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Field guide to halobiid and monotid pelecypods of the Alaskan Triassic

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May, 1963

Among the marine invertebrate megafossils in the Triassic rocks of Alaska, halobiid and monotid pelecypods are the most useful stratigraphic indices. By a large margin they are the most widely distributed of Triassic megafossils in Alaska, and they are represented by species with fairly restricted stratigraphic ranges. Ammonites would in most cases provide more refined stratigraphic age assignments, but with a few notable exceptions ammonite faunas are scarce in the Alaskan Triassic, and where present they are generally accompanied by halobiid or monotid pelecypods.

In addition to their value in subdividing Middle and Upper Triassic strata, the halobiid genera Daonella and Halobia, and the monotid genus Monotis, provide a ready means of recognizing beds of Triassic age. These genera are restricted to the Triassic, and reasonably well-preserved examples are not easily confused with other remotely related fossil pelecypods of older or younger systems.

The intent of this field guide is to characterize the genera Daonella, Halobia, and Monotis, to illustrate representative species from the Triassic of Alaska, and, in so far as possible, to provide information on their stratigraphic distribution. At present, however, the latter two of these objectives can be only partly fulfilled. In a number of cases the specimens available for illustration are inadequate, the stratigraphic ranges of the various species are uncertain to varying degrees, and the taxonomy of these pelecypods at the specific level is largely unsettled. Concerning this last point, the specific nomenclature within the important genus Halobia is especially confused. Well over 100 specific names have been proposed for Halobias from different parts of the world, but many of these names are poorly established, and a large proportion of them will upon further study probably prove to be synonomous. As a consequence, the specific names used herein are subject to drastic change.

Thus, although the present understanding of halobiids and monotids makes them useful in a general way, much remains to be learned about their taxonomy, stratigraphic distribution, and evolution. Hopefully, this preliminary field guide will not only be of some immediate value but will incite field parties to collect stratigraphically located samples which can be used in preparing a more definitive and better illustrated treatment of these pelecypods for eventual publication.

Table 1 shows, with perhaps not liberal enough sprinkling of question marks, the known stratigraphic ranges of the various forms illustrated.

The characteristic morphologic features of Daonella, Halobia, and Monotis are shown diagramatically on plate 1. Each of the figures on this plate represents a right valve, and the application of conventional descriptive terminology to these shells is indicated on figure 1 as follows:

H = height of shell

L = length of shell

d = dorsal margin or hinge line

v = ventral margin

a = anterior margin

p = posterior margin

In addition to these terms, the initial part of the shell at the point of origin of the radial ribs is the "umbo" or "beak," and inequilateral shells with the beak located anterior to the mid-length of the shell are termed "oblique." "Ears" are developed on either side of the beak where the dorsal part of the shell is differentiated from the rest of the shell surface. Depending on their convexity, shells range from "flat" to "inflated." Left and right valves of "equivalved" shells are alike in their convexity, structure, and ornamentation. Concentrically arranged folds representing growth stages are termed "rugae" (sing. "ruga").

The size of full-grown individuals is a potentially stable character of each species, but generally no independent means is at hand for discriminating mature shells from immature ones or for recognizing environmentally dwarfed shells. Shell size is thus based on negative empirical evidence and must be used with caution in making identifications. As halobiid and monotid pelecypods have similar size ranges, the species illustrated herein are characterized by maximum shell height as follows: less than 25 mm, "small"; 25-50 mm, "medium"; and more than 50 mm, "large." All illustrations on plates 2-6 are natural size.

Locality numbers refer to USGS Mesozoic locality registers either in Menlo Park, for numbers prefixed by the letter "M", or in Washington, D. C.

Photography of specimens from the USGS collections is by Kenji Sakamoto.

Genus DAONELLA Mojsisovics

Shell flat, equivalved, nearly equilateral to oblique. Dorsal margin elongate and straight. Radial ribs straight, rarely wavy. Concentric growth lines or rugae weakly developed, most conspicuous near beak. Ribbing extends to dorsal margin; ears not present. See pl. 1, fig. 1.

Daonella frami Kittl

Pl. 2, figs. 1-6

Shell longer than high, slightly oblique. Ribs on central part of shell relatively wide and flat topped, 3-4 times width of interspaces, gradually subdividing in two's and three's.

Age: Ladinian.

Daonella cf. D. subquadrata Yabe and Shimizu

Pl. 2, figs. 7-10

Shell evidently nearly as high as long, nearly equilateral. Ribs narrow, not much wider than interspaces, more or less even in strength with gradual 2- or 3-fold subdivision.

Age: Ladinian.

Remarks: The available specimens are inadequately preserved to accurately characterize this species, but it is clearly different from D. frami with which it occurs.

Genus HALOBIA Bronn

Shape like Daonella; shell flat, equivalved, more or less oblique, with straight, elongate dorsal margin. In some species radial ribs run straight across shell surface to the ventral margin; in others a distinct initial growth stage is delimited by uniform, anteriorly concave curvature of the ribs which ends with abrupt recurvature at a ruga near the umbo. This initial growth stage is followed in some species by one or more successive concentric growth stages with curved ribs, giving ribbing a regularly wavy aspect. Concentric growth striae or rugae developed to varying degrees. Shell surface smooth near anterior dorsal margin forming a triangular anterior ear, sometimes elevated above adjacent ribbed part of shell or separated from it by a groove. Ribbing fades towards posterior dorsal margin forming a poorly defined posterior ear. See pl. 1, fig. 2.

Halobia austriaca Mojsisovics

Pl. 2, figs. 11-15

Shell medium size, longer than high, slightly oblique. Ribs straight or gently curved across most of shell height. On central part of shell second and third order ribs are irregularly grouped together into several broad primary ribs separated by prominent interspaces.

Age: Late Karnian.

Remarks: Smith (1927) proposed the name H. brooksi for forms like this from the Wrangell Mts. with relatively sharp curvature of the ribs near the ventral margin, but the propriety of this distinction has not been demonstrated.

Halobia cf. H. superba Mojsisovics

Pl. 2, figs. 16-20

Small or medium size, longer than high, slightly oblique. Fine ribs of more or less equal strength distributed evenly across central part of shell. Distinct initial growth stage of curved ribbing.

Age and remarks: Reportedly widespread in rocks of late Karnian age, but many of the references to H. "superba" in the literature probably refer to the early growth stages of other species that have distinctive ornamentation when fully grown. It seems likely, however, that small forms with a relatively broad initial zone of curved ribbing and with ribs of equal strength across most of shell surface may be a distinct species like H. superba which is perhaps ancestral to some similar but more complexly ornamented species like H. cordillerana. The stratigraphic relation to similar species is unknown for the southeastern Alaska specimens illustrated here; in the Wrangell Mts. shells of this kind occur in the lower part of the Chitistone Limestone. Halobia "zitteli Lindstrom" of Tozer (1961) may correspond to this species.

Halobia ornatissima Smith

Pl. 3, figs. 1-3

Shell medium to large size, longer than high. Strong, flat-topped primary ribs bear 2, or sometimes 3 or 4, much weaker secondary ribs. Ribbing fades in strength and becomes irregularly wavy on posterior half of shell. Umbonal zone sharply set off by abrupt recurvature of ribs.

Age: Late Karnian; stratigraphic relation to other species presently unknown.

Remarks: Halobia gigantea Smith and H. "zitteli Lindstrom" of Kittl (1907) and Mojsisovics (1874) are possibly conspecific.

Halobia cordillerana Smith

Pl. 3, figs. 4-10

Shell medium to large size, longer than high. Ribs near beak narrow, closely spaced, and of more or less even strength or with tendency toward alternation of primary with weaker secondary interspaces. Distinct umbonal zone of curved ribbing, followed on anterior part of shell by several less distinct concentric zones defined by changes in direction of ribbing. Ribbing progressively decreases in strength and becomes irregularly wavy on posterior two-thirds of adult shell.

Age: Latest Karnian to early Norian (?).

Remarks: In addition to the localities represented by illustrated specimens, this species occurs in the lowermost 20 feet of the McCarthy Formation, just above the occurrence of Pterotoceras, East Fork of McCarthy Creek, Wrangell Mts.

Halobia dalliana Smith

Pl. 4, figs. 1-4, 5-8?

Shell medium to large size, proportions variable, length either greater or less than height. Dorsal margin relatively short. Radial ribbing straight, in the form of fine, somewhat wavy striation of uneven strength. Umbilical zone of curved ribbing poorly developed or absent.

Age: Uncertain; possibly early Norian.

Remarks: Halobia septentrionalis Smith and H. symmetrica Smith were originally described from the same population sample and are regarded as variants of H. dalliana.

Halobia cf. H. fallax Mojsisovics

Pl. 3, figs. 11-14, 15?

Shell small, longer than high. Fine, closely-spaced, flat-topped ribs curved anteriorly over most of shell surface. Closely spaced rugae on umbonal region pronounced but uneven in strength.

Age: Early Norian.

Remarks: In addition to the illustrated specimens, this species is known from the Pt. Hope area of northwestern Alaska interbedded with Monotis spp.

Halobia cf. H. dilitata Kittl

Pl. 3, fig. 16?; pl. 4, figs. 9-10, 15

Medium to large size; elongate lengthwise to nearly equilateral in shape. Closely-spaced, flat-topped straight ribs with tendency toward regular insertion of secondary interspaces so that each primary rib tends to bear 2 secondary ribs. Concentric striae and rugae usually distinct.

Age: Early to middle Norian.

Remarks: Specimens described by Smith (1927) as H. halorica Mojsisovics and H. alaskana Smith are provisionally included under this name, but more than one species may well be needed here.

Shells with similar shape and ornament, but without well-defined anterior or posterior ears occur at about the same stratigraphic level in the Alps where they have been named Daonella imperialis Kittl; similar forms may also occur in northern California and eastern Oregon and might be expected in Alaska. The relation of Daonella to Halobia is thus more complex than a simple change near the beginning of Late Triassic time from earless to eared halobiids.

Halobia cf. H. lineata (Münster)

Pl. 4, figs. 11-14

Shell small, height and length about equal, slightly oblique. Ribs straight, very fine, of even strength, and regularly spaced with a density of about 5 per mm. Concentric rugae well developed.

Age: early to middle Norian.

Genus MONOTIS Bronn

Shell inequivalved; left valve more inflated than right. Inequilateral and oblique, generally ovoid in shape with posterior margin more broadly rounded than anterior margin. Anterior part of posterior dorsal margin developed into a posterior ear which is more or less differentiated from the rest of the shell. Anterior ear represented by small spoon-like structure beneath beak of right valve only. Ribs generally narrow and sharp; different orders of ribs commonly differ markedly in strength and tend to alternate in position. Closely and regularly spaced concentric striae conspicuous in some species.

Monotis scutiformis cf. M. s. typica Kiparisova

Pl. 5, figs. 1-2

Small to medium size. Posterior ear poorly differentiated, characterized only by abrupt change from the convexly rounded outline of the posterior dorsal margin to the straight hinge line; ribbing on shell surface continues onto ear. Ribs narrow, closely spaced; ribs of different orders about equal in strength.

Age: Late Karnian.

Remarks: The available, secondarily flattened, Alaskan specimens included under this name are insufficient for adequate characterization.

Monotis scutiformis cf. M. s. pinensis Westermann

Pl. 5, figs. 3-14

Medium size; height of most shells 80-90% of length; left valves vary from slightly to much more inflated than right valves. Posterior ear obtusely truncated posteriorly, generally differentiated from posterior dorsal margin by only slight concavity in shell outline, commonly bears fine ribs. Ribbing on shell surface dense but variable in strength among shells of a single population; amount of contrast in strength between different orders of ribbing also variable. Concentric growth lines poorly developed.

Age: Early Norian.

Remarks: Canadian specimens from the "Himavatites zone" referred to M. "alaskana Smith" by McLearn and by Tozer probably belong to M. s. pinensis as pointed out by Westermann (1962, p. 759).

Monotis subcircularis Gabb

Pl. 5, figs. 15-17, 18?; pl. 6, figs. 1-4

Large size; left valve only moderately more inflated than right valve. Posterior ear well differentiated, unribbed, truncated posteriorly by pronounced concavity in shell outline. Radial ribs sharp and narrow; interspaces relatively wide and flat. Different order ribs tend to alternate regularly so that a relatively weak secondary rib intervenes between each pair of primary ribs, and a still weaker third-order rib intervenes in turn between adjacent first- and second-order ribs. Concentric growth striae regularly and closely spaced, conspicuous on outer shell surface.

Age: Middle or late Norian.

Remarks: Small, strongly inflated left valves like that illustrated by pl. 5, fig. 18 occur with M. subcircularis in the Wrangell Mts.; whether or not they morphologically intergrade with M. subcircularis is uncertain.

Monotis salinaria cf. M. s. salinaria Bronn

[= Monotis alaskana Smith]

Pl. 6, figs. 5-8

Medium size; elongate lengthwise; height only about 70% of length; left valve only slightly more inflated than right valve. Posterior ear well differentiated and smooth; posterior truncation angle of ear approaches 90°. Radial ribs numerous, narrow, and closely spaced; weak secondary ribs tend to intervene regularly between stronger primary ribs. Fine concentric growth striae regularly and closely spaced.

Age: Late Norian.

Monotis salinaria cf. M. s. haueri Kittl

Pl. 6, figs. 9-11

Size and shape of shell and character of posterior ear like that of M. s. cf. M. s. salinaria; ornamentation also similar, but closely-spaced radial ribs wider and less numerous.

Age: Late Norian.

Monotis ochotica (Keyserling)

Medium to large size. Left valve strongly inflated, right valve nearly flat. Posterior ear well differentiated and smooth. Radial ribs coarse and relatively few in number. Different orders of ribs differentiated by size, tend to alternate regularly. Concentric striae poorly developed.

Age: Middle or late Norian.

Remarks: In Alaska M. ochotica s.s. has been found only in the Brooks Range, and its stratigraphic relation to other species of Monotis is not known.

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Plate I

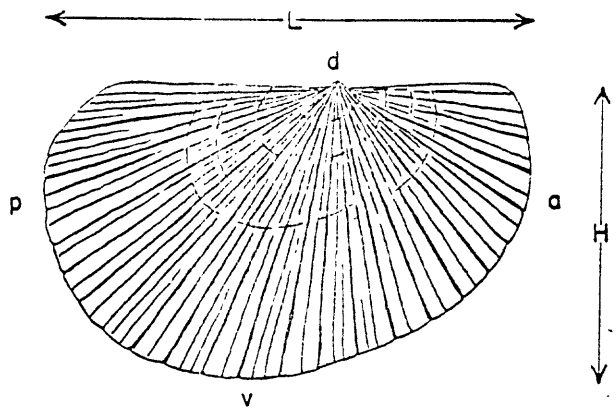


Fig. 1 - *Daonella*

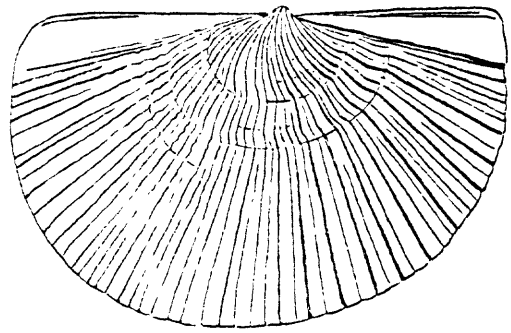


Fig. 2 - *Halobia*

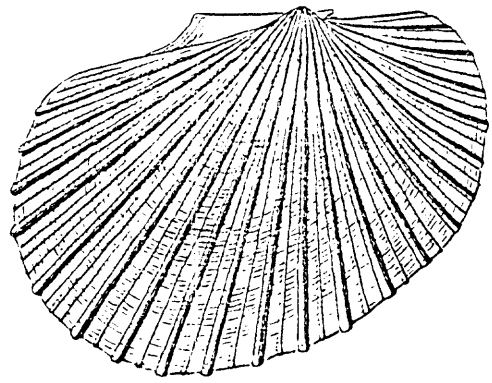
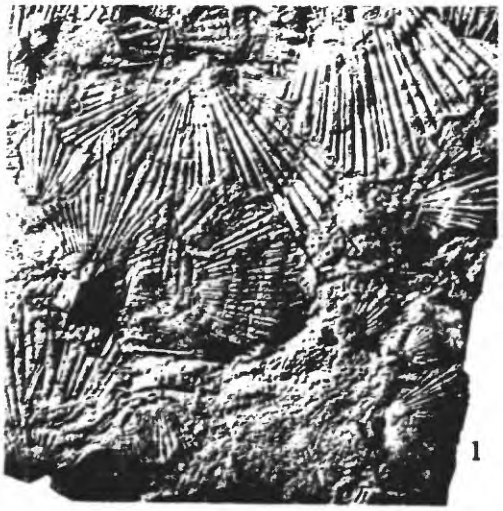


Fig. 3 - *Monotis*

Plate 2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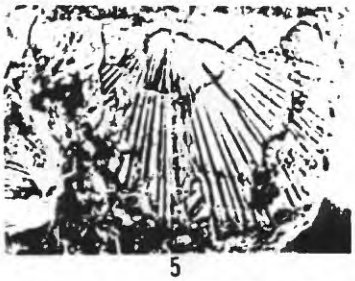
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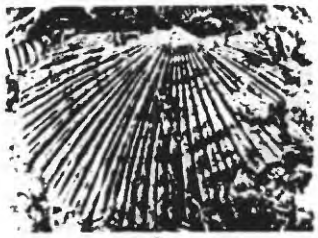
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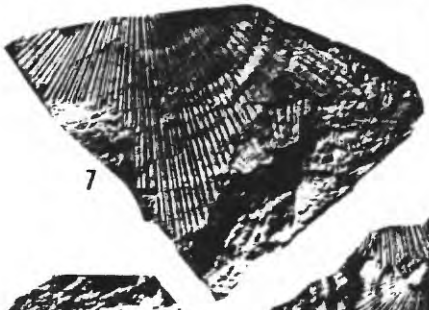
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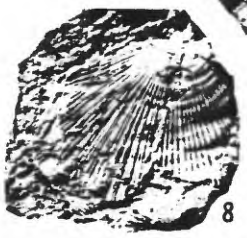
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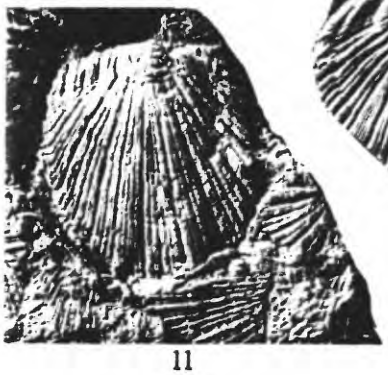
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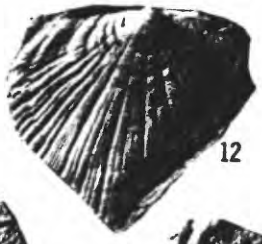
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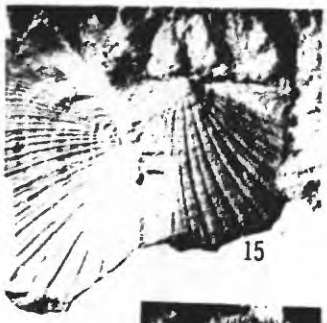
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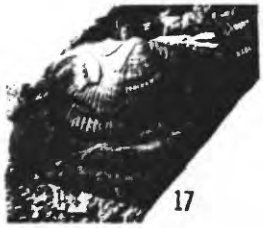
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Plate 3

Figures 1-3. Halobia ornatissima Smith.

Loc. 4823, Keku Straight, southeast Alaska.

4-10. Halobia cordillerana Smith.

4-5. Unflattened immature shells; loc. M1710, 20-30 feet stratigraphically above "Discophyllites limestone," spur between Nation and Yukon Rivers, Upper Yukon.

6-7. Loc. M676, West Fork Ivishak River, Phillip Smith Mtn. 1:250,000 quad., Brooks Rg. Stratigraphic position unknown.

8-10. Loc. M1713, a few tens of feet stratigraphically above "Discophyllites limestone," Trout Creek, Upper Yukon. Approximately stratigraphically equivalent to type locality on southwest bank of Yukon River near Nation.

11-14. Halobia cf. H. fallax Mojsisovics.

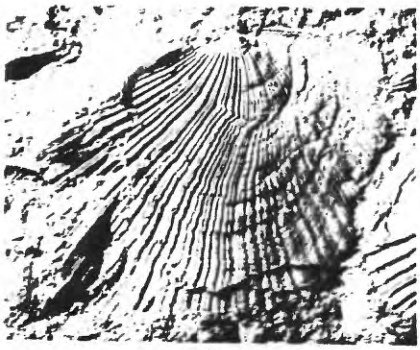
11-12, 14. Loc. M1714, a few hundred feet stratigraphically above "Discophyllites limestone," Trout Creek, Upper Yukon. Associated with Monotis scutiformis pinensis, a fragment of which appears on the left side of fig. 14.

13, 15?. Loc. 9383, southwest bank of Yukon River near Nation, Upper Yukon. A few hundred feet stratigraphically above "Discophyllites limestone" according to Blackwelder (1915 notebook, p. 26-27).

16. ?Halobia cf. H. dilitata Kittl.

Loc. 13425, southwest bank of Yukon River near Nation, Upper Yukon. Several hundred feet stratigraphically above "Discophyllites limestone" according to Mertie (1925 notebook, p. 109, 118).

Plate 3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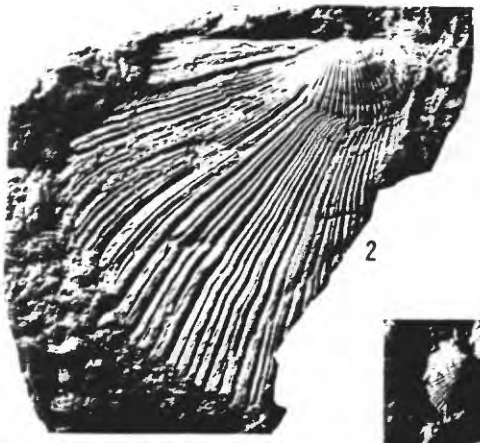
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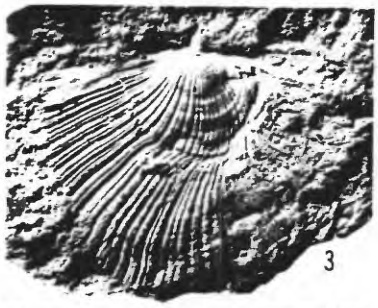
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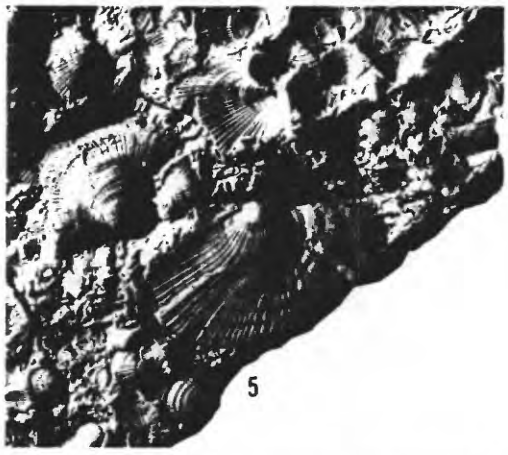
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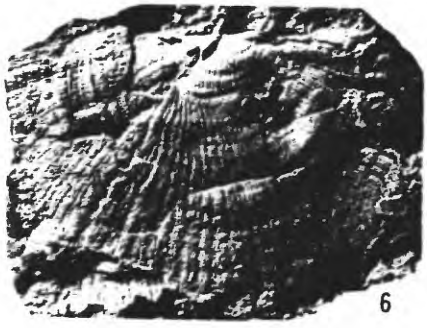
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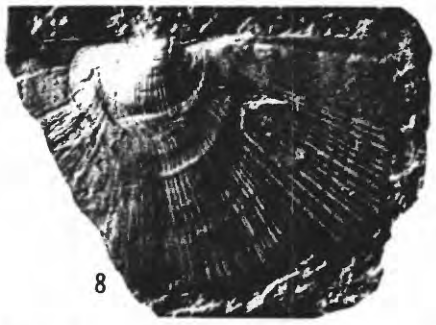
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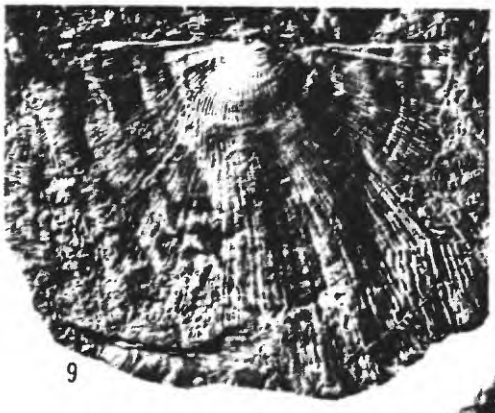
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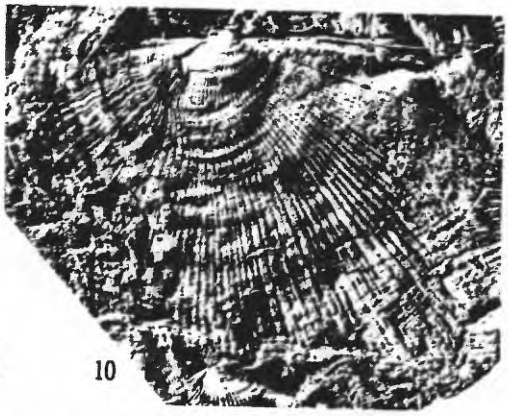
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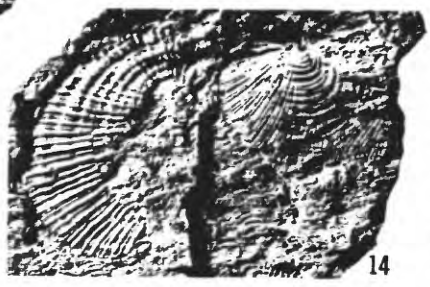
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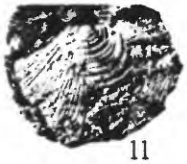
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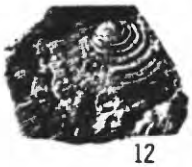
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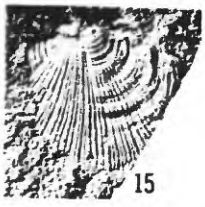
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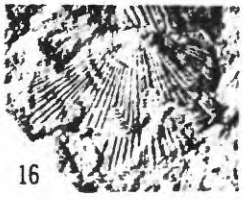
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Plate 4

Figures 1-4. *Halobia dalliana* Smith.

Loc. 10196, Keku Straight, southeast Alaska; stratigraphic position unknown.

5-8. ?*Halobia dalliana* Smith.

Loc. M1718, Michigan Creek, Upper Yukon; geographically close to exposures with *Monotis* sp.

9-10, 15. *Halobia* cf. *H. dilitata* Kittl.

9-10. Loc. 9533, Gravina Island, southeast Alaska; type locality of *H. alaskana* Smith.

15. Loc. M1698, about 200 feet stratigraphically above base of McCarthy Fm. and about 50 feet below lowest occurrence of *Monotis subcircularis*, East Fork of McCarthy Creek, Wrangell Mts.

11-14. *Halobia* cf. *H. lineata* (Münster).

11. Slab with numerous poorly-preserved individuals; loc. 6380, Port Graham area, Kenai Peninsula.

12-14. Loc. M1697, 30-100 feet stratigraphically above base of McCarthy Fm., East Fork of McCarthy Creek, Wrangell Mts.

Plate 4


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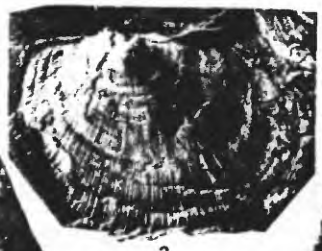
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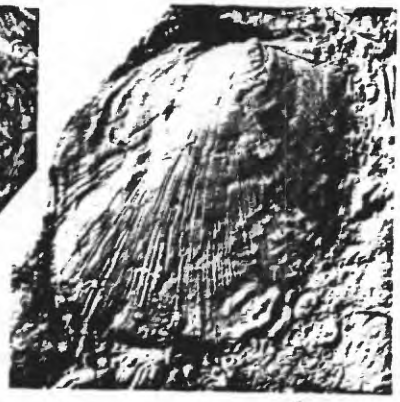
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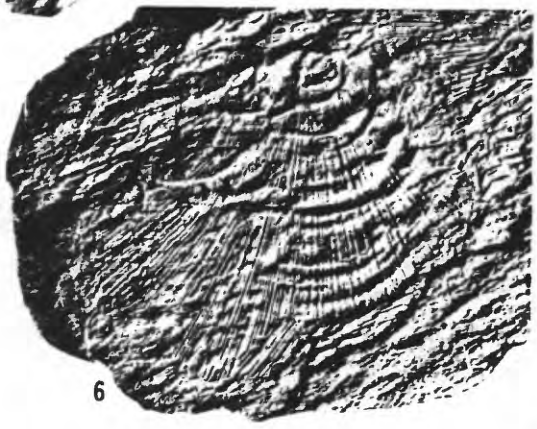
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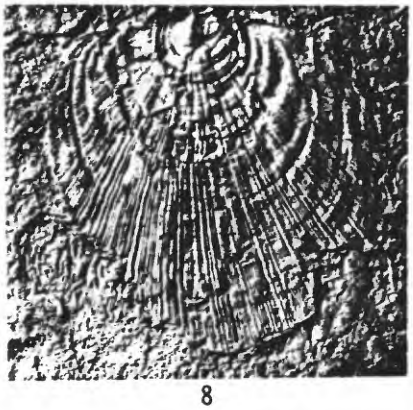
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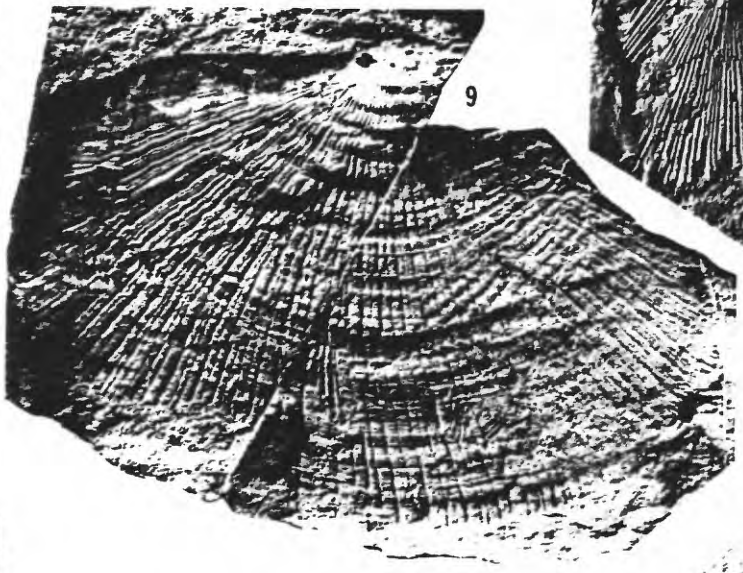
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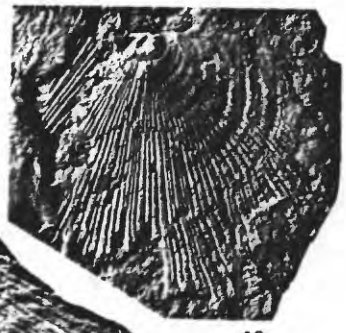
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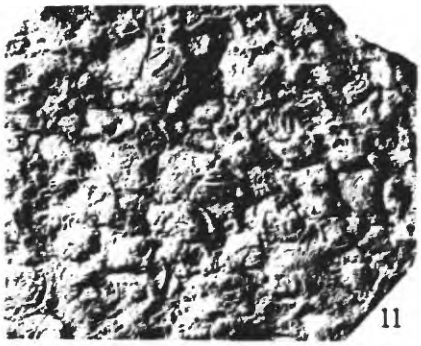
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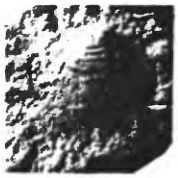
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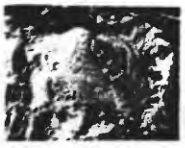
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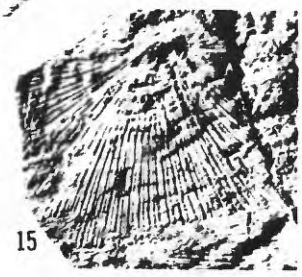
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Plate 5

Figures 1-2. Monotis scutiformis cf. M.s. typica Kiparisova.

1. Left valve, loc. M1020, about 20 feet stratigraphically above "Discophyllites limestone," Trout Creek, Upper Yukon. Approximately equivalent to loc. M1713 with Halobia cordillerana.

2. Right valve, loc. 8896, southwest bank of Yukon River near Nation, Upper Yukon. About 30 feet stratigraphically above "Discophyllites limestone" according to Martin (1914 notebook no. 2, p. 18). Halobia cordillerana and Tropites cf. T. welleri included in collection from this locality.

3-14. Monotis scutiformis cf. M.s. pinensis Westermann.

3-8. Loc. M1715, a few hundred feet stratigraphically above "Discophyllites limestone," Trout Creek, Upper Yukon. 10-30 feet higher than loc. M1714 with Halobia cf. H. fallax. Figs. 3-4, right valves (note anterior ear on fig. 3); 5, immature left and right valves; 6-8, ~~right~~ left valves showing variation in convexity.

9. Flattened "double image" showing exterior of right valve and interior of corresponding left valve. Loc. M1716, approximately the same as loc. M1715. Specimens associated with Himavatites? sp.

10-14. Loc. M1398, "40 feet below top of 270-foot section of Shublik Fm." (BP Expl. Co.), Sadlerochit Mts., Brooks Rg. Figs. 10-12, left valves; 13-14, right valves showing anterior ear.

15-17. Monotis subcircularis Gabb.

15. Left valve (top) and partial right valve (bottom). Loc. M1690, 280 feet above base of McCarthy Fm., East Fork of McCarthy Creek, Wrangell Mts.

16-17. Right and left valves. Loc. M1701, a few hundred feet above base of McCarthy Fm., "Monotis" Creek, Nizina River area, Wrangell Mts.

18. ?Monotis subcircularis Gabb.

Strongly inflated small left valve from same bed as figs. 16-17 above.

Plate 5


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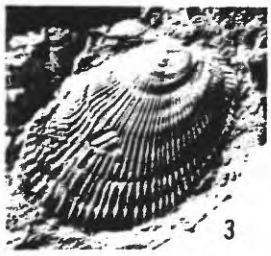
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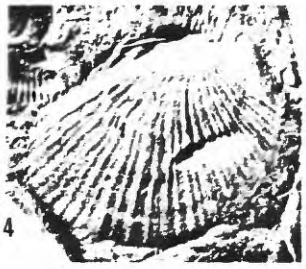
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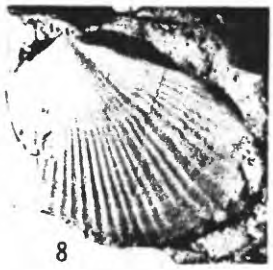
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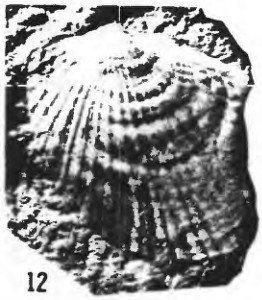
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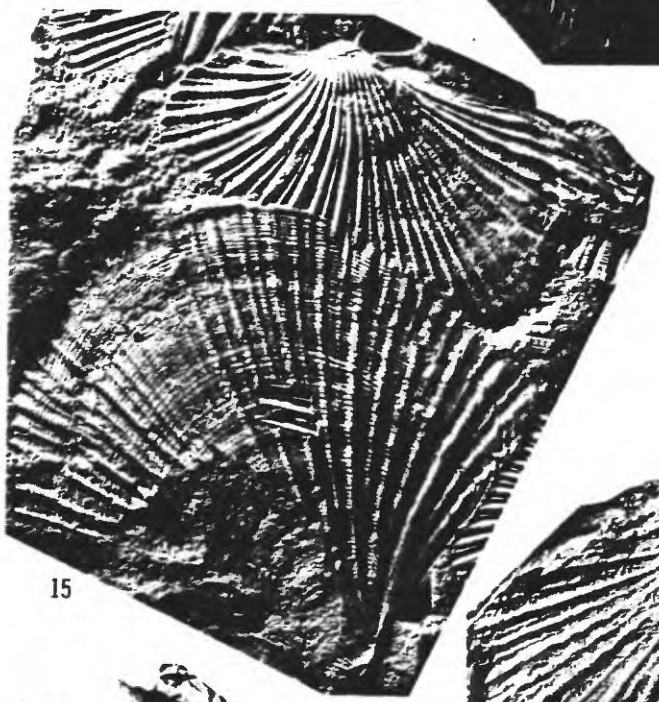
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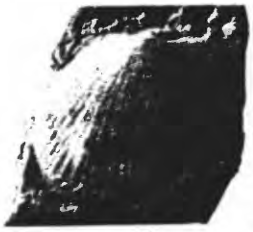
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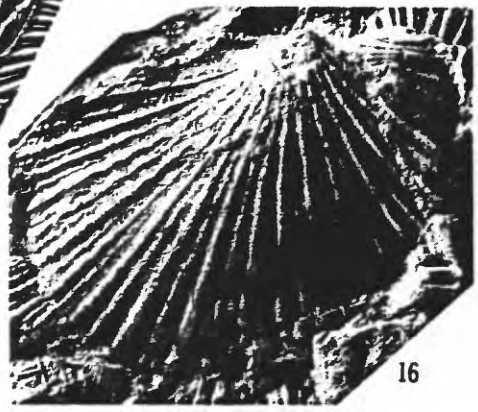
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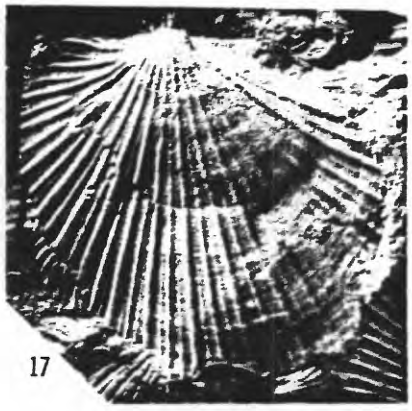
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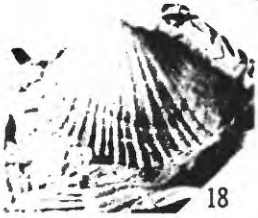
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Plate 6

Figures 1-4. Monotis subcircularis Gabb.

Loc. M1690, 280 feet above base of McCarthy Fm., East Fork of McCarthy Creek, Wrangell Mts. Figs. 1-3, right valves; 4, left valve.

5-8. Monotis salinaria cf. M.s. salinaria Bronn [= M. alaskana Smith].

Loc. M1692, 515 feet above base of McCarthy Fm., East Fork of McCarthy Creek, Wrangell Mts. Figs. 5-6, left valves; 7-8, right valves.

9-11. Monotis salinaria cf. M.s. haueri Kittl.

Loc. M1693, 575 feet above base of McCarthy Fm., East Fork of McCarthy Creek, Wrangell Mts. Fig. 9, left valve; 10-11, right valves.

12-16. Monotis ochotica (Keyserling).

12-13. Left and right sides of same specimen; copied from Tozer (1961, pl. 30, figs. 4a-4b). Heiberg Fgm., Ellesmere Island, Canadian Arctic.

14. Left valve; copied from Tozer (1961, pl. 30, fig. 8). Heiberg Fgm., Cornwall Island, Canadian Arctic.

15-16. Loc. M1453, "top of Shublik Fm. with total thickness of 330 feet" (BP Expl. Co), Sadlerochit River, Brooks Rg. Fig. 15, right side of a complete specimen; 16, two left valves.

Plate 6