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Glossary of Crinoid Morphological Terms

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PART T, REVISED, VOLUME 1, CHAPTER 7: GLOSSARY OF CRINOID MORPHOLOGICAL TERMS

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This glossary is a revision of the 1978 *Treatise Glossary of Crinoid Morphological Terms* (MOORE & others, 1978) and includes terms from HESS and MESSING (2011). Most changes in terminology from the 1978 *Treatise* reflect work that stressed morphological terminology definitions that address homology, a necessary step for understanding crinoid phylogeny. Obsolete terms are printed in italic type, and synonyms are noted. Terminology additions and changes since 1978 are given with citations. Although listed in the glossary for completeness, the use of abbreviated names (e.g., primibrach for primibrachial) or letter abbreviations (e.g., adamb for adambulacral plate) is discouraged. Abbreviated terminology can be confusing, and it is a deterrent for new crinoid workers, as crinoids are by necessity a terminology-rich clade.

A ray. Anterior ray located opposite the posterior (CD) interray; includes radial, succeeding brachitaxes and, if present, fixed intrabrachial plates, pinnules, and intrapinnular plates. Other rays are designated B, C, D, and E in clockwise order from A, if viewing adoral side of theca. This schema, the Carpenter Ray System, was proposed by CARPENTER (1884 in 1884–1888).

AB interray. Interray between A and B rays. Other interrays are designated as BC, CD, DE, and EA in clockwise order from AB if viewing adoral side of theca (syn., *anterior right*). See A ray.

abactinal (syn., aboral, *apical, dorsal*). See aboral.

abambulacral (adj.). Direction perpendicular to and away from the axis of an ambulacrum (syn., abmedial, abradial).

abaxial. Direction away from the oral-aboral axis.

abmedial. Away from the medial line of a ray or interray (syn., abambulacral, abradial).

aboral. Applied to surface of the body opposite adoral surface; in a typical stalked crinoid, this is the bottom surface where the column attaches to the crown (syn., *abactinal, apical, dorsal*).

aboral cup. Hard parts of the crinoid from the radial cirlet to, but not including, the column. Equivalent to calyx where arms become free on radial plates. (syn., cup; dorsal cup; calyx, if no fixed brachials).

aboral element. Terminal, nodose to very long spinose plate forming the proximal plate of roveacrinid calyxes (HESS, ETTER, & HAGDORN, 2016).

aboral ligament fossa. Narrow semicircular depression on aboral side of articular facet of any ray ossicle, serving for attachment of the extensor ligament tissue that connects apposed pairs of plates (syn., dorsal ligament fossa, *inner ligament area*) See MACURDA &

MEYER, 1975, MACURDA, MEYER, & ROUX, 1978.

aboral nerve center (syn., aboral nerve ganglion, *chambered organ*). See aboral nerve ganglion.

aboral nerve ganglion. Five-part (in living crinoids) nerve center of the aboral nervous subsystem positioned in the proximal aboral cup. The ganglion connects to nerves in the column, cirri, and in the crown (syn., aboral nerve center, *chambered organ*).

aboral skeleton. Part of calcareous framework located on aboral side of body; includes columnals, holdfast structures, centrodorsal, cirrals, centrale, lintels, infrabasals, basals, radials, interrarial plates, brachials, and pinnulars.

aboral subsystem (of the nervous system). Primary subsystem of the crinoid nervous system; proximally the part of the body and surrounds the aboral nerve ganglion. It includes the nerves that penetrate into the column and cirri. Distally above, it forms a pentagonal nerve ring from which branch nerves that continue into the arms. Nervous subsystem that is the primary control for regeneration (syn., entoneural subsystem) (BOHN & HEINZELER, 1999).

abortive cirrus. Not applicable to cirri. See abortive radices.

abortive radices. Degenerated or abandoned radices evidenced by pimple-like protuberance on columnal latas. Present in Paleozoic clades (adapted from BRETT, 1981; see DONOVAN, 2021a).

abradial. See abambulacral, abmedial.

abthecal. Applied to side of pinnule or pinnular directed away from theca.

accessory plate. General designation for any non-normal plate or interrarial plate incorporated into the calyx. Named types of accessory plates include gap plates and intercalaries.

- actinal* (syn., *adapical*, adoral, *ventral*). See adoral.
- aculet**. Terminal branch portion of an armllet (WEBSTER & MAPLES, 2008).
- adambulacral** (adj.). Direction perpendicular to and toward the axis of an ambulacrum (syn., admedial, adradial).
- adambulacral** (noun) (syn., adambulacral plate, *side-plate*). See adambulacral plate.
- adambulacral plate** (*adamb*; pl., *adambb*). Small plate of oral region or arm between ambulacrals and ventral edges of brachials and pinnulars (syn., adambulacral, *side-plate*). *adapical* (syn., *actinal*, aboral, *ventral*). See aboral.
- adaxial**. Direction toward the oral-aboral axis.
- adcentral crenulae** (of a petalodium). Adradial crenulae of columnar articulum located near lumen; may merge with central area of columnal.
- admedial**. Toward the midline of a ray or interray (syn., adambulacral, adradial).
- adoral**. The oral side of the aboral cup or calyx (syn., *actinal*, *adapical*, *ventral*).
- adoral-aboral pole* (syn., *central axis*, oral-aboral axis). See oral-aboral axis.
- adoral groove**. Furrow along adoral surface of free brachials and pinnulars; in life contains food groove and radial extensions from coeloms, such as the water vascular, hemal, nervous, and reproductive systems (syn., *ventral groove*).
- adoral ligament fossa**. On articular facets on arms of many crinoids (especially those connected by muscular tissue), one of two paired depressions on the ambulacral side of the fulral ridge and on either side of the facet that houses ligamentary connective tissue (syn., interarticular ligament fossa; inner ligament area). See MACURDA & MEYER, 1975; MACURDA, MEYER, & ROUX, 1978.
- adoral muscular field**. See muscular fossa.
- adoral muscular fossa**. See muscular fossa.
- adoral skeleton**. Part of the skeleton located on adoral side of body; may include primary peristomial cover plates, orals, ambulacral cover plates, interambulacrals, and some posterior plates (syn., *perisomic skeleton*).
- adoral subsystem** (of nervous system). See entoneural subsystem.
- adradial**. See adambulacral, admedial.
- adradial crenulae** (of petalodium). Crenulae of columnal articulum located along margin of petal adjacent to interpetal radii inside periphery; disposed obliquely or nearly normal to margin of petal.
- adthecal**. Applied to side of pinnule or pinnular directed toward theca.
- alphabrach*. See alphabrachial.
- alphabrachial**. Brachial of proximal brachitaxis of an axil-arm (typically developed in Calceocrinidae); succeeding brachitaxes not belonging to ramules are designated as betabrachials, gammabrachials, etc. (syn., *alphabrach*).
- alpha-ramule**. Ramule borne by axillary alphabrach of calceocrinids, invariably directed abanally; succeeding ramules of a given axil-arm are designated as beta-ramules, gamma-ramules, etc.
- ∝ *stereom*. See galleryed stereom (see ROUX, 1975).
- ambulacral** (*amb*, pl., *ambb*). (syn., ambulacral cover plate, *covering plate*). See ambulacral cover plate.
- ambulacral groove**. Simple or branched furrow in adoral surface of oral region, arms, and pinnules, underlain by ambulacral epidermis; serves to convey food to mouth (syn., food groove).
- ambulacral cover plate**. Plate over an ambulacrum when in closed position; may be moveable or fixed. Excludes plates of the same function if shared ambulacrals are present (syn., ambulacral, *cover plate*, *covering plate*). Also see shared ambulacra plate and shared ambulacrals cover plates.
- ambulacrum** (pl., *ambulacrals*). Simple or branched, elongate area on adoral surface of body, extending radially from mouth onto the oral region, arms, and pinnules, formed by ambulacral groove and its associated structures such as ambulacral, lappets, and tube feet (syn., ambulacral tract).
- anal* (syn., posterior plate, *anal plate*). See posterior plate.
- anal cone**. Erect structure commonly comprised of numerous imbricated plates that cover an anus that elevates the anus slightly above the oral surface; lacks vertical tessellate plating present in anal sacs and anal tubes (syn., *anal pyramid*).
- anal papilla**. Short, soft tissue extension elevating the anus above the oral surface.
- anal plate* (syn., *anal*, posterior plate). See posterior plate.
- anal pyramid*. See anal cone.
- anal sac**. Various shaped, generally inflated and erect part of oral region arising from the CD interray. Characteristic of crinoids with an oral surface and common in pentacrinoids (syn., *ventral sac*). See AUSICH & KAMMER, 2010.
- anal tube**. Conical to cylindrical structure, commonly of considerable height, arising from the tegmen and typically bearing the anal opening at or near its summit. Typically developed in camerate crinoids but also present in other crinoids, such as *Traumatocrinus* WÖHRMANN, 1889 (syn., *proboscis*). See AUSICH & KAMMER, 2010, 2016.
- anal X (X)**. In stemward pentacrinoids (disparids, cladids, and flexibles) second plate in posterior interray, above radianal and below right sac plate (originally named by WACHSMUTH & SPRINGER, 1879). In more crownward pentacrinoids with only two posterior plates, anal X is the second (distal plate). Typically to the left and above the radianal. Absent if only one posterior plate in aboral cup of pentacrinoids (disparids, cladids, and flexibles). Originally named by BATHER, 1890. See D. F. WRIGHT, 2015; AUSICH & others, 2020.
- angustary radial facet**. Articular facet on a radial plate that is less than or equal to 70% of the distal radial plate width; commonly ovate.
- anibrachial*. Obsolete term that designated an axillary brachial plate with its left shoulder bearing the proximal posterior plate (radianal) at the base of the anal sac and its right shoulder a brachial (e.g., *Iocrinus* HALL, 1866; *Merocrinus* WALCOTT, 1883). This plate was also designated as a brachianal by MOORE (1962, p. 28). This plate is now considered

- the C superradial plate (AUSICH, & others, 2020).
- aniradial.** Obsolete term for a radial (or superradial) plate with left shoulder bearing the proximal plate (radial) and on right shoulder proximal plate of the brachial series. In some catillocrinids and allagecrinids bearing proximal plates, as many as four arms may be present (e.g., *Eucatillocrinus* SPRINGER, 1923; *Isocatillocrinus* WANNER, 1937; *Xenocatillocrinus* WANNER, 1937) (MOORE, 1952). This plate is now typically considered the C superradial plate (AUSICH, & others, 2020).
- anisperradial.** Obsolete term for C superradial supporting the proximal posterior plate (radial) on its left shoulder (e.g., *Ectenocrinus* S. A. MILLER, 1889). This plate is now considered the C superradial plate (AUSICH, & others, 2020).
- anitaxial ridge.** Prominent ridge or plate convexity bisecting posterior interradius. Typically present in camerates; commonly begins on primate; and extends distally on the anitaxis column of plates.
- anitaxis.** Linear succession of posterior plates typically derived from the primate and bisecting the CD interray; commonly raised above laterally adjacent plates of posterior interray (e.g., *Reteocrinus* BILLINGS, 1859; *Xenocrinus* S. A. MILLER, 1881). Anitaxis may be defined by an anitaxial ridge and is typical of many camerates.
- ankylosis.** Fusion of adjoining plates, presumably effected by calcareous deposits at their interfaces and/or interlocking stereom, with or without disappearance of suture lines. Ankylosis results in a firmly cemented calyx wall.
- anterior.** Referring to direction or ray designated as A, located opposite CD (posterior) interray, which typically contains the anus.
- anterior left** (syn., EA interray). See AB interray.
- anterior right** (syn., AB interray). See AB interray.
- anus.** Opening of the digestive system for expulsion of waste; located on side of calyx, on surface of oral region, or elevated onto an anal cone, anal papilla, anal sac, or anal tube.
- apical** (syn., *abactinal*, aboral, *dorsal*). See aboral.
- apinnulate.** Arm that lacks pinnules.
- areola** (pl., *areolae*) (A). Area of columnal articular facet between lumen (or perilumen if present) and inner margin of crenularium, generally smooth and featureless, but it may be granulose or marked by fine vermicular furrows and ridges. In life, a region in which through-going ligaments are concentrated (syn., *central area*, perilumen).
- areolar index.** Ratio of total width (diameter) of areola to that of columnal articulum multiplied by 100 to avoid fractional numbers (see columnal indices). Areolar index combined with other articular indices has value of 100 (MOORE, JEFFORDS, & MILLER, 1968).
- arm.** Radial evagination of body articulated to the radial plate, normally extending upward or outward from aboral cup or calyx (where a free arm), containing coelom canals, and comprised of pinnulate or non-pinnulate brachitaxes. Proximal arm may be fixed into the calyx wall (syn., *brachium*; see fixed brachial, free brachial).
- arm facet.** See free arm facet, radial facet.
- arm fan.** See independent arm fan posture.
- arm opening.** Position where coelomic cavities leave the aboral cup or calyx to extend in the arms; occurs at point of attachment of free arms.
- arm posture.** Characteristic attitude of arms, include feeding postures, non-feeding postures, regeneration postures, and preservational postures (syn., filtration fan) (MESSING, AUSICH, & MEYER, 2021).
- arm trunk.** See ray trunk.
- armlet.** Narrower branch of a heterotomous axillary that itself has branching (WEBSTER & MAPLES, 2008).
- articular facet** (F). Smooth or sculptured surface of aboral cup, columnal, cirral, radice, or ray ossicle serving for ligamentary or muscular articulation with an adjoining ossicle. Also (by some authors) joint face of calyx plate or arm ossicle toward adjacent skeletal element (syn., articulation, *articulum*, facet, *joint face*).
- articular index.** Ratio of width (diameter) of columnal articular facet to that of entire columnal multiplied by 100, directly measurable in most circular columnals, but it is computed as mean of maximum and minimum values in pentagonal and elliptical columnals (MOORE, JEFFORDS, & MILLER, 1968).
- articular ridge.** Linear, raised feature across a facet that has a similar feature on the apposing plate. An articular ridge acts as a fulcrum (first-degree lever) on which movement between apposing plates occurs; articular ridge stereom is very dense. Articular ridges may be a part of a facet that contains muscular tissue or one that has only ligamentary tissue (syn., fulcral ridge, *transverse ridge*).
- articular rim.** Raised border of a facet (syn., facet rim).
- articulation.** Surface between any pair of adjoining plates connected by ligaments, ligaments and muscles, or cementation (syn., articular facet, *articulum*, facet, *joint face*).
- articulum** (pl., *articula*) (syn., articular facet, articulation, facet, *articulum*, *joint face*). See articular facet, facet.
- atomous.** Free arm that does not branch.
- attachment disk** (syn., discoidal holdfast, *discoid roots*, *hauptscheibe*). See discoidal holdfast.
- attachment structure.** See holdfast.
- augmentative regeneration.** Regeneration of part of an arm in which the arm branching increases as the arm grows back.
- axial canal.** Passageway for axial cord penetrating columnals, cirrals, thecal plates, arms, and pinnules; generally, but not invariably, located centrally; may be simple or multiple, with main canal accompanied by smaller accessory ones (on a columnal, forms the lumen) (syn., *central canal*).
- axial tube.** Thin-walled, straight-sided cylindrical passageway within axial canal (present in exceptionally well-preserved pluricolumnals).
- axil-arm.** Arm including its branches borne by any brachial of main-axil. Present in calceocrinids. Axil-arm excludes terminal ramule termed omega-ramule; may be differentiated as primaxil-arm, secundaxil-arm, etc.
- axillary** (AX). Brachial supporting two arm branches (syn., axillary brachial, *subaxillary*).
- axillary brachial.** (syn., axillary, *subaxillary*). See axillary.

- axillary cirral* (term introduced by BRETT, 1981). Ciri that do not branch (syn., axillary radice in many usages) (DONOVAN, 2021a). See axillary radice.
- axillary radice.** The radice ossicle on which the radice bifurcates (syn., *axillary cirral*) (adapted from BRETT, 1981).
- axis.** Medial line defined in calyx, ray, or column.
- azygous basal plate.** Small plate in basal cirlet with only one small and two large plates.
- B ray** (syn., *right anterior ray*). See A ray.
- BC interray.** (syn., *lateral interray between the B and C rays*) See AB interray.
- basal.** See basal plate.
- basal concavity.** Depression of all or part of the proximal-most cirlet (whether basal, infrabasal, or lintel plates) that is invaginated distally into the aboral cup/calyx so that the aboral cup/calyx-column articulation is distal to the base of the aboral cup/calyx (syn., depressed base).
- basal plate** (*B*; pl., *BB*). Any plate of the cirlet proximal to the radial cirlet; each basal plate typically in an interradial position. Absent in disparids if using homology scheme of AUSICH (1996) (syn., basal).
- basal plate cirlet.** Ring of plates comprised of all basal plates; beneath radial cirlet.
- basal ray.** Any of five rod-shaped basal plates extending along the adoral surface of a radial plate-radial plate suture from the rosette to nearly the exterior of the calyx wall; in an interradial position and present in some feather stars.
- basilarid.** One of a small number of most proximal columnals immediately beneath the base of aboral cup that are distinct and typically shorter than newly added columnals. Other columnals are introduced below the basilarid, rather than above most proximal columnal (STRIMPLE, 1963; WULFF & AUSICH, 1989).
- bell shaped* (for aboral cup shapes) (syn., *krateriform*, urn shape). See urn shape.
- betabrach.* See betabrachial.
- betabrachial.** (syn., *betabrach*). See alphabrachial.
- beta-ramule.** See alpha-ramule.
- β *stereom.* See labyrinthic stereom (see ROUX, 1975).
- biendotomy.** Arm branching condition where each half-ray is endotomous, that is, the two main branches of each half-ray have branches only along the midline of that half-ray.
- bifascial articulation.** See synarthrial articulation, synarthry.
- bifascial field.** Generally broad, smooth area on either side of the articular ridge of an articulum in elliptical columnals, which may be bordered on outer side by articular rim. It may also be developed on some cirrals (e.g., *Isocrinus* VON MEYER in AGASSIZ, 1836; *Austinocrinus* DE LORIOI, 1889; *Nielsenocrinus* RASMUSSEN, 1961) and may be bordered on outer side by articular rim.
- bilateral heterotomy.** Type of arm branching characterized by alternate ramules and/or armllets on either side of main arm. Size and spacing of branching symmetrical along the arm axis.
- binodal.** Paired nodal columnals that share equally in supporting radices. The radice lumen is along the articulation between these columnals, with distinct apposed articula or with columnals fused together (e.g., *Camptocrinus* WACHSMUTH & SPRINGER, 1897) (MOORE, JEFFORDS, & MILLER, 1968; BRETT, 1981) (syn., paired nodals of SPRINGER, 1926).
- biradial** (syn., compound radial, *multiple radials*).
- biserial arm.** Arm comprised of brachials arranged in double row with interlocking sutures along junction of rows (WEBSTER & MAPLES, 2008). Also see wedge biserial, rounded biserial, chisel biserial.
- biserial brachial.** Pentagonal (viewed aborally) brachial that does not extend full width of arm and that alternates medially with adjacent series of brachials; forms a biserial arm. See WEBSTER & MAPLES, 2008.
- bivum.** Differentiated C and D (posterior) rays, generally shorter than rays of opposed trivium (A, B, E) (e.g., many Comasterida, Holopodidae).
- bothrospire.** Endothecal rhomb-like structure comprised of a series of deep depressions separated by prominent ridges and nodes and centered at plate triple junctions. Present in Indocrinidae.
- bowl shape.** Aboral cup/calyx shape with the maximum width at the distal position and aboral cup/calyx sides convex.
- brach* (syn., brachial, *brachium*). See brachial.
- brachial** (*Br*; pl., *Brr*). Any individual ray plate above the radial cirlet, exclusive of pinnulars, ambulacrals, and adambulacrals; may be axillary or non-axillary and incorporated in calyx (fixed brachials) or not (free brachials) (syn., *brach*, *brachium*).
- brachial pair.** Two brachials united by ligamentary tissue, for example, by synostosis in hyocrinids. Brachial pairs are followed by a muscular articulation (syn., pinnular arm units) (HESS & MESSING, 2011).
- brachianal* (originally named by BATHER, 1890). Fixed brachial of C ray supporting proximal and a posterior plate on its left shoulder (e.g., *Peniculocrinus* MOORE, 1962). See C superradial.
- brachitaxis** (pl., *brachitaxes*) (*BrT*). Series of brachials extending from simple or compound radial plates to and including an axillary, or in arms lacking axillaries to distal extremity of arm; likewise brachial series extending from any axillary to and including the next axillary or to distal extremity of arm or branch.
- brachium* (pl., *brachia*). See arm.
- brachium* (syn., *brach*, brachial). See brachial.
- broken stick.** Pattern of column disarticulation in which the column initially breaks into pluricolumnal segments of nearly equal numbers of columnals resulting from the distribution of ligaments. (BAUMILLER & AUSICH, 1992; DONOVAN, 2021b).
- bulbroots.* See tuberous holdfasts.
- C ray** (syn., *right posterior ray*). See A ray.
- calyx.** Crinoid skeleton proximal to the free arms and distal to column (excludes free arms, oral region, and pelma). Calyx same as aboral cup where arms become free on the radial plates.
- calyx attachment.** Direct attachment (permanent and non-permanent) of the calyx to the substratum, (e.g., *Holopus* D'ORBIGNY, 1837; *Agassizocrinus* OWEN & SHUMARD, 1852; *Eridocrinus* S.A. MILLER, 1889; and feather stars) (BRETT, 1981).
- camouflage posture.** Unusual non-feeding arm posture in which the arms are aligned along branches of an

- octoral or *Halimeda* LAMOUREUX, 1812 (MESSING, AUSICH, & MEYER, 2021).
- canal.** See axial canal, interarticular radial canal.
- canaliculus** (pl., **canaliculae**). Subhorizontal, radially disposed, tubular canal within the body of a columnal leading from axial canal to or near to the surface of the columnal. May be branched or unbranched. May be in fives with angle of 72° between adjacent canaliculae, but with one or more of these suppressed in many columnals. Canaliculae may also terminate at outer surface of columnal in pimple-like node (abortive radice or abortive cirrus) or small open pore.
- cannt posture.** Obligate feeding posture formed in a crinoid with an asymmetrical calyx that positions the crown into a feeding posture; present in multiple clades of stalked crinoids (MESSING, AUSICH, & MEYER, 2021).
- catch-connective tissue.** See mutable collagenous tissue.
- cavannulus** (pl., **cavannuli**). Distinctive stereom forming a low hollow ring in inner medulla of some columnals, surrounding the axial canal and sloping somewhat inward toward mid-plane of columnal, paired with another on opposite side of mid-plane; may contain delicate, rather open vesicular tissue (function unknown).
- CD interray.** Posterior interray. See AB interray.
- central area.** See perilumen, areola.
- central axis** (syn., **aboral-aboral pole**). See oral-aboral axis.
- central canal.** See axial canal.
- central cavity.** Central lumen of aboral cup or calyx; surrounded by aboral cup and/or calyx plates.
- central nodicirral articulum.** Cirrus attachment scar socket located at or very near mid-height of latus of nodal, generally facing straight outward (= **central cirrus facet** of BATHER, 1909).
- central nodiradice articulum.** Radice attachment scar socket located at or very near mid-height of latus of nodal, generally facing straight outward (= **central cirrus facet** of BATHER, 1909).
- central plug.** Large or small, generally spongy calcareous deposit, on aboral surface of radial pentagon (e.g., some feather stars).
- centrale.** Noncirriferous thecal plate typically occurring inside infrabasal or basal (if infrabasals are vestigial); cirlet present in some eucladids (e.g., *Marsupites* MANTELL in J. S. MILLER, 1821; *Uintacrinus* GRINNELL, 1876).
- centrodorsal.** Commonly cirriferous columnals or semifused to fused columnals attached to theca of Comatulida (Thiolliericrinidae).
- centrodorsal concavity.** Depression on adoral surface of centrodorsal containing chambered organ and accessory structures.
- centrum** (pl., **centra**). Substance of columnal or cirral including luminal septa, if present; may be divisible into parts distinguished by differences in microstructure, such as the outer zone (between proximal and distal crenularia), intermediate zone (between proximal and distal areolae), and inner zone (corresponding to perilumina on columnal articular facet).
- chambered organ** (syn., aboral nerve center, aboral nerve ganglion). See aboral nerve ganglion.
- chiasma.** Figure formed by division of aboral nerve trunks within axillary.
- circulatory system.** See hemal lacunar system.
- cirral.** Single cirrus ossicle.
- cirriferous runners.** Commonly non-permanent column attachments with recumbent, unmodified columnals with flexible cirri in whorls (e.g., isocrinids) (BRETT, 1981).
- cirrinodal.** Columnal-bearing cirrus or cirri; other nodal columnals termed nudinodals.
- cirripore.** See latus pore.
- cirrus** (pl., **cirri**). Flexible articulated appendage of the column or centrodorsal, bearing an extension of the stem lumen consisting of cirralls, which are never branched. Articulation synarthrial except where ossicles inflexible (synostosis) near distal tip. DONOVAN (1993, 2021a) restricted the term cirri to the specialized, functionally distinct column appendages described above. Cirri existed in a few late Paleozoic crinoids but are primarily a feature of post-Paleozoic crinoid lineages (DONOVAN, 1993, 2021a).
- cirrus facet.** Articular facet of a cirrus (syn., cirrus scar, cirrus socket, nodicirral articulum).
- cirrus root** (syn., **radicular cirrus**, radical, radix). See radicular, radix.
- cirrus scar** (syn., cirrus facet, **cirrus socket**, nodicirral articulum). See cirrus facet, nodicirral articulum.
- cirrus socket** (syn., **cirrus scar**, cirrus facet, nodicirral articulum). See cirrus facet, nodicirral articulum.
- claustrum** (pl., **claustra**). Thick or thin inward projection of columnal medulla constricting axial canal, inner extremity acuminate to bluntly rounded, truncate with rabbeted edges, or clavate, comprised of dense stereom or with microstructure of fine annular lamellae subparallel to midplane of columnal, with or without intersecting longitudinally disposed lamellae that form microscopic cribwork. Transverse sections of claustra may have pentastellate indentations that are extensions of jugulum and between such indentations inner parts of claustrum may be thickened to form jugular ramparts.
- clinate.** Distinctly sloping, with inclination gentle, moderate, or steep, invariably applied at attitude longitudinally and understood to be essentially straight, unless modified by adjective (e.g., curved, with possible addition of descriptive designation such as gently, strongly, evenly, and the like); refers to attitude of plates in indicated cirlet, to disposition of mean surface of radial articular facet, or to orientation of interbrachial facets and sutures in relation to arm axis.
- close suture.** See zygosynostosis, zygosynostosis.
- coarse irregular node and pit sculpturing.** Plate sculpturing with coarse, gnarled appearance.
- coarsely nodose plate sculpturing.** Plate outer surface comprised of large, readily defined nodes clearly separated from adjacent nodes; may form a uniform texture or be irregularly distributed.
- coarsely pitted plate sculpturing.** Plate outer surface with a texture comprised of clearly visible pits; may form a uniform texture or be irregularly distributed.
- collecting-bowl posture.** Non-feeding arm posture

- assumed during periods of very low current velocity, rarely observed *in vivo* in feather stars (MESSING, AUSICH, & MEYER, 2021).
- columnn.** Pelma excluding cirri, radices, and anchorage structures (holdfasts), comprised of segments (columnnals); elongate aboral extension of the echinoderm body wall supported by calcareous plates (syn., stem, stalk) (BRETT, 1981). [In BRETT (1981) restricted to pelma with columnnals.]
- columnn attachments.** Attachment of a crinoid to the substratum by the column that is not a permanent dististele attachment structure. See simple runners or cirriferous runners.
- columnnal.** Individual ossicle of crinoid column (stem), exclusive of cirri, radices, and holdfast structures.
- columnnal diameter.** Dimension perpendicular to adoral-aboral axis of the column; if columnnal non-circular definition of diameter is necessary.
- columnnal flanges.** Type of epifacet with stereomic outgrowths of a columnnal in a thin sheet all around the periphery of a columnnal (BRETT, 1981, fig. 1A).
- columnnal height.** Dimension parallel to adoral-aboral axis of the column; but in comparatively rare columnnals with opposite articularia inclined to one another, plane of measurement needs to be specified for definition of minimum, maximum, and mean height.
- columnnal indices.** See different types: areolar, crenular, epifacetal, facetal, height, jugular, luminal, perluminal, septal, shape, zygial. Variations in outline of facet elements; normally the sum of measurements along two opposite radii (whether these are identical or different in length) provides the measurement of total width, but in elliptical facets or columnnals maximum and minimum radii (disposed at right angles to one another) are chosen (MOORE, JEFFORDS, & MILLER, 1968).
- columnniform cirrus.** See columnniform radice.
- columnniform radice.** Stout radice whose radicle ossicles have a width and height approaching that of the associated columnnals (adapted from BRETT, 1981).
- comb pinnules.** Pinnules with peculiar comb-like modification of distal part of lower pinnules (in Comasteridae).
- commissural canal (ring canal).** Passageway within aboral cup plate mainly in transverse direction for entoneural branch (ring-nerve or commissure) connecting neighboring entoneural cords.
- common fan.** Feeding posture in which two or more individuals overlap their fans to form a joint baffle of currents. Present in both feather stars and stalked crinoids (MESSING, AUSICH, & MEYER, 2021).
- complex axial canal.** Medial perforation of crinoid column characterized by successive alternating constrictions (jugula) produced by adaxial annular projections (claustra) of columnnals and intercolumnal expansions (spatia).
- compound basal.** Ossicle resulting from union of a basal ray with an interradianal process of the rosette in some feather stars.
- compound discoidal holdfast.** Category of discoidal holdfasts commonly comprised of a cemented basal disk and differentiated integument overlaying the disk (BRETT, 1981).
- compound nodal.** Two or more columnnals that share in bearing one or more radice or cirri. A feature primarily known for radice attachments, but note *Austinoocrinus* DE LORIO, 1889 (RASMUSSEN, 1978, fig. 572.1h).
- compound radial.** Pair of plates in any ray, exclusive of brachials, typically occupying the position of a simple radial plate; two plates are designated as inferradial (proximal) and superradial (distal) (syn., biradial, *multiple radials*).
- concave** (in reference to crown plate shape). Inner plate surface convex and outer surface concave.
- concavodeclinate.** Obsolete term for downwardly and outwardly sloping circlet of plates or proximal portions of plates located within basal concavity or aboral cup (e.g., *Delocrinus* S. A. MILLER & GURLEY, 1890).
- concavoplanate.** Obsolete term for horizontal or subhorizontal circlet of plates located within basal concavity of aboral cup.
- cone shape.** Aboral cup/calyx shape with the maximum width at the distal position and aboral cup/calyx axis straight.
- conical posture (feeding).** Arm feeding posture with arms forming a conical array; present in feather stars and stalked crinoids. The conical posture may be a transitional posture from a non-feeding posture to another feeding posture. (AUSICH, 1977; MESSING, AUSICH, & MEYER, 2021).
- conical posture (non-feeding).** In crinoids with a parabolic or disk posture, this is the non-feeding arm posture assumed when either current velocity is either too low or too high for feeding; may also represent a transitional arm position between a feeding and non-feeding posture (MESSING, AUSICH, & MEYER, 2021).
- consolidating apparatus.** Specialized array of oral plates (e.g., *Cupressocrinites* GOLDFUSS, 1831 in 1826–1844). See BOHATÝ & AUSICH, 2021.
- continuous arm growth.** Addition of brachials at the distal terminus of the arms (syn., direct arm growth).
- convex** (in reference to crown plate shape). Inner plate surfaces with inner surface concave and outer surface convex.
- convex base.** Proximal-most circlet (whether basal, infrabasal, or lintel plates) with a convex outline in sagittal section.
- convolute organ.** See perigastric coelom organ.
- cortex.** Peripheral skeletal material (stereom) of a columnnal, radice, or cirral next to the latus, rather clearly distinct from medulla or grading into it; substance of columnnals with undifferentiated cortex and medulla referred to simply as stereom.
- costal** (syn., *primibrach*, primibrachial). See primibrachial.
- cover plate.** (syn., *covering plate*, ambulacral). See ambulacral.
- covering plate.** See ambulacral, ambulacral cover plate.
- craspedospire.** Endothelial structure with a small plate at a plate triple junction that is the center of a rhomb-like structure with plate infoldings; present in *Peritocrinus* JAEKEL, 1902.
- creeping roots** (syn., *stem segment rootlets*, *stolon*, stoloniferous holdfast). See stoloniferous holdfast.
- crenella** (pl., *crenellae*). Narrow furrow between cul-

- mina of columnal or other articulum.
- crenula** (pl., **crenulae**). Ridge (culmen) combined with adjacent furrow (crenella) of a columnal facet or other articular facet (syn., culmen).
- crenularial index**. Ratio of total width of crenularium to that of columnal articular facet (C/F), multiplied by 100 to avoid fractional numbers.
- crenularium**. Entire area of crenulae on columnal articular facet.
- crenulate suture**. Externally visible wavy line of contact between symplectically united columnals or other adjoining plates.
- crinoidal plane of symmetry**. Plane of bilateral symmetry passing through A ray and CD interray; typical in most crinoids.
- crow**. Entire crinoid exclusive of the stem and holdfast.
- crustose holdfast**. Terminal holdfast and dististele modified by overgrowths of secondary stereom that cements the crinoid to the substratum (e.g., *Crotalocrinites*? AUSTIN & AUSTIN, 1843; see DONOVAN & others, 2010) (BRETT, 1981).
- cryptodicyclic**. See pseudomonocyclic.
- cryptomonocyclic**. See pseudodicyclic.
- cryptosymplexy**. Weakly sculptured articulation of symplectial type (commonly resembling synostosis), as developed between brachials, nodals, and infranodals of many crinoid columns (e.g., Isocrinidae) (syn., cryptosymplectic articulation) (HESS & MESSING, 2011).
- cryptosynarthry**. Weakly sculptured ligamentary bifascial articulation. In comasterids, ill-defined articulations with weak sculpturing occur in adult specimens. Because an adoral-aboral ridge is at least partly developed and juvenile specimens have a distinct synarthry, the term cryptosynarthry has been used by HOGGETT and ROWE (1986) (HESS & MESSING, 2011).
- cryptosyzygy**. Weak sculptured ligamentary articulations of syzygial type in crinoid arms, with fine marginal ridges that do not reach the axial canal; they occur in many Isocrinida and also in the Comatulida, Holocrinida, Millericrinida, and Hyocrinida (syn., *pseudosyzygy*) (HESS & MESSING, 2011).
- culmen** (pl., **culmina**). Narrow ridge between adjoining crenellae of columnal articulum (=crenella of many authors).
- cuneate uniserial**. Uniserial brachials where brachials are wedge shaped, or proximal and distal facets are not parallel. See also rectilinear cuneate uniserial, weakly cuneate uniserial, moderately cuneate uniserial, and strongly cuneate uniserial (WEBSTER & MAPLES, 2008).
- cup** (syn., aboral cup, *dorsal cup*). See aboral cup.
- cup-brachial** (syn., *fixed brach*, fixed brachial plate). See fixed brachial plate.
- cup-pinnular** (syn., fixed pinnular). See fixed pinnular.
- D ray** (syn., left posterior ray). See A ray.
- DE interray** (syn., *left posterolateral*). See AB interray.
- deeply impressed** (calyx plate sutures). Deep, wide groove along line of suture between adjoining plates.
- declivate**. Sloping downward and outward (e.g., infra-basal plates of *Delocrinus* S. A. MILLER & GURLEY, 1890 and radial articular facets of *Zeacrinites* TROOST in HALL, 1858).
- deep oral subsystem (of nervous system)**. See hyper-neural subsystem.
- defective pinnulation**. Condition in which pinnules are absent in positions along the arm where they would normally be present.
- deltoid**. (syn., *oral [sensu UBAGHS, 1978]*). See primary peristomial cover plate.
- dendritic radix**. Radix with approximately symmetrical, many-branched radices or pseudoradices, resembling a tree root (e.g., *Eucalyptocrinites* GOLDFUSS, 1831 in 1826–1844) (BRETT, 1981).
- depth**. Dimension of a plate in height, width, depth scheme. With the crinoid in an idealized closed and erect posture, depth is an adaxial-abaxial measure.
- depressed base**. See basal concavity.
- dichotomous**. Division of arm into two branches (dichotomy), which may be equal (isotomy) or unequal (heterotomy) (syn., heterotomy, isotomy).
- dichotomy**. Division of arm into two branches.
- dicyclic**. Aboral cup with two plate circlets proximal to radials or (in some cladids that lack radials) proximal to orals. Aboral cup comprised of radial, basal, and infrabasal plate circlets, as well as any posterior plates that may be present.
- differentiation of pinnules**. Mode of growth of arm branching in which axillaries form from the modification of a pinnule (GISEN, 1924).
- digestive system**. Coelom system from the mouth to the anus whose primary function is extracting nutrients from consumed food; confined to the interior of the theca and comprised of the mouth, esophagus, intestine, rectum, and anus.
- digitate pseudocirrus**. Applies only to radices (see BRETT, 1981). See digitate pseudoradice.
- digitate pseudoradice**. Pseudoradice that is short, fingerlike, and commonly branched (BRETT, 1981).
- direct arm growth**. See continuous arm growth.
- disk**. See oral surface.
- discoid roots** (syn., *attachment disc*, discoidal holdfast, and *haftscheibe*). See discoidal holdfast.
- discoidal holdfast**. Category of a terminal holdfast that lacks radices or cirri (UBAGHS, 1978) (syn., *attachment disc*, and *discoid roots*, EHRENBERG, 1929; *haftscheibe*, GANSS, 1937) (BRETT, 1981).
- discontinuous arm growth**. Mode of arm branch formation resulting from regeneration after autotomy or injury (syn., indirect arm growth).
- disk posture**. Feeding arm posture in which arms are arrayed in a circular, flat, or nearly flat array. Disk posture present in both feather stars and stalked crinoids (MESSING, AUSICH, & MEYER, 2021).
- distal**. Direction or position along the oral-aboral axis away from the suture between the crown and the column. Applies to both the crown and column independently.
- distal coil**. Category of dististelar holdfasts with a permanently coiled distal end of the column, with or without other modifications (BRETT, 1981).
- distal pinnule**. In crinoids with oral and genital pinnules, any pinnule distal to the latter, which has a feeding function.

- distichal* (syn., *palmer*, *tertibrach*, *tertibrachial*). See *tertibrachial*.
- dististelar holdfast**. Category of attachment structures in the dististele that includes a portion of the column with definable columnals (syn., *stem segment holdfast*) (BRETT, 1981).
- dististele**. Distal region of crinoid column, including the holdfast. (Term maintained, but note PHILIP, 1980).
- divergence of articular ridges**. Azimuthal angular difference in orientation of articular ridges on opposite articula of synarthrially joined columnals.
- division series* (syn., *taxis*). See *brachitaxis*.
- dorsal**. Referring to direction or side away from mouth, normally downward and outward; preferred term is *aboral* (syn., *abactinal*, *aboral*, *apical*).
- dorsal cup*. See *aboral cup*, *cup*.
- dorsal ligament fossa* (syn., *aboral ligament fossa*, *inner ligament area*, *interarticular ligament fossa*). See *aboral ligament fossa*, *interarticular ligament fossa*.
- dorsal star**. Stellate hollow around aboral pole of a centrodorsal in some feather stars.
- dotted suture**. External appearance of a syzygial articulation (*syzygy*).
- E ray** (syn., *left anterior ray*). See *A ray*.
- EA interray** (syn., *left anterior interray*). See *AB interray*.
- ectoneural subsystem** (of nervous system). A poorly developed subsystem of the crinoid nervous system; present in connective tissue near the mouth and extends distally beneath the ambulacra and enervates tube feet (syn., *superficial subsystem*).
- encrinoidal symmetry**. Aboral cup with perfect pentamerous symmetry in which each ray coincides with a plane of bilateral symmetry.
- endocyclic*. Characterized by central location of mouth with respect to coiled digestive tube, hence at or near center of oral surface.
- endospire*. See *endothecal structure*.
- endothecal structure**. Any invaginated rhomb-like structure interpreted to have had seawater circulating within (e.g., *Porocrinus* BILLINGS, 1857) (syn., *endospire*).
- entotomy**. Arm structure characterized by bifurcation in two main arms that each have branches only on their adradial side.
- entoneural subsystem**. See *aboral subsystem*.
- epifacet**. Extrafacetal part of crinoid columnal articulum.
- epifacetal index**. Ratio of total width of epifacet to that of the entire columnal multiplied by 100 to avoid fractional numbers (see *columnal indices*). Combined epifacetal and *facetal indices* have value of 100.
- epispire*. Term no longer applied to crinoid morphology.
- epizygial**. Distal brachial plate of syzygial pair; may bear a pinnule.
- esophagus**. Part of digestive system from the convergence of ambulacra until the diameter of the esophagus expands in diameter to form the intestine (or midgut) (syn., *foregut*).
- eustenocrinoidal plane of symmetry**. Plane of bilateral symmetry passing through C ray and EA interray; present in a few disparids.
- even synarthry**. Articulation of synarthrial type characterized by general equality of opposed facets of the two brachials joined by synarthry.
- exocyclic*. Obsolete term characterizing the location of mouth near or beyond border of coiled digestive tube, hence near margin of oral surface.
- exoplacoid plate sculpturing**. Plate sculpturing in the Cupressocrinitidae in which additional layers of stereom are added onto the outer surface of a crown plate (BOHATÝ 2005).
- exospire*. See *exothecal structure*.
- exothecal structure**. Any evaginated rhomb-like structure interpreted to have had coelomic fluids circulating within (e.g., *goniospires*) (syn., *exospire*).
- explenary radial facet**. Radial facet in which only the abaxial (outer) portion of the radial facet is in contact with the facets on the adjacent radial plate (WEBSTER, 2007).
- external obliquity**. Pinnule facet placement on the high side of an asymmetric facet.
- exterior pinnule**. Designating the position of a pinnule on the arm of comasteroid and mariametroid feather stars. See also *interior pinnule* (MESSING, AMÉZAIN, & ELÉAME, 2000; MESSING, 2001; HESS & MESSING, 2011).
- extotomy**. Arm structure characterized by bifurcation in two main arms that give off branches only on their abradial sides.
- facet** (syn., *articulum*, *articular facet*, *facet joint*, *joint face*). See *articular facet*.
- facetal index**. In crinoid columnals, ratio of total width of facet to that of entire columnal multiplied by 100 to avoid fractional numbers. Combined *facetal* and *epifacetal indices* have value of 100.
- facetal rim* (syn., *articular rim*). See *articular rim*.
- fan posture**. Feeding arm posture in feather stars in which arms arrayed upward and outward with pinnules extended. Arm array with <90 to 150° arcuate span (MESSING, AUSICH, & MEYER, 2021).
- filtration fan**. One of many feeding postures in which the arms are arrayed to conduct in aerosol suspension feeding (syn., *arm posture*).
- finely nodose plate sculpturing**. Plate outer surface with a texture of very small nodes; commonly indistinguishable without magnification; forming a uniform texture.
- finely pitted plate sculpturing**. Plate outer surface with a texture comprised of very small pits; commonly indistinguishable without magnification; forming a uniform texture.
- finial**. Ossicle of most distal brachitaxis that does not branch again.
- first interrarial plate**. Proximal-most plate of regular interrays; most common in camerates and flexibles.
- fixed arm**. Proximal portion of an arm in which brachials are ankylosed into the calyx wall; may vary from one to numerous fixed brachials.
- fixed brach* (syn., *cup-brachial*, *fixed brachial plate*). See *fixed brachial plate*.
- fixed brachial plate**. Ray plate above a radial or compound radial (exclusive of pinnulars) that is part of the calyx wall; joined more or less firmly to neighboring plates and not part of free arms (e.g., *Eustenocrinus* ULRICH, 1925, among disparids; *Amphicrinus*

- SPRINGER, 1906, and *Artichthycrinus* WRIGHT, 1923, among many flexibles; *Periechocrinus* MORRIS, 1843, and most camerates; *Uintacrinus* GRINNELL, 1876, among articulates) (syn., *cup-brachial*, *fixed brach*).
- fixed interradial plate.** Firmly or loosely sutured plate in a calyx that is between adjacent rays.
- fixed intrabrachial plate.** Firmly or loosely sutured plate in a calyx that is present between fixed or loosely fixed brachials within a ray; either within or between brachitaxes.
- fixed intrapinnular plate.** Firmly or loosely sutured plate in a calyx that is present between fixed or loosely fixed pinnulars within a ray.
- fixed pinnular.** Plate forming part of a pinnule that is incorporated into the calyx wall; joined more or less firmly to neighboring plates and not part of free arms (e.g., *Scyphocrinites* ZENKER, 1833) (syn., *cup-pinnular*).
- fixed pinnule.** Pinnule that is partially or completely incorporated into the the calyx wall.
- flange plates.** Two prominent, semi-rounded oral region plates at the base of the anal sac, present in several cyathoformes crinoids (McINTOSH, 2001, p. 786).
- flat** (in reference to aboral cup/calyx and tegmen shape). Aboral cup/calyx or tegmen with the height less than 50% times the maximum width.
- flat** (in reference to crown plate shape). Inner and outer plate surfaces flat and parallel.
- flat base.** Proximal-most cirlet (whether basal, infrabasal, or lintel plates) with straight sides and horizontal base in sagittal section.
- flat chisel biserial.** Biserial brachials in which width of the brachial is much greater than its height, the center line of the arm is a zig-zag suture separating biserial brachial plates, and the sides of the arm are flat (WEBSTER & MAPLES, 2008).
- floor** (of columnar articular surface). Generally smooth ligament area in median part of petal, mostly flush with articular surface of columnal but may be depressed or (rarely) slightly elevated, bordered by short crenulae; part of areola.
- floor plates.** Alternating plates along the bottom of the ambulacral groove.
- flush suture.** Line of articulation between adjoining plates not depressed in any way.
- food groove.** Simple or branched furrow along adoral surface of oral region, arms, and pinnules; serves to convey food to mouth (syn., ambulacral groove).
- foregut.** See esophagus.
- fossa** (pl., fossae). Depression in an articular facet for attachment of muscular (arms only) and/or ligamentary tissue.
- fossula** (pl., fossulae). Unbranched intercolumnal canal, thus traversing articular surfaces of two contiguous columnals and leading peripherally to axial canal of cirrus.
- free arm.** Part of ray that extends away from the aboral cup/calyx and is not incorporated into the calyx wall, freely mobile.
- free arm facet.** Specialized, moveable articulation above which an arm is a moveable appendage. For a crinoid with arms free above the radial plate, the entire arm is the free arm. For a crinoid with fixed rays forming a calyx, a free arm facet is developed on one or more fixed brachial plates (see also radial facet).
- free brach*, syn., free brachial.
- free brachial** (syn., *free brach*, free brachial plate). See free brachial plate.
- free brachial plate.** Ray plate above radial, superradial, or fixed brachial (exclusive of pinnulars) and not incorporated into the calyx wall (syn., *free brach*, free brachial).
- free face.** Surface of a plate not joined to another plate by an articulation.
- free pinnular.** Plate forming part of a free pinnule and not incorporated into the calyx wall.
- free pinnule.** Pinnule not incorporated into the calyx wall. In common usage synonymous with pinnule.
- fulcral ridge** (syn., articular ridge, *transverse ridge*). See articular ridge.
- galleried stereom.** Stereom microstructure that housed ligamentary connective tissue; formed by overlapping holes for penetration of long ligament fibers (syn., \propto *stereom*).
- gammabrach*. See gammabrachial.
- gammabrachial** (syn., *gammabrach*). See alphabrachial.
- gamma-ramule.** See alpha-ramule.
- gap plate.** Extra, proximal-most plate inserted into the infrabasal or basal cirlet (e.g., *Glenocrinus* GUENSBURG & SPRINKLE, 2003, and *Titanocrinus* GUENSBURG & SPRINKLE, 2003).
- gastric coelom system.** Coelom system that extends from the arms into the thecal interior. A flattened tube enters into the calyx beneath the arms and enters into a central perigastric ring. This structure coils around the foregut and midgut before terminating near the proximal end of the midgut (HAUGH, 1973).
- generating columnal.** Columnal separating proxistele and mesistele in flexible columns and in some other xenomorphic columns. New columnals formed on both sides of this columnal, proximally to the proxistele and distally to the mesistele (WULFF & AUSICH, 1989).
- genital pinnule.** Pinnule used for storage of gametes; present in the more proximal arms of some articulate crinoids.
- globe shape.** Aboral cup/calyx shape with the maximum width proximal to the distal margin and aboral cup/calyx sides convex.
- goniopore.** Opening on an oral surface plate, that was presumably for release of gametes, although this cannot be confirmed.
- gonioporoid.** Branched or unbranched canals on *Trybliocrinus flatheanus* (GEINITZ, 1867).
- goniospire.** Circular endothelial rhomb-like structure with thinning and folding of plates and centered at a plate triple junction (e.g., *Porocrinus* BILLINGS, 1857, and *Triboloporus* KESLING & PAUL, 1968).
- gracile cirrus.* Applies only to radices. See gracile radice.
- gracile radice.** Radice in which the proximal diameters are equal to or slightly less than the height of the columnals to which they are attached (adapted from BRETT, 1981).
- granulose plate sculpturing.** Plate surface comprised of very small nodes (indistinguishable without magnification) with a feel of fine sandpaper.

- grapnel radix.** Radix comprised of a few pseudoradices and terminal columnals that are fused into an anchor-like structure (e.g. *Ancyrocrinus* HALL, 1862) (BRETT, 1981; PLOTNICK & BAUER, 2014).
- growth-index line.** Graphic plot of selected dimensions of crinoid skeletal elements in graded series of specimens differing in size or number of elements considered.
- haftscheibe* (syn., *attachment disc*, *discoid roots*, and *discoidal holdfast*). See discoidal holdfast.
- hair cirrus.* See hair radice.
- hair radice.** Radice with proximal diameters less than one half the height of the columnals to which they are attached (adapted from BRETT, 1981) (syn. *hair cirrus*).
- height.** Dimension of columnal, aboral plates, calyx, and brachial measured parallel to the oral-aboral axis.
- height index.** For columnals, ratio of height to total width of columnal; for thecal and arm plates, ratio of height to width. In both instances, it is multiplied by 100 to avoid fractional numbers. See columnal indices. (MOORE, JEFFORDS, & MILLER, 1968).
- heirloglyphic plate sculpturing.** Short, irregularly positioned ridges irregularly distributed across a plate surface.
- hemal lacunar system.** Crinoid circulatory system with a series of interconnected spaces within the crinoid body rather than defined vessels (syn., circulatory system).
- heterocrinoidal plane of symmetry.** Plane of bilateral symmetry passing through D ray and AB interray; prominent in some disparids.
- heteromorphic** (column or pluricolumnal). Crinoid column comprised of a sequence of dissimilar columnals, which are commonly classified as nodal (with or without cirrus scars) and internodals of first-, second-, or higher-order subgroups that are typically arranged in a regular pattern.
- heterotomous.** Division of an arm with branches of unequal width (*heterotomous branch*).
- heterotomous arms.** See heterotomy.
- heterotomous branch* See heterotomous.
- heterotomy.** Arms characterized by division of axillaries of unequal width.
- hohlwurzel* (syn., *stele* of UBAGHS, 1978, stellar holdfast). See stellar holdfast.
- heterotomous arm branching.** See heterotomy.
- high** (in reference to aboral cup/calyx and tegmen shape). Aboral cup/calyx or tegmen with the height greater than or equal to 1.25, but less than 2.0 times, the maximum width.
- hindgut.** See rectum.
- holdfast.** Any structure at distal extremity of column (or along the dististele) serving for fixation. (syn., attachment structure).
- holomeric.** Columnals comprised of a single calcite crystal.
- holotomy.* Arm characterized by division on every successive brachial; typical of most of a pinnulate arm.
- homeomorphic** (column or pluricolumnal). Crinoid column comprised of similar columnals throughout length; may include gradual change of characteristics from proximal to distal parts of columns. Pluricolumnals from different parts of xenomorphic columns may be homeomorphic within themselves but dissimilar if compared with another part of the column.
- homocrinoidal plane of symmetry.** Plane of bilateral symmetry passing through E ray and BC interray; prominent in some disparids.
- hydrocoel crescent.** Grooves on the bottom side of the posterior primary peristomial cover plate that connect to an internal hydropore on a few camererate crinoids; grooves presumably housed the water vascular system immediately distal to the stone canal (HAUGH, 1973).
- hydropore.** Cilia-lined canal penetrating through the oral surface or oral region and connects to the water vascular system. May penetrate through a plate or through integument on an oral surface.
- hyperpinnulation.** Condition in which two or more pinnules branch from a single brachial.
- hyoneural subsystem.** Subsystem of the crinoid nervous system that enervates connective tissues; includes nerves in the epidermal tissue of the oral surface or below the tegmen and extends into the arms to enervate the connective tissue in the arms (syn., deep oral subsystem).
- hypozygal** (brachial). Proximal brachial plate of syzygial pair; lacks a pinnule.
- hypozygal* (columnal). Distal segment of syzygial pair. Internodal adjoining distal extremity of nodal (originally named by BATHER, 1909); considered inappropriate term because articulation of nodal and this internodal is not syzygial.
- impressed** (calyx plate sutures). Shallow, narrow groove along line of suture between adjoining plates (syn., *rabbet*, *rebate*).
- independent arm fan posture.** Feeding posture that is a single arm extended with pinnules positioned into a plane, typically positioned perpendicular to currents; present in cryptic settings (syn., arm fan) (MEYER, 1973a; MESSING, AUSICH, & MEYER, 2021).
- indirect arm growth.** See discontinuous arm growth.
- inferradial plate** (*IR*, pl., *IRR*). Proximal plate of a compound radial pair.
- inferradial plate** (*IRA*). The lower of the two plates if the radianal is compound (e.g., *Aethocrinus* UBAGHS, 1969, and *Elpasocrinus* SPRINKLE & WAHLMAN, 1994).
- infrabasal.** See infrabasal plate.
- infrabasal cone.** Fused infrabasal plates that form the proximal portion of the aboral cup in stemless taxa (e.g., *Agassizocrinus* OWEN & SHUMARD, 1852, and *Paragassizocrinus* MOORE & PLUMMER, 1940).
- infrabasal plate.** (*IB*, pl., *IBB*). Any plate of infrabasal circler (syn., infrabasal).
- infrabasal plate circler.** Plate circler proximal to the basal plate circler with individual plates in radial positions (if circler comprised of five plates); present in dicyclic and tricyclic aboral cups but absent in monocyclic aboral cups. In most dicyclic crinoids, infrabasal circler articulates with column.
- infracentral cirrinodal articulum** (or *facet*). Cirrus attachment scar of articuliformes crinoid and located below mid-height of nodal latus, generally directed obliquely downward and outward. In dissociated pluricolumnals (excepting those derived from a few

- genera of stalked Articuliformes), infra- and supra-central nodicirral articularia are not distinguishable because proximal and distal extremities are indeterminate (= *infracentral cirrus-facet* of BATHER, 1909).
- infracentral cirrus-facet*. See infracentral cirrinodal articularium.
- infranodal*. Internodal adjoining distal face of any nodal (CARPENTER, 1884 in 1884–1888).
- inner ligament area* (syn., adoral ligament fossa, *dorsal ligament fossa*). See adoral ligament fossa.
- inner perigastric coelom subsystem**. Coelom space that is inside the perigastric coelom organ (HAUGH, 1973).
- inplenary radial facet**. Radial facet in which only the adaxial (inner) portion of the radial facet is in contact with the facets of adjacent radial plates (WEBSTER, 2007).
- interambulacral** (adj). Position between ambulacra on oral surface of tegmen.
- interambulacral* (noun). See interambulacral plate.
- interambulacral plate** (*iamb*, pl., *iambb*). Any plate on oral surface or oral region lying between ambulacra (syn., *interambulacral* [noun]).
- interarticular canal**. Simple or branched duct between apposed articular facets of calyx plates (rarely columnals) with outer and inner openings or inner opening only, these openings invariably located on sutures (sutural pores) or at plate corners (goniopores).
- interarticular ligament fossa**. See adoral ligament fossa, inner ligament area.
- interarticular pore* (CARPENTER, 1884 in 1884–1888). See radial pore.
- interarticular radial canal*. See radial canal.
- interbrachial* (syn., *intercostal*, *interradial*). See *inter-radial*.
- intercalary**. One of many calyx plates occurring between radial and basal circlets of some crinoids (e.g., *Acrocrinus* YANDELL, 1855).
- intercolumnal ligaments**. Short ligament fibers that penetrate a short distance into a columnal, connecting only two adjoining columnals together (GRIMMER, HOLLAND, & HAYAMI, 1985).
- intercostal* (syn., *interdistichal*, *interprimibrachial*, *interradial* plate). See *interradial* plate.
- interdistichal* (syn., *intercostal*, *interprimibrachial*, *interradial* plate). See *interradial* plate.
- interior pinnule**. Position of a pinnule on the side closer to the extrapolated median axis of the preceding axillary in arms of feather stars. See also exterior pinnule (MESSING, AMÉZAINÉ, & ELÉAME, 2000; MESSING, 2001; HESS & MESSING, 2011).
- intermuscular furrow**. Linear depression separating muscular fossae of articular facet of brachials joined by muscular articulation (syn., intermuscular groove).
- intermuscular groove**. See intermuscular furrow.
- intermuscular ridge**. Linear elevation separating muscular fossae of articular facet of brachials joined by muscular articulation.
- internal hydropore**. Opening for the stone canal to the internal portion of the water vascular system; present on the posterior primary peristomial cover plate of a camerate crinoid with an internal madreporite (HAUGH, 1973).
- internal madreporite**. Known on a few camerate crinoids, a plate with numerous canals on the adaxial surface of the posterior primary peristomial cover plate that is exposed to the internal body cavity and through which pressure was presumed to have been regulated for the water vascular system (HAUGH, 1973).
- internal obliquity**. Pinnule facet placement on the lower side of an asymmetric muscular pentafascial facet.
- internal suture**. Line of contact of apposed columnals or cirrals inside of their latera, as seen in longitudinally cut or in weathered specimens.
- internodal** (*iN*, pl., *iNN*). Columnal intercalated between a pair of neighboring nodals, commonly lacking radices or cirri. Internodals are classifiable according to their different successive generations as first-order, second-order, third-order, etc., each generally distinguished by sequential reduction of diagnostic width and height measurements.
- internodal index**. Ratio of height of internodal to height of nodotaxis containing it, multiplied by 100 to avoid fractional numbers. Combined internodal and nodal indices have value of 100.
- internode** (*IN*). Section of column between any two successive nodals.
- interpinnular plate**. See intrapinnular plate.
- interprimibrachial*. See *interradial* plate.
- interradial** (adj.). Positioned between two adjacent rays.
- interradial* (noun). (syn., *intercostal*, *interdistichal*, *interprimibrachial*, and *interradial* plate). See *interradial* plate.
- interradial plate** (noun). Any plate in an interray fixed into the calyx wall above the basals (except posterior plates, fixed pinnulars, and interpinnular plates). Although rejected by UBAGHS (1978), this term is used here because it correctly identifies plates within a field rather than by names (i.e., intersecundibrachial plate) that implies homologies of specific plates—homologies that may or may not exist (syn., *intercostal*, *interdistichal*, *interprimibrachial*, *interradial*, *intersecundibrachial*, and *intertertibrachial*).
- interradial impression**. Faint petaloid impression on aboral side of centrodorsal in some feather stars.
- interradius**. One of five planes, regularly alternating with radii. See definition of radius.
- interray** (pl., *interadii*). Part of calyx between any two adjacent rays.
- intersecundibrachial* (syn., *interradial*, *interradial* plate). See *interradial* plate.
- intertertibrachial*. syn., *interradial*, and *interradial* plate.
- intestine**. Middle, wider portion of the digestive system, between distal, narrow esophagus (foregut) and proximal, narrow rectum (hind gut) (syn., *midgut*).
- intrabrachial plate**. Fixed, non-brachial ray plate between adjacent fixed brachials. Commonly either medially between half-rays or between quarter-rays.
- intrapinnular plate** (*iP* pl., *iPP*). Fixed, non-brachial or pinnular plate within a ray that are bound by two fixed pinnules or fixed pinnular and fixed brachial plates (syn., *interpinnular* plate).
- inverted bowl shape**. Tegmen shape with the maximum width at the proximal position and tegmen sides convex.
- inverted cone shape**. Tegmen shape with the maximum

- width at the proximal position and tegmen sides straight.
- inverted globe shape.** Tegmen shape with the maximum width distal to the proximal margin and tegmen sides convex.
- inverted urn shape.** Tegmen shape with the maximum width at the proximal position and tegmen sides concave.
- irregular nodes and pits plate sculpturing.** Plate outer surface with a gnarled texture comprised of various sizes and shapes of visible nodes and pits irregularly distributed across the plate surface.
- isotomous** (syn., isotomous arms, isotomy). See isotomy.
- isotomous arms.** (syn., isotomy). See isotomy.
- isotomy.** Arms characterized by axillaries yielding branches of equal width and primibrachitaxes comprised of equal numbers of non-axillary brachial plates, secundibrachitaxes comprised of equal numbers of non-axillary brachial plates, etc. (syn., isotomous) (MOORE, JEFFORDS, & MILLER, 1968).
- joint.* See articulation.
- joint face* (BATHER, 1900). (syn., articular facet, *articulum*). See articular facet.
- jugular index.** Ratio of total width of jugulum to that of columnal articular facet, multiplied by 100 to avoid fractional numbers. Also see columnal indices.
- jugular rampart.** Localized thickening of flange in columnal canal at margin of jugulum, typically developed as five petaloid bulges between radiating jugular slits.
- jugulum** (pl., *jugula*). Localized constriction of axial canal, commonly at mid-height of columnals; may be circular transversely or extended by very narrow slits radiating into septa in form of lineate star.
- krateriform* (in reference to aboral cup shape) (WARN & STRIMPLE, 1977) (syn., *bell-shaped aboral cup*, urn shaped aboral cup). See urn shape.
- kylixiform* (in reference to aboral cup shape) (WARN & STRIMPLE, 1977) (syn., very low bowl-shaped aboral cup and flat bowl-shaped aboral cup).
- labyrinthine stereom.** Stereom microstructure that housed muscular connective tissue; formed by random distribution of trabeculae and holes of the microstructure. Muscle fibers attach to surface trabeculae (syn., β *stereom*).
- lappet.** Folds of epidermis that border ambulacra when open and cover ambulacra when closed.
- lateral cirrus.** Cirri in the proxistele or mesistele of the column (BRETT, 1981).
- lateral plates.** Plates between an ambulacral cover plates and the brachial whose homology is unresolved.
- lateral pseudocirrus.* Term no longer used. See lateral pseudoradice.
- lateral pseudoradice.** Pseudoradice in the proxistele or mesistele of the column (adapted from BRETT, 1981).
- lateral radice.** Radice in the proxistele or mesistele of the column.
- lateral stereomic outgrowth.** New calcareous tissue on an ossicle that is atypical to the shape of a typical ossicle. It may be to cement to a substratum or be a result of a commensal or parasite.
- latus** (pl., *latera*). Surface of crinoid columnal or cirral exclusive of articular facets, equivalent to lateral side of columnal and epifacet (if present).
- latus pore.** Small circular opening of canalicula approximately at mid-height of columnal latus, commonly accompanied by four others distributed with even spacing around columnal, interpreted as a rudimentary type of cirrus or latus structure but of unknown function (e.g., *Mooreanteris* MILLER in MOORE & JEFFORDS, 1968). Latus pores are commonly nodals.
- Law of Wachsmuth and Springer.** “Considering the importance that has been given to the presence of underbasals [=infrabasals] in classification, and the difficulty of identifying them in some groups, it is of some importance, that we have discovered a method, by which, in most cases, the presence or absence of underbasals [=infrabasals] can be ascertained accurately from the column, the position this occupies toward the general symmetry of the calyx; from the outer angles of the stem joints [=columnals], their position and that of the cirrhi [sic], whether these are radial or interradian, and from the direction of the axial canal. The following rules prevail: 1. In species with underbasals [=infrabasals], whenever the column is pentangular, its longitudinal angles are directed interradianly, the sides and column cirrhi [sic] radially; on the contrary, in species with basals only, those angles are radial, the sides of the column and cirrhi [sic] interradian. 2. When there are underbasals [=infrabasals] and the column is pentapartite [pentameric], the five sections of the column are radial, the longitudinal sutures interradian, the radiation along the axial canal radial; but the opposite is the case when basals only exist.” (WACHSMUTH & SPRINGER, 1885 in 1880–1886, p. 7; brackets added).
- left anterolateral* (syn., EA interray). See AB interray.
- left anterior* (syn., E ray). See A ray.
- left posterolateral* (syn., DE interray). See AB interray.
- left posterior* (syn., D ray). See A ray.
- lekythosiform* (WARN & STRIMPLE, 1977). See high bowl-shaped aboral cup.
- length.** Measurement of a crinoid morphological feature that projects abaxially away from the oral-aboral axis.
- ligament field.* See ligament fossa.
- ligament fossa.** Concave or flat part of articular facet of a brachial for attachment of ligaments. In a columnal, this would be in the areola (syn., *ligament field*).
- ligament pit.** Generally steep-sided and small depression in aboral ligament fossa adjoining center of transverse ridge.
- ligamentary articulation.** Union of ossicles effected solely by ligaments, lacking muscle fibers, but some articulations of this type may be supplemented by more or less calcareous deposition.
- lintel.** See lintel plate.
- lintel plate.** Plate comprising the lintel plate cirlet; five plates, each in an interradian position (syn., lintel).
- lintel plate cirlet.** A fourth primary cup cirlet identified by AUSICH (1998), where present between the infrabasals and column or radials and column in an interradian position. Occurs in four-cirlet crinoids, such as *Aethocrinus* UBAGHS, 1969, and *Superlinicrinus* BOTTING, 2018. If employing the homology scheme of AUSICH (1998), the lintel cirlet is the

- plate circler traditionally considered basal plates in dispirids.
- lobolith radices.** Radix formed into a hollow ball structure traditionally interpreted as floats (but see GORZELAK & others, 2019), two distinct types, plate and cirrus loboliths (see HAUDE, 1972; HESS & others, 1999; PROKOP & PETR, 2001). Floats known as “Loboliths” or “Camarocrinus” and were the terminal column of *Scyphocrinites* ZENKER, 1833; *Marhoumcrinus* PROKOP & PETR, 1987; and *Carolicrinus* WAAGEN & JAHN, 1899 (BRETT, 1981).
- longitudinal oblique articulation.** Union of ray ossicles characterized by obliquity of articular facet plane in relation to longitudinal axis of ossicles; defined externally by oblique sutures.
- loose suture.** Obsolete term for externally visible line of contact between movably united ossicles.
- low** (in reference to aboral cup/calyx and tegmen shape). Aboral cup/calyx or tegmen with the height greater than or equal to 0.50, but less than 0.75 times the maximum width.
- lumen** (pl., **lumina**). Open space of columnal or cirral articular surface (axial canal), generally located centrally, highly variable in size and shape, surrounded on all sides by zygum.
- luminal index.** Ratio of total width of lumen to that of columnal articular facet, multiplied by 100 to avoid fractional numbers (see columnal indices). Combined luminal and zygum indices have value of 100.
- madreporite.** Oral surface plate penetrated by numerous cilia-lined canals leading to the water vascular system; typically developed on the posterior primary peristomial cover plate. Recognized in some Paleozoic crinoids and other echinoderms.
- main axil.** Proximal, stout basal portion of lateral arms in the Calceocrinidae; branching heterotomous with brachials supporting two branches. Typically, axillary plates with unequal branches, with the larger facet supporting the more distal portion of the main axil and the smaller facet supporting an axil-arm (e.g., *Synchirocrinus* JAEKEL, 1918). In some more stemward genera, bifurcations on the main axil may be equal or subequal (e.g., *Trypherocrinus* AUSICH, 1984). All plates of the main axil may be axillary, or non-axillaries plates are between axillaries.
- manosynostosis.** Ligamentary articulation characterized by concave fossae and separated by well-developed culmina and crenulae of various lengths and arrangements. Typically, culmina and crenulae are on the peripheral rim and is the portion articulated with adjacent plate.
- medium** (in reference to aboral cup/calyx and tegmen shape). Aboral cup/calyx or tegmen with the height greater than or equal to 0.75, but less than 1.25 times the maximum width.
- medulla.** Inner skeletal material (stereom) of a columnal girdled on outward side by cortex, from which it is distinguished by differences in microstructure if discernible at all. It may be divided into well-defined or indistinctly bounded inner (proximal) and outer (distal) portions and may consist solely of substance of claustrum, the remainder of columnal then being classed as thick cortex.
- meric suture.** Straight or zigzag suture on the latera of trimeric, tetrameric, and pentameric columnals and columnals.
- meridional posture.** Subspherical, non-feeding arm posture with arms arched over the oral surface (MESSING, AUSICH, & MEYER, 2021).
- mesistele.** Intermediate part of crinoid column with distinctive columnals as compared to proxistele and dististele; not always distinguishable in pluricolumnals (term maintained, but note PHILIP, 1980).
- midgut.** See intestine.
- moderately cuneate uniserial.** Uniserial brachials in which sutures between brachial plates deviate from being parallel. This creates a significant difference in the height of each side of a brachial plate (WEBSTER & MAPLES, 2008).
- monocyclic.** Aboral cup with only single circler of plates proximal to the radial plate circler; aboral cup comprised of the radial and basal plate circlers.
- mouth.** External opening of the digestive system for entry of nutrition; either on oral surface or beneath the surface of a tegmen.
- movable, articulated spines** (on Paleozoic crinoids). Independent, spine plates articulated onto a small spine boss on a calyx plate. Moveable and presumably attached with ligament tissue. *Arthroacantha* WILLIAMS, 1883 (Devonian camerate) is an example of this type calyx plate sculpturing.
- multibrachiate.** Character state of feather stars that have more than ten free arms.
- multidirectional posture.** Feeding posture in which a single arm has pinnules along the arm in a four-pinnule repeated pattern such that each pinnule is oriented 90° from adjacent pinnules; present in feather stars in settings characterized by multidirectional currents (MEYER, 1979; MESSING, AUSICH, & MEYER, 2021).
- multilayered fan.** Feeding arm posture in which arm number or span of individual arms makes it impossible to array arms in a monoplane fan, so they overlap, forming a multiple-baffle structure. (MESSING, AUSICH, & MEYER, 2021).
- multiplated compound discoidal holdfast.** Type of compound discoidal holdfast comprised of discrete polygonal plates (e.g., Lichenocrinus-like holdfast) (see BRETT, 1981).
- multiple radials.** See biradials, compound radials.
- muscle field.** See muscular fossa.
- muscular fossa** (pl., **fossae**). Circumscribed concave or flat area on a ray plate where muscular connective tissues are attached. In articuloforms typically two fossae on adoral side of a pentafacial articular facet and on opposite sides of the midline of a facet (syn., muscular field).
- muscular articulation.** Union of brachials by muscle and ligament fibers, characterized by presence of aboral ligament fossa (where pit may be developed); transverse ridge may be perforated by axial canal, two adoral ligament fossae, and two adoral muscle fossae (HESS & MESSING, 2011).
- mutable collagenous tissue (MCT).** Echinoderm ligament tissue under neural control that can rapidly change properties from flexible to stiff and back

- again (syn., catch-connective tissue).
- nervous system.** Nervous tissue subdivided into three primary subsystems and three others are also recognized. The aboral nervous subsystem is the primary subsystem, which contrasts with that of other extant echinoderms.
- nodal** (*N*, pl., *NN*). Columnal generally distinguished by having maximum width and height in succession of heteromorphic columnals differentiated as a noditaxis. If present, radices or cirri are typically articulated to sockets on the nodals (cirrinodals, if cirri). In columns without radices or cirri, nodals are distinguished only by maximum size (nudinodals). Two columnals may share in bearing a radice or cirrus and are defined as compound nodals. In a few crinoids (e.g., *Camptocrinus* WACHSMUTH & SPRINGER, 1897), binodals are present that are characterized by radices articulated to a pair of fused columnals. Radice scars on the binodal are along the line of the vanished inter-columnal suture. Note that all nodal types are considered to be homologous, regardless of whether radices or cirri are present or absent.
- nodal index.** Ratio of height of nodal to that of noditaxis containing it, multiplied by 100 to avoid fractional numbers. Combined nodal and internodal indices have value of 100.
- nodal cirral articulum** (or facet). Facet on latus of nodal for articulation of a cirrus (syn., cirrus facet, *cirrus scar*, *cirrus socket*).
- nodal radice articulum** (or facet). Facet on latus of nodal for articulation of a cirrus (syn., radice facet, *cirrus scar*, *cirrus socket*).
- noditaxis** (pl., **noditaxes**). Nodal and contiguous succession of internodals—in most fossil crinoid columns arbitrarily chosen in either direction from nodal, because proximal and distal directions may be undeterminable, but in extant stem-bearing crinoids and some fossil forms, such as *Isocrinus*, internodals on proximal side of nodal are joined with internodals to define a noditaxis, because each nodal precedes in origin next nodal above it and internodal series between pairs of nodals became intercalated after appearance of subjacent nodal.
- nodose** (in reference to crown plate shape). Greatly exaggerated convexity on the outer surface of a plate with depth of the plate less than or equal to the height or width (whichever is greater) of that plate; inner surface typically flat with outer surface convex.
- non-axillary brachial.** Plate of any brachitaxis adjoined on its distal side by single brachial.
- non-crenulate suture.** Externally visible straight or curved, non-way line of articular contact between adjacent ossicles.
- non-feeding posture.** Arm posture assumed when not feeding. Could result from very low current velocity, very high current velocity, or a crinoid during regeneration (MESSING, AUSICH, & MEYER, 2021).
- non-planar coils.** Type of distal coiled holdfast where distal column is not planispiral (e.g., *Acanthocrinus* ROEMER, 1850 in 1950–1952) (syn., *pyramidenwurzel*, EHRENBERG, 1929) (BRETT, 1981).
- normal cirri.* See cirrus.
- normal interray.* See regular interray.
- nudinodal.** Nodal lacking cirral or radice articulated on its latus. Note nudinodal, cirrinodal, and nodal are all the names for one homologous structure.
- oblique articulation.** See oblique pentafascial articulation.
- oblique pentafascial articulation.** Facet between two ray plates that are asymmetrical in relation to the midline of the facet of an articulation typically with muscular tissue (syn., oblique articulation).
- oblique ridge.** Angled linear elevation separating inter-articular ligament fossa and muscle field on articular facet of an articulation typically with muscular tissue.
- oblique suture.** Externally visible line of articular contact between contiguous ossicles of brachitaxes or columnals not perpendicular to longitudinal axis of united ossicles (e.g., distal suture of enlarged columnal in abruptly bent column of *Nevadocrinus* LANE & WEBSTER, 1966).
- omega-ramule.** Branchlet borne by terminal axial of main-axil in calceocrinids, invariably directed adanally.
- ornamentation.** See sculpturing.
- oral** (*sensu* KAMMER & others, 2013). See oral plate.
- oral* (*sensu* UBAGHS, 1978) (syn., *deltoid*, primary peristomial cover plate. See primary peristomial cover plate.
- oral-aboral axis.** Theoretical line through the center of an erect crinoid crown (in a closed posture) and column (syn., central axis, adoral-aboral pole).
- oral pinnule.** Any proximal pinnule differentiated from distal ones in function, structure, or both; typically serves a protective function for the oral region.
- oral plate** (*O*, pl., *OO*) (*sensu* KAMMER & others, 2013). One of the plates that comprises the solid circler of plates forming the periphery around the mouth or peristome. Note this definition is a departure from UBAGHS, (1978) and previous authors. This redefinition reflects homologies among all pelmatozoans (SUMRALL & WATERS, 2012; KAMMER & others, 2013).
- oral plate* (*sensu* UBAGHS, 1978) (syn., *deltoids*, primary peristomial cover plate). See oral plate *sensu* KAMMER & others, 2013.
- oral region.** General term for all adoral surfaces forming the cover over the aboral cup or calyx (KAMMER & others, 2013). Equivalent to tegmen *sensu* UBAGHS, 1978.
- oral surface.** Oral region in which the mouth and ambulacra are exposed directly to seawater (KAMMER & others, 2013).
- ossicle.** See plate.
- outer ligament area.* See aboral ligament fossa.
- outer perigastric coelom subsystem.** Coelom space that is outside the perigastric coelom organ and inside the thecal plating; covers much of the thecal interior (syn., peripheral coelom) (HAUGH, 1973).
- paired nodals.* See binodal.
- palmar* (syn., *distichal*, *tertibrach*, tertibrachial). See tertibrachial.
- parabolic filtration fan.** Feeding arm posture where the distal arms are recurved into the current, thus forming a parabolic-shaped filtration fan perpendicular to currents and, typically, perpendicular to the substratum; in extant feather stars and stalked crinoids

- (MACURDA & MEYER, 1974; MESSING, AUSICH, & MEYER, 2021).
- parapinnule.** Small branches from arms that may be laterally joined with two or more (however, no regular pattern per brachial; present in *Pandoracrinus* JAEKEL, 1918) (RAMSBOTTOM, 1961).
- pararadial.** Supplementary interradial arm-bearing plate in the radial circlet.
- patelloid process.** Proximal extension of the proximal margin of a brachial plate with a corresponding socket in the distal margin of the subjacent brachial plate. Common primarily on flexibles, including some species of *Cupulocrinus* D'ORBIGNY, 1849 in 1849–1851, the most stemward flexible.
- patina.** Obsolete term for essential, primitive part of cup or calyx comprising radials, basal, and in some crinoids, infrabasals, and/or lintels.
- pelma.** Crinoid body beneath the crown; comprised of the column, column appendages, and holdfast.
- peneplicate.** Almost, but not quite the same as planate, deviating very slightly by upward or downward slope or by extremely gentle convexity or concavity.
- penepenary radial facet.** Type of radial articular facet occupying more than 70%, but less than 100% of the width of a radial plate.
- pentafascial articulation.** Facet between ray ossicles with five fossae (one aboral ligament fossa, two adoral ligament fossae and two adoral muscular fossae) and a transverse ridge present (syn., *muscular articulation*). See straight pentafascial articulation, oblique pentafascial articulation.
- pentamere.** One-fifth part of columnal or column where the columnal is comprised of five separate plates; may be discrete or laterally ankylosed. Columnns may also be tetrameric (e.g., *Colpodecrinus* DONOVAN, 1983) or trimeric (*Bodacrinus columnus* DONOVAN, 1986).
- pentaradial.** Five-part symmetry, commonly well displayed but rarely perfect in crinoids.
- perforate brachial.** Brachial plate with an axial canal.
- perigastric coelom organ.** Calcareous or spiculate, coiled body within the theca of many camerate crinoids. This structure separates the inner and outer perigastric coelom subsystems (syn., *convoluted organ*).
- perigastric coelom system.** As known, this coelom system is essentially the entire thecal interior of most crinoids. In camerates there is a perigastric coelom organ that is divided into the inner perigastric coelom subsystem, which is inside the perigastric coelom organ, and the outer perigastric coelom subsystem, which is the space outside the perigastric coelom organ and inside the thecal plating (HAUGH, 1973).
- perilumen** (pl., **perilumina**). Columnal articulation, surrounding lumen with a smooth, granulose, tuberculate, or vermiform surface. Internally, perilumen of some columnals corresponds to dense inner medulla, which is very distinct from reticulate to spongy outer medulla between areolae and possibly part of crenularia of opposing facets (*central area*). See areola.
- periluminal index.** Ratio of total width of perilumen to that of columnal articular facet, multiplied by 100 to avoid fractional number (see columnal indices). Combined periluminal, areolar, and crenular indices are equal to zygial index.
- peripheral coelom.** See outer perigastric coelom subsystem.
- peripheral crenulae** (of a petalodium). Crenulae along abaxial border of petal, generally reaching margin of articulum next to columnal latus.
- periproct.** Opening in calyx for anus, covered in life by membrane or pyramid of small plates.
- periproctal.** Any plate covering calyx opening for anus, generally part of a small pyramid.
- perisomic skeleton.** See adoral skeleton.
- peristome.** Opening in calyx for mouth, may be open or covered by plates.
- peristomial.** See primary peristomial cover plate.
- perivisceral auxiliary “half-rim” canal.** The C-shaped loop in the CD interray of the perivisceral ring canal; gives rise to two flattened canals extending in the CD interray (in contrast with other interrays where a single flattened canal is present).
- perivisceral coelom ring.** Double-ring commissure connected with perivisceral coelom organ at summit of calyx cavity in some camerates (HAUGH, 1973).
- perivisceral coelom system.** Coelom system in the distal portion of the thecal cavity that is comprised of a perivisceral ring, a perivisceral half-ring canal, and six interradial, flattened tubes that lead to a coelom system that surrounds much of the thecal interior (HAUGH, 1973).
- perradial.** Precisely in position of crinoid radii.
- perradial crenulae** (of a petalodium). Coalesced or inosculating adradial crenulae near central area of some columnals (e.g., *Balanocrinus*).
- petal.** One of five teardrop shaped segments of a petalodium (petaloid columnal articulum).
- petalodium.** Pentalobate, petal-shaped arrangement of short crenulae typically developed on articular facets of some Articulata (e.g., Isocrinidae, Pentacrinidae).
- pinnular.** Plate forming part of a pinnule; may be incorporated in calyx plating (fixed pinnular), but most commonly is part of crown above calyx plating (syn., free pinnular).
- pinnular arm unit.** Any arm segment giving off one pinnule; may be comprised of a single brachial or more.
- pinnular adjustor muscles.** Muscle connecting the first pinnular to its brachial plate; may have two muscle fossae or fossae merged into a single muscle fossa.
- pinnular articulation.** Specialized articulation in living crinoids between the second and third pinnulars and all more distal pinnular articulations. This articulation has an aborally-aborally positioned fulcral ridge with small adoral muscles and large aboral ligaments.
- pinnulate.** Arm branching condition where every successive brachial bears a small side branch to alternating sides of the arm. With pinnulate arms, pinnular arm units comprised of one brachial plate. This condition was attained by at least a few members of nearly every early clade, but it is particularly characteristic of camerates, many eucladids, and articuliformes (syn., pinnulation).
- pinnulation** (syn., pinnulate).
- pinnule.** Generally slender, unbranched, uniserial branchlet of arm, borne on alternate sides of successive brachials (in otherwise pinnulate forms pinnules may

- be absent in proximal-most arms and on axillaries). Recognized as a morphologic grade among crinoids. In extant crinoids with syzygial pinnulation or sym-morphic pinnulation with a pinnular unit of two brachials, the side branch is commonly referred to as a pinnule.
- pinnule comb.** Modification of distal oral pinnules of feather stars. Ossicles bear one or a pair of blade-, spade-, or knob-shaped processes that together form a comb (a diagnostic feature of the Comasteridae) (HESS & MESSING, 2011).
- pinnule facet.** Articular facet on brachial for attachment of pinnule (syn., *pinnule socket*).
- pinnule socket** (syn., pinnule facet).
- pinnulet.** Proposed as small branches from pinnules of *Trichinocrinus* MOORE & LAUDON, 1943. Now regarded as articulated spines (AUSICH, BOLTON, & CUMMING, 1998, p. 124).
- planar coils.** Type of distal coil holdfast where the distal column is planispiral (BRETT, 1981).
- planate.** Level or horizontal; refers to shape of aboral-cup base, attitude of basal or infrabasal circler, or disposition of general plane of radial articular facet.
- plate.** Any individual calcareous skeletal element of a crinoid mesodermal skeleton (e.g., columnal, cirral, radial plate, brachial plate, pinnular, etc.) (syn., ossicle).
- plated pseudocirri.** Applicable only to radices; see pseudoradice.
- plated pseudoradice.** Radice comprised of irregular outer plating with a large lumen rather than a single plate with a lumen (e.g., *Stereosaster squamosus* FORESTE, 1919). Obsolete term (adapted from BRETT, 1981; see AUSICH, 1986).
- plenary radial facet.** Type of radial facet occupying 100% of distal width of a radial plate.
- plinth.** Rectangular to irregular-shaped plates that form a coating around the otherwise regular-looking column of the Permian crinoid *Tetrabrachiocrinus* (LANE, 1979, p. 123).
- pluricirral.** Two or more cirrals attached to one another.
- pluricolumnal.** Two or more columnals attached to one another.
- pluriradice.** Two or more radice ossicles attached to one another.
- polymodal articulation.** Attachment of a stout radice; two or more columnals are a part of the articular facet of the radice (BRETT, 1981).
- poor heterotomy.** Arms with heterotomous axillaries and brachitaxes of unequal lengths.
- poor isotomy.** Arms with isotomous axillaries and brachitaxes of unequal lengths.
- posterior.** Referring to interray (CD) containing anus or posterior plates, generally wider than other interrays.
- posterior left.** Interray or interradius next to left posterior (D) ray in clockwise direction when crinoid is viewed with adoral side directed upward.
- posterior plate.** All plates in the posterior (CD) inter-ray that are confined to cup/calyx; may be associated with an anal sac or anal tube (AUSICH & others, 2020). In pentacrinoids posterior plates (proximal to distal) may be the radianal plate, anal X plate, and right sac plate; typically the plating supports plates along the anal sac leading to the anus. In camerates, the proximal-most CD interray plate is the primanal; CD interray plates may or may not be connected to tegmen or oral surface plating (syn. *anal, anal plate*).
- posterior right.** Interray or interradius next to right posterior (C) ray in counterclockwise direction when crinoid is viewed with adoral side directed upward.
- postpalmar.** Any brachial distal from secundibrachial series (syn., tertibrachial, quartibrachial, etc.).
- preservational posture.** Arm posture of a fossil crinoid (MESSING, AUSICH, & MEYER, 2021).
- primanal.** Proximal-most plate in the CD interray in the majority of camerates (JAEKEL, 1918) (syn., *tergal*) (see AUSICH & others, 2020).
- primary skeleton.** Obsolete term for part of calcareous framework comprised of first ossicles developed in ontogeny; includes columnals, cirrals or radices, infrabasals, basals, radials, brachials, pinnulars, orals, and ambulacrals.
- primary peristomial cover plate (PPCP).** Interradially positioned plate covering the mouth; mouth may be exposed on the oral surface or may be fixed into tegmen plating. Posterior primary peristomial cover plate may be larger. This definition follows SUMRALL and WATERS (2012) and KAMMER and others (2013) and reflects homologies among all pelmatozoans (syn., *deltoid, oral* [sensu UBAGHS, 1978]).
- primaxil-arm.** In calceocrinids, the most proximal arm branched from the main axil.
- primaxil (Ibnax).** Axillary plate of primibrachitaxis; first bifurcation in a branching arm (syn., primaxillary).
- primaxillary** (syn., primaxil).
- primibrach** (syn., *costal, primibrachial*). See primibrachial.
- primibrachial (Ibr, pl., Ibrrr).** Plate of proximal arms above the radial plate to and including the first bifurcation (if present); may be axillary or non-axillary and fixed or free (syn., *costal, primibrach*).
- primibrachitaxis.** All brachial plates above the radial plate to and including the primaxil (if present). In an atomous arm, the primibrachitaxis includes all brachial plates in a ray.
- priminternodal (iN-1).** First-order internodal.
- proboscis.** See anal tube.
- proximal.** Direction or position along the oral-aboral axis toward the articulation of the crown and the column.
- proximale.** Noncirriferous uppermost columnal or fused uppermost columnals, distinguished typically by enlargement and permanent attachment to aboral cup.
- proxistele.** Proximal region of crinoid column near aboral cup, may be clearly delimited from mesistele. Dissociated columnals and pluricolumnals are rarely identifiable as belonging to proxistele (term maintained, but note PHILIP, 1980).
- pseudocirrus.** Applies only to radices; see pseudoradice.
- pseudoradice.** Unsegmented sideward projection from columnal resembling a radice in having axial canal, but irregular in form and distribution; simple or branched (adapted from BRETT, 1981).
- pseudocyclic.** Monocyclic crinoid that has gained one circler of aboral cup plates through ontogeny (syn., cryptomonocyclic).

- pseudohomeomorphic.** Crinoid column with perfect or near-perfect homeomorphic appearance externally possessing internodals that do not reach stem periphery and thus concealed (e.g., *Dianthicoeloma* MOORE & JEFFORDS, 1968).
- pseudomonocyclic.** Dicyclic crinoid that has lost the infrabasal cirlet during ontogeny (syn., cryptodicyclic).
- pseudosynarthy.** Free arm facets in some camerates that are compound, with two slightly concave surfaces articulated to two fixed brachials. The lateral admedial edge of the higher facet presumably acts as a rudimentary fulcrum.
- pseudosyzygy.* See cryptosyzygy.
- pseudotegmen.** A solid covering over an aboral cup or calyx covering the mouth and formed by aboral cup plates rather than oral surface or other plates that form a tegmen (AUSICH & KAMMER, 2016).
- pyramidenwurzeln.* See non-planar coils.
- quartaxil.** Axillary plate of the quartibrachitaxis; fourth axillary plate in a bifurcating arm (syn., quartaxillary).
- quartaxillary.** See quartaxil.
- quartibrachial** (*IVBr*, pl., *IVBrr*). Any ray plate of fourth brachitaxis; brachial plates above the tertaxil to and including the quartaxil.
- quartibrachitaxis.** All brachial plates above the tertaxil to and including the quartaxil.
- quartinternodal** (*iN-4*). Fourth-order internodal.
- rabbet.* (syn., impressed suture, *rebate*). See impressed suture.
- radial** (noun). See radial plate.
- radial** (adj.). Pertaining to a radius.
- radial canal** (of petaloidium). Radially disposed tubular passageway in apposed articula of contiguous petaloid columnals formed by matched radial grooves between petals, extending to periphery but not reaching lumen (e.g., *Isocrinus* VON MEYER in AGASSIZ, 1836) (syn., *interarticular radial canal*).
- radial cavity.** Lumen inside radial plate cirlet, may be separated into two cavities by the basal cirlet in roveacrinids (HESS & MESSING, 2011).
- radial dome plate.* Obsolete term for prominent ambulacral, especially axillary in nature, on tegmen of some camerate crinoids.
- radial facet.** Distal facet of a radial plate, smooth or sculptured, bearing marks of ligamentary and/or muscular connective tissue with first primibrachial; facet absent on radials that lack arms.
- radial groove** (of a petaloidium). Half of radial canal located on either of apposed petaloid articula of adjoining isocrinid or pentacrinid columnals. Narrow space between adjacent petals of petaloid columnal articulum (syn., *interarticular radial canals*).
- radial pentagon.* See radial plate cirlet.
- radial pit.** Radially disposed depression in adoral (proximal, upper) surface of centrodorsal in some feather stars (HESS & MESSING, 2011).
- radial plate** (*R*, pl., *RR*). Proximal plate of any ray (unless a compound radial plate); typically an arm is articulated to the radial plate (syn., radial).
- radial plate cirlet.** Typically subpentagonal ring formed of radial plates after removal of all other structures. Radial plate cirlet may be complete or one or more radial plates may be separated laterally by intervening plates (syn., *radial pentagon*).
- radial pore** (of a petaloidium). Small opening in radial position visible at periphery of two attached columnals formed by coincident radial grooves of apposed columnals (syn., *interarticular pore*).
- radial ridge groups** (of a petaloidium). Various types of perradial crenulae ranging from alternating, gable-shaped to rectilinear joined crenulae of adjacent petals.
- radial space** (of a petaloidium). Area between contiguous petals distinguished by absence of crenulae; may be broadly triangular, with base on rim of columnal and apex at or near central area (e.g., *Pentacrinites* BLUMENBACH, 1804 in 1802–1804), very narrow with apex not reaching central area (e.g., *Isocrinus* VON MEYER in AGASSIZ, 1836), or restricted to narrow radial groove.
- radial** (*RA*). Proximal posterior plate in stemward pentacrinoids (disparids, cladids, and flexibles); typically directly beneath, beneath to the left, or to the left of the C radial plate (originally named by BATHER, 1890). In more crownward pentacrinoids with only two posterior plates, the radial is still the most proximal plate. It is the only posterior plate in the aboral cup pentacrinoids (disparids, cladids, and flexibles) with only one posterior plate unless demonstrated otherwise through study of early development. In the Calceocrinidae, most proximal plate of posterior series, termed subanal (BRETT, 1981). May be referred to as T-plate (see WRIGHT, 2015; AUSICH & others, 2020).
- radice.** General term for stem and holdfast appendages that lack a synarthrial articulation and other attributes of cirri. Articulations symplectial or synostomial; branched or unbranched (syn., rootlets, rhizoids) (adapted from BRETT, 1981; DONOVAN, 2021a).
- radice canal.** Axial canal within a radice.
- radice facet.** Articular facet of a radice to a columnal(s). (syn., *radice scar*, *radice socket*, nodiradice articulum).
- radice nodal.** Column-bearing radice ossicle.
- radice ossicle.** Individual plate of a radice.
- radice scar.* See radice facet.
- radicular.** Bearing root-like extensions (=radices), branched or unbranched, most commonly either at or the distal termination of the column or arising from one side of the dististele. Other radices may arise from the mesistele and/or proxistele of some Paleozoic crinoids (e.g., *Macrostylocrinus cirrifer* RAMSBOTTOM, 1961), although their function remains uncertain. Radicles or radices may be branched or unbranched.
- radicular cirrus* (syn., *radicular holdfast*, radix, *cirrus root*). See radix.
- radicular holdfast* (syn., *radicular cirrus*, radix, *cirrus root*). See radix.
- radicular pseudocirrus.* Applies only to radices (see radicular pseudoradice).
- radicular pseudoradice.** Pseudoradice that is part of a radix in the column dististele (adapted from BRETT, 1981).
- radicular runners.** Column attachments with recumbent, unmodified columnals with radicles in

- whorls (adapted from BRETT, 1981).
- radicular stereomic outgrowths.** Dendritic extensions (or holdfast appendages) of the columnal in a holdfast (e.g., *Crotalocrinites verucosus* [SCHLOTHEIM, 1820]) DONOVAN & others, 2010, pl. 17,3).
- radius.** Midline of a ray.
- radix.** Category of attachment structures with well-developed radices or pseudoradices (roots of many authors) (adapted from BRETT, 1981) See radicle, radicular radice, and *cirrus root*.
- ramule.** Unbranched appendage of a heterotomous arm branch; on an arm with non-axillary brachials separating axillaries.
- ramus.** Main arm branch.
- ray.** Radial plate, together with all structures borne by it.
- ray ridge.** Narrow ridge or distinct convexity along the height of a ray; may include radial plate and/or fixed brachial plates.
- ray trunk.** Extreme arm heterotomy where a very wide arm has uniserial or multiserial brachials and bears biserial (typically) pinnulate appendages (syn., arm trunk).
- rebate* (syn., impressed suture, *rabbet*). See impressed suture.
- rectilinear uniserial.** Uniserial arms in which brachials are quadrangular; proximal and distal facets are parallel.
- rectum.** The digestive system from its narrowing at the base of the intestine (midgut) to the anus (syn., hindgut).
- regular dichotomy.** Bifurcation of arm, constantly repeated in regular manner.
- regular interray.** Any one of the non-posterior interrays, that is, AB, BC, DE, or EA (syn., *normal interray*).
- reproductive regeneration.** Regeneration of part of an arm in which the original arm branching pattern grows back.
- reversion.** The condition of oblique penta-fascial articulations where pinnules are borne on the low side of distal facets.
- Rhizocrinus-like root.* See virgate radix.
- rhizoidal holdfast.** Dististelar holdfast with radices or pseudoradices (e.g., *Periechocrinus* MORRIS, 1843 (syn., *stem segment cirrus root* of Brower, 1973) (BRETT, 1981).
- rhizoids.** See rhizoidal holdfast.
- rhomb-like structure.** Any endotheal or exotheal structure with a thinning and folding of plates and centered at either plate triple junctions or involving two plates across a suture. Several types exist in crinoids that are not directly homologous to rhombs of glytocyctoids (e.g., bothrospires, goniospires, and others without specific names).
- ridged plate sculpturing.** Linear ridges on plate outer surfaces in any non-radiating orientation.
- right anterolateral* (syn., AB interray). See AB interray.
- right anterior* (syn., B ray). See A ray.
- right posterolateral* (syn., BC interray). See AB interray.
- right posterior* (syn., C ray). See A ray.
- right sac plate (RX).** In stemward pentacrinoids (disparids, cladids, and flexibles) third-most proximal plate in posterior interray, typically above and to the right of the anal X plate (originally named first tube plate by BATHER, 1890). Absent from aboral cup in more crownward pentacrinoids with two or one posterior plate (see WRIGHT, 2015; AUSICH & others, 2020) (syn., *right tube plate*).
- right tube plate.* See right sac plate.
- rim** (of columnal articularum). See articular rim.
- rootlet.** See radice.
- rosette.** Delicate calcareous plate or structure formed of metamorphosed basal plates, typically located within the radial cavity and roofing the centrodorsal of feather stars. In many feather stars, five rod-like pieces known as basal rays extend from the rosette in interradial positions (HESS & MESSING, 2011).
- rounded biserial.** Biserial brachials where width and height of the brachial is approximately equal and the abaxial side of each brachial is convex (WEBSTER & MAPLES, 2008).
- sculpturing.** Texture on the outer surface of plates (syn., ornamentation).
- scutelliform compound discoidal holdfast.** Type of compound discoidal holdfast comprised of a single porous expansion of stereom, perhaps fused plates (e.g., the “Podolithus” holdfast) (BRETT, 1981).
- secondary skeleton.* Obsolete term for part of calcareous framework comprised of ossicles that are intercalated between primary pieces; includes interbrachials, interambucrals, intercalaries, and some posterior plates.
- secundaxial (IIBrax).** Axillary secundibrachial; second bifurcation (if present) on an arm (syn., *secundaxillary*).
- secundaxillary (IIBrax).* See secundaxial.
- secundaxil-arm.** In calceocrinids, the second most proximal arm branch from the main axil.
- secundibrachial (IIBr, pl., IIBrr).** Any ray plate of second brachitaxis; all brachial plates above the primaxil to and including the secundaxil (if present).
- secundibrachitaxis.** All brachial plates above the primaxil to and including the secundaxil.
- secundinternodal (iN-2).** Second-order internodal.
- septal index.** Ratio of total width of septum to that of columnal articular facet, multiplied by 100 to avoid fractional numbers (see columnal indices).
- septum** (pl., *septa*). Thick or thin inward projection of columnal centrum that locally constricts lumen, generally comprised of horizontal microlamellae with or without being crossed by vertically disposed annular microlamellae, thus producing a microscopic cribwork. In some crinoids, central septa are indented by very narrow radially placed slits extending outward from jugula, and opposite septal surfaces may be swollen between neighboring slit in manner that produced petaloid bulges (jugular ramparts).
- shared ambulacrum plate.** On oral surface with a 2–1–2 ambulacral symmetry, one of the plates along the length of two proximally merged ambulacra, that is, B and C rays and D and E rays.
- shared ambulacrum cover plate.** On oral surface with a 2–1–2 ambulacral symmetry, plate that covers ambulacra where they are merged proximally, that is, B and C rays and D and E rays.
- shaving-brush posture.** Preservational arm posture with

- the arms closed about the oral-aboral axis of the animal assumed during episodes of current velocities too high to maintain a feeding posture. If high-current conditions resulted in burial, this posture may be maintained in a fossil (BAUMILLER & others, 2008; MESSING, AUSICH, & MEYER, 2021).
- side-plate** (syn., *adambulacral*, *adambulacral plate*). See *adambulacral plate*.
- simple axial canal**. Axial canal of a column that is straight sided, lacking enlargements or restrictions.
- simple discoid holdfast**. Holdfast type comprised basically of a single more or less solid growth of stereom (BRETT, 1981).
- simple radial**. Typical condition in which a single plate occupies the radial position in the radial cirlet (syn., *radial plate*).
- simple runners**. Commonly non-permanent column attachments with recumbent, unmodified columnals lacking radices or cirri. (e.g., *Ptychocrinus* WACHSMUTH & SPRINGER, 1885 in 1880–1886, and *Archaeocrinus* WACHSMUTH & SPRINGER, 1881 in 1880–1886) (BRETT, 1981).
- skyphosiform**. Obsolete term for medium, bowl-shaped aboral cup; from WARN & STRIMPLE, 1977.
- simple sutural canal**. Unbranched canal that penetrates along the junction between two plates.
- smooth plate sculpturing**. Outer plate surface devoid of any texture.
- spatium** (pl., *spatia*). Localized widening of columnal axial canal opposite interarticular sutures.
- spine**. A spike-like extension from any plate in which the length is greater than the basal width of the feature; typically, rigidly attached to plate but may be articulated with only connective tissues (see movable, articulated spines). The distinction between an individual spine and a spinose plate may be a matter of judgement.
- spinose** (in reference to crown plate shape). Greatly exaggerated convexity or spike-like extension on the outer surface of a plate with depth of the extension is greater than the height or width (whichever is greater) of that plate; inner surface typically flat with outer surface convex or spike-like.
- spike-like pseudocirrus**. See spike-like pseudoradice.
- spike-like pseudoradice**. Pseudoradice that is elongate and relatively slender (adapted from BRETT, 1981).
- stalk**. See column.
- starburst posture**. Preservational arm posture of a fossil in which the arms are splayed out in a disk shape along a bedding surface. Arms may be oriented either ambulacra up (starburst-up) or ambulacra down (starburst-down) (BAUMILLER & others, 2008; MESSING, AUSICH, & MEYER, 2021).
- stèle** (syn., *Hohlwurzeln* of UBAGHS, 1978). See stellar holdfast.
- stèle**. In BRETT (1981), a pelma comprised of small plates surrounding a wide lumen.
- stellar holdfast**. Entire distal, multiplated column in primitive echinoderms that lacks columnals. Distal portion serves as a holdfast (=holdfast of SPRINKLE, 1973) (syn., *stèle*, *hohlwurzeln* of UBAGHS, 1978) (BRETT, 1981).
- stellate-ridged plate sculpturing**. Linear ridges, single or multiple, radiating from aboral cup/calyx plate centers or from near the distal or proximal margin of a plate.
- stem**. See column.
- stem holdfast**. Category of attachment structures formed in the dististele (BRETT, 1981).
- stem segment cirrus roots**. See rhizoidal holdfast.
- stem segment holdfast**. See dististelar holdfast.
- stem segment rootlets** (syn., *creeping roots*, *stolon*, *stoloniferous holdfast*). See stoloniferous holdfast.
- stereom**. See stereom microstructure.
- stereomatic outgrowths**. Solid, unsegmented calcareous outgrowths from columnals; may be thin strands, knobs, rods, or columnal flanges (syn., *creeping roots* and *stem segment roots*) (BRETT, 1981).
- stereom microstructure**. Calcareous fabric of all echinoderm plates, comprised of a network of calcareous trabeculae and porous space that is filled with mesodermal tissue during life. In a living crinoid, the calcite is high-Mg calcite, but the mineralogy converts to low-Mg calcite early during diagenesis. Stereom microstructure is a synapomorphy for the Echinodermata.
- stolon** (syn., *creeping roots*, *stoloniferous holdfast*, and *stem segment roots*). See stoloniferous holdfast.
- stoloniferous holdfast**. Dististelar holdfast with parts of the column recumbent on the substratum and with cemented outgrowths, either pseudoradices or simple stereomatic outgrowths (syn., *stolon*, *creeping roots* of FRANZÉN, 1977; *stem segment rootlets* of BROWER, 1973, e.g., *Dimerocrinites* PHILLIPS in MURCHISON, 1839) (adapted from BRETT, 1981).
- stone canal**. Tube connecting the madreporite to the remainder of the water vascular system.
- stout cirrus** (BRETT, 1981). See stout radice.
- stout radice**. Radice where proximal radice width is greater than the height of the columnal to which it is attached, thus radice sockets involve more than one columnal with a polynodal articulation (adapted from BRETT, 1981).
- straight muscular articulation**. See straight pentafascial articulation.
- straight pentafascial articulation**. Facet between two ray plates with fossae for connective tissue that are symmetrical with respect to the facet midline; articular ridge perpendicular to the facet midline (syn., *straight muscular articulation*).
- straight suture**. Externally visible line of articular contact perpendicular to longitudinal axis of adjoined ossicles.
- strongly cuneate uniserial**. Uniserial brachials where proximal and distal sutures converge on one side of the arm at a point; brachial plate is full width of arm, but one side contributes virtually nothing to the height of the brachial plate (WEBSTER & MAPLES, 2008).
- subanal** (BRETT, 1981). See radianal (see AUSICH & others, 2020).
- subaxillary**. See axillary.
- subradial cleft**. Deep, narrow furrow between aboral surface of radials and the apposed surface of the

- centrodorsal in feather stars (HESS & MESSING, 2011).
- subtegminal.** Beneath tegmen of a theca.
- superficial subsystem** (of nervous system). See ectoneural subsystem.
- superradial plate** (*SR*, pl., *SRR*). Distal plate of a compound radial pair.
- superradial.** The upper of the two plates if the radial is compound (e.g., *Aethocrinus*, *Elpasocrinus*).
- supracentral nodicirral articulum (or facet).** Cirrus attachment of scar located above mid-height of nodal latus, generally directed obliquely outward and upward.
- supranodal** (CARPENTER, 1884 in 1884–1888). Obsolete term for columnal adjoining proximal articulum of any nodal.
- suprattegminal.** On the tegmen of a theca.
- sursumate.** Surface sloping outward-upward (e.g., aboral cup plate sutures in *Poteriocrinites* J. S. MILLER, 1821, and radial articular facets of *Aesiocrinus* S. A. MILLER & GURLEY, 1890).
- sutural pore.** Opening to a canal located on line of juncture between ossicles.
- suture.** Externally visible line of articular contact between adjoined ossicles (syn., *joint*).
- symmorphic pinnulation.** Strictly speaking, a form of ramulate arm branching in extant crinoids in which one non-axillary brachial separates axillary brachial plates. One non-axillary plate (hypozygal) and one axillary plate (epizygal) are considered a pinnular unit.
- symmophy.** Articulation with toothlike prominences on one facet interlocking with corresponding grooves on apposed facets; facet is mostly cryptoszygial with fine, peripheral crenulae occurring in isocrinids (HESS & MESSING, 2011).
- symplexy.** Articulation in which culmina on one facet interlock with crenellar grooves on opposite facet, marked externally by crenulate suture (syn., symplectic articulation) (HESS & MESSING, 2011).
- synarthrial articulation.** See bifascial articulation, synarthry.
- synarthry.** Articulation in which each apposed facet bears a transverse ridge separating two fossae for attachment of ligament bundles (syn., bifascial articulation) (HESS & MESSING, 2011).
- synostosis.** Mostly smooth, flat, and inflexible articulation; ligament fossae may be more or less concave or have calcareous deposits, but intermediate conditions also exist (syn., unifascial synostosis) (HESS & MESSING, 2011).
- syzygial pair.** Two brachials joined by syzygy, the distal one termed hypozygal, the proximal one epizygal.
- syzygial pinnulation.** In arms, strictly speaking, a form of ramulate arm branching in extant crinoids in which one non-axial brachial separates axillary brachial plates. Specialized articulation for autotomy in feather stars, with ridges (culmina) of one articulum apposed to corresponding ridges of adjacent articulum. One non-axillary plate (hypozygal) and one axillary plate (epizygal) are considered a pinnular unit.
- syzygy.** Ligamentary articulation in which ridges (culmina) of one articulum are apposed to corresponding ridges of an adjacent articulum. True syzygies with coarse ridges are widespread among feather stars but also occur in stalked crinoids (HESS & MESSING, 2011).
- taxis** (pl., *taxes*). Definitive linear series of plates in any part of crinoid crown (syn., *division series*). See brachitaxis, anitaxis, noditaxis.
- tegmén.** Oral region in which the mouth is not exposed at the surface, typically a solidly plated surface (redefined by KAMMER & others, 2013) (syn., *vault*).
- tergal.** See primanal.
- terminal stem plate.** Distal-most columnal in comatulid larva. See holdfast.
- terminal holdfasts.** Category of attachment structures formed distal to the last differentiated columnal (BRETT, 1981).
- tertaxil** (*IIIBrax*). Axillary tertibrachial; third axillary plate in a bifurcating arm (syn., tertaxillary).
- tertaxillary** (syn., tertaxil).
- tertibrach** (syn., *distichal*, *palmar*, teribrachial). See teribrachial.
- tertibrachial** (*IIIBr*, pl., *IIIBrr*). Brachial plates above the secundaxil to and including the tertaxil (syn., *distichal*, *palmar*, *tertibrach*).
- tertibrachitaxis.** All brachial plates above the secundaxil to and including the tertaxil.
- tertinternodal** (*iN-3*). Third-order internodal.
- tetramere.** One-fourth part of column or columnal where columnal comprised of four separate plates; may be discrete or ankylosed. See pentamere.
- theca.** Crinoid skeleton exclusive of the free arms and pelma; either the calyx and oral region or aboral cup and oral region.
- tiering.** Community structure of organisms with characteristic heights or depths above or below the sediment-water interface for subdivision of resources. In crinoids, column height is the primary factor determining tier position (LANE, 1963, 1973; AUSICH, 1980; AUSICH & BOTTJER, 1982).
- through-going ligaments.** Long ligament fibers in columns that penetrate through multiple columnals (GRIMMER, HOLLAND, & HAYAMI, 1985). In isocrinids, these ligaments bind the proximal-most internodal of a noditaxis to the nodal beneath. Although not defined by nodals, similar heights of columnals are found in other crinoids (BAUMILLER & AUSICH, 1992; BAUMILLER & others, 1995; AUSICH & BAUMILLER, 1998; DONOVAN, 2021b). See broken stick.
- transverse oblique articulation.** Union of ray ossicles characterized by oblique position of transverse elements of articular facet in relation to longitudinal axis of joined ossicles.
- transverse ridge.** See articular ridge, fulcral ridge.
- trauma posture.** Non-feeding and preservational arm posture assumed during episodes of current velocities too high to maintain a feeding posture. If high-current conditions resulted in burial, this posture may be maintained in a fossil (MESSING, AUSICH, & MEYER, 2021).
- tricylic.** Aboral cup with three plate circlets proximal to radials. Radials, basals, inferradials, and lintels form the aboral cup (AUSICH, 1996).
- trifascial articulation.** Facet between two ray plates characterized by three gently concave areas for connective tissue attachment. The adoral fossae may

- contain both muscular and ligamentary tissue or only ligamentary tissue.
- trimere.** One-third part of column or columnal where columnal comprised of three separate plates; may be discrete or ankylosed. See pentamere.
- trivium.** Differentiated A, B, and E rays, general longer than rays of opposed bivium (C, D rays) in posterior position (e.g., many Comasterida, Holopodidae).
- true cirri.* See cirrus (pl. cirri).
- tubercular pseudocirrus.* Applies only to radices (BRETT, 1981). See tubercular pseudoradice.
- tubercular pseudoradice.** Pseudoradice comprised of low circular knobs (adapted from BRETT, 1981).
- tuberos holdfast.** Distiseler holdfast where distal column thickens into a bulbous structure (e.g., *Lepocrinites* CONRAD, 1840) (syn., *bulbroots*, BROWER, 1973) (BRETT, 1981).
- unifacial articulation.** See synostosis.
- unilateral heterotomy.** Type of arm branching characterized by occurrence of ramules on one side of main arm only; includes endotomous and exotomous arm branching.
- uniserial arm.** Arm comprised of brachials arranged in single row, with parallel or non-parallel sutures. See weakly cuneate uniserial, strongly cuneate uniserial, moderately cuneate uniserial (WEBSTER & MAPLES, 2008).
- uniserial brachial.** Individual plate of an arm in which brachials are arranged in a single row along the arm and occupying the full width of the arm, with parallel or non-parallel sutures. See weakly cuneate uniserial, strongly cuneate uniserial, moderately cuneate uniserial (WEBSTER & MAPLES, 2008).
- united compound basal.** Ossicle formed by union of two basal rays with two intraradial processes of rosette, in some feather stars.
- urn shape.** Aboral cup/calycal shape with the maximum width at the distal position and aboral cup/calycal sides concave (syn., *bell-shaped*, *kateriform*).
- vault.* See tegmen.
- ventral* (syn., *actinal*, adoral). See adoral.
- ventral groove.* See adoral groove.
- ventral sac.* See anal sac.
- vertical radial facet.** Radial facet oriented in a plane more or less tangential to the calyx surface and paralleling the oral-aboral axis (most common in camerate crinoids).
- very high** (in reference to aboral cup/calycal and tegmen shape). Aboral cup/calycal or tegmen with the height greater than 2.0 times the maximum width.
- very low** (in reference to aboral cup/calycal and tegmen shape). Aboral cup/calycal or tegmen with the height to maximum width ratio between 0.50 and 0.25.
- virgate radix.** Radix with only a few asymmetric radices or pseudoradices (e.g., *Gissocrinus* ANGELIN, 1878) (syn., *Rhizocrinus-like roots* of FRANZEN, 1977) (BRETT, 1981).
- visceral skeleton.** Spicules or calcareous network developed within crinoid body, especially in connective tissues surrounding visceral mass and walls of digestive tube.
- water vascular system.** Fluid-filled tubes, includes ring canal, surrounding the mouth region, penetrating in the arms (radial canals), and tube feet. Pressure within the water vascular system regulated through the hydroids (extinct and extant crinoids) or the madreporite (some extinct crinoids); stone canal connects the madreporite with the radial canal. The water vascular system is a synapomorphy for the Echinodermata.
- weakly cuneate uniserial.** Uniserial brachials where sutures between brachial plates deviate slightly from being parallel and each side of a brachial deviates slightly from being of equal height (WEBSTER & MAPLES, 2008).
- wedge biserial.** Biserial brachials where width of brachial is nearly the full width of the arm (WEBSTER & MAPLES, 2008).
- width.** Dimension of a columnal, aboral cup plate, or brachial measured perpendicular to the oral-aboral axis and may be tangential to the outer surface of that plate.
- wilted flower posture.** Non-feeding arm posture of a stalked crinoid or a feather star that is assumed during slack-water conditions. (MACURDA & MEYER, 1974; MESSING, AUSICH, & MEYER, 2021).
- xenomorphic column.** Crinoid column containing dissimilar types of columnals in proxistele, mesistele, and dististele regions, but dissimilarity excluding contrast between homeomorphic and heteromorphic pluricolumnals, either or both of which may be represented in a xenomorphic column.
- zygal index.** Ratio of total width of zygon to that of columnal articular facet, multiplied by 100 to avoid fractional numbers (see columnal indices) (MOORE, JEFFORDS, & MILLER, 1968).
- zygocirral.** Most proximal segment of cirrus, articulating with cirrus scar on nodal columnal (cirrinodal).
- zygosynostosis** (syn., *close sutures*). See zygosynostosis.
- zygosynostosis.** Articulation with apposed facets are nearly flat areas for attachment of short ligament fibers and may be combined with moderate calcareous deposits; may allow extremely slight differential movement of joined ossicles in all directions but generally forms immovable union; corresponds to "close synostosis" of some authors (syn., *close sutures*, *zytosynostosis*).
- zygous basal plate.** One of the two large plates in basal circler with only one small and two basal large plates.
- zygon (Z).** Part of columnal articular facet between borders of lumen and facet; may be divisible into parts (crenularium, areola, perillum, facetal rim, bifacial fields, articular ridge) or contain crenularium alone.

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