

Fig. 12. Diagrammatic representations to explain some terms and how some fundamental measurements have been taken. A, cranial roof, comprising fronto-ethmoidal shield, parietal shield and extrascapular bone series, B, fronto-ethmoidal shield, C, external cheek plate, D, lower jaw, and E, principal gular.

a, median length of parietal shield; b, median length of fronto-ethmoidal shield; br. G, breadth of principal gular; c, distance from centre of pineal foramen to posterior margin of frontal; d—h, of principal gular; e, at the deepest point of the division of fronto-ethmoidal shield, that is greatest breadth of snout; f, at preorbital corner (= greatest breadth of preorbital notch); g, at spiracular notch and h, at postero-orbital notch; i, at the deepest point of the postorbital notch; j, at spiracular notch and k, at postero-orbital notch; l, at the deepest point of the postorbital notch; m, distance from vertical pit-line of infradentary 2 to posterior end of lower jaw; n, distance from pit-line of principal gular to anterior of infradentary 2 to anterior end of lower jaw; o, distance from middle point of orbital notch to anterior end of infradentary 2; p, distance from middle point of orbital notch to anterior end of fronto-ethmoidal shield; q, distance from middle point of orbital notch to anterior end of fronto-ethmoidal shield; r, median length of preorbital division of fronto-ethmoidal shield; s, median length of postorbital division of fronto-ethmoidal shield; t, median length of orbital division of fronto-ethmoidal shield; u, median length of orbital division of fronto-ethmoidal shield; v, distance from middle point of orbital notch to posterior end of fronto-ethmoidal shield; w, distance from middle point of orbital notch to posterior end of fronto-ethmoidal shield.

At the lateral margin of the cranial roof the following corners and notches may be distinguished (fig. 12 A, B).

Anteriorly the lateral margin of the cranial roof meets the anterior tooth-bearing margin at a conspicuous angular corner, the subnarial corner (snc). Behind this corner there follows a normally shallow notch, the lachrymo-maxillary (i. La + Mx), occupied by portions of the lachrymal and maxillary. Posteriorly this notch is separated by a distinct corner, the preorbital corner (proc). From the orbital notch (i. o), which in its turn is separated by the postorbital corner (ptoc) from the postorbital notch (i. po), occupied by the dorso-medial corner of the postorbital bone. Behind the postorbital notch, which is often indistinctly bounded posteriorly, the lateral margin of the cranial roof presents a

spiracular notch (i. spir), which, together with a portion of the dorsal margin of the squamosal, bounds the spiracular fenestra (fe. spir, figs. 3 D, 37 A, B). Posteriorly the lateral margin of the cranial roof meets the postero-lateral margin at a normally distinct corner, the postero-lateral corner of the cranial roof (ple). This corner may be identical with the postero-lateral corner of the parietal shield, or may be formed by the lateral extrascapular (see p. 41).

The portion of the fronto-ethmoidal shield situated in front of the transverse line (d, fig. 12 A) running through the preorbital corners has been called the preorbital division (cf. fig. 12 B, r); that between this line and the transverse line running through the postorbital corner the orbital division (cf. fig. 12 B, s); and that behind the latter line, the postorbital division (cf. fig. 12 B, t).

As pointed out above, the measurements underlying the ratios given in the text and the tables have, as a rule, been carried out on photographs and sketches. Overlapped areas have never been included in the measurements (see fig. 12 E). Certain distances, frequently used in the calculation of the ratios, have been denoted by letters (a, b, etc.) as explained in fig. 12.

As regards other distances measured, the length has always been denoted by l, the height by ht, the breadth by br and the depth (of notches) by dp. These letters have been used together with the index letters of the bones or other structures. For example (see fig. 12), l. G means the length and br. G the breadth of the non-overlapped part of the principal gular; l. Ch the length and ht. Ch the height of the external cheek plate; l. Lj the length of the lower jaw and dp. i. o the depth of the orbital notch.

Shape and size.

The general shape of the head and its position in relation to the body have been described above (pp. 12—19).

As to the relative size and general proportions of the head there are only slight differences between the different genera and species. The length of the head in most species amounts to about 2/9 of the total length of the fish, as in large specimens of *Eusthenopteron* (GREGORY and RAVEN 1941, pp. 294—295). In *Thursius moy-thomasi* and *Gyroptychius agassizi* the head length is somewhat shorter in relation to body length, the corresponding ratio being about 1/5. However, in relation to the length of the parietal shield, the head in the latter two species is proportionately somewhat longer than in the other species. The head is thus in *Thursius moy-thomasi* and *Gyroptychius agassizi* about 3.4—3.5 times longer than the parietal shield, whereas in the species of *Osteolepis* and in *G. milleri* this ratio is about 3.25—3.30 and in *Thursius macrolepidotus* and *Th. pholidotus* only about 3.15.

Judging by the models of wax-plates, the head in all species seems to have been about 1.8—1.9 times longer than it was high. As regards the relation of the length to the breadth, however, there are some differences. The head is thus relatively narrow in *Gyroptychius agassizi*, being about 1.80 times longer than it is broad. In *O. macrolepidotus*, *O. panderi* and *Thursius moy-thomasi* the corresponding ratio is about 1.65, whereas in *Th. macrolepidotus* and *Th. pholidotus* it is only 1.5. *G. milleri* is characterized by a very broad head, only about 1.4 times longer than it is broad.

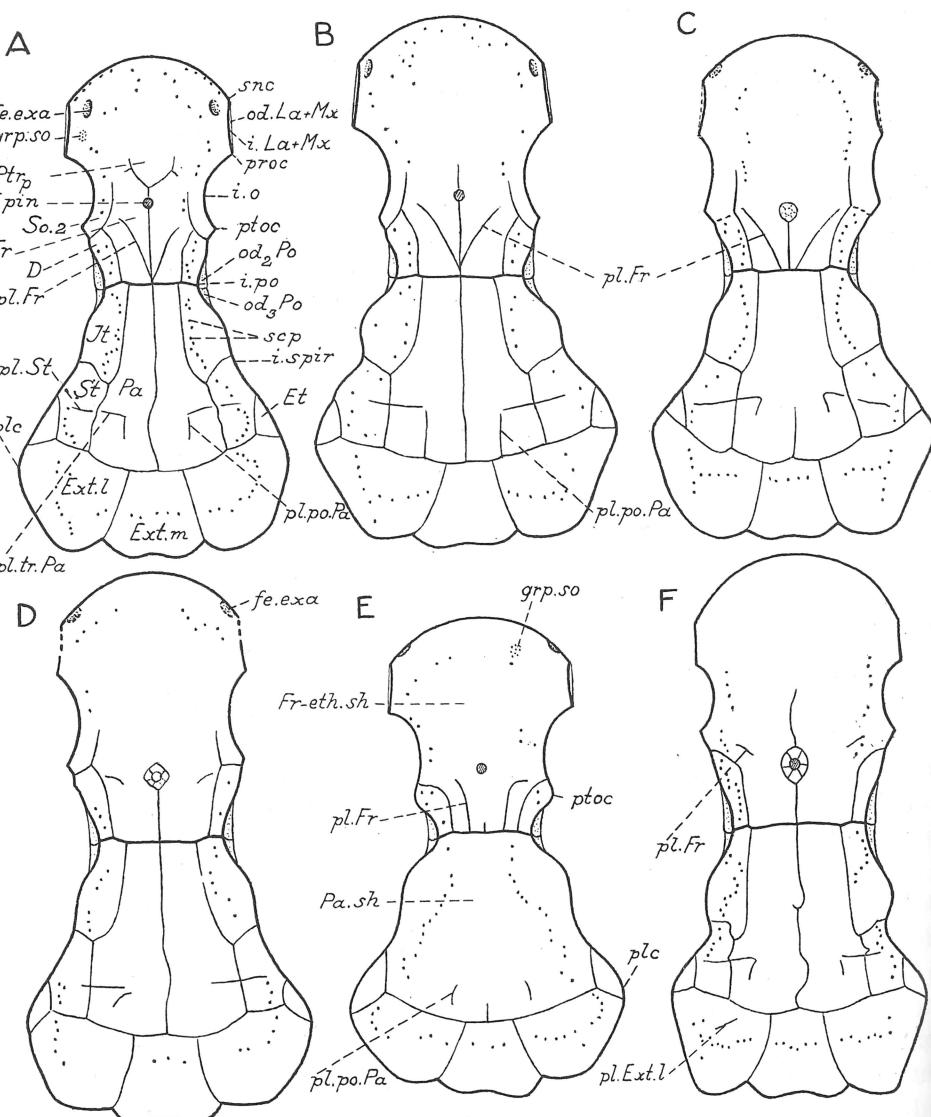
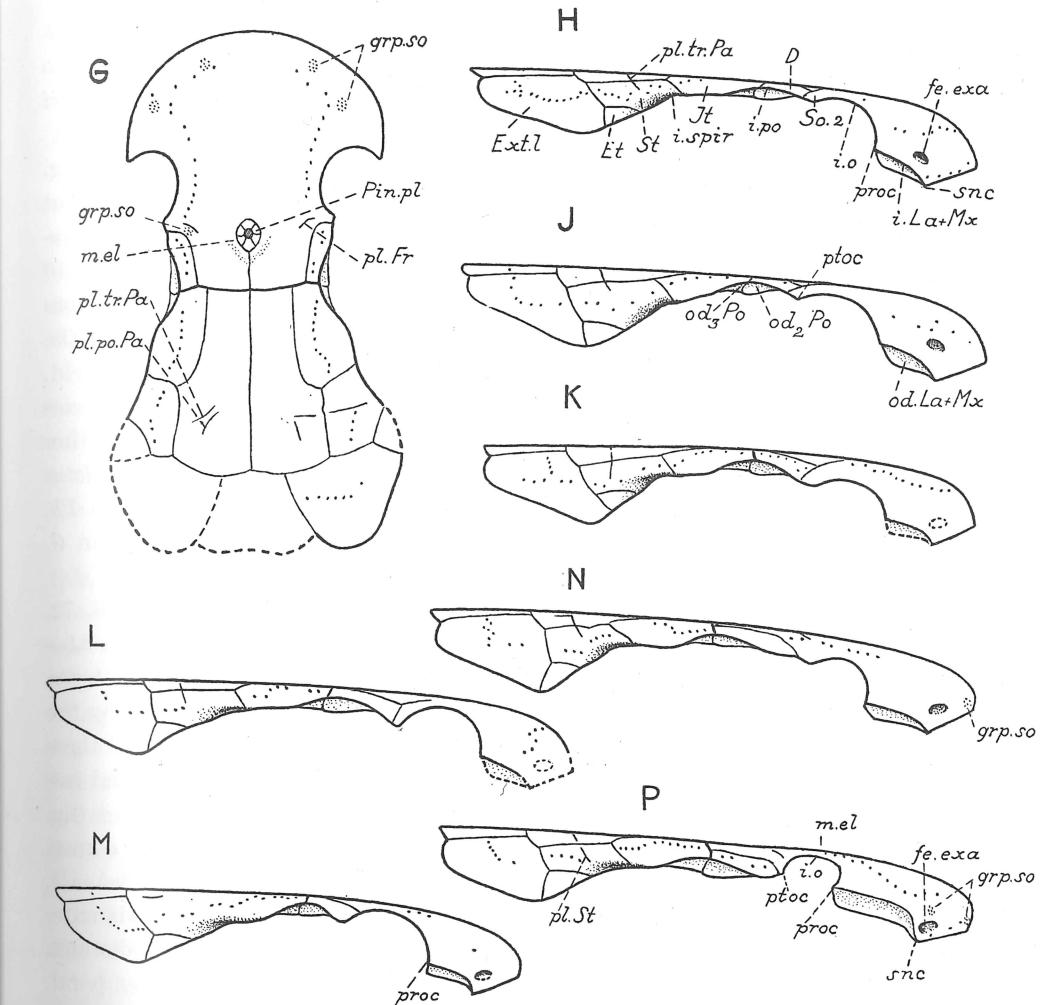


Fig. 13. Restorations of the cranial roof in dorsal and lateral views. A, H, *Osteolepis macrolepidotus* AGASSIZ. 2/1. B, J, *Osteolepis panderi* (PANDER). C, K, *Thursius macrolepidotus* SEDGWICK & MURCHISON. D, L, *Thursius moy-thomasi* n. sp. E, M, *Thursius pholidotus* TRAQUAIR. F, N, *Gyropygichthys agassizii* (TRAILL). G, P, *Gyroptychius milleri* n. sp. As far as possible the restorations are based on the type-specimens. In B—G and J—P the median length of the parietal shield is approximated in 4 and H (cf. pp. 7–8).

D, dermosphenotic; *Et*, extratemporal; *Ext. l*, *Ext. m*, lateral and median extrascapulars; *Fr.*, frontal; *Fr-eth. sh*, fronto-ethmoidal shield; *It*, intertemporal; *Pa*, parietal; *Pa. sh*, parietal shield; *Pin. pl*, pineal plates; *Ptrp*, posterior median postrostral; *So. 2*, posterior supraorbital; *St*, supra-temporal; *Sup. 1*, first supraorbital arm; *so*, group of small pores.

temporal; *fe. exa*, fenestra exonarina anterior; *f. pin*, pineal foramen; *grp. so*, group of small pores probably for nerve twigs to group of cutaneous sensory organs; *i. La + Mx*, *i. o.*, *i. po.*, *i. spir.*, lachrymo-maxillary, orbital, postorbital and spiracular notches; *m. el*, median elevation; *od. La + Mx*, area of cranial roof overlapped by lachrymal and maxillary; *od₂Po*, *od₃Po*, areas of cranial roof overlapped by postorbital; *pl. Ext. l*, pit-line of lateral extrascapular; *pl. Fr*, frontal pit-line; *pl. po*, posterior oblique parietal pit-line; *pl. St*, supratemporal pit-line; *pl. tr. Pa*, transverse parietal pit-line; *plc*, *proc*, *ptoc*, postero-lateral, preorbital and postorbital corners of cranial roof; *scp*, pores of sensory canals; *snc*, subnarial corner of cranial roof.



Osteolepis panderi, in which the orbital fenestra is relatively large, the orbital notch is long and shallow. Its length (*l. i. o*) ranges from ca. 0.48 to ca. 0.65 of the length (*a*) of the parietal shield (col. 6, tables 1 and 5) and from 0.40 to 0.50 of the length of the fronto-ethmoidal shield (*b*). In most specimens it is no less than about 5.10—6.10 times longer than deep (col. 7). In *O. macrolepidotus* the orbital notch is proportionately shorter and deeper, the ratios *l. i. o/a* (col. 6, tables 1, 3) and *l. i. o/b* ranging from ca. 0.40 to ca. 0.49 and from ca. 0.32 to ca. 0.40 respectively, and the ratio *l. i. o/dp. i. o* (col. 7, tables 1, 3) from about 3.25 to about 3.80. In the various species of *Thursius* the orbital notch is rather similar, and, on the whole, it has about the same proportions as in *O. macrolepidotus* (col. 6, 7, tables 1, 7). However, owing to the fact that the fronto-ethmoidal shield is relatively short in *Th. pholidotus*, the ratio *l. i. o/b* in this form is about 0.43, but only about 0.35 in *Th. macrolepidotus* and *Th. moy-thomasi*. In *Gyroptychius* the orbital notch is relatively short and deep. The ratio *l. i. o/a* (col. 6, tables 1, 9) thus ranges in *G. agassizii* from ca.

	3	4	5	6	7	8	9	10	11	12	13	14	15	7	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	
														Total length mm.	a mm.	b mm.	<i>l.i.o</i>	<i>l.i.o</i>	<i>l.i.po</i>	b a	r s+t	t r+s	d b	e a	f a	c b	<i>l.Ch</i>	<i>l.Ch</i>	<i>l.La</i>	<i>ht₁</i>	<i>ht₁</i>	<i>l.Ju</i>	<i>l.Po</i>
<i>Osteolepis macrolepidotus</i> . . .	125— 305	9— 22	12— 25	0.40— 0.49	3.25— 3.80	0.40— 0.50	1.15— 1.26	0.74— 0.90	0.22— 0.33	0.69— 0.80	0.44— 0.52	0.51— 0.65	0.50— 0.61	8— 44	0.30— 0.38	2.02— 2.18	2.46— 2.90	3.05— 3.28	0.75— 0.92	0.55— 0.68	1.65— 1.90	0.37— 0.46	1.00— 1.20	1.82— 2.14	1.35— 1.48	4.90— 6.40	2.25— 2.36	0.87— 0.92	2.02— 2.13	2.96— 3.21	1.70— 2.08	1.14— 1.27	
<i>Osteolepis panderi</i>	72— 135	5— 9	6.5— 11	0.48— 0.65	5.10— 6.10	0.38— 0.45	1.30— 1.42	0.70— 0.85	0.16— 0.27	0.75— 0.92	0.54— 0.67	0.73— 0.86	0.63— 0.76	8— 49	0.29— 0.36	2.03— 2.12	2.28— 2.58	2.85— 3.18	0.58— 0.64	0.36— 0.46	1.37— 1.91	0.38— 0.46	1.00— 1.21	1.41— 1.61	1.28— 1.50	5.50— 6.10	2.31— 2.45	0.83— 0.87	1.73— 1.95	2.63— 2.90	2.24— 2.36	1.13— 1.21	
<i>Thursius macrolepidotus</i> . . .	135— 150	9.5— 11	11— 13.5	0.44— 0.45	5.00— 0.54	0.50— 1.24	1.22— 0.74	0.68— 0.35	0.33— 0.84	0.84— 0.72	0.70— 0.88	0.65— 0.68	0.50— 0.30	0— 0.25	1.92— 1.98	2.18— 2.21	——	——	0.35— 1.61	0.50— 0.53	1.20— 1.23	1.29— 1.32	1.30— 1.40	6.10— 6.60	2.00— 2.08	0.86— 0.90	1.76— 1.80	3.12— 3.20	2.44— 2.80	1.23— 1.33			
<i>Thursius moy-thomasi</i> . . .	120— 250	7.5— 15	11— 21	0.47— 0.50	3.80— 4.00	0.60— 0.63	1.48— 1.50	0.54— 0.60	0.48— 0.53	0.78— 0.80	0.56— 0.62	0.84— 0.92	0.65— 0.74	8— 42	0.26— 0.28	2.25— 2.32	2.52— 2.59	2.28— 2.48	0.91— 1.08	0.70— 0.73	1.86— 1.93	0.58— 0.65	1.50— 1.72	1.50— 1.50	1.67— 1.70	8.30— 8.50	2.51— 2.51	——	——	2.12— 2.12	——	—	
<i>Thursius pholidotus</i>	175— 280	13— 18	16— 21	0.46— 0.54	3.60— 3.90	0.36— 0.41	1.10— 1.14	0.60— 0.70	0.20— 0.25	0.95— 1.06	0.58— 0.67	0.69— 0.73	0.48— 0.51	7— 41	0.31— 0.36	2.06— 2.12	2.40— 2.52	2.15— 2.36	0.97— 1.04	0.71— 0.82	1.38— 1.50	0.44— 0.48	0.98— 1.03	1.70— 1.84	1.57— 1.62	4.50— 4.90	2.22— 2.30	0.80— 0.82	1.92— 1.92	2.80— 2.98	2.40— 2.93	1.60— 1.75	
<i>Gyroptychius agassizi</i> ¹ . . .	295— 450	16— 29	24— 42	0.32— 0.35	2.50— 2.70	0.68— 0.75	1.47— 1.50	0.66— 0.71	0.50— 0.58	0.76— 0.81	0.60— 0.67	0.91— 0.95	0.68— 0.73	9— 32	0.20— 0.23	2.43— 2.49	2.66— 2.82	1.37— 1.82	1.34— 1.50	——	1.82— 1.96	0.73— 0.83	1.53— 1.78	1.45— 1.60	2.04— 2.27	10.10— 10.70	2.70— 2.82	0.61— 0.69	1.77— 1.91	2.98— 3.04	2.28— 2.60	0.79— 1.06	
<i>Gyroptychius milleri</i>	— —	15— 26	21— 39	0.34— 0.40	1.10— 1.89	0.52— 0.58	1.41— 1.43	0.85— 1.00	0.33— 0.44	0.93— 1.08	0.50— 0.57	0.78— 0.84	0.76— 0.84	6— 32	0.17— 0.23	2.20— 2.52	2.52— —	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——
<i>Gyroptychius cf. agassizi</i> . . .	— —	18— 25	— 40	— 0.30	— 1.90	— 0.80	— 1.48	— 0.57	— 0.77	— 0.84	— 0.57	— 0.83	— 0.86	— 0.25	— —	— —	— —	— —	— —														
<i>Gyroptychius sp. inc. 1</i> . . .	— —	25— 25	40— 40	0.30— 1.90	2.00— 0.80	0.68— 1.48	1.47— 0.57	0.66— 0.77	0.50— 0.84	0.76— 0.84	0.60— 0.57	0.91— 0.83	0.68— 0.73	9— 31	0.20— 0.23	2.43— 2.41	2.66— 2.81	1.37— 1.54	1.34— 1.40	— —	1.82— 1.94	0.73— 0.65	1.53— 1.60	1.45— 1.62	2.04— 2.04	10.10— 10.10	— —	— —	— —	— —	— —	— —	
<i>Gyroptychius sp. inc. 2¹</i> . . .	225— 290	15— 15	21— 24	0.35— 0.35	2.00— 2.00	0.61— 1.39	1.36— 0.70	0.65— 0.55	0.50— 1.00	0.98— 0.58	0.53— 0.83	0.53— 0.71	0.50— 0.31	240— 241	0.17— 0.23	2.80— 2.81	2.80— 1.54	2.80— 1.40	2.80— —	— —	— —	— —	— —	— —	— —	— —							
<i>Gyroptychius?</i> spp.	No. 33164	— —	— 17	19— 25	— 0.51	2.60— 3.20	— 0.60	— 1.55	0.58— 0.76	0.43— 0.36	0.87— 0.75	0.55— 0.48	— 0.75	— 0.42	0.24— 0.28	— 2.42	— 2.45	— —	— —	— —	— —	— —	— —	— —	— —								
No. P. 1602	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	1.72— —	

Table 1. The range of variation in total length (col. 3), in the length of the parietal (col. 4) and fronto-ethmoidal (col. 5) shields and in certain proportions (col. 6—35) in the various species. A few extreme values excluded (cf. tables 3, 5, 7, 9).

a, b, median length of parietal and fronto-ethmoidal shields; *br. G*, breadth of principal gular; *c*, distance from centre of pineal foramen to posterior margin of frontal; *d*, breadth of cranial roof at preorbital corner; *dp. i. o*, depth of orbital notch; *e, f, g*, breadth of cranial roof at orbital, postorbital and postorbital notches; *ht. Ch*, height of external cheek plate; *ht. Ju*, height of jugal; *ht. La*, height of lachrymal; *ht. Mx</*

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The maxillary (*Mx*, figs. 10, 11 G, 21 A, 22, 32 A, 36 A, 37 A, 39, 53 A, 55, 58 A, 59 D, 62 A, 63 E, 65 A, 67, 71 A, 73, 77 A, 80 A, 81, 82 B, 83, 84 B; pl. 1: 1, 3; pl. 2: 1, 2; pl. 3; pl. 4: 1; pl. 5; pl. 6: 2, 4; pls. 8, 9, 12; pl. 13: 1, 3, 4; pl. 14: 2; pl. 15: 1; pl. 16: 2; pl. 17: 2; pl. 18: 2; pl. 19: 1; pl. 20: 1; pl. 22: 1, 2; pl. 23: 1; pl. 25: 2, 3; pl. 26: 2; pl. 29: 1; pl. 30: 1; pl. 32; pl. 34: 1; pl. 36: 3) is provided anteriorly with a dorsal process (*pr. Mx*, pl. 1: 1; pl. 16: 2; pl. 36: 3), as in *Eusthenopteron* (JARVIK 1942, p. 454; cf. p. 483; 1944 a, p. 23, fig. 9 A). In both species of *Osteolepis* the maxillary is usually about 4.90—6.40 times longer than it is high (col. 29, tables 1, 3, 5). In *O. macrolepidotus*, however, the posterior part of the bone situated behind the postero-dorsal corner — like the postero-dorsal margin — is proportionately longer than in *O. panderi*. In the former species this part thus usually occupies about 0.35—0.40, and in *O. panderi* only about 0.25—0.30, of the total length of the bone. Judging by the available material, the species of *Thursius* are also distinguishable by the proportions of the maxillary (col. 29, tables 1, 7). In *Th. pholidotus* this bone is thus comparatively high, its length being about 4.50—4.90 times its height, whereas the corresponding ratio in *Th. macrolepidotus* has been found to range from ca. 6.10 to ca. 6.60 and in *Th. moy-thomasi* from about 8.30 to about 8.50. The genus *Gyroptychius* is characterized by the maxillary being very low; in *G. agassizi* it is about 10.10—10.70 times longer than it is high.

The small additional bone *Y* (fig. 67 D; pl. 23: 1), found only in a single specimen of *Thursius pholidotus*, is situated between the postero-dorsal part of the lachrymal and the adjoining part of the jugal, and forms part of the margin of the orbital fenestra. It is situated exactly like the bone *Y* in *Eusthenopteron* (JARVIK 1944 a, p. 23, fig. 10 D), and the presence of such a bone in these two forms indicates that it is probably an old formation inherited from their common ancestor, and that its occurrence is thus not fortuitous.

The orbital fenestra (*fe. o*, see figs. 1, 37 A, B, 53 A, B, 58 A, B, 62, 65 A, B, 71 A, B, 77 A, B; pl. 1: 1, 3; pl. 2: 1; pl. 4: 1; pl. 12: 1; pl. 13: 1, 4; pl. 14; pl. 17: 2; pl. 32: 2; pl. 34: 1), which is rarely well displayed, is generally longer than it is high and more or less oval in shape. It has a somewhat varying position and size in the different species (cf. the variations in the size of the orbital notch of the cranial roof, pp. 37—40, and in the relative length of the preorbital, orbital and postorbital divisions of the fronto-ethmoidal shield, pp. 44—45). It is thus relatively large in *O. panderi*, of moderate size in *O. macrolepidotus* and *Thursius*, and relatively small in *Gyroptychius*. In *G. agassizi* it is situated farther forward proportionately than in *G. milleri*.

The sclerotic ring (*Scl. pl*, figs. 32 A, B, 37 A, B) is shown mainly on the type-specimen of *Osteolepis macrolepidotus* (pl. 1: 1; see also SÄVE-SÖDERBERGH 1933, pp. 21, 27, 117—118, figs. 19, 20; pl. 1; pl. 2: 1; pl. 4). The exact number of sclerotic plates could not be definitely established, but it seems probable that they have been at least 17 (cf. pp. 159—160). As in *Eusthenopteron*, which has 28—30 such plates (JARVIK 1944 a, p. 23, figs. 2 A—C, 7 E—G), the exposed part of the external face of each plate is provided with a delicate ornamentation.

The lower jaw.

The lower jaw (figs. 1, 3 A—E, 23, 32 A, C, 36, 37 A, C, 40, 53 A, C, 55 E—J, 58 A, C, 59 E, F, 62 A, 63 F, 65 A, C, 68 A—F, 71 A—C, 74, 77 A, C, 80 B—D, 83, 84 C; *Lj*, pl. 1: 2; pl. 2: 1, 3; pl. 3; pl. 4: 1; pl. 5; pl. 6: 2, 4; pl. 8: 2; pl. 9; pl. 12; pl. 13: 3; pl. 14: 1; pl. 15: 2, 3; pls. 16—18; pl. 19: 2; pl. 20: 2; pl. 22: 1, 2; pl. 23; pl. 24: 1, 3; pl. 26: 1, 2; pls. 27, 28; pl. 29: 2; pl. 30: 2, 3; pl. 31: 1, 3, 6; pl. 32; pl. 34: 2; pl. 35: 7—9) is still imperfectly known, but as far as it could be made out it agrees fundamentally with that in *Eusthenopteron* (JARVIK 1944 a, p. 26, fig. 11).

On the external side of the lower jaw no traces of sutures between dermal bones have been observed, and, according to SÄVE-SÖDERBERGH (1933, pp. 84—85), the lateral side of the meckelian bone in *Osteolepis macrolepidotus* is covered by one dermal bone only, which he calls mixisplenio-dentary, and which according to him has arisen by complete fusion of a series of infradentaries (splenials) with a tooth-bearing dentary. This compound bone should thus have only one centre of radiation (cf. JARVIK 1944 a, p. 5). However, as is evidenced by specimens of Osteolepids from the Moray Firth area (fig. 40 M; pl. 5: 1), in which the radiation of the dermal bones is often displayed, the external side of the lower jaw is covered by a dentary above and by a series of probably four infradentaries below (cf. WATSON 1935, fig. 30; MOY-THOMAS 1939, fig. 19 A; ROMER 1945, fig. 62 C), exactly as in *Eusthenopteron* (JARVIK 1944 a, figs. 2, 10 A, 11, 16; cf. fig. 33 A below). The absence of sutures on the external face is thus most probably due to the fact that the bones, like those of the anterior part of the fronto-ethmoidal shield, have grown together in the superficial layers only (the enamel and dentine layers). That this is so is supported by the fact that sutures between the dermal bones of the external side of the lower jaw in *Eusthenopteron* are often not traceable until the external bone layer has been removed (see JARVIK 1944 a, figs. 1, 11 C).

At the postero-dorsal corner of the external face of the lower jaw there is a distinct depressed area (*od. Qj*, fig. 23; pl. 2: 1; pl. 3: 2; pl. 6: 2; pl. 15: 3; pl. 22: 1, 2; pl. 29: 2; pl. 30: 2; pl. 31: 3; pl. 35: 7, 8), which, when the mouth is shut, is overlapped by the lowermost part of the quadratojugal, and perhaps also in its most anterior part by the maxillary. At the posterior end of this area the pars articularis of the meckelian bone (*p. art. Mb*) is visible.

Sometimes a small depressed area is found most anteriorly at the antero-medial end of the external face. This area (*od. Sy*, fig. 40 D), which may be incompletely divided into two parts, dorsal and ventral, was most probably occupied by small symphysial dermal bones corresponding to those previously described in *Eusthenopteron* (JARVIK 1944 a, pp. 26, 36, figs. 2 B, D, 10 C). However, no other traces of such bones have been found in the Osteolepid material available, but they have been figured by AGASSIZ (1835, pl. 63 a) in *Megalichthys*.

The dorsal and medial faces of the lower jaw, which have been disclosed in one specimen (pl. 35: 9) and are partly shown in others (pl. 30: 3), are always poorly preserved and cannot be described in detail. As in *Eusthenopteron* (JARVIK 1944 a, fig. 11), the medial side of the meckelian bone is covered by a long prearticular, probably bearing an independent prearticular dental plate (*Prart. dpl*). Dorsally

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	
																	<i>c/a</i>	<i>l.Ch</i>	<i>l.Ch</i>	<i>l.La</i>	<i>ht₁</i>	<i>ht₁</i>	<i>l.Ju</i>	<i>l.Po</i>	<i>l.Po</i>	<i>l.Sq</i>	<i>l.Qj</i>	<i>l.Mx</i>	<i>l.Lj</i>	<i>l.G</i>	<i>l.G</i>	<i>k/m</i>	<i>p/n</i>		
Mus. No.	Locality	Total length mm.	a	b	<i>l.i.o</i>	<i>l.i.o</i>	<i>l.i.po</i>	<i>dp.i.o</i>	<i>a</i>	<i>b</i>	<i>s+t</i>	<i>r+s</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>	<i>c/a</i>	<i>l.Ch</i>	<i>l.Ch</i>	<i>l.La</i>	<i>ht₁</i>	<i>ht₁</i>	<i>l.Ju</i>	<i>l.Po</i>	<i>l.Po</i>	<i>l.Sq</i>	<i>l.Qj</i>	<i>l.Mx</i>	<i>l.Lj</i>	<i>l.G</i>	<i>l.G</i>	<i>k/m</i>	<i>p/n</i>		
Pc.6(neotype)	Sandwick	185	12	14.8	0.41	3.35	0.46	1.23	0.80	0.29	0.75	0.49	0.59	0.51	0.80	0.43	0.36	2.14	2.58	3.14	0.90	0.68	1.70	0.46	1.13	2.00	1.40	4.92	2.32	—	—	1.90	—		
Pc. 7	"	145	9.5	12.0	—	—	0.45	1.26	—	0.31	—	0.50	0.61	0.54	0.80	0.44	0.37	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1.80	—	
Pc. 10	"	170	11.6	14.0	0.40	3.80	—	1.18	—	—	—	0.48	0.56	0.54	0.80	0.40	0.34	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
1899. 83. 10	Hooveth	220	15	—	—	—	—	—	—	—	—	—	—	—	—	0.44	0.38	—	—	3.15	0.92	0.67	1.88	—	—	—	—	5.00	2.25	—	—	2.00	—		
1899. 83. 11	"	175	12	14.6	0.40	3.40	0.43	1.18	0.75	0.28	0.74	0.50	0.57	0.53	0.70	0.44	0.32	—	2.90	3.28	0.90	0.64	1.80	—	—	2.14	1.48	6.00	—	0.87	—	3.21	2.25	1.27	
1899. 83. 12	"	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—			
1898. 120. 55	Instabillie (Quoyloo)	190	12	14.2	0.42	3.30	0.41	1.19	0.82	0.27	0.74	0.44	0.51	0.54	0.80	0.38	0.35	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
1898. 120. 63	"	125	9.2	11.8	0.44	3.80	—	1.19	—	—	—	—	—	—	—	0.40	0.35	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—			
1898. 120. 82	"	—	20	—	0.41	3.70	0.46	—	—	—	—	—	—	—	—	0.40	0.31	2.08	—	—	—	—	—	—	—	—	0.44	1.19	—	—	2.28	—	1.87	—	
1898. 163. 13	"	195	13	17	—	—	0.46	1.22	0.74	0.31	—	0.46	0.57	0.52	0.70	0.38	0.32	2.07	—	3.25	0.85	—	—	0.37	1.20	—	—	6.20	2.30	—	—	1.81	—		
L. 12107	R. k. n. e. y	185	12	15	0.43	3.40	0.41	1.23	0.90	0.24	0.73	0.46	0.57	0.60	0.70	0.34	0.30	2.02	—	3.05	0.86	—	1.90	0.41	1.20	—	—	5.60	2.36	—	—	—	—		
L. 12108	"	160	10.5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—				
O. 1897. 53. 7	Birsay	180	13	16	0.44	3.38	0.43	1.23	0.90	0.24	0.70	0.46	0.56	0.57	0.70	0.34	0.30	2.16	2.67	3.28	0.80	0.60	1.80	0.43	1.14	1.82	1.47	6.20	—	—	—	—	—	—	
1897. 53. 8	"	—	16	19	0.41	3.25	0.45	1.26	0.80	0.29	0.78	0.48	0.59	0.56	0.70	0.38	0.31	2.12	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
A. 6006	Stromness	165	11	14	0.44	3.40	0.43	1.21	0.90	0.22	0.71	0.47	0.57	0.61	0.70	0.34	0.31	2.14	2.46	3.05	0.76	0.55	1.73	0.43	1.14	1.86	1.30	5.17	—	—	—	—	—	—	
P. 4607	"	290	20	25	0.42	3.60	0.50	1.19	0.86	0.33	0.70	0.48	0.60	0.50	0.70	0.34	0.31	2.14	2.46	3.05	0.76	0.55	1.73	0.43	1.14	1.86	1.30	5.17	—	—	—	—	—	—	
P. 818	Orkney	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—			
98. 163. 18	"	—	13	16	0.41	3.30	0.42	1.23	0.85	0.29	0.69	0.44	0.56	0.46	0.61	0.31	0.31	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
1896. 110	Caithness	165	12	15	0.46	3.30	0.40	1.24	0.77	0.31	0.76	0.48	0.59	0.59	0.60	0.34	0.35	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
P. 4105	"	—	15	18	—	—	—	1.24	—	—	—	—	—	—	—	0.57	0.43	0.30	2.16	2.67	3.18	0.77	0.55	1.67	0.38	1.08	1.84	—	6.38	—	—	—	—	—	—
1896. 144. 1	Caithness	145	10	13	0.48	3.60	0.46	1.22	0.89	0.24	0.77	0.48	0.59	0.58	0.60	0.38	0.33	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
A. 6010	Firth area	215	15	17	0.45	3.																													

The ratio $l. Po/a$ (col. 25, table 3) thus ranges from ca. 0.37 to ca. 0.46, and the ratio $l. Po/ht. Po$ (col. 26) from about 1.00 to about 1.20. The development of the bone may be rather different in specimens from the same locality. In No. 1886. 31. 9 Edinb. (fig. 39 J; pl. 5: 2) from Lethen Bar, in which the postorbital strongly resembles that of the type-specimen (fig. 39 A, B; pl. 1: 1), its length is thus about 0.46 of the length of the parietal shield, and it is about 1.13 times longer than it is high, whereas in No. A. 6011 Sedgw. Mus. from the same locality (fig. 39 K; pl. 6: 2) it is proportionately much shorter and higher, the ratio $l. Po/a$ being about 0.38 and the ratio $l. Po/ht. Po$ about 1.00. The postorbitals in specimens No. L. 12108 and No. 1898. 120. 82 Edinb. from Instabillie also differ correspondingly. Along the antero-dorsal margin of the bone there is a narrow depressed area ($od_1 D$, fig. 21 A; pl. 2: 2) overlapped by the dermosphenotic, and sometimes also by the posterior supraorbital ($od_2 So$. 2).

The squamosal (Sq , figs. 10, 21 A, 22 A, 32 A, B, 37 A, B, 39; pl. 1: 1, 3; pl. 2: 1, 2; pl. 3: 2; pl. 4: 1; pl. 5; pl. 6: 1, 2, 4; pl. 9; pl. 12: 2; SÄVE-SÖDERBERGH 1933, 1941) is from about 1.82 to about 2.14 (col. 27, table 3) times longer than it is high (the height is measured anteriorly, across the antero-ventral corner; see fig. 12 C), but otherwise the bone is rather similar in the various specimens. It usually increases in height posteriorly and is slightly higher across the postero-ventral than across the antero-ventral corner. In most specimens it is almost exactly as long as the parietal shield. The squamosal is provided with a small depressed area ($od. It$, fig. 21 A; pl. 1: 1; pl. 2: 2) overlapped by the intertemporal (cf. pp. 86, 88, 90).

The preopercular (Pop , figs. 10, 21 A, 22 A, 32 A, B, 37 A, B, 39; pl. 1: 1; pl. 2: 1; pl. 3: 2; pl. 5; pl. 6: 1, 2, 4; pl. 9), which is frequently incompletely preserved or missing, is rather large. Its height amounts to about 0.67—0.75 of the length of the parietal shield, and it is about 3.2—3.4 times higher than it is long.

The quadratojugal (Qj , figs. 21 A, 22 A, 32 A, 37 A, 39; pl. 1: 1, 3; pl. 2: 2; pl. 3: 2; pl. 4: 1; pl. 5: 1; pl. 6: 1, 2, 4; pl. 9; pl. 12: 2), which, like the preopercular, is rarely well preserved, is high and short, about 1.30—1.48 times longer than it is high (col. 28, table 3). Its length amounts to nearly 0.5 of the length of the parietal shield.

The maxillary (Mx , figs. 10, 11 G, 21 A, 22 A, 32 A, 37 A, 39; pl. 1: 1, 3; pl. 2: 1, 2; pl. 3; pl. 4: 1; pl. 5; pl. 6: 2, 4; pl. 12: 2) is comparatively high, being about 4.92—6.38 (col. 29, table 3) times longer than it is high. In the type-specimen (fig. 39 A, B; pl. 1: 1) the maxillary of the right side is slightly higher than that of the left side. It is about 1.6 times longer than the parietal shield and the length of its postero-dorsal margin is about 0.60—0.70 of the length of the antero-dorsal one. The anterior dorsal process ($pr. Mx$, pl. 1: 1; cf. p. 92) is rarely displayed.

The orbital fenestra (figs. 32 A, B, 37 A, B) is well shown in a few specimens only ($fe. o$, pl. 1: 1, 3; pl. 2: 1; pl. 4: 1; pl. 5: 2). It is generally about 1.25 times longer than it is high, but is of somewhat different size. In the type-specimen its length is about 0.40 of the length of the parietal shield, and approximately the same ratio is found in No. 97. 163. 18 Edinb., which is probably from Orkney, and in No. 1886. 31. 9 Edinb. from Lethen Bar. In No. A. 6006 Sedgw. Mus. from Orkney, and in No. 1896. 144. 1 Edinb. from Caithness, it is proportionately larger, the corresponding ratio being 0.46 and 0.49 respectively.

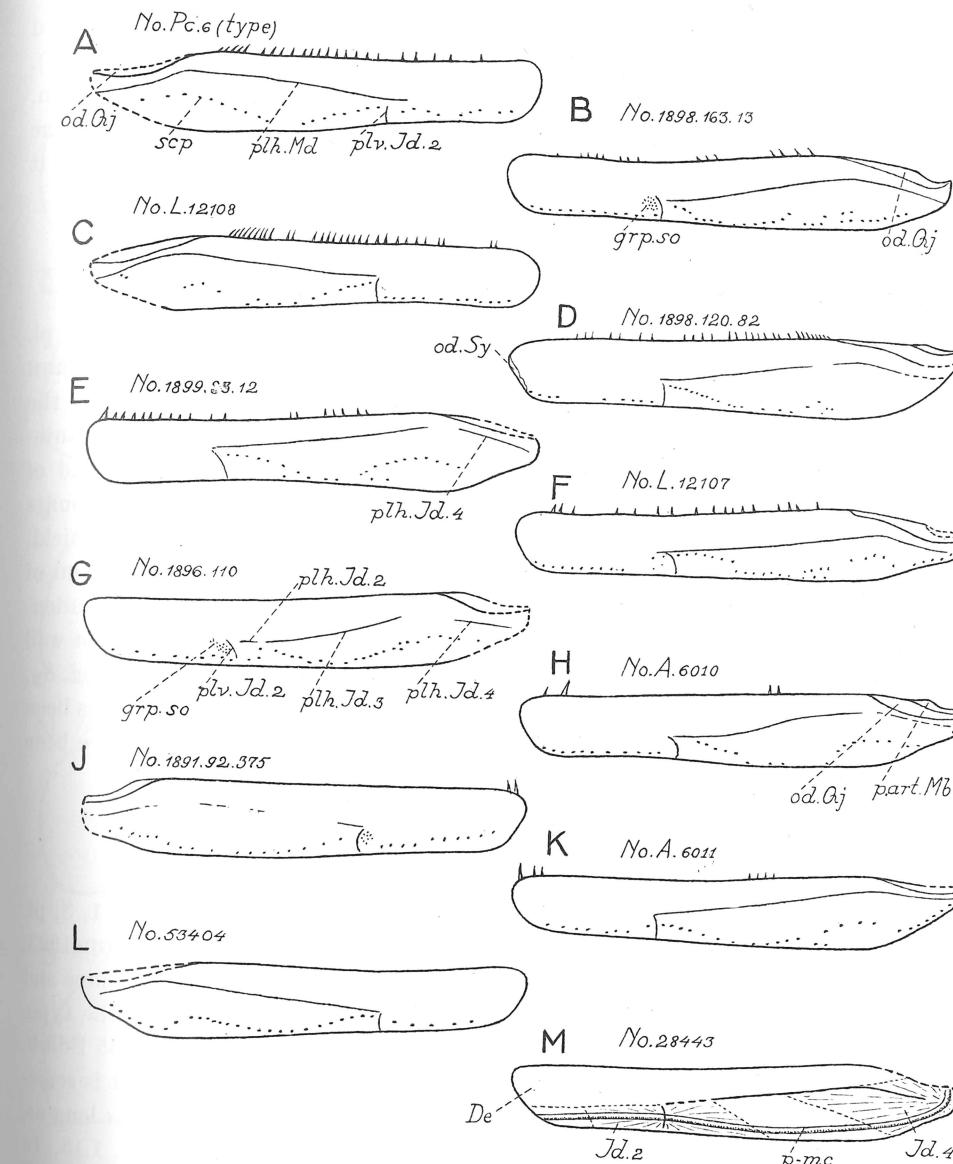


Fig. 40. *Osteolepis macrolepidotus* Ag. Sketches of lower jaw in lateral views. All figures give the size of the jaw at a length of the parietal shield of approximately 24 mm. (cf. fig. 38). Key to specimen-numbers on p. 146.

De, dentary; *Id. 2*, *Id. 4*, infradentaries 2 and 4. *grp. so*, groups of pores probably for nerves to cutaneous sensory organs; *od. Qj*, area overlapped by quadratojugal, *od. Sy*, area probably overlapped by symphysial dermal bones; *p. art. Mb*, pars articularis of meckelian bone; *plh. Id. 2*, *plh. Id. 3*, *plh. Id. 4*, horizontal pit-lines of infradentaries 2, 3, and 4, constituting portions of horizontal part of mandibular pit-line (*plh. Md*); *plh. Id. 2*, vertical pit-line of infradentary 2 (transverse part of mandibular pit-line).

Plates of the sclerotic ring (*Scl. pl.*, figs. 32 A, B, 37 A, B; pl. 1: 1) have been found in the type-specimen, in No. Pc. 7 Uppsala (see SÄVE-SÖDERBERGH 1933, pp. 21, 31, 97; pl. 2: 1; pl. 4: 1), and in some other specimens. As shown by No.

1877. 30. 3 Edinb. from Tyne Burn, the external face of the plates is ornamented distally and smooth proximally, as in *Eusthenopteron* (JARVIK 1944 a, fig. 6 E—G). SÄVE-SÖDERBERGH estimated the number of plates as having been about eleven. However, on the left side of the type-specimen, where a little less than the dorsal half of the ring is preserved, there are 8 more or less complete plates, and it is therefore likely that the total number has amounted to at least 17 or 18.

The lower jaw.

The lower jaw (*Lj*, figs. 3 A—E, 10, 23 A, 32 A, C, 37 A, C, 40; pl. 1: 2; pl. 2: 1, 3; pl. 3; pl. 4: 1; pl. 5: 1; pl. 6: 2, 4; pl. 8: 2; pl. 9; pl. 12: 2; SÄVE-SÖDERBERGH 1933; 1941) is rather similar in all specimens. It is generally lowest at about the vertical pit-line of infradentary 2, thence increasing slightly in height both anteriorly and posteriorly, attaining its maximal height at about the anterior end of the area (*od. Qj*) overlapped by the quadratojugal. The length of the jaw amounts to approximately 2.25—2.36 (col. 30, table 3) of the length of the parietal shield. In some specimens (fig. 40 M; pl. 5: 1) from the Moray Firth area the radiation of the infradentaries is partly shown, and judging from these specimens the infradentaries seem to be four in number (cf. p. 93). The medial face of the jaw is not well displayed in any of the specimens. Sometimes a narrow depressed area (*od. Sy*, fig. 40 D), which has probably been occupied by symphysial dermal bones, has been observed at the anterior end of the jaw. But, no remains of such bones have been found (cf. p. 93).

Opercular and gular bones.

The opercular (*Op*, figs. 3 F, 10, 24 A, 32 A, B, 37 A, B, 41; pl. 1: 1, 3; pl. 2: 1, 2; pl. 3; pl. 4: 1; pl. 5; pl. 6: 1—3; pl. 7: 3; pls. 8, 9; SÄVE-SÖDERBERGH 1933, 1941), which is well preserved in several specimens, has a rather varying shape and may be different on each side of the same specimen (fig. 41 F, G). In the type-specimen (fig. 41 A), and in a few other specimens, e. g. in No. 1898. 120. 55 Edinb. (fig. 41 H), and on the right side of No. 1898. 120. 82 Edinb. (fig. 41 F), it is somewhat shorter than the parietal shield, whereas in most specimens it is as long as, or longer than, that shield. The ratio $l. Op/a$ ranges from ca. 0.91 to ca. 1.15. In the type-specimen the opercular is high in relation to its length and about as high as long, whereas in the other specimens it is from ca. 1.10 to ca. 1.35 times longer than it is high. It increases more or less strongly in height posteriorly, generally attaining its greatest height at the posterior end of the area (*od₂Ext. l*) overlapped by the lateral extrascapular. As a whole the bone is slightly bent so that the external face is somewhat convex transversely. The dorso-lateral ridge (p. 16; *ri. dl*, fig. 3 F; pl. 3; pl. 5: 2; pl. 7: 3) is discernible in a few specimens. The overlapped areas (*od₁Pop*, *od₂Ext. l*, figs. 24 A, 40) are generally imperfectly displayed.

The subopercular (*Sop*, figs. 11 C, 24 A, 32 A, C, 37 A, C, 42; pl. 2: 2; pl. 3: 1; pl. 4: 1; pl. 5; pl. 6: 1, 3; pl. 7: 3; pl. 8: 2; pl. 9; pl. 12: 2) is of somewhat the same length as the opercular. As demonstrated by fig. 42, it varies strongly as to shape

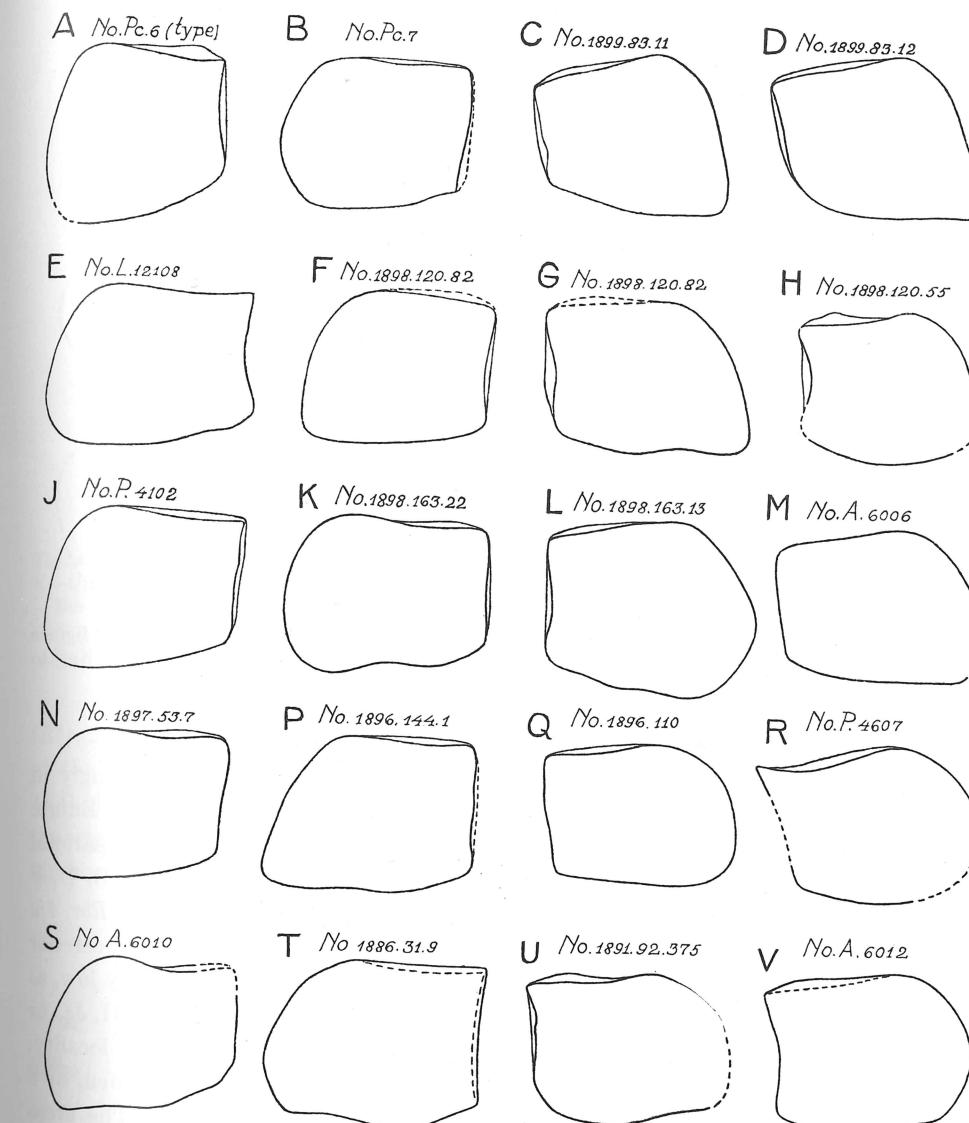


Fig. 41. *Osteolepis macrolepidotus* Ag. Sketches of opercular. All figures give the size of the bone at a length of the parietal shield of approximately 24 mm. (cf. fig. 38). Key to the specimen-numbers on p. 146.

and size. The anterior margin of the non-overlapped part consists of two concave divisions, one dorsal, fitting to the posterior margin of the external cheek plate, and one ventral, matching the posterior end of the lower jaw. The overlapped areas of the bone (*od. Op*, *od₂Pop*, *od. Lj*) are rarely well shown.

The branchiostegal rays consist of a large posterior ray and probably 6 anterior rays (fig. 44), thus 7 rays in all.

The large posterior branchiostegal ray, or the first branchiostegal ray (*Rbr. 1*, figs. 3 F, 10, 11 B, D, 24 B, 32 A, C, 37 A, C, 43 A—J, 44 A, C, D, F—J; pl. 4: 1; *Kungl. Sv. Vet. Akademiens Handlingar. Band 25. N:o 1.*