, are those given in *International Tables for X-ray Crystallography* (1962) and all structural calculations were performed with the NRC system (Ahmed, Hall, Pippy & Huber, 1973).

Discussion. The structure found is clearly that of a quinazolinedione, and it is therefore indicated that many compounds previously formulated as benzotriazepines are, in fact, quinazolines. The result is in strong confirmation of the conclusions of Peet & Sunder (1975) that the six-membered hetero-ring is favored, regardless of the synthetic route.

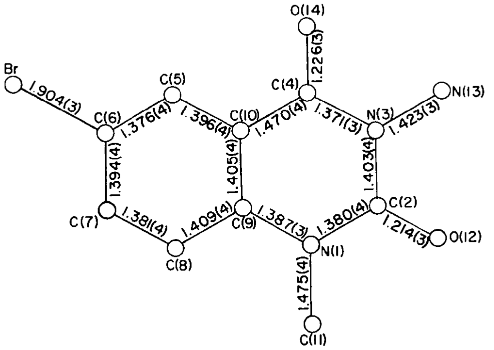


Fig. 1. Bond distances (Å) between the non-hydrogen atoms, corrected for molecular libration.

The bond distances between non-hydrogen atoms are shown in Fig. 1. These have been corrected for molecular libration (Schomaker & Trueblood, 1968), the corrections ranging from 0·003–0·006 Å. The bond angles (uncorrected) are given in Table 3. The C–H distances range from 0·91–1·05 Å with e.s.d.'s of 0·03–0·04 Å for the H atoms bonded to ring C atoms and 0·06–0·08 Å in the methyl group. The N–H distances are 0·87 (4) and 0·84 (5) Å. The molecular dimensions show no abnormalities. The two six-membered rings are separately planar within experimental error but the dihedral angle between their weighted least-squares mean planes is 1°.

Within the molecule there is an interaction shorter than the van der Waals distance between O(12) and H(13,1) which are 2·11 (5) Å apart. The O(12)–N(13) distance is 2·642 (3) Å and the angle O(12)–H(13,1)–N(13) is 119 (4)°. Intermolecular hydrogen bonding exists between the pair of molecules related by the symmetry center at $\frac{1}{2},\frac{1}{2},\frac{1}{2}$. The distance H(13,2)–O(14′) is 2·25 (5) Å, N(13)–O(14′) is 3·039 (4) Å and the angle O(14′)–H(13,2)–N(13) is 155 (4)°.

We thank Dr D. M. Bailey of Sterling Drug, Inc., for crystals of the title compound.

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* Lists of structure factors and anisotropic thermal parameters have been deposited with the British Library Lending Division as Supplementary Publication No. SUP 33569 (21 pp.). Copies may be obtained through The Executive Secretary, International Union of Crystallography, 5 Abbey Square, Chester CH1 2HU, England.