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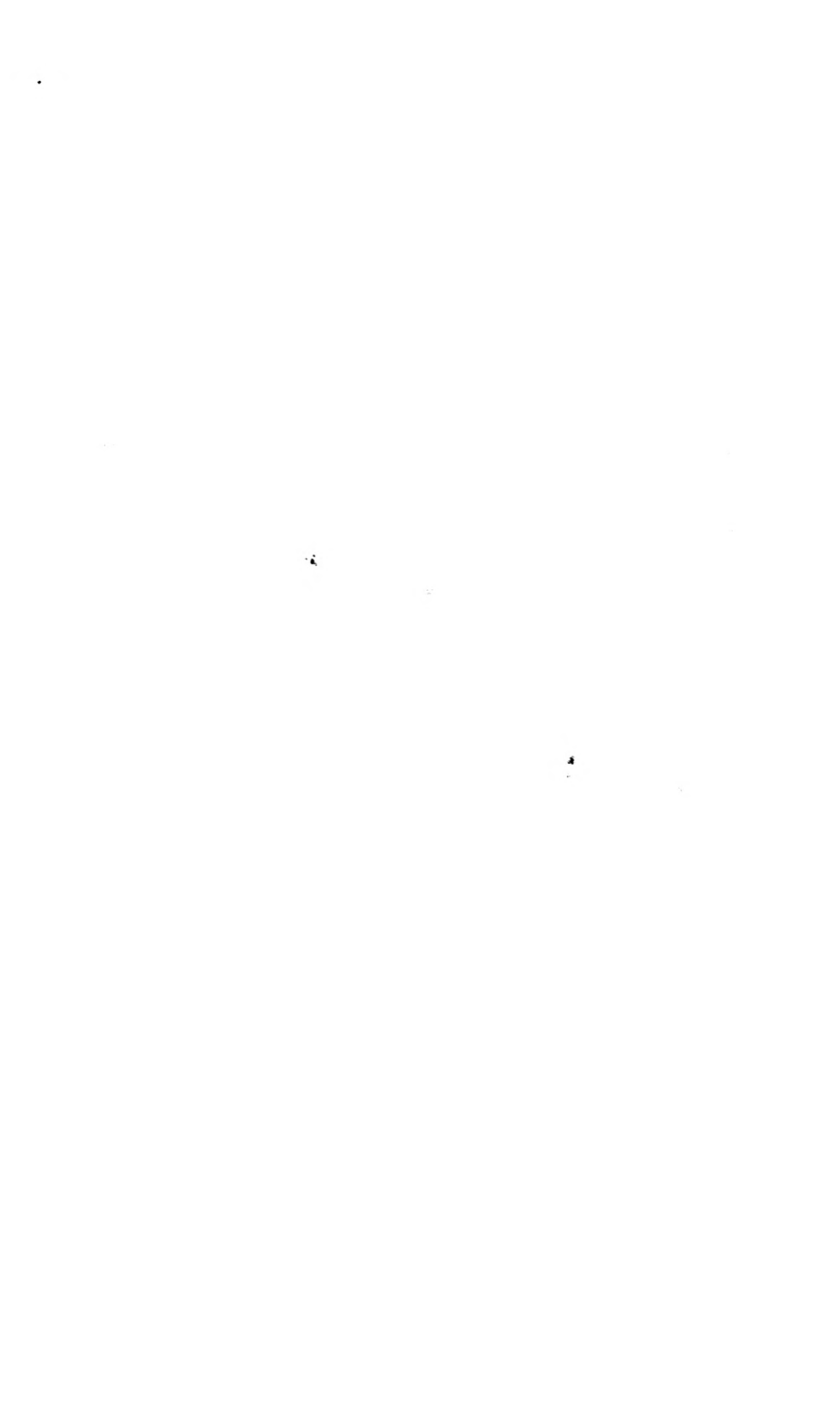
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A Reconstruction of the Shield of the Arthrodire, *Bryantolepis brachycephalus* (Bryant)

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Bryantolepis brachycephalus is the commonest arthrodire and one of the commonest fishes in the Early Devonian Beartooth Butte formation at Beartooth Butte, Wyoming. Its plates are widely scattered, but no association of plates of one individual has been demonstrated except when the plates are fused, as in the cranial roof and in the antero-ventro-lateral complex of the trunk shield. The determination of the appearance of the shield can only be accomplished by a reconstruction, but assembly of the plates, or of replicas of them, is difficult because of the considerable range of individual size. The reconstruction was accomplished by using the method earlier employed for the trunk shield of *Phlyctaenaspis sherwoodi* (Denison, 1950).

Outline drawings showing sutural overlap areas were made of selected plates, preferably those that were flattened in the matrix. The drawing of the median dorsal (fig. 55, *MD*) was enlarged about five times, and this was used as the basis for fitting other plates. The drawings of the anterior dorso-lateral and posterior dorso-lateral plates were enlarged to fit the margin and overlap areas of the median dorsal, and also to fit each other. The anterior lateral and posterior lateral plates were next enlarged and fitted, and then the plates of the ventral shield, starting with the anterior ventro-lateral and spinal plates. After assembly of the median dorsal and anterior dorso-lateral plates, the cranial roof was easily enlarged to fit them, using the spacing of the main lateral line canals as a guide.

When enlarged and fitted drawings of all of the plates had been prepared (figs. 54-56), these were transferred to perforated sheet lead, from which a replica of each plate was cut out. Perforated

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sheet lead was used because of the ease with which a flat piece of it may be given a three-dimensional shape, using nothing more than the fingers. The lead used was .040 inch thick, and the holes were

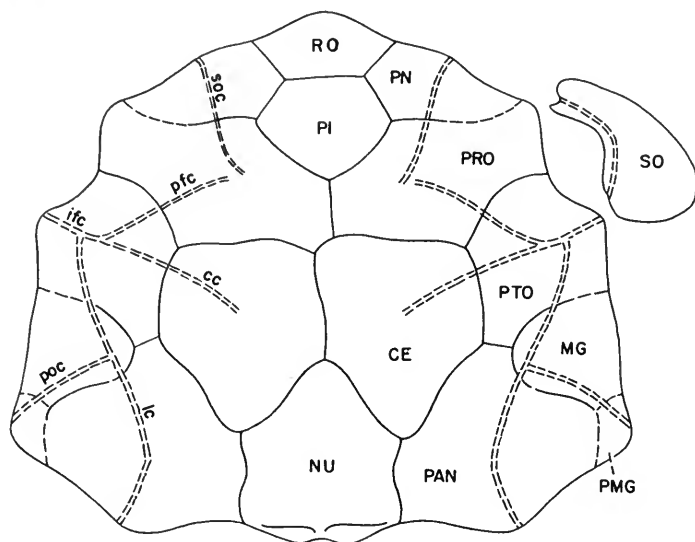


FIG. 54. Cranial roof, PF 1544 ($\times 3.3$), and suborbital plate, PF 1597 ($\times 2.3$). *CE*, central; *MG*, marginal; *NU*, nuchal; *PAN*, paranuchal; *PI*, pineal; *PMG*, postmarginal; *PN*, postnasal; *PRO*, preorbital; *PTO*, postorbital; *RO*, rostral; *SO*, suborbital; *cc*, central canal; *ifc*, infraorbital canal; *lc*, main lateral line; *pfc*, profundus canal; *poc*, preopercular canal; *soc*, supraorbital canal.

.079 inch in diameter, spaced at their centers .125 inch. After the lead replicas had been shaped they were assembled. Copper wire was used to hold the pieces together temporarily. When all of the plate replicas had been assembled and fitted satisfactorily, they were soldered together. The reconstruction was then stiffened and smoothed by the application of an epoxy resin. The type of the latter employed was a thick paste, resistant to sag and flow. It was applied in several coats, each of which was smoothed after curing by filing and sanding. After the model had been finished the sutures and lateral line canals were marked and the model was painted (fig. 57).

In a general discussion of early Euarthrodira (Denison, 1958), I showed that *Bryantolepis* was a typical member of the subfamily Actinolepinae of the family Phlyctaenaspidae. It shows the characteristics of the subfamily in its short, broad median dorsal, its moderately short spinals, presence of paired antero-ventrals, and absence

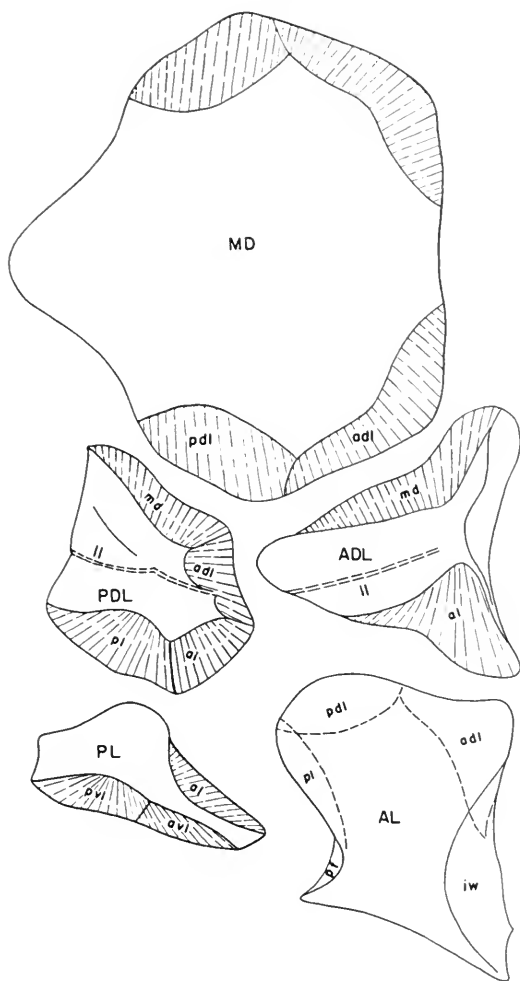


FIG. 55. Dorsal and lateral plates of trunk shield. *ADL*, anterior dorso-lateral, PF 1600 ($\times 2.2$); *AL*, anterior lateral, PF 1553 ($\times 2.3$); *MD*, median dorsal, PF 162 ($\times 2.3$); *PDL*, posterior dorso-lateral, PF 180 ($\times 2.2$); *PL*, posterior lateral, PF 183 ($\times 1.9$); *adi*, *al*, *avi*, *mdi*, *pdi*, *pli*, *pvl*, overlap areas for the anterior dorso-lateral, anterior lateral, anterior ventro-lateral, median dorsal, posterior dorso-lateral, posterior lateral, posterior ventro-lateral; *iw*, anterior quadrant; *ll*, main lateral line; *pf*, endoskeletal attachment of pectoral fin.

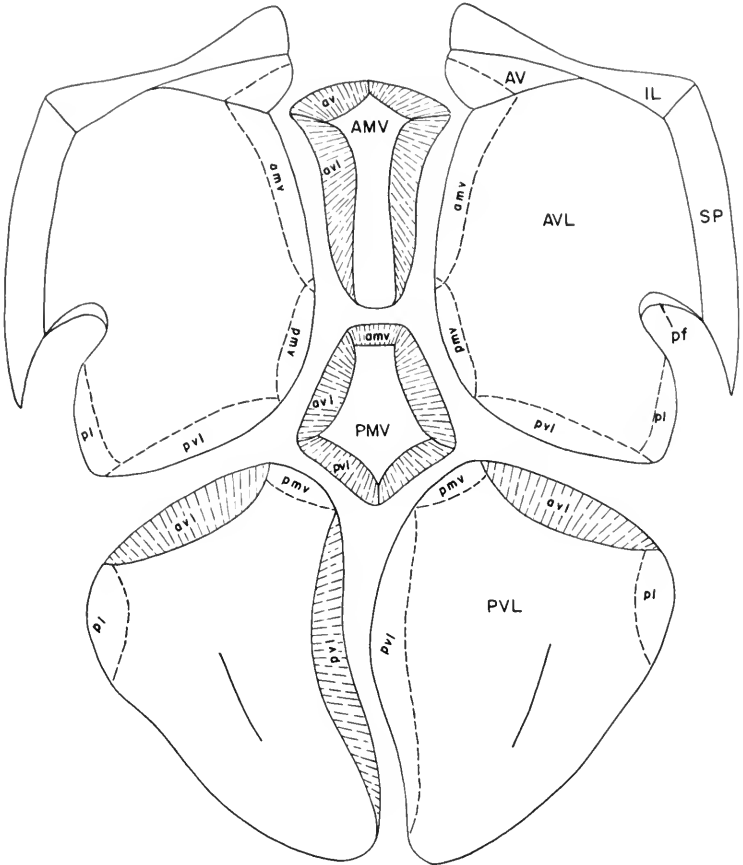


FIG. 56. Ventral plates of trunk shield. *AMV*, anterior medio-ventral, PF 1551 ($\times 2.3$); *AV*, antero-ventral, PF 189 ($\times 2.2$); *AVL*, anterior ventro-lateral, PF 189 ($\times 2.2$); *IL*, intero-lateral, PF 189 ($\times 2.2$); *PMV*, posterior medio-ventral, Princeton no. 13720 ($\times 2.6$); *PVL*, posterior ventro-lateral, PF 170 ($\times 2.2$) and PF 1546 ($\times 2.3$); *SP*, spinal, PF 189 ($\times 2.2$); *amv*, *av*, *avl*, *pl*, *pmv*, and *pvl*, overlap areas for anterior medio-ventral, antero-ventral, anterior ventro-lateral, posterior lateral, posterior medio-ventral, and posterior ventro-lateral; *pf*, endoskeletal attachment of pectoral fin.

of differentiated exoskeletal articulations between the cranial roof and trunk shield. I concluded that it was a rather primitive member of the subfamily, but with a number of distinctive specializations. The latter are: the shortening of the posterior part of the cranial roof; the large, wide preorbitals and postnasals; the large pineal; the narrow pectoral sinuses; and the inturning of the anterior quadrants of the anterior laterals. I determined that pectoral fenestrae

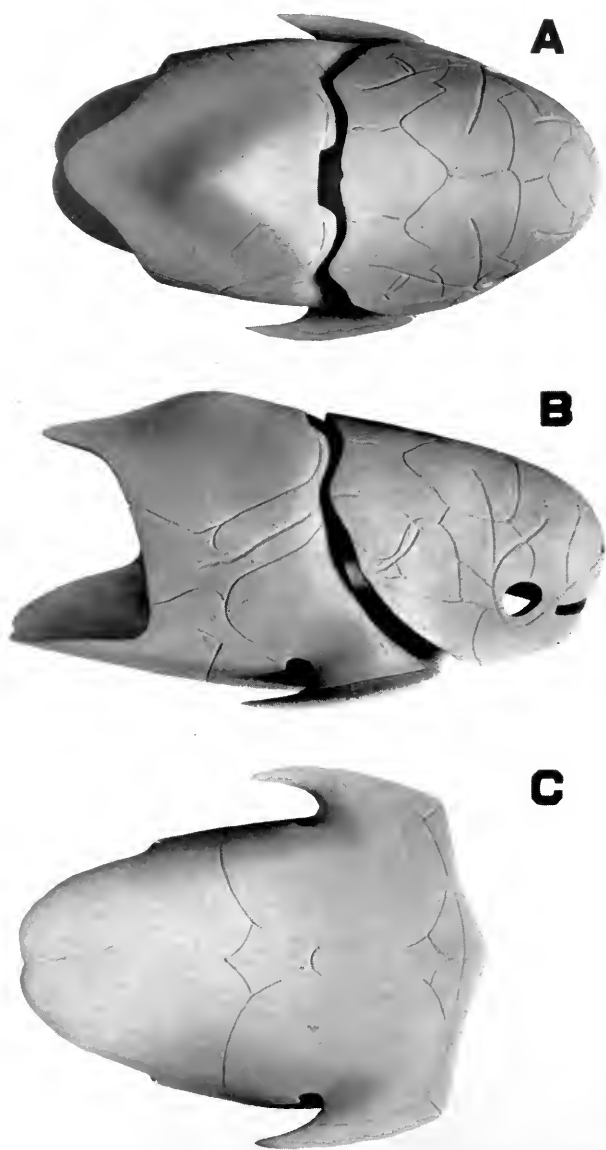


FIG. 57. Restoration of head and trunk shields. A, dorsal view; B, dorso-lateral view; C, ventral view. Approximately $4/3$ times natural size; scale based on the median dorsal and anterior ventro-lateral plates used in the restoration.

were present and were bounded not only by the anterior laterals and anterior ventro-laterals, but also to a small extent by the posterior laterals. It is of interest that in restoring the trunk shield of *Phlyctaenaspis sherwoodi* (Denison, 1950, pl. 3, fig. 2), I showed the posterior laterals extending forward to enter into the posterior edges of the pectoral fenestrae, although these plates are not known in this species. The nature of the overlap areas and the fit of the plate replicas in assembly indicated that pectoral fenestrae must have been present and that the posterior laterals reached them. Gross (1954, fig. 8B) has altered my restoration to exclude the posterior lateral from the pectoral fenestra, but in *Bryantolepis* the posterior lateral is known and definitely had the same relations as those originally shown in *Phlyctaenaspis sherwoodi*. An overlap of the posterior laterals by the anterior ventro-laterals is unusual, but it is indicated by overlap areas on the latter.

The difficulties of interpreting the shape of a shield from individual plates is indicated by one example. In my paper (1958, p. 521) I wrote that the exposed face of the anterior dorso-lateral plate of *Bryantolepis* was long and low, suggesting a relatively low trunk shield. The reconstruction shows quite definitely that this is not the case. The trunk shield is rather high in relation to its width, especially when compared to such forms as *Arctolepis* and *Phlyctaenaspis sherwoodi*. Personal experience with a reconstruction of this sort is perhaps necessary before one can be convinced of its reliability. A good fit of adjacent plates can be obtained, at least in those arthrodires where the overlapping sutures are clear. When this has been accomplished, there are very limited possibilities for altering the shape of the resulting reconstruction.

Except as otherwise noted, all specimens are in the Chicago Natural History Museum collection (PF).

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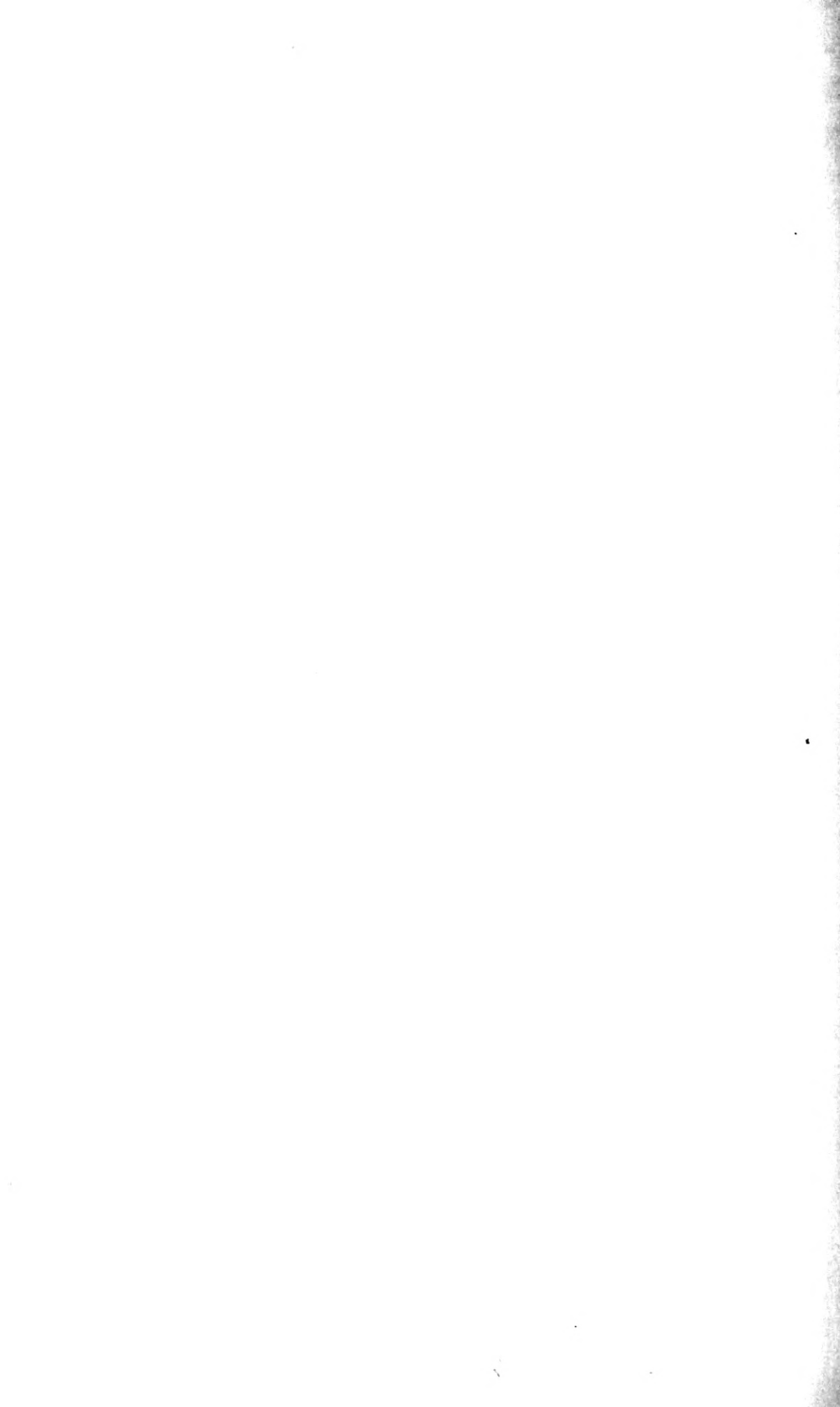
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