Bromophenols from the Marine Red Alga *Polysiphonia urceolata* with DPPH Radical Scavenging Activity

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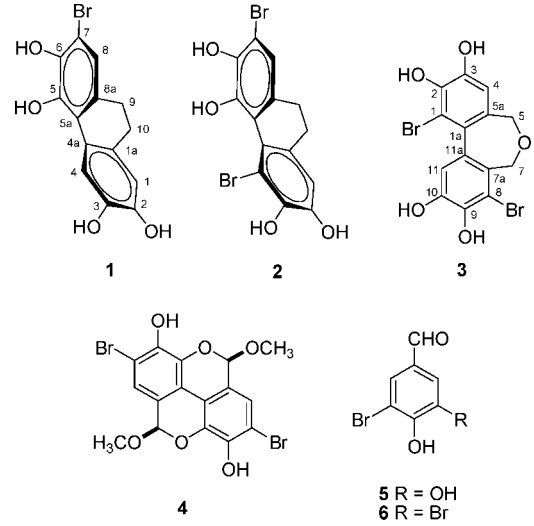
Three new (**1**–**3**) and three known (**4**–**6**) bromophenols were isolated and identified from the marine red alga *Polysiphonia urceolata*. On the basis of extensive analysis of spectroscopic data, the structures of these compounds were determined to be 7-bromo-9,10-dihydrophenanthrene-2,3,5,6-tetraol (**1**), 4,7-dibromo-9,10-dihydrophenanthrene-2,3,5,6-tetraol (**2**), 1,8-dibromo-5,7-dihydrodibenzo[*c,e*]oxepine-2,3,9,10-tetraol (**3**), urceolatol (**4**), 3-bromo-4,5-dihydroxybenzaldehyde (**5**), and 3,5-dibromo-4-hydroxybenzaldehyde (**6**). Each of the isolated compounds was evaluated for α,α-diphenyl-β-picrylhydrazyl (DPPH) radical scavenging activity, and all were found to be potent, with IC_{50} values ranging from 6.1 to 35.8 μM, compared to the positive control, butylated hydroxytoluene (BHT), with an IC_{50} of 83.8 μM.

Polysiphonia urceolata Grev. is a marine red alga of the family Rhodomelaceae, belonging to the order Ceramiales. A number of bromophenols have been previously isolated from algal species of this family,[1–8] and some species have been evaluated for α,α-diphenyl-β-picrylhydrazyl (DPPH) radical scavenging activity.[9,10] In the course of our evaluation on DPPH radical scavenging activity of marine algae that were colleted from Chinese coastal waters, the organic extract, fractions, and semipurified subfractions of *P. urceolata* were found to possess strong activity comparable to the positive control, butylated hydroxytoluene (BHT).[9] Therefore, this species was selected for further chemical investigation.

The air-dried and ground algal material *P. urceolata* was extracted using 95% EtOH, and the concentrated extract was suspended in water and successively partitioned with petroleum ether, EtOAc, and *n*-BuOH. The EtOAc-soluble extract was chromatographed over Si gel eluting with petroleum ether–acetone and $CHCl_3$–MeOH. The subsequent fractions were further purified using a variety of chromatographic techniques to yield three new bromophenols, 7-bromo-9,10-dihydrophenanthrene-2,3,5,6-tetraol (**1**), 4,7-dibromo-9,10-dihydrophenanthrene-2,3,5,6-tetraol (**2**), and 1,8-dibromo-5,7-dihydrodibenzo[*c,e*]oxepine-2,3,9,10-tetraol (**3**). In addition, three known bromophenols, urceolatol (**4**),[3] 3-bromo-4,5-dihydroxybenzaldehyde (**5**),[3,11] and 3,5-dibromo-4-hydroxybenzaldehyde (**6**),[11] were also isolated and identified. The structures of these compounds were established on the basis of the interpretation of NMR (^{1}H, ^{13}C, COSY, HSQC, and HMBC) as well as low- and high-resolution mass spectroscopic data. Compounds **1**– **6** were evaluated for DPPH radical scavenging activity, and all of them exhibited potent activity, with IC_{50} values ranging from 6.1 to 35.8 μM.



Results and Discussion

Compound **1** was obtained as a yellowish, amorphous powder. The IR spectrum displayed an absorption band for hydroxyl groups at 3395 cm^{-1} as well as the characteristic absorption bands for aromatic rings at 1607 and 1513 cm^{-1}. The EIMS spectrum exhibited a characteristic monobrominated molecular-ion cluster at *m/z* 324/322 (1:1), and the molecular formula $C_{14}H_{11}BrO_4$ was determined by HRESIMS at *m/z* 322.9915 $[M + H]^+$ (calcd for $C_{14}H_{12}{}^{79}BrO_4$, 322.9918). The ^{1}H NMR spectrum of **1** showed the presence of three singlets attributed to aromatic protons at δ_H 6.71 (1H, s, H-1), 6.88 (1H, s, H-8), and 8.01 (1H, s, H-4) and two multiplets assigned to two methylenes at δ_H 2.63 (2H, m, H-9) and 2.58 (2H, m, H-10). The ^{13}C NMR and DEPT spectra (Experimental Section) exhibited the presence of 14 carbon signals assignable to two methylenes, a pentasubstituted benzene ring, and a tetrasubstituted benzene ring with one brominated (δ_C < 120 ppm) and four oxygenated (δ_C > 140 ppm) quaternary carbons. In the ^{1}H−^{1}H COSY spectrum, a correlation between H-9 (δ_H 2.63) and H-10 (δ_H 2.58) was observed. The chemical shift values, the coupling patterns, and the observed ^{1}H−^{1}H COSY correlation as well as the molecular composition ($C_{14}H_{11}BrO_4$) suggested that **1** possesses a 9,10-dihydrophenanthrene skeleton with one bromine and four hydroxyl groups substituted on the phenyl moieties. The HMBC spectrum revealed long-range correlations from H-1 to C-3 (δ_C 143.7), C-4a (δ_C 125.2), and C-10 (δ_C 30.0), from H-4 to C-2 (δ_C 145.0), C-1a (δ_C 131.3), and C-5a (δ_C 122.5), and from H-8 to C-6 (δ_C 141.8), C-5a, C-7 (δ_C 107.8), and C-9 (δ_C 30.6) (Figure 1). HMBC correlations from H-9 to C-1a, C-5a, C-8 (δ_C 122.4), and C-8a (δ_C 133.0) and from H-10 to C-1 (δ_C 115.4), C-4a (δ_C 125.2), and C-8a (δ_C 133.0) were also observed.

The absolute configuration of compound **1** was established on the basis of its CD spectrum as compared with a literature report. Similar to that of polysiphenol,[12] a negative Cotton effect at 217 nm ($\Delta\epsilon$ = –55.7) and a positive Cotton effect at 220 nm ($\Delta\epsilon$ = +155.5) were observed in the CD spectrum of **1**, which suggested

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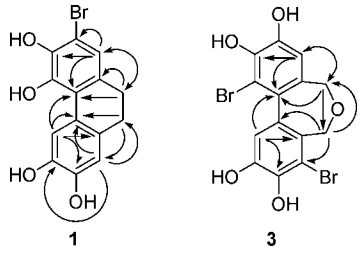

Figure 1. Key HMBC correlations of compounds **1** and **3**.

negative helicity of the diphenyl chromophore, and therefore an *R* configuration.[12]

On the basis of the above evidence, the structure of compound **1** was identified as 7-bromo-9,10-dihydrophenanthrene-2,3,5,6-tetraol.

Compound **2**, obtained as yellowish needles (acetone), was elucidated as a 4-brominated derivative of **1**. Its EIMS spectrum showed a characteristic molecular-ion cluster at *m/z* 404/402/400 in a ratio of 1:2:1, which clearly indicated the presence of two bromine atoms in the molecules. The molecular formula was determined as $C_{14}H_{10}Br_2O_4$ by HRESIMS at *m/z* 424.8825 $[M + Na]^+$ (calcd for $C_{14}H_{10}{}^{79}Br^{81}BrO_4Na$, 424.8823). The IR and NMR spectra of **2** were very similar to those of **1** (Experimental Section), except for the lack of an aromatic proton and an aromatic methine carbon at δ_H 8.01 (1H, s, H-4) and δ_C 116.9 (C-4) as observed in the ^1H and ^{13}C NMR spectra of **1**, respectively. Instead, a brominated quaternary carbon at δ_C 111.8 (C-4) was observed in the ^{13}C NMR spectrum of **2**. The HMBC spectrum revealed long-range correlations from H-1 (δ_H 6.79) to C-3 (δ_C 142.6), C-4a (δ_C 126.3), and C-10 (δ_C 32.0) and from H-8 (δ_H 6.95) to C-5a (δ_C 122.7), C-6 (δ_C 143.0), C-7 (δ_C 108.2), and C-9 (δ_C 31.0).

As for compound **1**, the absolute configuration of **2** was established on the basis of its CD spectrum. The observed negative Cotton effect at 220 nm ($\Delta\epsilon = -2011.6$) and positive Cotton effect at 225 nm ($\Delta\epsilon = +3939.7$) in the CD spectrum also suggested a negative helicity of the diphenyl chromophore, the same as that for **1**. Thus, the chemical structure of **2** was assigned as 4,7-dibromo-9,10-dihydrophenanthrene-2,3,5,6-tetraol.

Compound **3** was obtained as a yellowish powder. The TLC and HPLC profiles exhibited it as a pure compound. However, besides the major compound **3**, the ^1H and ^{13}C NMR spectra indicated the presence of a minor component in **3**. Attempts to separate the two compounds by different column chromatography steps as well as by preparative HPLC with different solvent systems failed. Because of the limited amount of the minor compound, its structural determination was not successful.

The IR spectrum showed an absorption band for hydroxyl groups at 3439 cm^{-1} as well as the characteristic absorption bands for aromatic rings at 1610 and 1579 cm^{-1}. The EIMS spectrum exhibited a characteristic dibrominated molecular-ion cluster at *m/z* 420/418/416 (1:2:1), and the molecular formula was determined to be $C_{14}H_{10}Br_2O_5$ by HRESIMS at *m/z* 440.8746 $[M + Na]^+$ (calcd for $C_{14}H_{10}{}^{79}Br^{81}BrO_5Na$, 440.8772). The ^1H NMR spectrum exhibited the presence of two aromatic singlets at δ_H 7.19 (1H, s, H-11) and 6.95 (1H, s, H-4) and four doublets attributed to two oxygenated methylene protons at δ_H 4.32 (1H, d, $J = 11.3$ Hz, H_a-5), 3.75 (1H, d, $J = 11.3$ Hz, H_b-5), 4.95 (1H, d, $J = 11.5$ Hz, H_a-7), and 3.86 (1H, d, $J = 11.5$ Hz, H_b-7). The ^{13}C NMR and DEPT spectra (Experimental Section) displayed the presence of 14 carbon signals consisting of two oxygenated methylenes at δ_C 67.8 (C-5) and 65.7 (C-7), two sp^2 methines at δ_C 116.1 (C-4) and 117.1 (C-11), and 10 sp^2 quaternary carbons at δ_C 110.1 (C-1), 112.2 (C-8), 127.6 (C-7a), 129.1 (C-5a), 132.4 (C-1a), 133.0 (C-11a), 143.7 (C-3), 144.5 (C-9), 145.3 (C-2), and 146.1 (C-10). Again, the brominated and oxygenated quaternary carbons were identified by their chemical shifts at $\delta_C < 120$ and $\delta_C > 140$ ppm, respectively. In the HMBC spectrum (Figure 1), cross-peaks from aromatic protons to their correlated long-range carbons established the substitution patterns of the two aromatic rings. The HMBC correlations from H-11 to C-1a, C-7a, and C-9, from H-4 to C-1a, C-2, and C-5, from H-5 to C-1a, C-4, and C-7, and from H-7 to C-5, C-8, and C-11a demonstrated that the structure of **3** was 1,8-dibromo-5,7-dihydrodibenzo[*c,e*]oxepine-2,3,9,10-tetraol.

Table 1. DPPH Radical Scavenging Activity of Compounds **1–6**

compound	IC_{50} (μM)	compound	IC_{50} (μM)
1	6.8	**5**	20.3
2	6.1	**6**	35.8
3	8.1	BHT	83.8
4	15.1		

Bromophenols have previously been isolated and reported from many species of marine red algae.[1–8] For the above identified bromophenols, **1** and **2** possess a unique 9,10-dihydrophenanthrene structural feature, while **3** possesses an unusual 5,7-dihydrodibenzo[*c,e*]oxepine structural moiety. To the best of our knowledge, **1** and **2** represent only the second example of a 9,10-dihydrophenanthrene skeleton from a marine source, the first report being polysiphenol, a brominated 9,10-dihydrophenanthrene phenolic derivative isolated from *P. ferulacea*,[12] while **3** represents new structural skeleton.

The radical scavenging activity of compounds **1–6** was evaluated by using the DPPH radical scavenging assay as reported previously.[9,10] Compounds **1–3** showed strong activities, with IC_{50} values of 6.8, 6.1, and 8.1 μM (Table 1), respectively. Their activities were 13-, 13-, and 10-fold more potent than that of the known synthetic antioxidant butylated hydroxytoluene ($IC_{50} = 83.8$ μM), respectively. Furthermore, compounds **1–3** contain more phenolic hydroxyl groups and showed stronger activities than the other compounds that had fewer phenolic hydroxyl groups. This result is in good agreement with the previous observation that free radical scavenging activity increases significantly with the numbers of hydroxyl groups in related molecules.[13]

Experimental Section

General Experimental Procedures. Melting points were determined by a SGW X-4 micromelting apparatus (uncorrected). IR spectra were performed on a Nicolet NEXUE 470 infrared spectrophotometer. UV spectra were measured on a Varian Cary 50 UV–vis−NIR spectrophotometer. 1D and 2D NMR spectra were recorded on a Bruker Avance 500 MHz spectrometer. Mass spectra were performed on a VG Autospec 3000 mass spectrometer. HPLC analysis was carried out on a Dionex HPLC system (P680 HPLC pump, UVD 340U UV–visible detector) using a C18 column (5 μm, 8.0 × 250 mm). Si gel (200–300 and 300–400 mesh, Qingdao Haiyang Chemical Co., Qingdao, China) and RP-18 reversed-phase Si gel and Sephadex LH-20 (Merck, Darmstadt, Germany) were used for open CC. TLC was carried out on glass plates with precoated GF_{254} Si gel, and spots were visualized under UV light at 254 nm and detected by spraying with 1% $FeCl_3$ solution.

Material. The marine red alga *Polysiphonia urceolata* Grev. was collected at the coast of Qingdao, China, in April 2006 and identified by Prof. B.-M. Xia at the Institute of Oceanology, Chinese Academy of Sciences (IOCAS). A voucher specimen (No. HZ06041) was deposited in the Hebarium of Marine Organisms at IOCAS.

Extraction and Isolation. The air-dried and ground marine red alga *P. urceolata* (30.5 kg) was extracted with 95% EtOH at room temperature for 3 × 72 h. After the solvent was removed under reduced pressure at <40 °C, a dark residue (980 g) was obtained. The residue was suspended in H_2O and then partitioned with petroleum ether, EtOAc, and *n*-butanol, successively. The EtOAc extract (300 g) was chromatographed over Si gel (1200 g) eluting with petroleum ether–acetone and $CHCl_3$–MeOH to give 36 fractions on the basis of TLC analysis. Fraction XVI (16.3 g) was further fractionated by CC on Si gel eluting with a gradient of

increasing acetone (10–100%) in petroleum ether to yield three subfractions. The second and sixth subfractions were chromatographed over Sephadex LH-20 eluting with MeOH to yield compound **4** (10.1 mg). Fraction XVII (6.0 g) was further chromatographed over Si gel eluting with a gradient of increasing acetone (20–100%) in petroleum ether to yield five subfractions. The third and fourth subfractions were further purified by reversed-phase semipreparative HPLC using MeOH–H_2O (3:7) as the mobile phase to yield compound **6** (12.3 mg). Fraction XVIII (1.0 g) was chromatographed over Sephadex LH-20 eluting with $CHCl_3$–MeOH (1:1) to yield compound **1** (14.8 mg). Fraction XIX (21.3 g) was chromatographed over Si gel eluting with a gradient of increasing amount of acetone (30–100%) in petroleum ether and further purified by CC on Sephadex LH-20 eluting with $CHCl_3$−MeOH (1:1) to yield compound **5** (12.1 g). Fraction XX (10.2 g) was further chromatographed over Si gel eluting with a gradient of increasing acetone (40–100%) in petroleum ether to yield five subfractions. The third and fourth subfractions were combined and further purified by CC on Sephadex LH-20 and RP-18, eluted with MeOH and MeOH–H_2O (4:1), respectively, to yield compounds **2** (10.3 mg) and **3** (12.3 mg).

7-Bromo-9,10-dihydrophenanthrene-2,3,5,6-tetraol (1): yellowish, amorphous powder, mp 147–149 °C; UV (EtOH) λ_{max} (log ϵ) 216 (1.38), 281 (1.26) nm; CD (MeOH) λ_{max} nm ($\Delta\epsilon$) 217 (–55.7), 220 ($\Delta\epsilon = +155.5$); IR (KBr) ν_{max} 3395, 2933, 2835, 1607, 1513, 1480, 1440, 1335, 1283, 1262, 1239, 1182, 1122, 1069, 1030,1013, 989, 880, 841, 782, 730, 685, 663, 626, 550 cm^{-1}; ^1H NMR (acetone- d_6, 500 MHz) δ_H 8.01 (1H, s, H-4), 6.88 (1H, s, H-8), 6.71 (1H, s, H-1), 2.63 (2H, m, H-9), 2.58 (2H, m, H-10); ^{13}C NMR (acetone-d_6, 125 MHz) δ_C 145.0 (qC, C-2), 144.7 (qC, C-5), 143.7 (qC, C-3), 141.8 (qC, C-6), 133.0 (qC, C-8a), 131.3 (qC, C-1a), 125.2 (qC, C-4a), 122.5 (qC, C-5a), 122.4 (CH, C-8), 116.9 (CH, C-4), 115.4 (CH, C-1), 107.8 (qC, C-7), 30.6 (CH_2, C-9), 30.0 (CH_2, C-10); EIMS *m/z* 324 (100), 322 (92) $[M]^+$, 307 (5), 305 (8), 279 (2), 278 (5), 244 (16), 242 (37), 227 (7), 226 (29), 197 (37), 168 (18), 139 (25), 98 (30), 84 (16); HRESIMS at *m/z* 322.9915 $[M + H]^+$ (calcd for $C_{14}H_{12}{}^{79}BrO_4$, 322.9918).

4,7-Dibromo-9,10-dihydrophenanthrene-2,3,5,6-tetraol (2): yellowish needles (acetone); mp 132–134 °C; UV λ_{max} (EtOH) (log ϵ) 219 (1.43), 278 (1.40) nm; CD (MeOH) λ_{max} nm ($\Delta\epsilon$) 220 (–2011.6), 225 ($\Delta\epsilon = +3939.7$); IR (KBr) ν_{max} 3428, 2939, 2854, 1627, 1581, 1478, 1436, 1360, 1309, 1236, 1167, 1069, 1031, 913, 841, 781, 757, 729, 667, 629 cm^{-1}; ^1H NMR (acetone- d_6, 500 MHz) δ_H 6.95 (1H, s, H-8), 6.79 (1H, s, H-1), 2.62 (2H, m, H-10), 2.41 (2H, m, H-9); ^{13}C NMR (acetone- d_6, 125 MHz) δ_C 145.2 (qC, C-2), 143.7 (qC, C-5), 143.0 (qC, C-6), 142.6 (qC, C-3), 135.0 (qC, C-1a), 134.5 (qC, C-8a), 126.3 (qC, C-4a), 122.7 (qC, C-5a), 121.6 (CH, C-8), 114.3 (CH, C-1), 111.8 (qC, C-4), 108.2 (qC, C-7), 32.0 (CH_2, C-10), 31.0 (CH_2, C-9); EIMS *m/z* 404 (23), 402 (44), 400 (21) $[M]^+$, 324 (40), 322 (50), 305 (97), 303 (100), 139 (17); HRESIMS at *m/z* 424.8825 (calcd for $C_{14}H_{10}{}^{79}Br^{81}Br\ O_4Na$, 424.8823).

1, 8-Dibromo-5,7-dihydrodibenzo[*c,e*]oxepine-2,3,9,10-tetraol (3): yellowish powder; IR (KBr) ν_{max} 3439, 2943, 2891, 1610, 1579, 1488, 1440, 1364, 1314, 1277, 1236, 1180, 1109, 1047, 1016, 995, 931, 901, 860, 795 cm^{-1}; ^1H NMR (acetone-d_6, 500 MHz) δ_H 7.19 (1H, s, H-11), 6.95 (1H, s, H-4), 4.95 (1H, d, $J = 11.5$ Hz, H_a-7), 4.32 (1H, d, $J = 11.3$ Hz, H_a-5), 3.86 (1H, d, $J = 11.5$ Hz, H_b-7), 3.75 (1H, d, $J = 11.3$ Hz, H_b-5); ^{13}C NMR (acetone-d_6, 125 MHz) δ_C 146.1 (qC, C-10), 145.3 (qC, C-2), 144.5 (qC, C-9), 143.7 (qC, C-3), 133.0 (qC, C-11a), 132.4 (qC, C-1a), 129.1 (qC, C-5a), 127.6 (qC, C-7a), 117.1 (CH, C-11), 116.1 (CH, C-4), 112.2 (qC, C-8), 110.1 (qC, C-1), 67.8 (CH_2, C-5), 65.7 (CH_2, C-7); EIMS *m/z* 420 (47), 418 (100), 416 (54) $[M]^+$, 339 (55), 337 (53); HRESIMS at *m/z* 440.8746 $[M + Na]^+$ (calcd for $C_{14}H_{10}{}^{79}Br^{81}BrO_5Na$, 440.8772).

Determination of the DPPH Radical Scavenging Activity. DPPH radical scavenging activity of compounds **1–6** was evaluated as previously reported.[9,10]

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Supporting Information Available: ^1H, ^{13}C NMR and DEPT spectra and selected 2D NMR spectra of compounds **1–3**. This material is available free of charge via the Internet at http://pubs.acs.org.

References and Notes

(1) Flodin, C.; Whitfield, F. B. *Phytochemistry* **2000**, *53*, 77–80.
(2) Zhao, J. L.; Fan, X.; Wang, S. J.; Li, S.; Shang, S. Q.; Yang, Y. C.; Xu, N. J.; Lu, Y.; Shi, J. G. *J. Nat. Prod.* **2004**, *67*, 1032–1035.
(3) Liu, Q. W.; Tan, C. H.; Zhang, T.; Zhang, S. J.; Han, L, J.; Fan, X.; Zhu, D. Y. *J. Asian Nat. Prod. Res* **2006**, *8*, 379–383.
(4) Kurihara, H.; Mitani, T.; Kawabata, J.; Takahashi, K. *J. Nat. Prod.* **1999**, *62*, 882–884.
(5) Zhao, J. L.; Ma, M.; Wang, S. J.; Li, S.; Cao, P.; Yang, Y. C.; Lu, Y.; Shi, J. G.; Xu, N. J.; Fan, X.; He, L. *J. Nat. Prod.* **2005**, *68*, 691–694.
(6) Choi, J. S.; Park, H. J.; Jung, H. A.; Chung, H. Y.; Jung, J. H.; Choi, W. C. *J. Nat. Prod.* **2000**, *63*, 1705–1706.
(7) Wang, W.; Okada, Y.; Shi, H. B.; Wang, Y. Q.; Okuyama, T. *J. Nat. Prod.* **2005**, *68*, 620–622.
(8) Fan, X.; Xu, N. J.; Shi, J. G. *J. Nat. Prod.* **2003**, *66*, 455–458.
(9) Duan, X. J.; Zhang, W. W.; Li, X. M.; Wang, B. G. *Food Chem.* **2006**, *95*, 37–43.
(10) Zhang, W. W.; Duan, X. J.; Huang, H. L.; Zhang, Y.; Wang, B. G. *J. Appl. Phycol.* **2007**, *19*, 97–108.
(11) Kurata, K.; Amiya, T. *Bull. Chem. Soc. Jpn.* **1980**, *53*, 2020–2022.
(12) Aknin, M.; Samb, A.; Mirailles, J.; Costantino, V.; Fattorusso, E.; Mangoni, A. *Tetrahedron Lett.* **1992**, *33*, 555–558.
(13) Son, S.; Lewis, B. A. *J. Agric. Food Chem.* **2002**, *50*, 468–472.

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