



Stratigraphic distribution.—*P. striatus* is common in the quartzites of the Upper Member of the Poleta Formation; one specimen was found in siltstone at the base of the Upper Member of the Poleta Formation. A questionable specimen was collected from quartzite of the middle Harkless Formation.

Hypotypes.—UCLA 49018, 49019.

PLANOLITES ANNULARIUS Walcott, 1890 ?
Plate 2, fig. 10; Plate 3, fig. 5

Planolites annularius Walcott, 1890a, p. 34; WALCOTT, 1890b, p. 602, Pl. 60, fig. 5; J. F. JAMES, 1891a, p. 36, text-fig. 7; OSGOOD, 1970, Pl. 77, fig. 3.

Planolites? sp. Webby, 1970, p. 96–97, text-fig. 15.

Description and stratigraphic distribution.—Horizontal burrows with transverse annulations. Two specimens were found: one (Pl. 2, fig. 10; UCLA 49020), from shale of the lower Montenegro Member of the Campito Formation, is 15 mm wide and lenticular in transverse section; the other (Pl. 3, fig. 5), at the top of the quartzite unit of the Upper Member of the Poleta Formation, is 20 mm wide, curved, and dips below the bedding surface in places.

Remarks.—The larger specimen of *P. annularius* (Pl. 3, fig. 5) could be a backfilled burrow; the cross-sectional shape and internal structure is unknown, as the specimen could not be removed from the rock.

The above specimens are larger than the holotype, which is 4 mm wide.

PLANOLITES VIRGATUS (Hall, 1847)

Plates 3, figs. 2, 6

Palaeophycus virgatus Hall, 1847, p. 263, Pl. 70, fig. 1; GOEPPERT, 1851, p. 189; NICHOLSON, 1875, p. 38, text-fig. 13; non J. F. JAMES, 1885, p. 158; ?PACHECO, 1908, p. 85, Pl. 1, fig. 2.

Planolites virgatus Walcott, 1890b, p. 602–603, Pl. 61, fig. 5.

?*Palaeophycus* sp. Hall, 1852, p. 24, Pl. 8, fig. 3.

?*Chondrites* sp. Salter, 1856, p. 246; SALTER, 1866, p. 243, text-fig. 1, p. 292, Pl. 3, fig. 4; SALTER, 1881, p. 336, text-fig. 1, p. 483, Pl. 3, fig. 4.

Palaeophycus incipiens Billings, 1861a, p. 2; BILLINGS, 1861b, p. 943–944.

Planolites incipiens Walcott, 1890a, p. 35.

?*Scolecites* SALTER, 1873, p. 2, 10.

non *Trichophycus venosum* Miller, 1879, p. 112–113, Pl. 9, figs. 5, 5a; OSGOOD, 1970, p. 347–350, Pl. 60, fig. 7, Pl. 68, figs. 1, 3, 4–7, Pl. 70, fig. 4, text-figs. 16, 29w.

non *Planolites virgatum* (Hall) J. F. JAMES, 1891b, p. 47 (= *Trichophycus venosus*).

non *Arthropycus montalto* Simpson in LESLEY, 1889, p. 40–41, text-fig.

?*Planolites montalto* (Simpson) HOWELL, 1943, p. 17–23, Pl. 8, figs. 1, 2.

Planolites superbus Walcott, 1899, p. 236–237, Pl. 24, fig. 9; WALCOTT, 1914, Pl. 21, fig. 9; RAYMOND, 1922, p. 114.

?*Palaeophycus arthropycoides* Wilckens, 1947, p. 48, Pl. 9, fig. 3.

?“trace fossil” Wolfe, 1969, p. 274–276, Pl. 14–15.

Description.—Long, flat, horizontal burrows, 7 to 23 mm wide; elliptical to lenticular in transverse section. Length generally 15 to 50 cm. Surface smooth, may have a few faint longitudinal striations, grooves, or ridges, or a prominent median ridge (Nelson and Durham, 1966, Pl. 4, fig. 3). Burrows straight, curved or sinuous, and tend to overlap rather than intersect.

EXPLANATION OF PLATE 3

- FIGS. 1, 7, 8—*Planolites beverleyensis* (Billings). 1, hypotype, UCLA 49015. Harkless Formation, UCLA Loc. 6051. $\times 1$. 7, several specimens, two largest exhibit looping. Hypotype, UCLA 49016. The smaller burrows are *P. montanus*. Montenegro Member, Campito Formation, UCLA Loc. 6095. $\times 0.6$. 8, numerous specimens on upper bedding surface of quartzite in Harkless Formation (UCLA Loc. 6051), resembling *Diplocraterion* (bottoms of U-shaped burrows, seen on bottom of beds, only). Two burrow segments collected (UCLA 49017). Six-inch scale. $\times 0.25$.
- 2, 6—*Planolites virgatus* (Hall). 2, several overlapping specimens on probable lower bedding surface; one burrow preserved as a groove. Hypotype, UCLA 49160; collected by C. A. Nelson and J. N. Moore. *P. montanus*, *P. beverleyensis*, and other trace fossils are also present on the slab. Lower Andrews Mountain Member, Campito Formation, UCLA Loc. 6097. $\times 0.25$. 6, *P. virgatus* (left; hypotype, UCLA 49021), and cast of large trial (right, broken). Upper Andrews Mountain Member, Campito Formation, UCLA Loc. 6103. $\times 0.75$.
- 3, 4—*Planolites striatus* (Hall). Quartzite, Upper Member of the Poleta Formation. 3, burrow with distinct striations. Hypotype, UCLA 49018. UCLA Loc. 6094. $\times 1$. 4, burrow with fainter striations. Hypotype, UCLA 49019. UCLA Loc. 6096. $\times 1$.
- 5—*Planolites annularius* Walcott ? Large specimen visible on upper bedding surface of quartzite beds in the Upper Member of the Poleta Formation (UCLA Loc. 6099). A two-inch segment of the same burrow is visible five inches from the left end along a straight line (not in figure). Specimen not collected. $\times 0.4$.

Remarks.—Unflattened, cylindrical specimens of other species of *Planolites* occur with *P. virgatus*, suggesting that the flatness of the burrows is a primary feature and not due to compaction.

Structures resembling *P. virgatus*, but larger (29 to 60 mm wide), are found with *P. virgatus* (Pl. 3, fig. 6) in the upper Andrews Mountain Member of the Campito Formation. These occur as slightly curved ridges which do not transect bedding surfaces; they are probably hypichnial casts of large trails, and not *Planolites*. Similar forms have been found that are three-dimensional and oval in cross section; however, insufficient material is available at the present time to name a new species for these large forms of *Planolites*.

Stratigraphic distribution.—Questionable specimens occur in the upper Wyman Formation, in the Middle Member of the Deep Spring Formation, and in the lower Harkless Formation. *P. virgatus* is common in the Campito Formation, especially the Andrews Mountain Member, where it is generally found in thin shaly partings among the quartzitic siltstone and sandstone beds; the burrows are filled with siltstone or sandstone.

Hypotypes.—UCLA 49021, 49160.

DIAGNOSTIC CHARACTERS OF SPECIES OF *PLANOLITES* PRESENT IN WHITE-INYO MOUNTAINS

- P. ballandus*—up to 2 mm wide; straight to sinuous; commonly inclined.
P. serpens—up to 2 mm wide; curved to sinuous; rarely inclined.
P. montanus—1 to 5 mm wide; commonly inclined; short segments visible on bedding surface.
P. reticulatus—1 to 5 mm wide; burrows overlap, form network on bedding surface.
P. beverleyensis—3 to 19 mm wide; wall smooth; long, continuous segments visible on bedding surface.
P. striatus—10 to 15 mm wide; wall longitudinally striated.
P. annularius—burrows transversely annulated.
P. virgatus—7 to 23 mm wide; lenticular in transverse section; long.

OTHER SPECIES OF *PLANOLITES* AND *PALAEOPHYCUS*

The remaining species of *Planolites* (not found in the White-Inyo Mountains) are *P. ophthalmoides* Jessen, 1950, p. 34; *P. rugulosus* Reineck, 1955, p. 79; *P. ? vermiculare* Müller, 1955, p. 657; and *P. ? octichnus* Chamberlain, 1971, p. 227. Of these, only *P. ? octichnus* truly represents the genus *Planolites*. Three species of *Planolites* are *nomena nuda*: *P. granosus* Nicholson, 1873; *P. articulatus* Nicholson, 1873 (*non Palaeophycus articulatus*

Winchell, 1864, as Nicholson cites himself as author); and *P. arcticus* Ami, 1906.

J. F. James (1891b, p. 47) transferred many diverse trace fossils into the genus *Planolites*, at the beginning of his manual of paleontology of the Cincinnati area. Systematic treatment was to appear later in the Annelida section of the manual, which was never published. The new combinations James created (with the original genus following in parenthesis) are *P. diadematum* (Miller & Dyer) (*Blastophycus*); *P. ramulosus* (Miller), *P. succulens* (Hall), and *P. crassa* (Hall) (*Buthotrephis*); *P. ? flabellum* (Miller & Dyer) (*Licrophycus*); *P. radiatus* (Orton), *P. rugosa* (Hall), *P. tubularis* (Hall), and *P. virgatum* (Hall) (*Palaeophycus*); and *P. asperum* (Miller) and *P. subangulatum* (Hall) (*Rusophycus*). The above species should not be placed in *Planolites*. The *Palaeophycus virgatum* mentioned by James is *Trichophycus venosus* Miller, 1879 (Osgood, 1970, p. 300, 347).

Eight species of *Palaeophycus* have been transferred, some questionably, to *Planolites* (see synonymies herein). Thirty-two remaining species of *Palaeophycus* and specific names associated with *Palaeophycus* are listed below in chronologic order, some dates being unknown. Those species with burrows that exhibit branching, or questionably branch, are noted by an asterisk (*); those species for which I have been unable to find an illustration or description are noted by a double asterisk (**).

- P. tubularis* Hall, 1847, p. 7; type species, subsequent designation by Miller, 1889, p. 130; (*).
P. irregularis Hall, 1847, p. 8, (*).
P. rugosus Hall, 1847, p. 63, (*).
P. simplex Hall, 1847, p. 63.
P. tortuosus Hall, 1852, p. 6, (*).
P. obscurus Billings, 1862, p. 98.
P. articulatus Winchell, 1864, p. 231, (*).
P. informis Winchell, 1864, p. 232, (*).
P. spinatus Geinitz, 1867, p. 16, (*).
P. hartungi Geinitz, 1867, p. 16, (*).
P. macrocystoides Geinitz, 1867, p. 17, (*).
P. acicula Eichwald (**), (see Bigsby, 1868, p. 1).
P. hoesianus Geinitz (**), (see Schimper, 1869, p. 198).
P. insignis Geinitz (**), (see Schimper, 1869, p. 198).
P. kochi Ludwig, 1869 (= *Cochlichmus*; see Häntzschel, 1965, p. 23).
P. heberti (Saporta, 1872), (see Saporta and Marion, 1883, p. 97–98, text-fig. 23). Transferred back to (and type species of) original genus, *Siphonites* (see Häntzschel, 1962, p. W215; 1965, p. 85).
P. radiata Orton, 1873, (*), (see Osgood, 1970, p. 345).
P. devonicus Schimper, 1874, p. 2, Pl. 2, fig. 2, (*).

- P. milleri* Lesquereux, 1876, p. 136, (*).
P. gracilis Lesquereux, 1876, p. 137, (*).
P. divaricatus Lesquereux, 1876, p. 138, (*).
P. occidentali Whitfield, 1877 (**), (see Miller, 1889, p. 131).
P. plumosus Whitfield, 1878, p. 50 (*).
P. flexosus U. P. James, 1879 (inorganic ripple marks; present in White-Inyo Mountains).
P. limaciformis Lewis, 1880, p. 293.
P. ornatum Ulrich, 1880, *nomen nudum*.
P. sculptum Ulrich, 1880, *nomen nudum*.
P. marginatus Fritsch, 1908, p. 18.
P. fluctuans Ruedemann, 1925, p. 10, (*).
P. ? dichotoma Wilson, 1948, p. 9, (*).
P. gracilis Borrello, 1966, p. 18 (*non* Lesquereux, 1876), (*).
P. vulgaris Borrello, 1966, p. 19 (*non* *Planolites vulgaris* Nicholson and Hinde, 1875).

The species listed above have not been studied in detail by the writer who therefore does not necessarily believe that they are all referable to the genus *Palaeophycus*.

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LOCALITIES OF FIGURED SPECIMENS

UCLA Locality numbers

For localities 6048, 6050, and 6051, see Alpert, 1973, p. 923. The following localities are in the Waucoba Mountain 15' quadrangle (1951), Inyo County, California (Nelson, 1966a).

6109—1.2 miles west and 700 feet north of SW corner sec. 7, T. 10 S., R. 36 E.

6110—200 feet west and 1300 feet north of SW corner sec. 7, T. 10 S., R. 35 E.

The remaining localities are in the Blanco Mountain 15' quadrangle (1951), Inyo County, California (Nelson, 1966b).

6094—Northwest slope of ridge, east of Cedar Flat; 250 feet east and 1000 to 2000 feet north of SW corner sec. 34, T. 7 S., R. 35 E.

6095—South of gravel quarry at end of Payson Canyon; 2000 to 2500 feet north (from south end) along border of sections 26 and 27, T. 7 S., R. 35 E.

6096—2000 feet east and 2000 feet north of SW corner sec. 26, T. 7 S., R. 35 E.

6097—800 feet south of Goat Spring; 1250 feet east and 250 feet south of NW corner sec. 19, T. 6 S., R. 35 E. (locality 3 of Nelson and Durham, 1966).

6098—1200 feet north and 250 feet west of SW corner sec. 18, T. 6 S., R. 35 E. (locality 2 of Nelson and Durham, 1966).

6099—2400 feet west and 2400 feet north of SE corner sec. 35, T. 7 S., R. 35 E.

6100—2500 feet west and 1500 feet north of SE corner sec. 35, T. 7 S., R. 35 E.

6101—2250 feet east and 1750 feet south of NW corner sec. 8, T. 8 S., R. 35 E.

6102—1750 feet west and 2550 feet north of SE corner sec. 29, T. 7 S., R. 35 E.

6103—2500 feet east and 1900 feet south of NW corner sec. 29, T. 7 S., R. 35 E.

6104—North of road near end of Payson Canyon; 1750 feet west and 1950 feet south of NE corner sec. 27, T. 7 S., R. 35 E.

6105—NW $\frac{1}{4}$, sec. 25, T. 7 S., R. 35 E.

6106—700 feet west and 1900 feet south of NE corner sec. 34, T. 7 S., R. 35 E.

6107—Along stream bed, 400 feet east and 1700 feet north of SW corner sec. 35, T. 7 S., R. 35 E.

6108—500 feet west and 2250 feet north of SE corner sec. 34, T. 7 S., R. 35 E.

6111—2000 feet west and 1250 feet south of NE corner sec. 32, T. 7 S., R. 35 E.

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