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# ARENICOLA FROM SOUTH-EASTERN AUSTRALIA.[1]

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(Plate xviii; Figures 1–6; Map.)

This note records the occurrence for the first time on the Australian mainland of the widely distributed southern form *Arenicola assimilis* var. *affinis* Ashworth, the nearest locality from which it has been recorded being at Burnie on the north coast of Tasmania (Ashworth, 1912). Ashworth (1916) also describes four specimens of *Arenicola loveni* from Kangaroo Island and Lacepede Bay (South Australia). The writer and other members of the McCoy Society collected a large series of specimens referable to *A. loveni* during that society's expedition to the Sir Joseph Banks Islands in Spencer Gulf (South Australia) in December, 1936 (McCoy Society, 1937, 1939), thus extending the range of this form further west in southern Australia. The south Australian form of this species merits varietal distinction from the typical South African form as described by Ashworth (1910, 1911).

*Arenicola loveni sudaustraliense*, var. nov., is one of the dominants of the *Katelysia-Arenicola-Entromorpha* faciation of the sand beach association of the intertidal biome of southern Australia. This faciation is described in detail elsewhere by the writer (Stach, 1944).

### **Arenicola assimilis** Ehlers var. **affinis** Ashworth, 1903.

*A. assimilis* var. *affinis* Ashworth, 1903, p. 764; *idem*, 1912, p. 124.

Specimens identical with Ashworth's description and ranging in size between 8 and 17 cm. were obtained in abundance at several localities along the coast in Western Port Bay (Victoria) between Balnarring and Point Leo. In life the trunk is light brown in colour and nearly transparent, the blood vessels being visible through the integument; the tail region is pale green-brown and transparent.

### **Arenicola loveni sudaustraliense,** var. nov. (Figs. 2–6; Plate xviii.)

*Arenicola loveni* Ashworth, 1916, p. 38.

*Descriptive Notes.*—The largest of the series of twenty-three specimens examined (and probably the largest specimen of *Arenicola* yet recorded) attains a total length of 560 mm., the trunk being 235 mm. long; the smallest specimen of the series has a trunk length of 117 mm. In life the trunk is deep brown in colour posterior to the first nephridial aperture, while anterior to it the leathery integument is heavily pigmented with black; the tail is light brown. The external characters (Figs. 2, 3; Plate xviii, fig. 1) agree in all particulars with Ashworth's most recent account (1916, pp. 38–41) of the species and need not be discussed further, except to note in one specimen the presence of an additional posterior segment consisting of four small annuli and an enlarged chaetiferous annulus without gills, but with notopodium and neuropodium on the right side only (Figs. 4, 5; Plate xviii, fig. 1).

In the twelve specimens dissected, it was found that in no case did both septal pouches pierce the second septum. In four of these, one pouch pierces septum 2 and the other, like those of the remaining eight specimens, is doubled back from septum 2 towards septum 1 (Plate xviii, fig. 2, *sp*).

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[1] This paper was completed in 1937, but owing to the author's absence from Australia, presentation has been delayed. Circumstances do not permit reference to literature (if any) bearing on *Arenicola* later than 1937.

The globular dilatations of the dorsal blood vessel immediately anterior to the paired hearts, previously noted by Ashworth only in the South Australian specimens (1916, p. 40), are present in all the specimens dissected and vary from 4 to 5 mm. in diameter.

In all species of *Arenicola* known up to the present time the gonads have been found to develop only in association with the nephridia, but in the South Australian specimens there is, in addition to the nephridial gonads, a large gonad (proved by sectioning) developed on the anterior face of septum 3 (Plate xviii, fig. 2, *t*), both septal and nephridial gonads in each individual being of the same sex. Examination of further material from South Africa, collected in the breeding season, may show the same relations in the South African form, but if such is not the case, this feature, together with the development of the dilatations of the dorsal blood vessel and the difference in the arrangement of the septal pouches will necessitate at least varietal distinction for the South Australian form.

*Type Material.*—Holotype: Fig. 2, Aust. Mus. Coll. Regd. No. W3444. Paratypes: Aust. Mus. Coll. Regd. Nos. W3380, W3445, W3446; National Museum (Melbourne) Regd. Nos. 70806–70814 (inclusive).

*Mode of Life.*—The large diameter (6 to 8 mm.) of the heaped castings of *A. loveni* readily distinguishes them from those of other sand burrowers. In the inshore lagoons of Moreton Bay (Map) at each low tide, heaps of castings from 7 to 10 cm. in diameter were observed. The mouth of the burrow, which is found about 2 cm. away from the castings, leads to an inclined straight tunnel about 10 to 15 mm. in diameter proceeding downward in a direct line with and away from the castings and the mouth of the burrow (Fig. 1). At a depth of one foot or more the tunnel then becomes horizontal, and proceeding more or less in the same general direction for a foot or two, eventually meanders through the zone of decayed *Posidonia*.

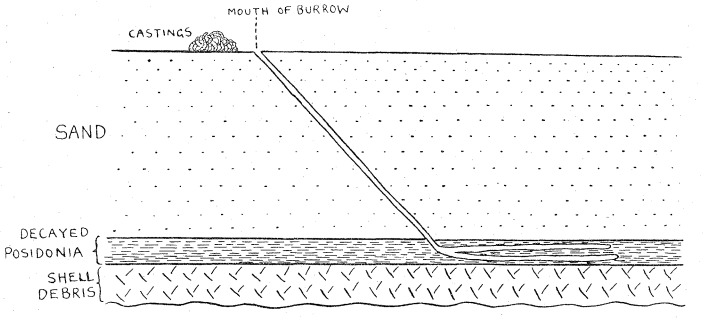
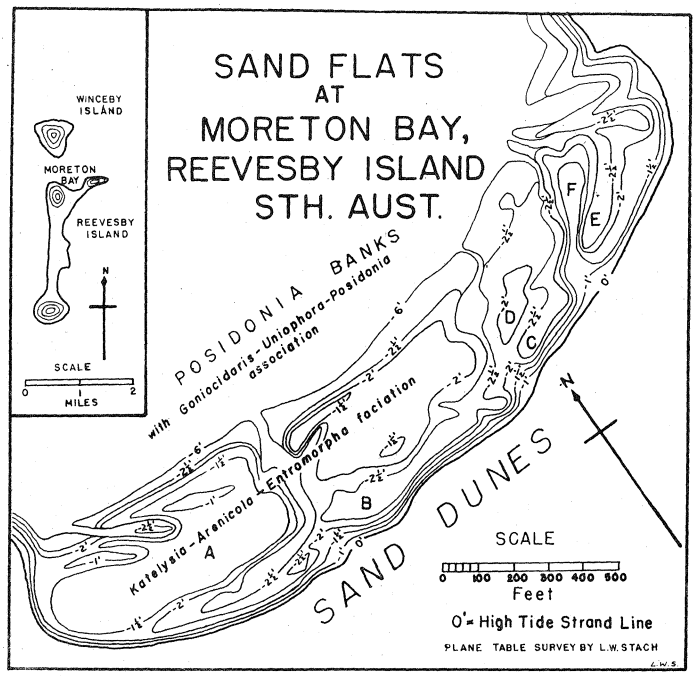



Figure 1.
Burrow of *Arenicola loveni sudaustraliense*.

This consistent arrangement of the burrow greatly facilitated the capture of the specimens. The technique evolved was to dig a short trench about two feet away from the castings, and in a direct line with the castings and the mouth of the burrow. By working towards the castings, the lugworm is met head-on and obtained entire. It was found that following down the burrow with a spade almost invariably resulted in injury to the worm, which moves rapidly down the burrow when the sand is disturbed.

*Ecology.*—Among the Sir Joseph Banks Islands, *A. loveni* was found only in Moreton Bay, a shallow inlet on the north coast of Reevesby Island. A ridge of sand dunes connecting two low, travertine-capped, granitic outcrops protects the bay from the strong prevailing southerly winds, while the granitic outcrop forming Winceby Island, about one mile north of Moreton Bay, breaks the strength of the north winds, thus affording a great measure of protection from wave action which appears to be a controlling factor of the habitat suitable for *A. loveni*, since, although other conditions were similar, the wide sandy beaches of the east and west coasts of Reevesby Island, which are unprotected from the force of the winds, were destitute of *Arenicola*. The sand

flats of Moreton Bay (Map) are being built up and extended northward by the addition of sand blown from the dune ridges. The wind-blown sand assists in the holding and burial of tidal scour, consisting mainly of the marine angiosperm, *Posidonia australis* J. Hooker, the attrition and decay of which probably provides the bulk of the organic debris upon which the lugworm feeds. The tidal scour is concentrated towards the eastern half of the bay, the western half always being remarkably clean.

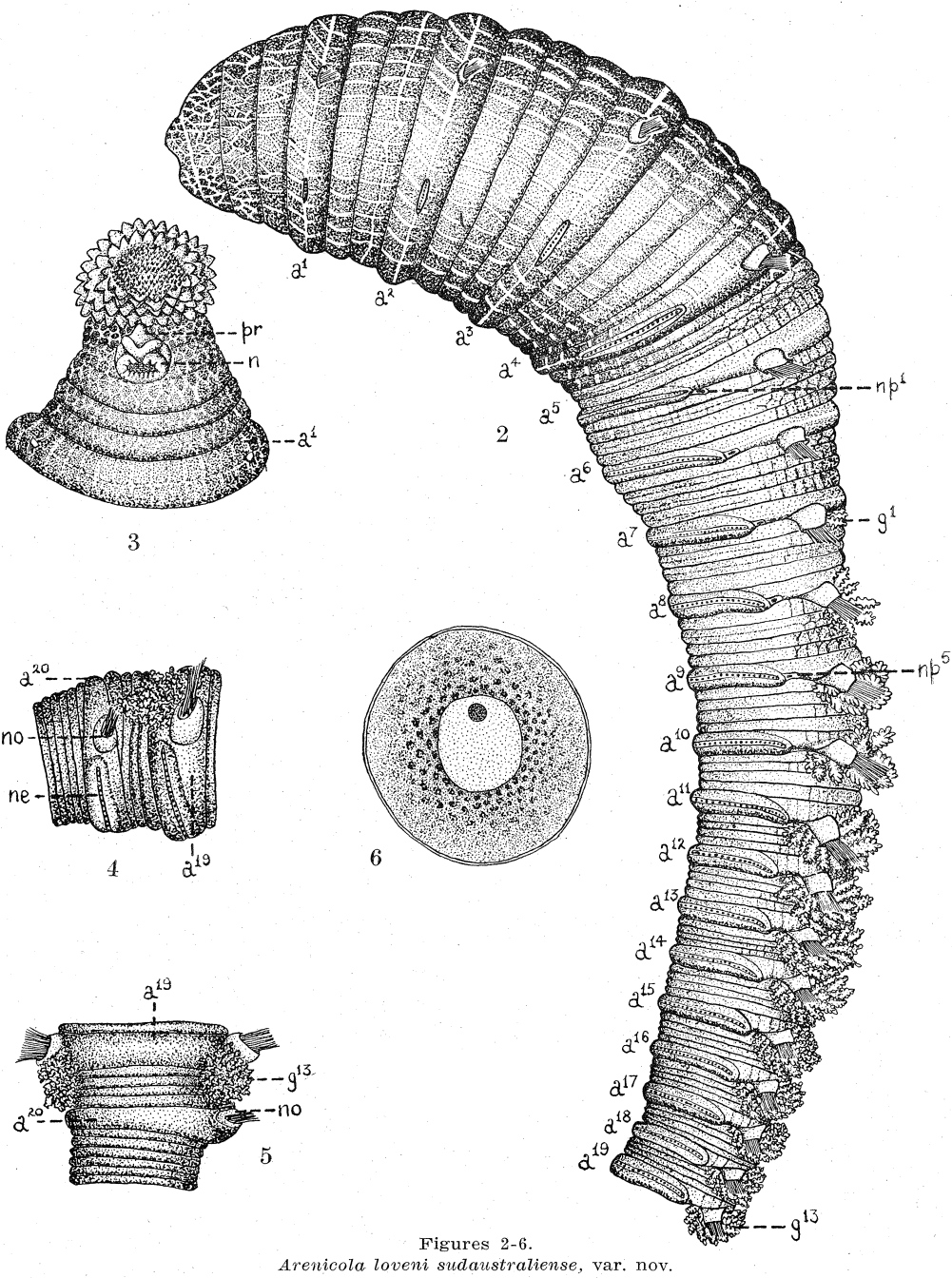



From high-tide mark, the beach slopes regularly and rapidly to the −1′ 6″ contour. Beyond this is a series of shallow inshore lagoons (bounded by the −2′ 6″ contour) separated by low ridges connecting with the barring outer sand flats and emptying by shallow channels with a very gradual fall to the sea at low water. Hayman and Henty (1939, plate x, fig. 1) have published a photograph of portion of Moreton Bay showing the dune ridge with inshore lagoon C in the foreground. As the tide recedes, the water drains out very slowly until, when the tide is fully out, a thin film of water about ¼″ to ½″ deep covers the floors of the inshore lagoons. The broad sand flats barring the lagoons fall within the −1′ 6″ and −2′ contours over the inshore half of their area and fall away regularly and rapidly to low-water mark, at the −6′ contour.

The largest unbroken areas of sand flat occur in the western half of the area (Map, A), most of which rises above the −1′ 6″ contour; no *Arenicola* were observed here. The long lagoon in the western half of the bay (Map, B) had the comparatively sparse population of two *Arenicola* per square yard (estimated by the number of castings over a selected average area of nine square yards), although the sand was more than one foot in thickness.

In the lagoon to the east of this (Map, C) no castings were seen; sectioning revealed 6″ of sand overlying at least 9″ of coarse shell debris (principally composed of valves of *Katelysia scalarina* and *Soletellina biradiata*). Just on the seaward side of this lagoon and within the −2′ contour (Map, D) a section in the sand flat showed 15″ of sand overlying coarse shell debris; here the incidence of castings was about three per square yard.

The next lagoon to the east (Map, E) averaged five to six castings per square yard; a section of this area showed 1′ of yellow-grey sand, followed by 2″ of dark grey-brown,




Figures 2-6.
*Arenicola loveni sudaustraliense*, var. nov.

Fig. 2.—External features of trunk region. Natural size. (Holotype, Aust. Mus. Coll. Regd. No. W.3444.)

Fig. 3.—Anterior end of trunk showing detail of prostomium and nuchal organ. × 1½.

Fig. 4.—Lateral view of abnormal specimen with a twentieth chaetiferous segment bearing notopodium and neuropodium on the right side, but without gills. × 1½. (Paratype, Aust. Mus. Coll. Regd. No. W.3445.)

Fig. 5.—Dorsal view of additional chaetiferous segment seen in lateral view in Fig. 3. × 1½. (Paratype, Aust. Mus. Coll. Regd. No. W.3445.)

Fig. 6.—Egg from body cavity. × 300. $a^1$-$a^{20}$, chaetiferous annuli of segments 1 to 20; $g^1$, $g^{13}$, first and thirteenth gills; *n*, nuchal organ; *ne*, neuropodium; *no*, notopodium; $np^1$, $np^5$, first and fifth nephridial apertures; *pr*, prostomium.

fibrous decayed organic matter derived from *Posidonia australis*, overlying 5″ of sand passing into coarse shell debris. On the sand flat adjoining this lagoon on the seaward side and falling within the −1′ 6″ contour (Map, F), a section revealed two feet of yellow-grey sand and 2″ of decayed organic matter overlying coarse shell debris. Here the frequency of the castings was only about two per nine square yards.

On the seaward slope of the sand flats, in the eastern half of the bay (Map, G), there is more than 2′ 6″ thickness of sand, the incidence of the castings being two to three per square yard.

From these observations, it is seen that *A. loveni*, despite ideal conditions of food supply and thickness of sand, as is shown by the section of the sand flat adjoining the last lagoon described, occurs very rarely above the −1′ 6″ contour, probably because of the long period of exposure (about six or seven hours every tide) and consequent drying out of the sand between high tides. The controlling factor in this case could not be the greater depth of sand to be traversed before the feeding zone is reached, since a much higher incidence of castings is recorded on the seaward slope of the flats where the sand is more than 2′ 6″ thick.

A determining factor is the depth of sand available for burrowing, as is shown by a comparison of lagoons C and E. From this it is seen that a thickness of at least one foot of sand is necessary before an impassable substratum, such as coarse shell debris or travertine, is reached.

The concentration of tidal scour in the eastern half of the bay is obviously correlated with the much greater incidence of castings in this area. The lagoons of the western half of the bay, although ideal as regards thickness of sand, lack the large amount of organic matter which is found in the sands of the eastern half of the bay and consequently the frequency of *Arenicola* is diminished. On the seaward slope of the sand flats, the much greater thickness of sand and the smaller proportion of organic debris have both probably contributed to the lowering of the incidence of *A. loveni*.

*Breeding.—Arenicola loveni* was commencing its breeding season at Reevesby Island in December. No young stages were met with, the trunk of the smallest specimen, which bore a well-developed septal ovary, being 117 mm. long. In four of the specimens dissected the septal gonads had not yet shed their products into the body cavity, while in the remainder the body cavity was either packed with masses of bright orange eggs (Fig. 6) varying from 0·10 to 0·15 mm. in diameter, or the coelomic fluid was crowded with sperm.

In the shallow water just beyond the outer limits of the sand flats at low tide numerous long, slender, clavate, gelatinous masses studded with minute red-brown eggs were seen issuing from burrows of the same diameter as those of *A. loveni*, but owing to their being covered by about one foot of water, the sand caved in too rapidly for any actual specimens of the inhabitants of the burrows to be captured. These egg masses, up to two feet long, almost certainly belong to *A. loveni* and agree with the egg masses described for *A. cristata* (Ashworth, 1912, p. 74) as found on the Atlantic coast of the United States, the only other species from which they have been recorded.

## References.

Ashworth, J. H., 1903.—The anatomy of *Arenicola assimilis*, Ehlers, and a New Variety of the Species, with some Observations on the Post-larval Stages. *Quarterly Journal of Microscopical Science*, xlvi, 737-785, Pls. xxxvi, xxxvii.

————, 1910.—An Account of *Arenicola loveni* Kinberg. *Arkiv für Zoologi Stockholm*, vii, (5), 1-19, Pl. i.

————, 1911.—The Arenicolidae of South Africa, including an account of *Arenicola loveni* Kinberg. *Annals South African Museum*, xi, 1-27, Pl. i.

————, 1912.—Catalogue of the Chaetopoda in the British Museum. A. Polychaeta. Part 1—Arenicolidae, 1-175, Pls. i-xv.

————, 1916.—On the occurrence of *Arenicola loveni*, Kinberg, on the coast of South Australia. *Transactions Royal Society of South Australia*, xl, 38-41.

Hayman, R. H., and E. F. Henty, 1939.—Survey of the Vegetation Community on Reevesby Island. Reports McCoy Society, No. 2, Part 2, *Proceedings Royal Society of Victoria*, n.s., li, (1), 149-152, Pls. ix, x.

McCoy Society, 1938, 1939.—Reports on Expedition to the Sir Joseph Banks Islands, Part 1—*Proceedings Royal Society of Victoria,* n.s., 1, (2), 301-413; Part 2—*ibid.,* li (1), 141-186.

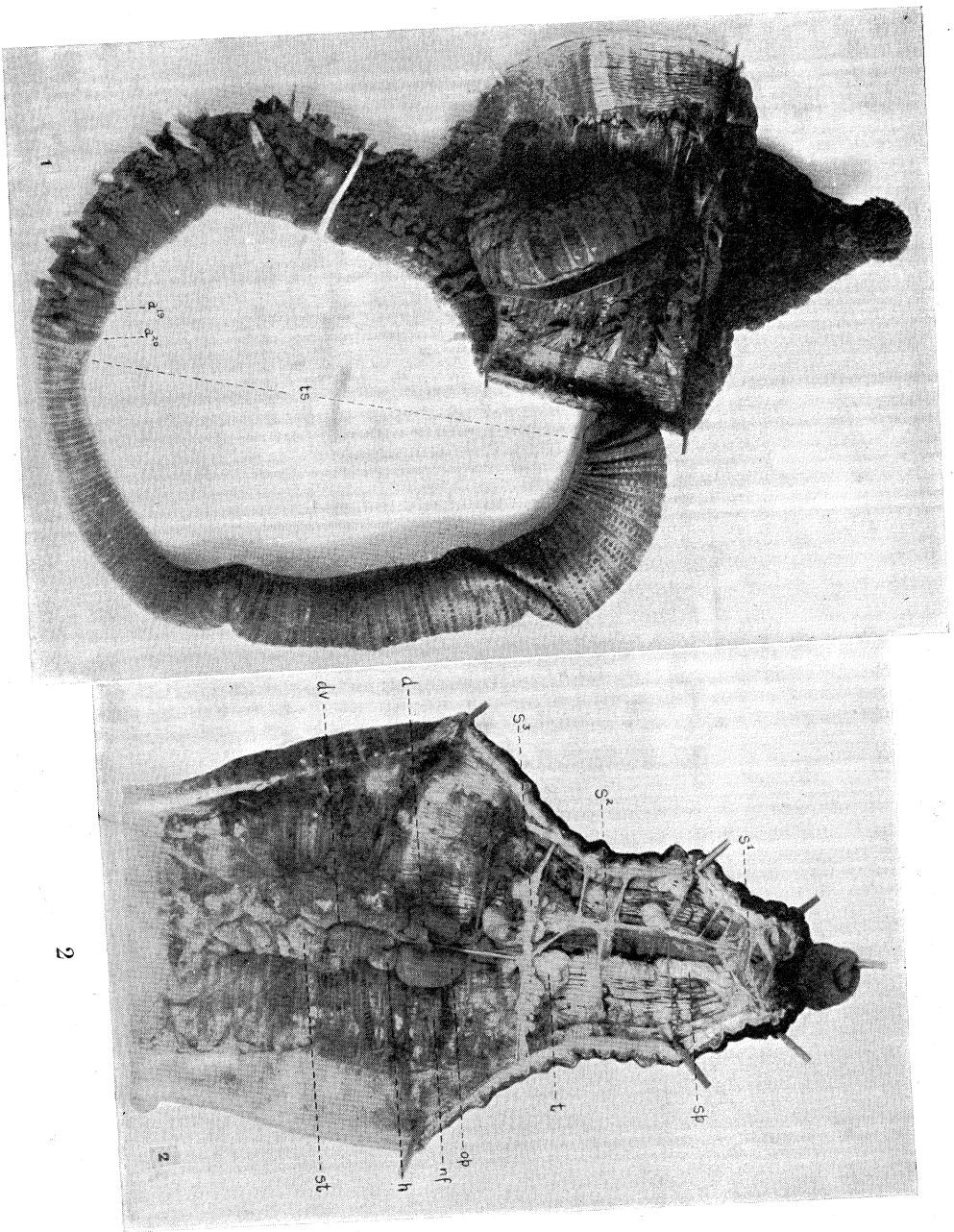
Stach, L. W., 1944.—Ecology of the sand flats at Moreton Bay, Reevesby Island, South Australia. *In MS.*

## EXPLANATION OF PLATE XVIII.

Fig. 1.—Abnormal specimen of *A. loveni sudaustraliense* with an additional chaetiferous segment ($a^{20}$). Approximately natural size. $a^{10}$, nineteenth chaetiferous annulus; *ts,* tail region. (Paratype, Aust. Mus. Coll. Regd. No. W.3445.)

Fig. 2.—Specimen of *A. loveni sudaustraliense* opened along the mid-dorsal line to show the internal anatomy of the anterior region of the trunk. Approximately natural size. *d,* globular dilatation of the dorsal blood vessel; *dv,* dorsal blood vessel; *h,* heart, *nf,* nephridium; *op,* oesophageal pouch; $s^1$, $s^2$, $s^3$, first, second and third septa; *st,* stomach; *t,* testis on anterior face of third septum. (Paratype, Aust. Mus. Coll. Reg. No. W.3446.)

Photos.—L. Preston.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