ellipsoids. Inspection of the result indicates that the carbon atoms which are not involved in the crowding around the central Si atom undergo stronger vibration; they are  $C(\alpha, 3)$ ,  $C(\alpha, 4)$ ,  $C(\alpha, 6)$ ,  $C(\alpha, 7)$  and the three outside carbon atoms in the phenyl ring. The directions of the maximum amplitudes are almost in the ring planes. The characteristics of the thermal motion in the two crystals are quite similar and the *F* compound has larger amplitude than the *H* compound; this is reasonable in view of the stability of these two compounds.

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#### References

- Ashida, T., PEPINSKY, R. & OKAYA, Y. (1963). Acta Cryst. 16, A48.
- BROOK, A. G. & LIMBURG, W. W. (1963). J. Amer. Chem. Soc. 85, 832.
- COLE, H., OKAYA, Y. & CHAMBERS, F. W. (1963). Rev. Sci. Instrum. 34, 872.
- CRUICKSHANK, D. W. J. (1957). Acta Cryst. 10, 504.
- HAMILTON, W. C. (1965). Acta Cryst. 19, 502.
- IBERS, J. A. & HAMILTON, W. C. (1964). Acta Cryst. 17, 781.
- OKAYA, Y. (1963). Abstract for the ACA Computing Conference, IBM Research Center, March.
- OKAYA, Y. (1964). Control Program for Computer-Controlled Diffractometers. IBM Internal Report.
- PAULING, L. (1960). The Nature of the Chemical Bond.
- SMITH, G. S. (1964). Paper J-9, ACA Meeting, Montana State College.
- SOMMER, L. H. (1962). Angew. Chem. Internat. Ed. 1, 143.
- SOMMER, L. H., FRYE, C. L., MUSOLF, M. C., PARKER, G. A., RODEWALD, P. G., MICHAEL, K. W., OKAYA, Y. & PE-PINSKY, R., (1961). J. Amer. Chem. Soc. 83, 2210.

Acta Cryst. (1966). 20, 471

### The Crystal Structure of Tetraphenylarsonium 3-Fluoro-1,1,4,5,5-pentacyano-2-azapentadienide

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One of the two carbanions produced by the reaction of sodium or potassium cyanide with 1,2-dichlorohexafluorocyclopentene has been identified by X-ray diffraction as 3-fluoro-1,1,4,5,5-pentacyano-2azapentadienide. The crystal structure analysis of the tetraphenylarsonium salt was completed without any chemical assumptions.

Tetraphenylarsonium 3-fluoro-1,1,4,5,5-pentacyano-2-azapentadienide forms deep red orthorhombic crystals with a=9.789, b=24.601, c=23.918 Å. The space group is *Pcab* with 8 molecules per unit cell. The structure was refined by least-squares methods and the final residual (*R*) was 5.7 % for the 2835 reflections included in the analysis.

In the cation the arsenic atom is bonded to four carbon atoms at the corners of a tetrahedron with an average As-C bond distance of  $1.897 \pm 0.009$  Å. The cation's ideal 4 symmetry is destroyed by rotation of the four planar phenyl groups around the As-C bond. The average C-C bond distance in the four phenyl groups is  $1.389 \pm 0.012$  Å.

The deep red carbanion is nonplanar, probably the result of internal steric effects. The average of the five  $C \equiv N$  bonds is  $1.146 \pm 0.012$  Å, in agreement with other reported cyano compounds.

#### Introduction

The reaction of sodium or potassium cyanide with an excess of 1,2-dichlorohexafluorocyclopentene produces deeply colored solutions. From this reaction mixture, Carpenter (1965) found that two strongly colored carbanions could be isolated as the tetraalkylammonium, -phosphonium or -arsonium salts. The microanalyses indicated that the red carbanion had an approximate

empirical formula of  $C_{9-11}N_6OF$ . The magenta carbanion was formulated as  $C_{11}N_6F$ . Since the chemical and physical properties did not suggest a structure, an X-ray crystal structure determination appeared essential. The tetraphenylarsonium salt of the red anion (henceforth TPAS<sup>+</sup> RD<sup>-</sup>) was chosen for the X-ray investigation since it was the most unusual of the two carbanions. The presence of the tetraphenylarsonium cation suggested that the structure of the anion could be ascertained with a minimum of chemical assumptions. The results of our study showed that the anion was 3-fluoro-1,1,4,5,5-pentacyano-2-azapentadienide:



Experimental

The TPAS<sup>+</sup> RD<sup>-</sup> crystallizes from acetone as deep red surfboard-shaped crystals. Weissenberg photographs taken about the  $\tilde{a}$  axis indicated orthorhombic symmetry with no evidence of twinning or disorder. The systematic absences were:

hkl no absences

$$0kl$$
 absent if  $l=2n+1$ 

$$h0l$$
 absent if  $h=2n+1$ 

$$hk0$$
 absent if  $k=2n+1$ 

The space group is uniquely determined to be *Pcab*  $(D_{2n}^{15})$ .

A crystal was cleaved to give a parallelepiped  $0.05 \times 0.09 \times 0.21$  mm, dipped in liquid nitrogen, and then mounted on a General Electric single-crystal orienter. The long dimension of the crystal (the  $\tilde{a}$  axis) was parallel to the  $\varphi$  axis of the orienter. The unit-cell dimensions were determined with a narrow beam of copper radiation ( $\alpha_1 = 1.54050$  and  $\alpha_2 = 1.54434$  Å) with a narrow slit at the counter window. The averages of these measurements are given below:

$$a = 9.789 \pm 0.003, \quad b = 24.601 \pm 0.006,$$
  
 $c = 23.918 \pm 0.006 \text{ Å}.$ 

The density of TPAS<sup>+</sup> RD<sup>-</sup> was determined by flotation in a potassium iodide solution to be 1.368g. cm<sup>-3</sup>. The molecular weight of the anion was calculated to be 205.0 g, indicating that the microanalyses were probably in error. The density calculated for eight molecules of tetraphenylarsonium 3-fluoro-1,1,4,5,5-pentacyano-2-azapentadienide per unit cell is 1.371 g.cm<sup>-3</sup>.

Intensity measurements were made using a proportional counter with a linear amplifier-pulse height selector combination. The stationary-crystal stationarycounter technique was employed in measuring the 4278 reflections with  $2\theta \le 120 \cdot 0^\circ$ . The 285 0kl reflections with l=2n+1 were also surveyed and were used to calculate a background correction. The 2850 reflections which were greater than 1.2 times the background count at that particular value of  $2\theta$  were considered to be observed reflections. A correction for the  $\alpha_1 - \alpha_2$ splitting was calculated by comparing selected stationary crystal intensities with the corresponding values measured by the moving crystal-moving counter technique.

#### Determination and refinement of the trial structure

A sharpened three-dimensional Patterson synthesis with the origin peak removed was calculated. The arsenic-arsenic vectors were easily identified in the Harker sections. The value of the x coordinate for the arsenic atom is approximately  $\frac{1}{4}$ , introducing an ambiguity in the z coordinate between z and  $\frac{1}{4} - z$ . By comparing a minimum function based on the arsenicarsenic vector with a series of low-resolution Fourier syntheses computed using only the terms with l=2n, the orientations of the four phenyl groups were determined. Structure factors were computed for all the observed reflections, using the two choices for the zcoordinate of the arsenic atom. The agreement between the observed and calculated values was better for z=0.142 than for z=0.108 and the former value was used in all subsequent calculations.

An observed and a difference Fourier synthesis were then computed with the contribution of the tetraphenylarsonium group to determine the phases. Only sixteen peaks ranging in heights from 2.4 to 6.6 e.Å<sup>-3</sup> were found which could be assigned to the anion. The identification of the atom peaks was based on chemical considerations; for example, three collinear terminal atoms were assumed to be a cyano group attached to a carbon atom. The mean carbon atom peak height was  $3.8 \text{ e.}\text{Å}^{-3}$ , and the mean nitrogen atom peak height was  $3.9 \text{ e.}\text{Å}^{-3}$ . The fluorine atom peak height was 6.6e.Å<sup>-3</sup>. An observed and a difference Fourier synthesis using all 41 atoms for determining the phases revealed no additional peaks. Since a nitrogen atom in the chain was unexpected, N(40) was assumed to be a carbon atom in the initial refinement. The initial parameters for the least-squares refinement were obtained from the 41 atom-observed Fourier synthesis. The starting value of R, the usual residual, was 19.1%.

Because of the large number of variables involved in the refinement, the block approximation to the full matrix was employed. A  $3 \times 3$  block was used for the positional parameters and a  $6 \times 6$  block for the anisotropic thermal parameters. The quantity minimized was  $\Sigma w (\Delta F)^2$ , where  $\Delta F = |F_o| - |F_c|$  and the weighting scheme was:

if $F(obs) < 100$	$\sqrt{w} = F(\text{obs})/100$
if $100 < F(obs) \le 400$	y/w = 1.0
if $400 < F(obs)$	w = 400/F(obs).

Partial shifts of 0.75 and 0.375 were used for the positional and thermal parameters respectively. The scale factor G was shifted by 0.20 times the amount calculated by dividing  $\Sigma w \Delta F(\partial |F_c|/\partial G)$  by  $\Sigma w(\partial |F_c|/\partial G)_2$ .

A total of four least-squares cycles reduced the residual R to 8.5%. A comparison of the thermal parameters for atom 40 (which had been refined as a carbon atom to this point) with those of carbons 30–33 in the chain indicated that atom 40 was a nitrogen and not a carbon atom. The subsequent refinements all used atom 40 as a nitrogen atom. Five more least-squares cycles reduced the residual R to 6.7%.

At this point a careful study of the observed and calculated structure factors, the original data, and some Weissenberg photographs revealed a few errors in the observed amplitudes. These errors were corrected where feasible. Three reflections for which a setting error had been made were removed from the data and are noted by an asterisk in Table 4.

A difference Fourier synthesis was calculated in an attempt to locate the 20 hydrogen atoms of the four phenyl groups. Positions for all the hydrogen atoms

 Table 1. Final positional parameters and their estimated deviations for the heavy atoms

were obtained from the difference synthesis. An isotropic temperature factor (the average of the isotropic equivalent of its respective carbon atom) was assigned to each hydrogen atom. The contribution of the hydrogen atoms was included in the subsequent leastsquares refinement, but their positional and thermal parameters were not varied.

Six additional least-squares cycles were computed before the refinement was terminated. On the final cycle the average shift in the positional parameters for the carbon and nitrogen atoms was 0.0004 Å. The largest shift was 0.0022 Å [for the y coordinate of N(39)], which is one-third of the standard deviation for that

## Table 2. Final thermal parameters and their estimated standard deviations for the heavy atoms

From final least After correction for libration squares All values have been multiplied by 105.  $(\times 10^{4})$  $(\times 10^{4})$ The temperature factor for an atom is of the form  $\exp\left[-(\beta_{11}h^2 + \beta_{22}k^2 + \beta_{33}l^2 + \beta_{12}hk + \beta_{13}hl + \beta_{23}kl)\right]$ y Atom х z х z y Atom  $\beta_{11}$  $\beta_{22}$ β33  $\beta_{12}$  $\beta_{13}$ B23 C(1) C(2) C(1) -00028C(3) C(2) C(4) C(3) -0236-0237C(4) -00015 C(5) C(6) -0114-0115C(5) -0098C(6) C(7) -0097C(8) -0574-0575C(7) C(9) -1041C(8) -00177\_ -1038-1030-1032C(10) C(9) -0562C(10) -00231-00027-0560C(11) C(12) -0091 C(11) C(13) C(12)-00006 C(13) C(14) -0004-1205-1214C(14)-00035C(15) - 1626 -1637 C(16) C(15) -- 00090 C(17)-0865 -0874C(16) --00145 C(18) C(17) C(19) C(18) C(20) C(19) \_ -00019C(21) C(20) -00044-00066C(22) C(21) -00200-00067C(23) C(22) -00296-00028C(24) C(23) -00105C(25) -1816-1827C(24) -00118C(26) -0366-0372C(25) -00129-0716 C(27) -0719C(26) -00037-00024C(28) C(27) -00011C(29) C(28) -00128-00319 C(30) -0771-0778C(29) -00059\_ -0216 C(30) -00081 -00032 C(31) -0213 C(32) C(31) -00109-00026C(33) C(32) -00159-00054-00040 C(33) -00145σ \_\_\_\_  $\sigma(C)$ F(34) F(34) σ *σ*(F) N(35) -2646-2660N(35) -00161 -00472-0104-0111N(36) N(37) -1157 N(36) -00169-00755-00013-1161 N(37) N(38) -00168 -00147\_\_\_\_ N(39) N(38) -01504N(40) N(39) -00575N(40) σ  $\sigma(N)$ 05314 14186 \*As(41) 05314 14186 As(41) σ Values times 105.  $\sigma(As)$ 

parameter. The final value of R was 5.7% for the 2835 observed reflections. The final positional parameters for the heavy atoms are given in Table 1 and their final thermal parameters in Table 2. The standard deviations quoted are the average values obtained from the inverse of the appropriate block matrix.

A final difference synthesis was computed and a new set of hydrogen positions was obtained. The hydrogen parameters are given in Table 3 and do not differ significantly from the earlier set used in the least-squares refinement. The final set of structure factors calculated using the parameters given in Tables 1, 2 and 3 are listed in Table 4.

### Table 3. Probable hydrogen positions

The hydrogen atom is given followed by the atom to which it is bonded, the position parameters times  $10^{+3}$ , the bond distance, and the peak height on the second difference map

				Dis-	Peak height
Atom	<i>x</i> .	у	z	(Å)	(e.Å <sup>-3</sup> )
H(2)-C(2)	119	104	241	1.00	0.5
H(3) - C(3)	081	083	340	1.18	0.4
H(4) - C(4)	208	005	373	1.00	0.4
H(5) - C(5)	335	-059	315	1.10	0.3
H(6) - C(6)	350	-035	207	1.11	0.5
H(8) - C(8)	109	046	124	1.25	0.4
H(9) - C(9)	245	-133	083	0.78	0.4
H(10) - C(10)	440	-142	030	1.16	0.5
H(11) - C(11)	561	- 060	027	1.03	0.4
H(12) - C(12)	478	026	072	1.01	0.4
H(14) - C(14)	040	011	073	0.99	0.2
H(15) - C(15)	-175	054	020	1.03	0.3
H(16) - C(16)	- 245	135	046	1.01	0.4
H(17) - C(17)	107	190	115	0.99	0.3
H(18) - C(18)	087	153	144	0.84	0.4
H(20) - C(20)	480	086	207	1.09	0.3
H(21) - C(21)	649	163	202	1.10	0.4
H(22) - C(22)	620	232	131	1.10	0.3
H(23) - C(23)	424	214	043	1.24	0.4
H(24) - C(24)	287	143	064	0.98	0.4

The scattering factors used in all the calculations were hydrogen and carbon-graphite from McWeeny (1951), nitrogen from Hoerni & Ibers (1954), and arsenic (uncorrected for dispersion) from *International Tables for X-ray Crystallography* (1962).

#### **Results and discussion**

#### The tetraphenylarsonium cation (TPAS<sup>+</sup>)

An analysis of the rigid-body translational and librational motions of TPAS<sup>+</sup> was carried out by the method of Cruickshank (1956, 1961). The arsenic atom was assumed to be the center of mass. The results of the rigid-body analysis are given in Table 5. The r.m.s. difference between the observed and calculated  $U_{ij}$  is 0.0082 Å, the poor agreement probably due to an oscillation of the phenyl groups around the As-C bond. The use of the rigid-body approximation for TPAS<sup>+</sup>, however, is questionable. Therefore, the treatment of each phenyl group and the arsenic atom as a separate rigid-body with the arsenic atom as the origin was also tried. In this case the four sets of  $\mathbf{T} - \boldsymbol{\omega}$  values were not interpretable in terms of the geometry of the phenyl groups. Consequently, although the rigid-body approximation is a crude model, the position parameters for TPAS<sup>+</sup> were corrected in this manner. The libration-corrected positional parameters are given in Table 1. Using these parameters the intramolecular distances and angles in TPAS<sup>+</sup> were calculated and are illustrated in Fig. 1, with the nonbonded distances tabulated in Table 6.

The least-squares planes for the four phenyl groups were calculated and are summarized in Table 7. There is no significant nonplanarity in any of the four phenyl groups. The average value of the 24 carbon–carbon bond distances in the four groups is 1.389 Å, in good agreement with the distances in benzene of 1.397 Å reported by Stoicheff (1954) and 1.393 Å found by Cox,



Fig.1. The atomic numbering, distances and angles in the tetraphenylarsonium cation. The angles C(1)-As-C(13) of 112.0° and C(7)-As-C(19) of 110.2° are not shown.

## Table 4. Observed and calculated structure factors

The values of h and k are given above each group with the values of l, 10F (observed) and 10F (calculated) given in that order. A negative F (observed) indicates an unobserved reflection. The reflections marked with an asterisk were not included in the least-squares and R calculations.

H= 0,00 0 10 2 1193-155312 4 3409-450816	793 889 12 184 -220 4 337 310 14 337 350 5 949-1002 14 -73 20 6	511 -572 H= 1+K=11 10 1011 100# 1 699 -79511 1004 -907 7 1563 148712	400 -440 -71 76 456 435 H# 148#76 H	76 443 -646 9 10 7,7 4 11	403 -190 4 420 -42 568 -421 4 -70 -30 -70 0 4 210 22	213 271 -24417 178 814 1087 106114 268 515 285 27519 188	1 -14316 409 421 5 24117 -70 -24 5 14914 148 -175 He 4474 2
6 1599-154616 9 473 -38814 10 1158-113920 12 1124-103527	142 144 7 715 737 A 441 -472 H= 0.8 23 9 197 -603 2 -70 -7310	78 17 4 467 1811 909 481 4 759 -81514 -41 -59 4 761 78414 217 -263 6 1195-124716	-69 72 1 -69 -73 82 -70 -76 7 -69 -12 3 405 -445 3 147 -162 4	400 -014 Ha 2,2-11 17 2178 2449 1 -51 7414 1009-1000 2 841 -84314 1270-1220 3 371 -32214	455 476 7 -73 - 127 154 -70 89 -70 -52 H= 2.K=27	14 14 -14820 197 17 167 14821 -67 19 734 -70322 285 19 203 -27623 171	7 -184 0 1981 2110 1 -51 1 -51 111 9 -100 H= 3,K=20 2 267 -514 1 -121 C 110 127 3 374 386
14 775 76424 16 830 774 18 798 -738 20 294 283 H	587 610 4 266 26411 6 409 44412 8 409 -47318 = 0.4=11 10 113 -14414	271 -777 7 717 408 17 81 78 5 675 72318 -48 -64 0 359 -35310 197 -18716 1070 101220	-69 27 4 302 -291 7 282 292 7 117 123 8	1777-1781 5 166 19211 139 64 6 740 80318 1141 1230 7 571 54410	-68 12 -176 1 -71 -1 -68 12 1 -71 -1 -70 31	221 -70 -14 227 584 469 Hr 3.1 23 123 99 1 -60	$\begin{array}{cccccccccccccccccccccccccccccccccccc$
24 353 -348 4 26 219 -756 6	447 447 14 -71 -6616 981-1019 17 297 149 18	а77 37012 798 -790 191 -12913 -69 -41 112 -4114 -74 98 не	10 11 14K+18 H* 14K+27 17	910 948 9 -61 24 131 -12710 -63 -53 1663-180111 103 -69	H= 3.K= 1 1 120 -3 1 2.K=14 2 1172 126	24 -73 16 3 -6 5 4 -6 9 4 12	
H. O.K. 1 17 2 584 79714 4 -60 -7610	452 -515 0 544 -53920 133 159 7 -70 2821 164 118 4 120 14922	136 -11116 676 661 1 171 20117 -70 -4 2 187 -19518 214 -222 3	-74 -68 3 -71 -87 16 -74 -68 3 -71 79 18 -74 -70 4 -73 -87 16	168 -72313 137 -73 1 199 19614 -74 -62 1 1221 116814 108 73 1	-74 3 1202-120 112 147 5 196 -11 -74 6 1742-17	5 H 3 K 7 6 -6 6 1 998 982 4 48 7 7 1380-1409 8 18 8 3 641 -631 9 21	5 154 0 122 -137 17 51 -140 6 49210 327 -334 14 129 -109 -22111 153 -163 14 802 740 7 23212 -69 401s -74 23
4 2477 77471 4 76 4520 10 121 -7421 17 1003 99422	204 -225 6 140 14624 -70 -66 8 -68 -6224 280 29210 -69 3924 -70 -3412 -70 4#24	-70 5219 -67 73 4 -68 3020 335 -349 4 -69 -3621 132 146 6 -77 12422 -68 15 7	-74 134 14 -74 144 10 -73 63 H= 247= 0 20	196 -38117 -70 10 -70 1518 -69 -29 62* -*5510 -70 -79	-71 A4 8 767 78 217 -200 9 411 47 -77 -4510 951 40	5 4 884 90610 95 13 5 297 -13311 12 15 6 407 40912 31 16 7 79 8013 18	A -1601* 117 1/716 248 -263 2 15214 166 16717 179 110 1 25214 144 -14318 426 -496 6 18214 -70 -7919 -69 40 - 127 314
14 729 -820 16 424 -641 18 287 274 20 171 149	на п.ка12 на 0.ка24 на 1 1287-1324 2 247 -26380	24 171 110 0 1,K * 6 10 2474-7761 11	-71 -84 1 782 907 27 -70 6 2 178 130 21 149 -124 1 782 781 24	234 22121 232 -225 0 -69 -127 213 -18810 574 55823 -70 821	133 11317 993-100 676 59513 -67 -69 -7614 244 2	010 448 -42016 -6 1311 424 -42417 18	$\begin{array}{cccccccccccccccccccccccccccccccccccc$
22 -69 57 24 240 -279 26 236 235	949 1098 6 159 182 2 128 -377 8 183 -196 1 535 -533 10 214 -246 4	1274 1462 0 1385 143613 186 111 1 363 39214 424 501 2 715 -74214	-69 14 4 3163 1352 169 145 6 962 914 113 127 7 1634 1576 -	= 2+K= 6 H= 2+K=12	-70 -71 16 878 7 484 -501 17 110 149 -171 18 343 -2	5911         247         -20410         -6           9314         164         12*20         -6           9714         263         -27521         -6	0
H= 0.K= 2 1 0 1330 11901 2 -32 -241 4 911-10541	595 597 6 1020-1108 H= 0.x=76 7 -71 -103 0 175 -194 8	445 -538 4 778 -25717 1297-1308 8 266 -27418 468 -590 4 94 12619 425 372 7 207 14320	160 -145 • 1213-1194 1 146 -154 10 1801 1873 -70 24 11 494 -584 125 136 12 367 361	789 808 1	-66 47 20 692 -60 419 456 21 -70 -70 61 22 607 6	6617 189 173 181# 167 181 1019 -69 79 H# 3,	67 - 00
4 117 -1062 145 -582 10 1594-16522	-70 -7 4 179 21110 7 274 -28# 6 143 -16%11 180 189 # 106 -10717	1404 1487 8 276 107 1404 1487 8 276 107 140 607 0 145 171 87 11010 964 -984 He 364 -34131 138 -187 1	13 298 -295 14 1645-1638 1.5 19 15 417 402 -74 2616 607 598	237 -246 c -55 65 195 182 6 299 317 1425-1463 7 98 -77 437 462 8 383 423	24 129 1 4 2,8 10 24 115 1 1 -72 85 -72 116	5121 243 247 1 2 1927 164 -179 7 31 23 176 181 3 -6 2: 270 -280 4 9	1 -760 10 374 392 6 466 481 1 -76710 374 392 6 466 481 1 -752 -6 55 -14112 300 -296 8 991-1037 4 896 - 216 -254
14 1074 1057 16 278 -299 16 529 -468	14 0+K#13 H= 0+K#27 14 2 1446 1596 2 167 -18616 210 186 4 -77 -18616	1951-133812 125 -55 7 -66 8611 -79 -33 3 230 71014 831 792 4 177 -16818 -77 -11 5	1344-1728 17 165 -150 0 175 -165 18 787 67910 -73 -102 19 582 -35411 -72 15 20 488 -4781	617 -680 9 -64 87 516 -51510 509 -927 551 55411 316 126 212 -22112 3/8 -377	а -72 -99 н= 3,К= 2 -71 -7 0 1594 18 - 116 яя 1 1238 12 -70 10 2 -57	80 5 6 6 6 11 15 H# 3,K# 8 7 -4	15 23814 121 -10010 -58 34 17 -61414 -70 -111 -62 28 69 -104 12 1018 974 17 -695 13 -67 31
27 124 121 24 454 -112 26 187 -1721	6 911 -916 14 4 981 947 19 n 95 134 H= 1,K= 1 20 2 1000-1104 1 338 -27521	910 84614 -71 52 6 -70 1217 122 114 7 250 -72818 848 -884 8 217 20619 -70 18 9	651 762 21 191 12911 -71 -11 22 389 -33212 471 -464 23 100 18511 184 170 24 457 5731	169 11715 -74 -44 614 59414 844 804 184 27418 -71 -69 -73 -616 -70 -521	7 179 187 5 887 -8 8 -70 60 6 105 9 -69 13 8 171 -1 0 106 -93 6 600 3	00 1 746 810 9 - 65 2 464 -44510 8 49 3 379 -41611 1 87 4 1015-112712 4	74 -54 Ht 347=77 14 105 -113 h7 746 n 590 4991* 216 228 44 162 1 -71 11716 938 -861 10 430 7 117 -13217 279 -253
1 H= 0.K= 1 H= 0	A 268 280 2 2320-255522 6 786 625 3 156 17723 8 129 -51 4 357 45524 0 557 -626 4 627 -50624	537 -51020 510 56510 109 -11321 237 -25411 365 35422 310 37212 -70 -#23 180 18413	182 -348 24 148 1821 178 165 26 248 2551 911 835 1 -70 15 21	7 184 16917 -69 -191 600 -56518 326 -3591 7 205 -20418 -70 -971 7 215 21920 161 1861	1 286 -255 7 582 5 2 -70 -1 8 104 -1 3 -70 -103 9 564 -5 4 146 -131 10 1349-14	63 x 295 -27214 - 27 A 563 61114 10 62 7 -43 4214 2 10 8 328 34216 -	70 -21 3 -70 9718 208 216 22-1027 4 440 -41019 -69 -17 21 199 5 -70 -2220 585 582 70 -76 6 501 50021 -70 -1
4 2424 77462 4 1295-1415 10 1531-1402 12 869 919	2 214 225 6 2616 279426 7 229 163 8 214 60 He Oskela 9 161 310 He	-74 9324 339 -32714 15 16 1,K= 7 H= 1,K=13 17	147 140 H+ 2+X= 1 2 -69 79 1 354 3272 504 -551 2 367 -8162 138 -130 3 324 -3352	-70 9421 -68 -721 218 20322 278 248 -68 -123 146 133 207 -204	5 -68 12011 185 -2 6 242 24012 612 -5 7 -69 10513 317 2 8 -70 -014 883 8	09 • 296 77717 1 7010 278 -2761* 7 8911 218 23819 -	12 -114 7 164 -18122 247 -268 67 776 8 -69 11923 -69 91 68 9 169 15124 244 -271 81 -60410 410 -412
14 472 468 16 1327-1369 18 -74 10 20 483 453	0 480 42010 1741-1741 1 7 266 -34711 88 48 7 4 -38 10812 1391 1147 3 6 621 -63313 224 -213 4	140 -234 1 318 32118 1281 1477 7 365 36614 177 -130 3 -54 -117 852 -852 4 493 -435	146 141 #4 2563-27992 -77 -97 4 2504-2572 6 501 441 7 690 690	4 2.8 -707 4 2.8 13 1 447 -447 4 2.8 7 2 1097-1109	14 -68 -1 16 141 -1 H= 2+K=20 17 -74 1 0 681 -616 14 182 -	1411 114 -16421 - 5914 896 874 4814 900 -289 6016 118 -112 H# 3	70 9911 -69 75 12 197 -188 H= 4+K= A 13 -70 -36 0 921 1003 1+K=15 14 326 324 1 -51 -52
27 228 -204 24 264 -271 26 384 4241	8 505 54814 460 -443 4 0 -68 -2214 206 20846 2 -74 4516 1073-1075 7 4 422 -47817 128 58 8	291 294 4 416 420 4 94-1459 6 -18 -37 0 672 699 7 -60 44 1 947 999 8 796 827 2	-71 87 9 534 544 400 387 10 410 386 402 375 11 295 273	1 573 524 1 184 -196 2 765 836 4 293 335 3 855 836 4 199 227 4 702 -673 6 797 819	1 -70 10 19 -70 2 201 201 20 300 3 266 263 21 -70 • 926 663 22 331	13817 -70 -63 1 - 18818 409 -196 2 - 2719 -69 -0 3 3 12620 112 -48 4 -	-66 -21 7 3 516 527 -67 77 3 516 527 -26 -335 He 1exe21 4 -51 67 -68 60 1 -70 -66 5 143 -88 -69 60 1 -70 -66 5 143 -88
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14 141 -148 16 146 -117 18 328 106 20 452 -411	16 313 441 1 370 44221 18 -68 1747 1780-201423 20 138 -160 3 178 -46224 4 1002-11252	295 -284 -68 199 177 175 H= 1+K=15 -70 26 1 -61 99	-69 30 24 409 454 749 707 24 -69 -8 125 -90 26 124 134 612 -627	LA 848 -77722 -70 -18 14 121 100 20 171 154 21 -70 28 Hz 2.5815	7 -70 58 8 609 8 115 -118 9 241 9 153 -110 10 1723-1 10 305 200 11 719 -	461 R -60 1* 126 9 384 -388 He 177610 110 294 1 24111 101 102 2	$\begin{array}{cccccccccccccccccccccccccccccccccccc$
27 186 -186 24 240 256 26 146 148	H= 0,K=18 6 1283 1321 0 1610 1550 7 -51 47 1 2 398 -384 8 265 -331 1	2 209 -211 1 -67 -71 4 1.K= 9 4 -63 174 1 109 -280 5 -64 271	7 249 -257 8 326 -317 H= 2+K= % 9 -70 94 1 94 -185 9 494 480 7 373 960	27 404 424 1 -63 -70 23 -68 -62 2 990 -944 24 386 -408 1 146 121 24 107 -121 4 553 592	11 134 -127 12 447 - 12 -68 42 13 102 13 141 132 14 1339 1 14 -70 -83 14 196 -	44317 138 58 1 10813 -74 48 4 31014 467 -422 4 18315 315 308 6	-74 14 5 152 -131 321 -308 -73 178 H# 4+K# 6 790 -763 H# 4+K# 0 0 271 -349
H= 0.K= 7 2 1611-1667 4 318 -275	4 987 -926 9 123 164 6 640 61310 506 -499 8 363 32511 117 -110 10 893 -84212 970 1001	2 1045 1092 6 490 4841 5 -51 -120 7 474 3961 6 744 -794 8 218 -2091 6 497 449 9 289 -2721	1 -68 74 1 -49 100 7 -68 107 4 284 -346 3 -68 5 4 1326 1434 4 433 -433 4 799 -901	<pre>4 -66 -117 6 781 781 Hu 2,K= 0 7 308 328 1 75 -34 # 1137-1104</pre>	14 -72 23 16 199 - 17 203 18 919 - H# 2+K=73 19 224 -	-14514 -70 -3 7 17517 366 -354 A -86518 544 447 9 -22219 103 9510	-77 10 40 1767 7053 1 -41 -32 471 422 1 475 514 7 274 168 157 177 2 722 4841 7 448 697 578 514 3 730 -750 4 567 644
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H= 0,K= 8 0 840 -977 7 223 167 4 1543 1610	17 273 27126 400 4331 18 -70 46 2 16 116 -128 2 18 -70 127 H# 1sK# 4 2	9 183 190 0 576 -473 1 1 -70 -17' H# 1+K=16 1 2 476 434 0 1049 10721	4 -68 54 20 647 -601 0 180 -184 21 151 184 1 -68 -64 22 415 412 7 -69 -14 24 121 -111	14 -74 0722 461 -451 14 282 294 17 140 -174 18 -70 -47 H= 2.55=16	14 122 -112 4 73 6 242 7 102 H# 2 55 -24 8 -51	-104 7 202 201 1 -234 8 517 -478 2 -132 8 -65 118 3 1510 338 -317 4	244         248         17         13         851#         180         164           147         107         18         704         -67019         153         152           164         165         10         195         -18320         -70         -20           188         166         20         -70         5821         -69         -90
6 211 -110 4 1184-1264 10 579 681 12 805 801	0 1920-1475 2 1 1999-1445 2 H= 0.K=20 2 1436 1591 2 0 565 546 3 1165-1273	100 -91 1 210 -2181 355 341 7 430 -6111 5 192 207 5 176 736 4 699 -731	1 -70 -87 24 117 165 4 -71 81 24 -70 -6 26 256 -276	19 127 135 0 320 -310 20 157 -166 1 175 -220 21 138 121 2 -67 -30 22 146 -138 3 154 176	0 247 240 4 348 1 -64 -68 in 1080 2 -64 -50 in 169 3 -64 -76 in 169	-18711 314 -308 4 108212 899 885 4 11413 -74 -53 7 -1814 -73 18 8	191 178 21 233 -21222 209 -206 -71 -89 22 599 587 23 101 -175 102 -101 23 -68 61 24 147 183 640 -681 24 377 -377
14 784 -816 16 -74 4 18 888 85 20 696 -68	5 7 271 235 4 1558 1650 6 802 -804 5 1031 -961 5 6 310 292 6 2374-2530 7 8 379 365 7 191 -67	5 184 147 He 1.K=10 6 414 494 n 5n7 488 7 144 169 1 440 419 8 797 684	Ha 1.5424 0 554 -529 Ha 2.44 4 1 -70 -88 at 2113-2370 2 -70 60 1 676 -798	23 -68 -7 4 776 75 24 -70 88 8 133 -4 6 365 -36 7 -74 14	4 -68 -120 13 -65 4 119 -108 14 340 5 -68 21 14 230 5 -68 -14 16 448	3015 183 -163 + -35816 1025 -983 10 -21017 344 334 11 -41218 245 27912	-70 -27 24 -74 -3 128 130 HF 4,KF 7 119 -104 1 403 -424 214 231 HE 4,KE 1 2 1443-1463
27 243 -26	10 469 -476 8 1540-1609 17 -70 -30 9 325 350 14 409 44510 1424 1467 16 186 -23911 380 400	7 171 166 9 -76 7 7 98 -177 10 635 -581 4 612 -644 11 118 -102 9 -41 1412 467 -449	1 -70 -74 7 2108 7107 4 956 169 1 1274-1241 5 -69 97 4 89 -6 6 472 -421 5 403 418	0 1048 1054 0 -74 -9 1 104 11210 180 14 2 418 -42211 -71 -6	A -68 1717 -72 9 -69 8118 140 10 -70 -719 220 11 -70 -3120 -69	10414 -70 4113 6520 426 46014 21821 -68 4014 4027 278 -26616	716 707 1 89 -26 1 177 144 -70 10 7 567 -625 4 550 596 -68 -60 1 1006 1023 4 473 -675 -68 15 4 747 801 6 786 786
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14 166 20 20 122 11 22 118 10 24 -69 2	12 161 -1112 100 -001 12 161 -1012 -69 -68 1 14 181 20127 526 -517 1 16 418 -41221 -70 17 1 7 24 445 418 1	4 464 -414 6 -73 144 7 104 -113 H= 1.K=17 8 380 -330 1 297 -290	Hu 14K-25 15 136 -72 1 -68 7816 249 27 7 375 37517 129 119 3 111 6718 154 -149	17 644 -47421 -17 -7 13 202 -195 14 1167 1068 14 - 74 -41 He 2.44-17	6 128 -321 1 101 7 -70 -64 2 441 8 129 320 3 -51 0 -70 -68 4 1469-	57 8 -60 84 4 -186 6 240 -280 8 -8 7 345 -101 6 1611 8 624 -628 7	$\begin{array}{cccccccccccccccccccccccccccccccccccc$
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2 518 59 4 727 84 6 1193-190 8 643 -74	4 401 -380 H# 1.5K# 5 4 4 -70 -70 1 1178-1247 0 8 106 217 7 911 866 010 181 -202 3 403 454	23 -68 -93 6 746 703 24 -70 -105 7 144 -88 8 744 -649 9 -73 16	n         106         137         181         -10           o         -70         -18         24         -68         7           10         -71         75         25         -70         -11           11         -74         28         26         -73         14	20 443 410 x 337 33 21 -70 22 6 570 40 327 351 360 7 378 -50 323 149 113 x 211 -77	A 0 480 470 0 380 0 1 -70 14 10 1278- 6 2 -70 -74 11 461 7 3 -70 10 12 274	47713 748 730 17 137714 491 -488 13 47015 192 -188 14 -28014 114 147 15	312 -121 27 -69 -10 24 184 -180 -70 10 21 -68 18 -68 -21 24 -70 26 -68 17 25 108 -141 H= 4,5= 8

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$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	A 1 754 -75917 -60 11313 0 2 -66 11814 -56 -55 7 4 981 10320 -50 -13 7 4 981 10320 130 135 Hi T5 5 -69 25 - 1 6 4 533 -530 - 2	108 100 13 -70 -102 10 14 484 -46611 14 184 -16611 15 184 -16112 -64 134 17 -70 4814 487 -164 13 10 10	-70 16 H# 648970 7 216 214 0 461 -466 8 747 218 1 276 -416 0 -70 -45 2 -65 12910 -70 34 3 -68 -6711	130 -63 4 447 44611 447 420 5 106 21427 275 247 4 160 -190 555 -676 7 367 -330 101 -63 9 337 -334		$\begin{array}{cccccccccccccccccccccccccccccccccccc$
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16 489 457 5 -74 -132 17 354 -528 A 778 -720 H= 4,5524 14 865 822 7 192 -204 0 -69 11 19 387 368 4 758 692 1 -60 14 20 335 -300 0 106 115 7 -60 -8 21 115 -117 10 205 203 3 -69 -8	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	240 -242 -60 54 115 6,45 4 Mi -70 -91 1 171 -711 0 137 -140 7 1047 1090 1 193 193 3 -64 5 7 - 6 5 7	10 444 43519 6,K=12 11 -73 -3210 344 330 141 175 235 -240 M: 6,F=21 M: -73 34 1 -69 -12 1	275 -26615 -71 -42 -70 22 HE 7.8515 1 7.85 7 1 -70 311 156 188 2 -70 311	7 117 1017 -70 -1410 559 -5714 127 -7811 0 -69 -7518 -77 -4117 0 774 -213 13 1 -70 -34 14 2 504 502 48 85722	481 497 4 704 432 -68 33 8 -68 32 -60 67 6 298 -200 249 263 7 107 219 443 -446 8 278 -284
27 374 -185 11 -70 -74 4 -70 21 123 -141 12 459 -4-6 5 -70 -1 13 148 -156 6 -70 -5 14 -70 86 7 -70 -7 He 455 9 15 -70 28 -175 - 71 2	714 687 66711 -70 -62 919 -70 -9912 -69 -61 -61 420 202 -21111 218 221 0 121 -68 1516 -70 -21 1 522 418 -46918 -70 -24 2	- 194 -193 A 5+x=22 A 006 -601 A -68 -56 7 111 122 A -68 -96 R 585 614 7 -68 65 9 -76 66 R	181 -200 2 313 295 7 -72 -73 1 -69 34 3 288 294 4 145 -144 4 210 -200 5 -70 91 5 437 450 5 240 -242 5	117 - 173 3 - 70 141 331 - 310 4 148 - 1801 186 204 4 - 70 1301 176 180 4 167 - 1841 721 709 7 134 - 1511	1 107 177 0 737 -702 4 -68 40 1 -70 -63 4 5 -68 76 7 -70 83 1 4 314 -140 8 -70 -19 7 7 -70 4 4 431 444 7	10 302 30] 9.r. 11 -74 -56 -70 122 -70 115 -70 -40 H=10.r. 1
1 AV 152 16 30V 417 0 -75 2 2 -54 38 17 116 167 3 162 -131 18 144 -182 4 118 195 10 104 75 H= $4_{1}X_{-2}A$ 5 $R_{2} -116 20 376 -402 1 -70 -7 4 106 -176 -2 386 -7$	H= 5+K= 7 10 -70 -62 6 H= 5+K= 7 10 -70 -62 6 R 1 -57 5620 111 -155 7 2 7 1176 1197 4	-68 -610 619 472 0 274 20711 498 47610 104 12112 964 -87911 107 -30213 176 -15812 -70 -6614 -70 -6013 261 -25215 -69 -114	-70 97 7 -70 -84 7 288 -305 8 277 250 5 140 143 9 -73 27 9 179 -308 10 158 -157 11 386 400 48 65822 12	-71 73 8 126 1361 261 -244 0 -68 -8 -70 -64 10 -68 11 458 -45211 -68 -8 -69 -2612 -69 -25 390 37612 -70 -31		-70 41 1 -68 44 -70 -70 7 774 233 115 -120 3 -68 -37 -70 -41 4 -68 -43 -69 20 5 468 -51 -69 20 5 468 -51
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10 -70 64 10 343 -316 6 678 71 20 -69 50 11 261 -261 7 140 -17 21 -68 68 12 -60 26 8 530 -46 22 110 100 13 117 121 9 -61 -0 23 145 -166 14 204 22010 577 -48	414 1-7 140 - 181 - 194 8 514 244 24210 813 - 194 8 514 215 16511 145 - 450 617 - 69 5813 208 - 01 018 283 - 26713 408 - 424 44 319 - 70 3214 688 775 0	-71 -49 2 -65 72 4 -73 -49 2 -65 72 4 3 -66 104 4 4 574 -602 7 5 45-24 5 -67 -55 8 463 -447 6 20 21 7 9	1,K2         1,K6         1         -74         -1[0] 1           1,RC         -160         2         258         245         2           471         454         -	-73 124 7 -48 181 -73 80 8 338 -330 -73 -111 9 228 -251 244 -23810 380 216 19011 -69 16 -71 -3412 154 160	1 -70 -1 - 147 - 147 - 144 - A -68 13 4 267 -289 <u>4</u> 5 -68 40 7 -68 -56 6 6 -69 -72 8 292 292 4 17 -70 -33 9 124 132 7 19 -75 4110 128 117 8	146 -148 3 109 -117 203 288 6 203 221 -70 54 5 217 230 170 -173 6 219 -240 -70 55 7 -69 -114 256 -268 8 195 -220
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* 09 -1%6 + 17 5%6 -* * 1341 1457 + 4 * * * 17 1 * 17 10 2 10 * -60 -6 1 175 -175 1 * 187 -17 6 677 -726 2 666 * 6120 49 46 7 485 448 1 135 151 2 -68 -6	2 n 187 -214 4 1 196 -205 HE 5,8 = 15 H 5 2 241 209 1 -73 -77 n 5 3 -61 -188 2 518 -515 1 0 4 238 281 3 -77 -38 2	14 209 -1671A 6.44 0 14 344 32017 1505-140214 -60 -1014 98 4516 241 -206 292 32617 125 127	10 212 -243 1 394 -434 5 62 41 13 -70 -48 9 400 -347 14 -71 107 10 449 404 14 11 348 328 16 12 765 -726 17	-70 24 7 117 101 -70 -14 7 -69 53 131 104 4 196 -201 118 107 5 -68 -6 -68 -30 6 346 -369 -69 -70 7 260 -287	4 266 252 1 163 -184 4 266 252 1 163 -184 4 -70 -48 1 120 -142 4 143 321 7 -69 56 4 17 197 184 3 -69 18 1 8 476 -389 4 -68 46 7	1 -68 -11 2 74 294 4 944 7 3 -68 47 2 76 -225 4 121 -147 3 18 343 4 -68 4
n 610 -842 4 145 -116 22 411 -47 9 244 - 284 4 158 156 23 -70 12 10 1074 1068 6 188 -174 11 188 -220 7 -70 -56 12 744 721 8 221 199 H= 5.45 2 13 -73 48 0 152 -133 0 970 -99	a 27 - 720 a - 77 - 80 a 7 248 - 259 6 232 270 a 8 322 - 324 7 - 50 0 4 A 9 322 - 302 R 257 - 246 7 9 10 601 487 9 - 69 16 a	174 -16419 174 -140 H. 1423 134919 153 -151 0 474 42520 238 240 1 545 -51021 -70 121 2 271 238 3 821 -740	+ 648 = 14 13 229 23214 =71 = 414 = 69 = 2519 =70 = 6514 106 = 88 124 = 14016 614 614 =70 1817 159 162 H 115 16018 107 = 117 1	-70 -118 8 278 293 146 -184 9 107 114 10 143 144 11 -70 104 748 9 12 295 -297	0 170 10268 -63 9 4 10 100 -777 6 -68 39 4 11 212 -730 7 -68 3 1 12 744 771 8 -68 -77 4 13 -69 20 9 -69 27 7 14 -68 3012 -70 4 8	114 144 6 288 -296 116 -151 7 -69 -21 -70 72 8 278 288 -70 -98 9 -70 -65 7 -69 -8410 160 176 2 249 249
14 1006 -965 10 169 140 1 789 18 16 276 275 11 200 190 9 90 4 16 144 -167 12 486 -467 $^{2}$ -57 $^{-7}$ 17 -66 73 13 -70 -38 4 676 68 18 433 480 14 -70 -13 $^{2}$ 570 75 19 185 184 14 -70 -13 $^{2}$ 570 75	11 284 27210 113 -128 0 7 12 -73 -011 190 21310 6 13 -71 11112 -70 6811 2 14 488 -44613 -70 7412 3 15 -70 9514 106 13113 5 14 -69 -7115 109 9214	527 -432 Hn 6+8 7 4 623 485 1 -66 44 4 143 114 2 805 848 7 823 765 3 205 848 7 823 765 3 209 226 8 521 506 4 340 -332 0 1182-1097 5 143 -11871-	-70 10419 121 -91 2 -70 -7620 363 -380 3 120 -115 6 141 133 6 249 251 H= 7.8= 2 6	743 -67# 254 -248 H= 7.5=18 724 707 0 -68 -60 360 -355 1 -68 80 610 587 7 -68 81	15 153 12611 -70 28 c 16 442 -47312 -73 -810 17 -70 -78 13 Hz 8,r518 13 Un 8,r 4 1 56 758 14	-68 -50 143 133 H+10+5+ 4 146 187 n -68 26 362 -379 1 182 -226 3 115 -39 2 -68 29
20 300 -201 16 175 160 7 340 34 21 120 -63 17 -70 -22 8 -41 -11 22 310 -324 18 -70 -33 9 154 -18 23 170 -187 10 17 -10 17 -13 67 11 222 75 10 -13 -14 -14 -14 -14 -14 -14 -14 -14 -14 -14	4 17 135 12016 118 -1541* 5 18 333 31817 -69 -3316 9 10 -69 11718 -70 3017 3 20 -68 -7019 -75 -9818 0 21 -69 20	562 -523 6 623 -63011 457 418 7 206 -17612 -70 24 8 601 48013 394 369 -74 -7013 -69 -2110 450 42514	-70 -134 0 174 241 7 -70 -18 1 145 205 8 -70 18 2 -71 44 9 104 -115 3 -77 70 10 -68 71 4 622 -582 11 -68 -43 5 359 -333 12	24 - 565 4 - 68 - 64 193 219 5 - 68 - 44 238 - 207 6 - 69 - 81 - 69 - 103 7 - 69 A1 327 314 8 123 - 129	0 477 -480 2 403 414 1 -70 -144 3 186 185 5 2 -70 94 4 278 -301 4 -70 -92 5 -68 6 1 4 347 357 6 390 -602 2	4 -68 37 4 -68 37 4 9.4 8 4 -69 12 627 -631 6 100 -117 1 90 -208 7 -70 14 7 -70 110 8 113 -74
H= 4.K=11 0 868 804 1 -74 10 1 -60 -78 1 247 216 4 77 -78 7 201 220 7 -70 -122 1 573 -57 7 127 -114 7 151 174 14 -70 4 4 727 -459 4 625 -590 17 389 -75	R         H= 5+K=16         21           K         0         768         K7823           Z         H= 4,K= 0         1         -11           6         1         -62         -67         3         147         -132           6         1         -62         -67         3         147         -137           6         1         -62         -67         3         147         -137	179 17617 176 -68517 291 -27213 127 18 - 14 196 -188 14 -69 18 43 14 -69 18 43	-70 10 4 927 40113 -70 34 7 232 -20714 a 458 42518 9 -72 2816 6 sc=16 10 449 -40117 -70 -8411 191 14518	$\begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$	$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	X -70 -44 0 -70 21 4 317 12410 -71 63 4 -69 113 4 -49 -44 7 -68 -12 He10474 4 8 122 -136 1 -68 -95
6- 104 - 208 -20914 226 10 6 465 -492 6 385 36519 103 10 7 256 -263 7 199 15420 -70 -1 8 620 625 8 269 25721 195 18 9 -69 26 9 -69 3327 185 -19 10 159 137 10 444 -4262 3 -70 5	6 1 615 664 4 413 -438 1 7 4 408 -197 4 -70 20 2 8 4 -65 -43 6 266 247 3 8 6 997-1038 7 -70 -24 4 5 7 209 -230 8 385 366 5 2 8 917 947 9 40 11 4	741 -76417 -70 -46 ? 313 3118 205 -205 3 615 49510 -68 -11 4 448 -44820 284 -285 5 198 17021 -71 -09 6 70	541 -406/2 164 -177 244 -23313 -69 -73 390 39214 656 611 H= 152 18315 182 177 0 449 44616 115 -118 1 288 28017 -4 631	1 -60 -64 7 610 613 7,c=10 3 131 146 -71 -24 4 167 -175 254 259 6 -70 16 -71 14 4 17 -14	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	•         -68         -51         2         307         360           C         -69         77         3         216         208           1         -70         -34         4         193         -270           7         -70         80         #         493         -40           3         -73         67         6         321         -311
11 103 247 11 165 176 12 714 $-674$ 12 $-70$ 30 13 113 $-40$ 13 146 $-1^{48}$ He 5,47 3 14 219 208 14 327 376 1 118 $-14$ 14 49 $-127$ 376 1 118 $-16$ 14 $-107$ $-107$ $-107$ $-107$ $-107$	9 350 -316 10 484 -468 7 10 901 862 11 -70 -70 8 11 389 -383 12 117 -83 0 912 804 -728 13 173 -19310 314 -71 -21 14 462 47711	250 -251 394 367 HE 64E 8 9 -70 -134 0 1009 104100 371 334 1 -67 11311 764 267 2 209 -2412	594 -56518 320 -340 3 -70 -6310 107 -128 4 289 -30520 -70 104 4 196 -210 A 452 463 7	-71 -113 7 -70 -144 275 274 8 323 326 137 -127 9 -73 -22 -70 -101 165 -166	17 -77 11 4 188 -707 5 -69 -74 1 6 178 707 1 -70 102 1 -70 -73 5 -70 102 1 -70 -98	A 267 291 A 267 291 A 217 -22310 204 214 2 317 313 3 231 258
17 245 244 17 -70 72 4 177 20 18 -70 35 5 4 298 -72 19 -69 -34 6 36 40 20 357 -390 H= 4+K=19 7 85 -6 21 104 100 1 -70 -50 8 449 -45	14         14         130         16         -60         -60         1           016         658         659         17         100         98         18         617         -60         1           017         -658         659         17         100         98         18         617         -60         1           017         -70         83         18         423         -409         1           017         718         291         -311         16         319         -68         4         17	100 -100 4 -68 K01 178 140 4 1000 -97814 169 128 4 -71 -2018 118 -128 6 715 71216 108 -110 7 -74 -217 312 -313 8 587 556	-68 94 1 -71 02 M 275 268 2 441 47710 465 -485 3 204 2241 -74 -73 4 146 -13212 4 248 -26113	174         150         c         -70         67           136         132         1         -70         51           -70         -9         -70         -21           -70         13         109         144           -70         64         132         -141	2 171 -166 0 -72 11 3 216 -710 4 126 143 5 -69 6 448 8+5437 6 135 142 1 -69 -34 7 253 230 2 297 289	$\begin{array}{cccccccccccccccccccccccccccccccccccc$
27 199 181 2 - 70 15 - 70 3 - 69 1010 219 - 73 74 4 - 69 - 2011 273 74 H= 4.82=12 4 137 - 1371 7 645 54 n 119-1113 6 167 19013 195 14 1 132 - 135 7 155 148 18 - 73 4	7 431 -430 HB 53417 14 727 424 410 2 809 -76220 727 424 410 2 809 -76220 7 3 136 -13521 7 4 310 27822 6 HE 534 = 10 4 268 - 290	-70 53 9 -73 -4 -69 5610 438 -391 M 126 -10711 279 -745 0 -70 -7917 236 -245 1 140 11617 -70 28 7 14 508 458 3	6 548 -52514 6 5516 7 165 -19015 -67 -112 8 375 34516 -67 -26 0 -71 4217 -69 -8010 214 14818 168 -17011 165 145	-68 * -70 -96 -68 -22 6 -72 57 -69 7 7 -74 -14 -70 -21 -73 12 Ht 7-5-21	A 107 -104 3 -70 761 0 141 144 4 107 -1401 10 -70 -16 4 -70 -631 11 107 -130 4 177 -710 12 284 291 7 116 -93 13 121 110 4 -74 113	C 155 143 5 -70 -12 1 138 127 6 -70 68 2 168 -107 7 -70 0 8 186 175 9 -73 40 HE 945+10
7 -64 97 R -70 -214 244 24 4 -65 5 9 116 14416 446 -42 4 496 525 10 -70 1217 291 -11 5 187 149 11 165 -15918 -69 6 238 -261 12 -69 -3319 -70 -5 7 -68 1020 358 38	4 0 515 -535 6 322 316 4 1 374 -364 7 269 262 4 0 2 111 155 8 246 -250 0 7 3 -65 -122 9 -70 74 1 1 4 -66 -9810 -70 -77 1 2 5 -66 -61 112 -132 3	15 -70 90 4 5 648 2 14 121 -113 6 5 58 -60817 -70 - 6 313 -30518 357 -360 7 - 61 4619 -69 8 8 263 -77620 182 188 9	144 14812 157 -124 156 14811 -69 64 HI 120 -14814 -70 -24 1 -70 -1318 290 -282 2 274 -25414 403 400 3 167 -16013 137 161 4	1 -73 -2 7.K-11 2 162 174 314 230 3 -74 1 505 -578 224 -238	14 -44 -10 14 -69 30 16 315 310 Hz 8.7-18 17 -74 -110 0 397 402 1 158 144 2 -70 -31	69 124 1 -69 -64 H±10,00 7 2 -68 -172 1 -69 37 3 370 360 2 211 249 4 -68 -35 2 -69 66 5 -58 -100 6 -70 -112
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	1 6 -68 517 103 21 4 8 7 202 23513 -68 -60 0 4 -72 -1914 -68 54 4 9 149 19015 220 205 7 10 129 -7016 318 -337 9	749 71021 -74 8710 500 478 11 537 -573 12 121 -87 H= 6+K= 9 1 672 -663 1 -69 -4514	167 18218 -68 -10 E -69 -4519 -70 17 A -68 3820 180 -198 7 166 147 R 120 -118 9	177 174 n 816 791 519 483 1 348 286 260 -274 2 -71 -50 -69 -77 3 164 178 -69 -67 4 826 -744	H 8.55 8 3 -71 42 0 563 -546 4 477 -434 1 -69 -108 4 140 -160 2 -69 -21 3 439 -366 1	A 126 10A 5 -70 -40 7 -68 48 A 275 -294 8 -69 17 7 133 -144 9 -70 1A 8 183 194 0 -70 -54
14 566 -567 0 485 441 0 850 -01 14 566 -967 0 485 441 0 850 -01 14 122 -99 1 -69 74 1 458 -66 16 105 103 2 -69 21 2 235 25 17 236 243 3 215 213 2 34 27 18 230 234 4 663 -640 4 1394 148	11 707 -770 1 - 1 - 0 0 12 365 726 10 213 -70 32 11 14 164 171 H# 5+K=18 13 314 -69 71 0 -69 4313 316 -70 -120 1 -69 1914	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	-70 57 44 7.77 4 10 -77 26 0 828 82611 1 251 28212 2 212 -24813 = 6+5=17 3 -74 2514 -69 56 4 843 -75415	-70 -0 x 41% 387 -401 -70 -0 x 41% 387 454 440 7 137 138 105 123 8 419 370 159 -186 9 103 60 -69 10 10 648 -554	A 420 417 48 046 1 1 - 60 1 1 188 1911 5 118 -172 7 501 -540 7 248 740 3 124 -144 3 09 -183 4 315 720 1 0 -70 -118 4 -70 13	i -71 -73 -75 -4 H=10,55 8 0 465 476 1 178 185 H= 9,55 11 2 170 -181 1 194 -209 3 -70 41
20 102 -103 6 208 205 6 996 -99 21 -70 -94 7 -70 -72 7 278 20 27 218 -212 8 519 517 8 1051-100 9 -70 117 9 222 -10 10 477 -45910 894 87	6 17 161 180 7 361 -127 16 1 18 260 -274 9 109 127 16 0 10 -48 -85 4 -60 8% 17 5 20 -69 99 8 -60 -6% 18 0 21 -70 -105 4 -70 108 19 7 -70 62 20	69 112 m -73 10 7 - 106 100 0 -72 40 3 - 70 -1710 -71 30 4 - 284 29711 220 -200 m - 69 -7812 167 164 4 - 100 -8413 26 -290 7	3^5 - 20 K 516 - 48516 143 - 170 6 402 44317 198 222 7 - 73 11 153 150 8 644 407 107 134 6 343 133 1 -70 2110 617 - 40 0	198 -183 11 214 -220 -70 -141 12 204 -284 13 -70 R0 14 6F0 650 = 74017 14 212 104 376 -767 16 112 -112	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	7 607 677 4 700 -334 3 97 124 4 210 -710 4 170 -223 6 173 717 5 -68 116 7 -77 76 4 286 -330 8 244 224 7 -69 -70
H= $4 \cdot x = 1^{-1}$ 11 -68 511 1'0 10 1 -65 43 12 131 -12612 397 43 2 1145 1140 13 -69 -11413 246 27 3 202 216 14 380 38214 842 -76 4 867 -865 15 -71 -7614 268 -25 5 -68 -119 16 199 17	) A 208 20521 A R= 5#K=11 0 105 -6022 1 1 257 -24710 -70 -61 A 2 653 69411 -69 -15 6 3 239 24712 143 -160 P 0 4 676 -70513 169 -153 1	-70 1214 -69 48 4 200 -21614 -70 47 9 16 -70 1010 17 -69 1611 16 644 3 18 181 -1012 369 -37019 123 11813	213 -22811 105 111 1 101 -7817 184 -187 2 116 -11913 212 -194 3 -65 1714 648 616 4 383 37618 -70 80 8	247 24417 -70 -14 -70 -2018 269 -288 226 -240 374 -349 388 -344 we 845 1 492 -450 - 231 449	14 -71 - 24 12 - 443 - 443 - 13 - 60 - 47 - 14 - 70 - 221 -46 8,75 - 0 - 12 1 - 60 - 12 2 - 238 - 250	a 117 141 a -70 Z HalOakk a C 246 269 1 148 -167 1 127 119 7 -69 63 a -70 110 4 -70 -50
6 991 -979 [7 243 -75 7 -72 -79 H 4.4521 [8 373 72 8 576 533 1 -70 -7019 165 20 9 227 242 7 176 -17720 241 -78 10 553 507 3 -70 -10921 -68 6	0 5 254 246 14 -69 76 2 0 6 611 -605 14 -70 71 9 7 7 -73 74 14 -73 70 4 7 8 772 712 5 9 169 -121 6	914 98320 -70 -6714 107 -106 1* 719 -684 310 284 H= 645-10 813 -795 0 745 723 H	-70 017 -68 -60 7 -73 4018 462 -477 8 10 -70 42 0 20 214 22610 11	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	4 114 143 H= 94% 2 1 4 110 -113 D 656 -655 5 -69 -35 1 149 -352 6 415 365 2 203 149 7 144 -162 3 -70 -37	H= 9+K=12 5 -71 60 C +68 50 A -72 -35 1 -68 43 7 -75 13 2 -68 -25 -68 -71
11 -72 6 4 -77 7022 22% -76 12 723 -710 4 -70 -11723 -70 -4 13 197 -111 4 -70 85 14 -69 33 7 -70 107 18 129 -111 9 415 -630 Hz 5,5 4 4 16 723 705 9 183 215 1 327 -34	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	1 146 -99 1 497 414 0 6 30 404 2 201 -114 1 2 27 267 7 212 213 2 5 616 565 4 907 -840 3 3 91 359 7 - 74 -9 4 5 22 -458 4 433 589 5	409 -408 17 -70 91 45 7,458 4 17 -70 29 1 294 10314 -70 -38 2 225 -22815 415 512 3 226 -22514 144 164 4 155 -17117	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	A 170 113 4 601 61 1 -70 -66 4 -70 36 1 10 -70 -130 6 273 -774 1 11 -69 -61 7 -70 -11 1 17 -68 10 P 106 -200 1 13 100 P 105 -501	$ \begin{array}{c} 1 & 1 & -1 & 4 & 1 & 1 & 1 & 1 & 1 \\ 4 & 2 & 0 & 7 & 1 & 7 & 1 & 7 & 0 & 7 & 4 & 2 \\ 7 & -7 & 0 & 6 & 1 & -7 & 0 & 26 \\ 7 & 1 & 1 & 1 & 4 & 7 & 110 & -13 & 7 \\ 9 & -71 & 111 & 3 & -71 & 53 \\ 9 & -71 & 111 & 3 & -74 & -56 & 7 \\ \end{array} $
17 -70 29 10 -68 76 7 407 44 18 -69 14 11 -69 33 3 -55 5 19 -68 35 12 303 306 4 -56 2 20 505 -53 19 -70 -43 5 211 17 21 -71 22 14 -72 24 6 263 -23 7 129 -0	0 16 396 405 4 354 351 14 4 17 -70 70 7 -70 12014 4 18 -66 -60 8 435 -679 18 4 19 109 156 9 -69 -114 16 1 20 413 -60210 169 -15713 -21 142 -5611 -68	205 -202 7 372 -167 A 106 -364 8 777 710 7 227 -31 0 -71 44 A 551 51210 733 -686 9 247 24211 90 8410	146 -113 6 163 -176 -60 -11 6 138 110 355 -363 7 777 700 4 159 -150 8 -71 -47 1 402 180 0 -71 6 7	17 106 109 14 -69 4 15 7.5 13 15 -68 55 -69 -2014 201 -373 241 -23117 -70 -58	14 -60 -54 10 179 163 15 -70 10 11 -68 74 16 -71 -10 12 -68 -1 13 105 113 14 214 -201	5 279 -194 Hs 0,5511 1 -69 77 H=10,5511 7 -69 92 1 -73 84
R 206 17 He 4.K=74 He 4.K=72 9 191 11 0 487 -484 0 353 93510 -67 -1 1 109 -162 1 -70 211 121 -9 2 170 144 2 -710 7212 -74 7 1 -60 -107 3 -70 -74 7	2 12 618 618 10 3 12 618 618 10 3 13 124 1492 7 0 952 95016 -73 -622 3 1 -68 -38 5 2 14 -156		132 12211 - 70 14 4 132 15012 - 60 64 6 473 -44213 110 103 6 14 - 70 - 64 3 14 - 70 17 6	- A9 -0 - 69 -0 - 241 -772 HE 81X = 7 - 262 -264 -0 616 639 - 303 -287 1 -71 -71	0 874 - 744	70 -82 1 148 -191 4 -70 -82 4 147 -182 7 -70 74 8 -72 91
4 -70 94 4 212 -1814 168 -70 -2 4 -72 27 4 -69 -5114 146 144 14 A 278 302 6 -68 1016 -70 -2 7 -76 106 7 -68 6117 -69 -5 217 204 8 125 15218 -70 5	1 3 - 40 44 HI 548420 4 4 4 814 - 494 0 - 70 - 87 1 3 5 270 - 280 1 158 - 185 1 4 7 286 - 10 7 - 70 - 69 1	14 240 -240 -240 15 6.45 4 10 -30 -86 1 16 6.46 20 241 248 3 168 403 101 770 4 213 227 44 6.45811		10 -117 3 208 -203 -70 -117 3 142 144 207 -193 4 426 -394 213 220 4 314 -278 - 68 6* 5 422 413 - 69 6* 7 -70 4 5	- 100 H1 3 -70 -74 A -70 -50 4 162 180 7 -70 -51 5 -70 -58 0 101 -200 4 107 115 0 141 -143 7 -70 -77 10 345 566 6 700 -75	HE 9,5%=34 7 9,14 8,04 1 -70 -37 7 144 -35#
9 -73 14 9 140 -140 19 -70 -1 10 312 -100 10 353 -345 20 -46 - 11 -70 -67 11 -70 4921 -48 -0 12 222 -197 12 -71 -45 22 103 4	7 8 777 716 6 187 197 , 4 9 -77 -49 6 -70 89 ; 1 10 463 -578 6 309 -111 4 6 11 -70 5 7 -69 86 ;	271 247 1 -74 44 4 04 103 2 762 -713 1 1=4 -213 1 -76 -14 4 401 -4/A 4 120 144	-49 11 1 -68 46 HE 747 6 1 -69 33 5 1040 1016 -69 -77 1 -76 94	-70 17 n 218 211 161 -100 0 726 208 10 660 -646 11 113 113	11 -68 -17 0 -60 48 19 100 0010 100 -116 10 100 10 10 100 -116 14 100 0010 100 -00	3 107 211 4 307 -427 4 -70 -114 4 364 307

Table 4 (cont.)

Table 5. <i>Rigid-body thermal parameters</i>	for i	the t	etraphen	vlarsonium	cation	(TPAS+	•)
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	$\mathbf{T} = \begin{pmatrix} 48 \\ 48 \end{pmatrix}$	5 14 465	$\begin{pmatrix} -10 \\ 6 \\ 346 \end{pmatrix}$ ×	< 10 <sup>-4</sup> Ų	$\boldsymbol{\omega} = \begin{pmatrix} 53 & -2 \\ & 6 \end{pmatrix}$	$   \begin{array}{r}     24 & -15 \\     51 & -9 \\     94   \end{array} $	$) \times 10^{-1} c$	leg <sup>2</sup>
	$\sigma(\mathbf{T}) = \begin{pmatrix} 2 & 2 \\ 2 & 2 \end{pmatrix}$	22 18 22	$\begin{pmatrix} 19\\18\\21 \end{pmatrix} >$	< 10 <sup>-4</sup> Ų	$\sigma(\boldsymbol{\omega}) = \begin{pmatrix} & 7 \\ & & \end{pmatrix}$	5 6 8 6 8	$) \times 10^{-1} c$	leg <sup>2</sup>
P	rincipal axes	Di (×	rection cos 104) relativ	ve to		Di (×	rection cos 104) relativ	ines ve to
Ei T ( (	genvalue )·0493 Ų )·0458 )·0345	<i>a</i> 8923 4450 0761	<i>b</i> 4495 – 8913 – 0592	c - 0415 - 0871 9953	Eigenvalue ω 9·9 deg <sup>2</sup> 8·2 2·8	<i>a</i> 2957 5981 7449	<i>b</i> 0345 - 7860 6173	<i>c</i> 9546 1568 2531
Atom*	$U_{11}$	i	U <sub>22</sub>	U 33	$U_{12}$	U	13	$U_{23}$
$\begin{array}{c} C(1) \\ C(2) \\ C(3) \\ C(4) \\ C(5) \\ C(6) \\ C(7) \\ C(8) \\ C(7) \\ C(10) \\ C(11) \\ C(12) \\ C(13) \\ C(14) \\ C(15) \\ C(14) \\ C(15) \\ C(16) \\ C(17) \\ C(18) \\ C(19) \\ C(20) \\ C(21) \\ C(22) \\ C(23) \\ $	501(-48) 706(76) 841(46) 688(-185) 775(-26) 808(172) 617(39) 977(253) 1253(266) 1166(123) 860(41) 602(-13) 477(-27) 513(-21) 587(19) 674(66) 660(1) 490(-101) 408(-131) 507(-64) 517(-180) 611(-217) 720(-92)	497( 549( 727( 705( 724( 665( 451( 484( 451( 537( 788( 626( 589( 589( 589( 589( 589( 589( 515( 494( 601( 724( 582( 646( 646( 646( 646( 646( 646( 646( 64	-21) -33) 4) -85) 21) -99) -33) 5) -49) -40) 146) 54) 29) 63) 175) 29) -102) -80) -16) -38) -57) -142 52)	$\begin{array}{r} 336(-15)\\ 345(-12)\\ 333(-26)\\ 374(5)\\ 438(42)\\ 368(-12)\\ 281(-97)\\ 470(-5)\\ 562(-12)\\ 432(-111)\\ 493(26)\\ 394(-8)\\ 328(-59)\\ 394(-63)\\ 458(-107)\\ 536(-52)\\ 812(291)\\ 640(214)\\ 403(-31)\\ 574(40)\\ 797(30)\\ 916(40)\\ 684(-28)\\ \end{array}$	$\begin{array}{r} 72(30)\\ 154(76)\\ 145(-3)\\ 46(-138)\\ 216(52)\\ 160(71)\\ -42(-83)\\ -108(-102)\\ -8(-45)\\ 232(48)\\ 262(54)\\ 97(-11)\\ -25(-73)\\ 65(51)\\ 53(-18)\\ 206(-18)\\ 179(-69)\\ -14(-144)\\ -5(30)\\ -27(66)\\ -122(111)\\ -181(100)\\ -64(79)\\ 200\\ \end{array}$	-17( $41($ $48($ $-94($ $59($ $-53($ $-53($ $-137($ $53($ $37($ $45($ $-43($ $-85($ $-133($ $-86($ $-80($ $-44($ $-18($ $17($ $202($ $114($ $42($	-19) 16) -6) -61) 31) 47) -10) 63) -79) -209) -34) -6) 68) 440) 54) -45) -87) -90) 44) 31) 70) 152) 5) -7)	$\begin{array}{r} 46(25)\\ 33(25)\\ -18(-47)\\ 63(-28)\\ 145(32)\\ 104(43)\\ -10(-2)\\ -2(34)\\ 64(144)\\ -40(34)\\ 25(40)\\ -9(-17)\\ 88(71)\\ -52(-41)\\ -134(-139)\\ 18(-58)\\ 61(-23)\\ 76(35)\\ -28(-36)\\ -98(-70)\\ -100(-51)\\ -42(-56)\\ 101(20)\\ \end{array}$
C(24) As	660(12) 473(-12)	552( 448(	34) 	446(-51) 348(2)	-72(-38) -12(-26)	49( 21(	-7) 31)	92(37) 34(28)

\* The experimental values of  $U_{ij}$  are given followed by  $U_{ij}(obs) - U_{ij}(calc)$  in parentheses.

Table 6.	Nonbonded	distances	in	the	tetraphenyl-
	arsonium	(TPAS+)	Са	itior	1

Table 7. Least-squares planes for the phenyl groups in the tetraphenylarsonium ion Plane and deviations (× 10<sup>3</sup>)

Atoms	Distance			Plane a	ind devi (Å	ations (× )	103)
C(1)-C(7)	3·065 Å		~	I	II	III	IV
C(1) - C(19)	3.085	Atom	(i=	=0) (	i = 6)	(i = 12)	(i = 18)
C(13) - C(19)	3.052	C(1+i)		002	001	003	-008
C(1) - C(13)	3.147	C(2+i)		- 002	-002	001	006
C(7) - C(13)	3.127	C(3+i)	-	003	003	- 006	002
C(7) - C(19)	3.111	C(4+i)		003 -	-003	007	009
C(1) - C(20)	3.332	C(5+i)	_	003	002	-003	006
C(7) - C(6)	3.240	C(6+i)		003	000	-002	002
C(7) - C(14)	3.359	As(41)*		093 -	-087	044	-087
C(13) - C(24)	3.307	* The arsenic	atom wa	s not inc	luded in	the calcu	ilation of the
C(19) - C(12)	3.293			plar	ne.		
C(19) - C(18)	3.391		Directio	n cosines	s ( × 104)	l	
C(18) - C(24)	3.395		wit	h respect	to to		
C(1) - H(20)	2.78		<u> </u>			<b>D</b> is	tance to
C(7) - H(6)	2.60	Plane	а	b	с	(	origin
C(7) - H(14)	2.72	Ι	8456	5130	1475	5	3·098 Å
C(13)-H(24)	2.82	II	- 4849	2651	- 8334	↓ —	3.552
C(19) - H(12)	2.74	III	5112	3790	-7714		0.945
C(8)-H(14)	2.60	IV	6148	- 5795	- 5350	) —	1.018

Table 8. Rigid-body thermal parameters for the anion (RD-)

	$\mathbf{T} = \begin{pmatrix} 510 \\ 0 \end{pmatrix}$	5 – 72 580	$\begin{pmatrix} 51\\-40\\375 \end{pmatrix} >$	< 10−4 Å2	$\omega = \begin{pmatrix} 155 - 0 \\ 0 \end{pmatrix}$	-88 199	119 110 171	$) \times 10^{-1} c$	leg <sup>2</sup>
	$\sigma(\mathbf{T}) = \begin{pmatrix} 4 \\ 2 \\ 2 \\ 2 \\ 2 \\ 2 \\ 2 \\ 2 \\ 2 \\ 2 \\$	9 41 45	$\begin{pmatrix} 47\\41\\49 \end{pmatrix} >$	<10−4 Å2	$\sigma(\omega) = \begin{pmatrix} 28 \\ \\ \end{pmatrix}$	19 25	23 19 28	$) \times 10^{-1} $	leg <sup>2</sup>
Pri	ncipal axes	D (×	irection cos 10 <sup>+4</sup> ) relati	sines ive to	Principal axes		Di (×	rection cos 10 <sup>4</sup> ) relati	sines ve to
Eige	envalue	a	b	c	Eigenvalue	~	a	b	
ΤÖ·	0641 Å2	5532	-8019	22.58	$\omega$ 38.7 deg <sup>2</sup>	5	320	- 5991	5984
 0·	0473	7886	5914	1684	9.5	5	274	7873	3193
0.	0358	2686	- 0849	- 9595	4.2	6	624	- 1457	- 7349
Atom	$U_{11}$		U <sub>22</sub>	$U_{33}$	$U_{12}$		U	13	$U_{23}$
C(25)	537(-207)	570	(-163)	580(-54)	-79(-12)		120	(186)	48(19)
C(26)	636(-107)	616	5(10)	520(-76)	-23(21)		- 134(	(-43)	-36(-35)
C(27)	599(-197)	524	(-102)	510(-114)	4(110)		56	(251)	-16(30)
C(28)	876(52)	782	.(64)	588(-69)	-78(18)		- 189	(55)	52(62)
C(29)	810(68)	644	(-46)	493(-152)	-36(-20)		-1120	(2)	106(66)
C(30)	483(-111)	5/3	(-56)	455(-13)	- 49(8)		40	(18)	-48(-39)
C(31)	4/3(-70)	202	(9) (54)	403(-9)	-00(9)		300	(14)	-39(-4)
C(32)	638(22)	662	(-34)	432(33) 472(-23)	-89(-30)		-1040	(-61)	-00(-20) 12(13)
F(34)	966(295)	521	(-70)	788(284)	-112(-30)		-369	(-298)	-46(3)
N(35)	706(-244)	892	(39)	809(-51)	-98(-14)		-2800		57(-13)
N(36)	1067(18)	653	(57)	922(29)	-103(-56)		-448	(-150)	-19(-28)
N(37)	850(-341)	681	(18)	875(-91)	- 102(45)		- 870	(434)	-176(-112)
N(38)	178(586)	880	(84)	1211(256)	-200(-62)		- 8920	(-321)	42(70)
N(39)	1041(106)	898	(165)	864(11)	25(-7)		- 341	(-111)	37(-46)
N(40)	600(43)	641	(49)	438(18)	- 16(46)		21(	(-4)	4(34)

Table 9. Least-squares planes for the anion

Plane and	l deviations	in Å (×10	) <sup>3</sup> ) from the	plane.
Atom	I	п	III	IV
C(25) N(35) C(26) N(36) C(30) C(31) C(31) C(27) N(37) C(32) F(34) N(40) C(33) C(28) N(38) C(29)	$ \begin{array}{r}     -18 \\     -44 \\     55 \\     103 \\     -8 \\     -18 \\     -14 \\     -15 \\     -17 \\     -24 \\     16 \\     14 \\     -55 \\     -95 \\     52 \\ \end{array} $	-5 1 -3 11 -5		-2 3 0 1 -4 3
N(39)	66		8	

	Dire wit	ection cosin ( $\times$ 10 <sup>4</sup> ) th respect to	es )	Distance	
Plane	a	b	c	origin	Description of plane
I II III IV	- 7122 - 7004 - 7226 - 7152	-0078 0262 -0453 -0058	7019 7133 6898 6989	5·494 Å 5·799 5·175 5·498	All atoms in anion Dicyano group at one end Dicyano group at other end Middle cyano group and F(34)

Cruickshank & Smith (1958). The standard deviation calculated on the basis of the 24 observed C–C distances is 0.012 Å. The value of 0.008 Å was computed from the least-squares standard deviations. The larger value is preferred since it more closely reflects the experimental deviations.

The average As-C bond distance is  $1.897 \pm 0.009$  Å, where the standard deviation is 1.5 times the value computed from the least-squares standard deviations. The values reported for the arsenic-carbon bond distance in various compounds range from 1.82 to 1.99 Å (*e.g.* see Cullen & Trotter (1963) and references therein) with large estimated standard deviations. Hedberg, Hughes & Waser (1961) reported the average As-C distance in arsenobenzene to be  $1.966 \pm 0.021$  Å. Using the criterion suggested by Cruickshank & Robertson (1953), the two bond lengths are significantly different ( $t_0 = 3.0$ ). Although the shortening of the As-C bond in TPAS<sup>+</sup> may be attributed to a formal charge effect, precise values for other As-C bond distances are required before the presence of a formal charge effect can be ascertained.

In both the iodide salt examined by Mooney (1940) and the tetrachloroferrate salt studied by Zaslow & Rundle (1957), TPAS<sup>+</sup> is required by the space group to have  $\overline{4}$  symmetry. In the present study the  $\overline{4}$  symmetry of TPAS<sup>+</sup> is destroyed by the rotation of the phenyl groups around the As-C bond. The observed asymmetry is apparently the result of crystal packing and is not an effect of intramolecular steric repulsion.

# The 3-fluoro-1,1,4,5,5-pentacyano-2-azapentadienide anion ( $RD^{-}$ )

An analysis of the rigid-body translational and libration motion for  $RD^-$  was carried out by the method given by Cruickshank (1956, 1961). The center of mass was taken as the unweighted average of the positional parameters of the atoms in the anion. As expected, the



Fig. 2. Views down the four arsenic-carbon bonds in the cation: (a) down As-C(1); (b) down As-C(7); (c) down As-C(13) (d) down As-C(19).

center of mass at 0.0616, 0.2316, 0.3555 is close to C(32). The results of the rigid-body analysis are given in Table 8. The libration-corrected positional parameters are given in Table 1. The intramolecular distances and angles in the anion were calculated using the corrected parameters and are illustrated in Fig.3.

The validity of using the rigid-body approximation for the anion is also questionable. The r.m.s. deviation between the observed and calculated U's is 0.0131. This large value is probably due to wagging of the cyano groups. A similar effect was observed by Bekoe & Trueblood (1960) in tetracyanoethylene and by Long, Sparks & Trueblood (1965) in 7,7,8,8-tetracyanoquinodimethane. The average correction for the five  $C \equiv N$ bonds was 0.0045 Å, which is probably too small by a factor of two. However, since the standard deviation of a bond length is 0.012 Å, there is little merit in attempting to obtain a more accurate correction.

The five  $C \equiv N$  bond lengths, after the libration correction, average  $1 \cdot 146 \pm 0 \cdot 012$  Å, in agreement with other cyanocarbons [see Bekoe & Trueblood (1960) and Long, Sparks & Trueblood (1965)]. The average C-C  $\equiv N$  angle is  $176 \cdot 8 \pm 1 \cdot 1^{\circ}$ , significantly different from a linear bond angle of  $180 \cdot 0^{\circ}$ . The nonlinearity is due to steric repulsion involving the fluorine atom and the cyano groups. The large angles of C(31)-C(30)-C(26) and N(40)-C(33)-C(28) are due to a repulsion between F(34) and C(26) and C(28). The resulting distortion equalizes the two fluorine intramolecular contacts: F(34)-C(26) is  $2 \cdot 672$  Å and F(34)-C(28) is  $2 \cdot 682$  Å.

The C-C (cyano) bond distances average  $1.435 \pm$  0.012 Å and are not significantly different from com-



Fig. 3. The atomic numbering distances and angles in the 3fluoro-1,1,4,5,5-pentacyano-2-azapentadienide anion.

#### Table 10. Intermolecular distances

The distance given is from atom I in the molecule specified by the parameters in Tables 1 and 2 to the atom J in the molecule specified by the letters A-G. Molecules A-G are located as follows:

$A \ 1+x, y, z$	$E \ 1-x, \frac{1}{2}-y, \frac{1}{2}+z$
B - x, -y, -z	$F \frac{1}{2} + x, \frac{1}{2} - y, z$
$C \ 1-x, \ -y, \ -z$	$G x, \frac{1}{2} + y, \frac{1}{2} - z$
$D = \frac{1}{2} + x, -y, \frac{1}{2} - z$	

I	J	Molecule	Distance (Å)	Ι	J	Molecule	Distance (Å)
H(21)	N(35)	A	2.98	C(10)	N(40)	D	3.47
H(22)	N(35)	Α	2.70	$\mathbf{C}(11)$	C(29)	D	3.48
H(15)	C(9)	В	2.83	C(11)	N(39)	D	3.41
H(15)	C(10)	B	2.99	N(38)	C(23)	Ē	3.45
H(16)	C(10)	В	2.84	N(38)	H(23)	$\overline{E}$	2.83
H(12)	C(11)	С	2.99	H(18)	N(35)	F	2.92
H(11)	C(12)	С	2.95	H(20)	N(36)	F	2.85
H(11)	H(12)	С	2.52	C(32)	C(25)	F	3.49
C(12)	C(11)	С	3.48	C(31)	N(35)	F	3.47
H(5)	C(13)	D	2.99	F(34)	H(9)	G	2.56
H(5)	C(18)	D	2.99	N(36)	H(8)	G	2.54
H(6)	N(37)	D	2.75	N(38)	H(10)	G	2.61
H(11)	C(29)	D	2.81	N(36)	C(8)	G	3.28
H(11)	N(39)	D	2.58	F(34)	C(9)	G	3.32
C(11)	H(3)	D	2.97	N(38)	C(10)	G	3.49
C(6)	N(37)	D	3.44	`	<b>、</b>		

parable bonds in tetracyanoethylene  $[1.449 \pm 0.009 \text{ Å}]$ , Bekoe & Trueblood (1960)], in 7,7,8,8-tetracyanoquinodimethane  $[1.440 \pm 0.004 \text{ Å}, \text{Long}, \text{Sparks \& Trueblood}$ (1965)], in pyridinium dicyanomethylide  $[1.41 \pm 0.01 \text{ Å}]$ , Bugg & Sass (1965)], and in ammonium tricyanomethide  $[1.40 \pm 0.01 \text{ Å}, \text{ Desiderato & Sass (1965)}]$ . The length of this C-C bond is discussed in some detail by Bekoe & Trueblood (1960). The small C-C-C angles of 113.8 and 114.5° in the dicyano groups are a consequence of intermolecular steric repulsion between F(34)and the atoms C(26) and C(28).

The average C-N bond distance in the chain is  $1.326 \pm 0.012$  Å which is equivalent to the C-N bonds in an aromatic system (Sutton, 1958). The C-C bonds in the chain average  $1.392 \pm 0.012$  Å and are close to the value in benzene (Sutton, 1958). These facts suggest that the bonds in the chain have about 50% double bond-character, in agreement with the resonance stabilized character of the anion.

The C-F distance of  $1.359 \pm 0.012$  Å is slightly shorter than the average value of 1.37 Å found in compounds

where there is only one fluorine bonded to a carbon atom (Sutton, 1958). When two or three fluorine atoms are bonded to the carbon atom the average distance is 1.33 Å (Sutton, 1958). Karle, Karle, Owen & Hoard (1965) observed a similar effect in the dimer of hexafluorobutadiene where they found 1.367 and 1.327 Å for the C-F distances in the two cases.

A number of least-squares planes were calculated for the anion and are tabulated in Table 9. As expected, the various cyano groups are planar. However, the entire anion, which is a highly resonance-stabilized system, is definitely nonplanar. Thus, RD<sup>-</sup> provides an example of the fact that exact planarity is not a prerequisite to resonance stabilization.

#### Intermolecular distances

All the intermolecular distances less than 3.5 Å were calculated. Distances involving a hydrogen atom which were less than 3.0 Å are tabulated in Table 10, together with the heavy atom distances less than 3.5 Å. As expected, the majority of the intermolecular contacts in-



Fig.4. A projection of the structure on the (100) plane illustrating the molecular packing.

volve the hydrogen atoms of the TPAS<sup>+</sup>. The three short  $N \cdots H$  contacts of 2.54, 2.58 and 2.61 Å are close to the value of 2.6–2.7 Å expected for van der Waals contact. The  $F \cdots H$  distance of 2.56 Å is the sum of the van der Waals radii. The shortest contacts between the heavier atoms are F(34)  $\cdots$  C(9) (3.32 Å) and N(36)  $\cdots$  C(8) (3.28 Å), both of which are van der Waals contacts.

#### References

- BEKOE, D. A. & TRUEBLOOD, K. N. (1960). Z. Kristallogr. 113, 1.
- BUGG, C. & SASS, R. L. (1965). Acta Cryst. 18, 591.
- CARPENTER, W. (1965). Private communication.
- Cox, E. G., CRUICKSHANK, D. W. J. & SMITH, J. A. S. (1958). Proc. Roy. Soc. A, 247, 1.
- CRUICKSHANK, D. W. J. & ROBERTSON, A. P. (1953). Acta Cryst. 6, 698.
- CRUICKSHANK, D. W. J. (1956). Acta Cryst. 9, 747, 754.
- CRUICKSHANK, D. W. J. (1961). Acta Cryst. 14, 896.

- Cullen, W. R. & TROTTER, J. (1963). Canad. J. Chem. 41, 2983.
- DESIDERATO, R. & SASS, R. L. (1965). Acta Cryst. 18, 1.
- HEDBERG, K., HUGHES, E. W. & WASER, J. (1961). Acta Cryst. 14, 369.
- HOERNI, J. A. & IBERS, J. A. (1954). Acta Cryst. 7, 744.
- International Tables for X-ray Crystallography (1962). Vol. III. p. 211. Birmingham: Kynoch Press.
- KARLE, I. J., KARLE, J., OWEN, T. B. & HOARD, J. L. (1965). Acta Cryst. 18, 345.
- LONG, R. E., SPARKS, R. A. & TRUEBLOOD, K. N. (1965). Acta Cryst. 18, 932.
- MCWEENY, R. (1951). Acta Cryst. 4, 513.
- MOONEY, R. C. L. (1940). J. Amer. Chem. Soc. 62, 2995.
- PAULING, L. (1960). *The Nature of the Chemical Bond*. 3rd ed. p. 260. Ithaca: Cornell Univ. Press.
- STOICHEFF, B. P. (1954). Canad. J. Phys. 32, 339.
- SUTTON, L. E. (1958). Tables of Interatomic Distances and Configuration in Molecules and Ions. Special Publication No. 11. London: The Chemical Society.
- ZASLOW, B. & RUNDLE, R. E. (1957). J. Phys. Chem. 61, 490.

Acta Cryst. (1966). 20, 482

## Étude par Diffraction de Rayons X de Complexes d'Halogénures Alcalins et de Molécules Organiques. IV. Structure de NaBr.2CH<sub>3</sub>CONH<sub>2</sub>\*

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The structure of NaBr . 2CH<sub>3</sub>CONH<sub>2</sub> has been determined by a three-dimensional X-ray analysis. Space group  $P2_1/c$ , Z=4;  $a=9\cdot11$ ,  $b=6\cdot49$ ,  $c=17\cdot72$  Å,  $\beta=115\cdot4^\circ$ . Each sodium atom is octahedrally coordinated (2Br and 4O) and the structure consists of infinite chains of octahedra having one face in common. There are N-H  $\cdots$  Br bonds between the chains. Distances Na-Br: 2.99 and 3.12. Mean distances: Na-O=2.35, N(H)-Br=3.50, C-O=1.22, C-N=1.31, C-C=1.50.

Le complexe NaBr .  $2CH_3CONH_2$  a été préparé par la méthode décrite par Titherley (1901): on dissout le bromure de sodium et l'acétamide dans l'éthanol anhydre et on refroidit la solution dans un exsiccateur au chlorure de calcium sous vide. Les cristaux se présentent sous forme d'aiguilles incolores très hygroscopiques (point de fusion:  $145^{\circ}C$ ). Pour l'étude aux rayons X, nous les avons enfermés dans des tubes en verre de Lindemann.

#### Paramètres de la maille

Les dimensions de la maille-unité ont été mesurées sur des diagrammes de rotation (autour des axes a et b) et de Weissenberg. Le spectre d'un fil d'argent a servi d'étalon (a = 4,086 Å). Le groupe spatial est  $P2_1/c$ , correspondant aux absences systématiques h0l pour  $l \neq 2n$  et 0k0 pour  $k \neq 2n$ . Les paramètres valent:

$$a = 9,11 \pm 0,01 \text{ \AA}$$
  

$$b = 6,49 \pm 0,01$$
  

$$c = 17,72 \pm 0,03$$
  

$$\beta = 115,4^{\circ} \pm 0,2^{\circ}.$$

Les résultats publiés précédemment (Gobillon & Piret, 1962) étaient basés sur une valeur légèrement erronée pour le paramètre a de l'argent. Il y a quatre 'molécules' de complexe par maille. La densité calculée, vérifiée expérimentalement, vaut 1,55.

#### Intensité des rayons diffractés

Les spectres de diffraction ont été obtenus à l'aide d'une caméra de Weissenberg, munie d'un dispositif intégrateur. La radiation incidente était Cu K $\alpha$  ( $\lambda =$ 1,5418 Å). Les réflexions *hkl* ont été enregistrées par

<sup>\*</sup> Partie III: Structure de NaI . 3CH<sub>3</sub>OH (Piret & Mesureur, 1965).

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