HYDROGEN CYANIDE PRODUCTION IN
NORTH AMERICAN AND AFRICAN
POLYDESMOID MILLIPEDS

BY HANS E. EISNER, WILLIAM F. WOOD, AND THOMAS EISNER

A diversity of substances has been isolated from the defensive secretions of millipedes, including hydrogen cyanide, benzaldehyde, phenols, 1,4-benzoquinones, quinazolinones, and nitrogen-containing terpenes (references in Altman and Dittmer, 1973; Duffield et al., 1974; Meinwald et al., 1975; Smolanoff et al., 1975; Wood, 1974; Wood et al., 1975). Hydrogen cyanide, the first of these compounds identified (Guldensteeden-Egeling, 1882), has been reported from over a dozen European and New World species, all members of the suborder Polydesmidia (Barbetta et al., 1966; Blum and Woodring, 1962; Blum et al., 1973; Casnati et al., 1963; Davenport et al., 1952, Duffield et al., 1974; Eisner et al., 1963; H. E. Eisner et al., 1963; Hall et al., 1969; Monteiro, 1961). We have demonstrated hydrogen cyanide production in four additional polydesmoid species, strengthening the view that cyanogenesis may be of widespread, if not general, occurrence within the suborder. Three of the species, *Apheloria trimaculata*, *A. kleinpeteri*, and *Pseudopolydesmus branneri*, stemmed from the U. S. A. (the first species was from Clifton Forge, Virginia; the other two from Roanoke, Virginia); the fourth species, *Astrodesmus laxus*, was from Africa (Mombasa, Kenya). The animals were tested for cyanogenesis by manipulating them and gently squeezing them, while at the same time holding beside their bodies strips of filter paper impregnated with benzidine acetate-copper acetate reagent (Feigl, 1966). In all instances the papers turned blue, indicating release of hydrogen cyanide vapor from their glands. In single individuals of each of the North American species, cyanogenetic output was assayed quantitively (see accompanying table), using the technique previously developed in our laboratories (H. E. Eisner et al., 1967).
TABLE

Cyanogenetic Output of Millipedes

<table>
<thead>
<tr>
<th>Species</th>
<th>Sex and Body Weight of individual</th>
<th>Cyanogenetic Output (µg/individual)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apheloria trimaculata</td>
<td>♂ (769 mg)</td>
<td>16</td>
</tr>
<tr>
<td>A. kleinpeteri</td>
<td>♀ (1053 mg)</td>
<td>27</td>
</tr>
<tr>
<td>Pseudopolydesmus branneri</td>
<td>♂ (199 mg)</td>
<td>32</td>
</tr>
</tbody>
</table>

Cyanogenesis in polydesmoid millipedes involves simultaneous release of hydrogen cyanide and aldehyde from stored cyanohydrin (Eisner et al., 1963). The aldehyde has been shown to be benzaldehyde in several species (Barbetta et al., 1966; Blum et al., 1973; Blum and Woodring, 1962; Casnati et al., 1963; Duffield et al., 1974; H. E. Eisner et al., 1963; Monteiro, 1961; Weatherston and Gardiner, 1973). We made no effort to isolate the aldehyde in the three North American species, but found evidence that Astrodesmus laxus produces benzaldehyde. Gas-liquid chromatography of a sample of secretion from this millipede, obtained by wiping the discharged fluid from the gland openings with pieces of filter paper, showed a peak of identical retention time to that of authentic benzaldehyde. Some polydesmoid millipedes have ancillary phenolic components in their secretion (Blum et al., 1973; Duffield et al., 1974; Monteiro, 1961). We did not attempt to isolate such components in our species, although the secretion of Pseudopolydesmus branneri had a phenolic odor.

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