395. *The Optical Stability of (+)-Methyl 9-Aminofluorene-2-carboxylate.*

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(+)-Methyl 9-aminofluorene-2-carboxylate is not optically unstable *per se*. Loss in rotatory power which it suffers on storage is due to chemical changes initiated by aerial oxidation. Recrystallisation restores the original rotatory power, provided that decomposition has not gone too far.

AFTER their experiments on the resolution of 1 : 2 : 3 : 4-tetrahydro-2-naphthylamine Pope and Harvey[1] reported that this base racemises during liberation from its salts or during preparation of its derivatives. On the other hand it was shown by Pickard and Kenyon[2] that 1 : 2 : 3 : 4-tetrahydro-2-naphthol is optically stable. The present authors[3] re-examined the resolution of 1 : 2 : 3 : 4-tetrahydro-2-naphthylamine and showed that Pope and Harvey's conclusion of optical instability was explicable by the incompleteness of their resolution combined with differences of solubility between the (+)- and the (±)-compound with which they worked.

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[1] Pope and Harvey, *J.*, 1901, **79**, 74.
[2] Pickard and Kenyon, *J.*, 1912, **101**, 1427.
[3] Davies, Edwin, and Kenyon, *J.*, 1956, 250.

Recently Ray and Kreiser[4] showed that, whilst (+)-9-hydroxyfluorene-2-carboxylic acid gave no evidence of optical instability, the corresponding (+)-methyl 9-aminofluorene-2-carboxylate " racemised readily, even on standing at room temperature, and recrystallisation was impossible without loss of activity." We repeated Ray and Kreiser's experiments and obtained (+)-methyl 9-aminofluorene-2-carboxylate with a rotatory power much more than that recorded by these authors. The (+)-base, when kept in the dark and in an atmosphere of nitrogen, maintains its rotatory power almost unimpaired for at least three weeks, and it can be recrystallised unchanged in melting point or optical activity. On the other hand, [α] falls to half its original value when the (+)-base in ethanolic solution in the presence of air is kept in the dark for 12 days; later, the solution became too yellow to permit its further measurement. When not protected from light the solutions are even more unstable: optical activity was fully maintained for at least 14 hr., but after 40 hr. had fallen by 25%. During 3 weeks the solution became deep green and deposited colourless crystals and evolved ammonia. In contrast (+)-methyl 9-acetamidofluorene-2-carboxylate which is chemically stable is also optically stable.

It appears then that the free base is not optically unstable *per se*, and that loss of rotatory power results from chemical reaction with air.

It was shown by Goldschmidt *et al.*[5] that 9-aminofluorene is readily oxidised in air to coloured solutions which evolve ammonia and deposit almost colourless, sparingly soluble tetra-9-fluorenylhydrazine. Diphenylmethylamine on the other hand gave diphenylmethylenediphenylamine. The analysis of our product would be compatible with a structure analogous to either of these.

EXPERIMENTAL

By following Ray and Kreiser's procedure[4] the hydrochloride of methyl 9-aminofluorene-2-carboxylate was obtained in excellent yield, with m. p. 238° (previous sintering). The free base separates from light petroleum in needles, m. p. 92—95°.

(+)-*Methyl 9-Aminofluorene-2-carboxylate.*—The hydrochloride of the (±)-base (12 g.) was thoroughly triturated with 3% sodium hydroxide solution (100 c.c.), and the liberated base washed thoroughly with water (a small portion, dried *in vacuo*, had m. p. 98—100°). The damp cake was suspended in a solution of (+)-tartaric acid (7 g.) in water (100 c.c.), and the whole gently heated until dissolution was complete. The crystals which separated overnight (crop A) were removed by filtration and roughly dried [needles, 12 g., m. p. 195° (Found: C, 55·6; H, 5·7; N, 3·4. Calc. for $C_{19}H_{19}O_8N,H_2O$: C, 56·0; H, 5·2; N, 3·4%)]. After recrystallisation from ethanol the salt had m. p. 210° and, as shown by analysis, was anhydrous (Found: C, 58·3; H, 4·8. Calc. for $C_{19}H_{19}O_8N$: C, 58·6; H, 4·9%).

The salt (A) was then recrystallised six times from water, previous experiments having shown this to be more than adequate for complete separation of the diastereoisomers, and a seventh time from ethanol to render the salt anhydrous. This least soluble fraction (1 g.) had m. p. 210° and $[\alpha]_D^{20}$ +41° (*l* 1; *c* 0·591 in H_2O).

Decomposition of this salt with aqueous sodium hydroxide yielded the free (+)-base (0·6 g.), m. p. 108—110°, $[\alpha]_D^{20}$ +52° (*l* 1; *c* 0·730 in EtOH). Recrystallisation did not alter the m. p. or [α] of the (+)-base.

Experiments to show the Optical Stability and the Chemical Instability of (+)-*Methyl 9-Aminofluorene-2-Carboxylate.*—(i) (+)-Methyl 9-aminofluorene-2-carboxylate, m. p. 100—103°, $[\alpha]_D^{20}$ +38° (*l* 1; *c* 0·580 in EtOH) (Found: C, 75·5; H, 5·6; N, 6·1. Calc. for $C_{15}H_{13}O_2N$: C, 75·3; H, 5·5; N, 5·85%), after 3 weeks in the dark in an atmosphere of nitrogen had $[\alpha]_D^{20}$ +37° (*l* 1; *c* 0·625 in EtOH).

(ii) A solution of the base, m. p. 105—108°, $[\alpha]_D^{20}$ +32° (*l* 1; *c* 0·713 in EtOH), in warm light petroleum was allowed to crystallise and the solvent then completely removed *in vacuo*. The crystals still had m. p. 105—108° and $[\alpha]_D^{20}$ +32·3° (*l* 1; *c* 0·715 in EtOH). After storage in the dark under nitrogen they had m. p. 105—108°, $[\alpha]_D^{20}$ +31·7° (*l* 1; *c* 0·835 in EtOH) and still gave excellent analytical values for C, H, and N.

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[4] Ray and Kreiser, *J. Amer. Chem. Soc.*, 1945, **67**, 504; 1947, **69**, 3068.
[5] Goldschmidt *et al.*, *Annalen*, 1926, **447**, 197; 1927, **456**, 152.

(iii) A solution of the base, m. p. 108—110°, $[\alpha]_D^{20}$ $+52°$ (*l* 1; *c* 0·730 in EtOH), in ethanol, after 5 days under air in the dark had become slightly yellow and α_D^{20} $+0·38°$ had fallen to α_D^{20} $+0·25°$. After 7 days more the solution had become distinctly yellow and had α_D^{20} $+0·19°$. Thereafter the solution became more deeply coloured and further measurements were impracticable.

(iv) A solution of the base, $[\alpha]_D^{20}$ $+45°$ (*l* 1; *c* 0·972 in EtOH), in ethanol (α_D^{20} $+0·44°$) was kept under air but not protected from daylight. After 14 hr. the rotation was unchanged, but after 40 hr. had fallen to α_D^{20} $+0·32°$ and the solution had become slightly yellow. During the next 4—5 days the colour gradually became deep green and colourless needles began to separate: concurrently the solution gradually lost some of its own colour. After being washed with ethanol this *substance* had m. p. 165°, unchanged after recrystallisation from ethanol (Found: C, 78·6; H, 4·6; N, 2·3. $C_{30}H_{21}O_4N$ requires C, 78·4; H, 4·6; N, 3·0. $C_{60}H_{44}O_8N_2$ requires C, 78·2; H, 4·8; N, 3·0%).

(v) A solution of the (±)-base, m. p. 93—95° [freshly liberated from its (stable) hydrochloride and dried] (1 g.), in ethanol (10 c.c.) was kept for 3 weeks: it became deep green and deposited colourless needles. There was a strong smell of ammonia on opening the flask; the crystals (*ca.* 0·7 g.) separated from ethanol in needles, m. p. 165°, unchanged on recrystallisation (Found: C, 78·55; H, 4·6; N, 2·3%).

Optical and Chemical Stability of (+)-*Methyl* 9-*Acetamidofluorene*-2-*carboxylate*.—By interaction with acetic anhydride and pyridine the base (0·5 g.) of $[\alpha]_D^{20}$ $+32°$ was quantitatively converted at room temperature into (+)-*methyl* 9-*acetamidofluorene*-2-*carboxylate*, needles (0·4 g.) (from ethanol), m. p. 246°, $[\alpha]_D^{20}$ $+26°$ (*l* 1; *c* 0·862 in EtOH) (Found: C, 72·8; H, 5·0; N, 5·2. $C_{17}H_{15}O_3N$ requires C, 72·6; H, 5·4; N, 5·0%). The solution in ethanol retained its rotatory power undiminished for a week and the crystalline acetyl derivative, after 2 weeks in a vessel exposed to air and light, had $[\alpha]_D^{20}$ $+26·2°$ (*l* 1; *c* 0·930 in EtOH).

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