Synthesis of Cyclopenta[*cd*]pyrene, a Ubiquitous Environmental Carcinogen

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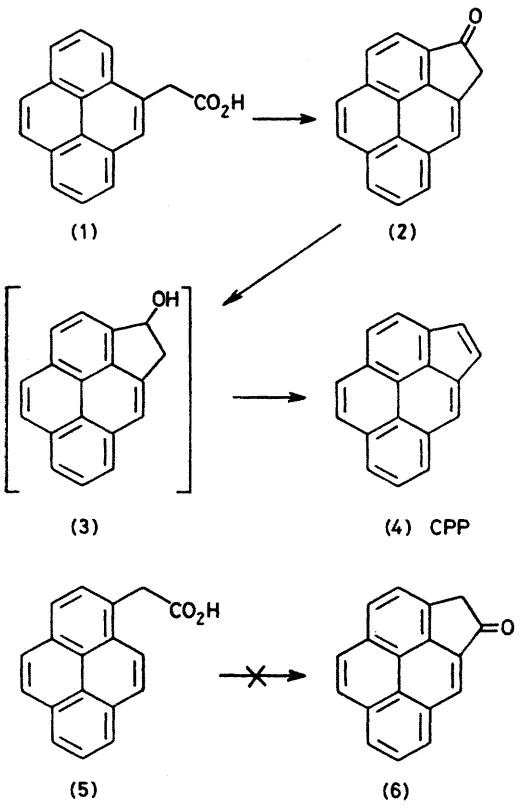
Summary A new and efficient synthetic approach to the potent mutagen, cyclopenta[*cd*]pyrene, is described.

CYCLOPENTA[*cd*]PYRENE (**4**) (CPP) is a recently detected mutagen with a wide environmental distribution. CPP has been found in automobile exhaust condensates, in concentrations 10 times greater than those of benzo[*a*]pyrene,[1] and in a large variety of carbon black soots.[2–5] The carcinogenicity[2] and mutagenicity[6,7] of CPP have been reported, and a model of the mutagenic metabolite proposed.[7]

CPP was first isolated in small amounts by extraction from carbon soots,[2] and has recently been isolated in 22%



yield from a pyrolysate of 1-pyrenylethanol.[8] However, the method is best suited for a small scale preparation and requires chromatographic separation of a complex mixture. In view of the need of relatively large amounts of CPP for metabolic and mutagenic studies, we have undertaken a nonpyrolytic synthesis of CPP.

We now report that cyclization of pyrene-4-acetic acid[9] (**1**) with HF gives the previously unreported ketone (**2**) in 45% yield; m.p. 210—212 °C (benzene); ν_{max} (KBr) 1702 cm^{-1} (C=O); λ_{max} (EtOH) 250, 256, and 350 nm (ϵ 48,100, 47,700, and 37,700); and *m/e* (70 eV) 242 (M^+, 100%). Reduction of the ketone (**2**) with sodium borohydride in ethanol affords the alcohol (**3**), which is readily dehydrated upon treatment with dilute acid. Traces of polar impurities were removed by passing a benzene solution of the product through a small column of basic alumina. Removal of the solvent gave pure CPP, m.p. 171—172 °C, in 90% yield from the ketone (**2**).†

In contrast to the closure of pyrene-4-acetic acid (**1**), our attempts at closure of pyrene-1-acetic acid (**5**), using a variety of conditions, were unsuccessful; only polymeric material or unchanged (**5**) was isolated. The lack of closure of (**5**) was unexpected in view of the conversion of phenanthrene-1-acetic acid into acephenthrene.[10]

Our procedure provides a new direct method for the preparation of relatively large quantities of CPP by standard synthetic methods.

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† The u.v. and mass spectral data for CPP were identical to those previously reported (refs. 3 and 8).

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