

DET NORSKE VIDENSKAPS-AKADEMI I OSLO

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# SKRIFTER OM SVALBARD OG NORDISHAVET

RESULTATER AV  
DE NORSKE STATSUNDERSTØTTEDE  
SPITSBERGENEKSPEDITIONER

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Nr. 12

ERIK A:SON STENSIÖ:

THE DOWNTONIAN AND DEVONIAN  
VERTEBRATES OF SPITSBERGEN

PART I

*FAMILY CEPHALASPIDAE*

B. PLATES

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UTGITT PÅ BEKOSTNING AV DEN NORSKE STAT  
OG STATENS FORSKNINGSFOND AV 1919  
VED SPITSBERGENKOMITEEN

REDAKTØR: ADOLF HOEL

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A. W. BRØGGERS BOKTRYKKERI A/S

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**THE DOWNTONIAN AND DEVONIAN  
VERTEBRATES OF SPITSBERGEN**

PART I  
*FAMILY CEPHALASPIDAE*

BY  
**ERIK A:SON STENSIÖ**

WITH 1 MAP, 103 TEXT-FIGURES, AND 112 PLATES

**B. PLATES**



## EXPLANATION OF PLATES

The plates accompanying this monograph are reproductions in part of photographs (pls. 1—72), in part of drawings of section series (pls. 73—112). The plates of the last mentioned category exhibit six different series of sections denoted by the letters A—F.

For the photographing I have used solely panchromatic plates (Ilford special rapid panchromatic plates). The Devonian forms, which are white, red-white or blue-white and lie in a more or less dark-red matrix, have usually been taken with an Ilford Gamma filter. On the other hand, for the photographing of the Downtonian forms, which are black or black-brown and are embedded in a more or less green-grey or greenrock, an Ilford micro-filter no. 5 has given the best results. The photos, which are slightly enlarged or in natural size or diminished, have been taken with a Zeiss Tessar objective 1:6,3, F. 25 cm. More strongly enlarged photos have been taken with Zeiss microplanar objectives F. 10 cm, F. 7,5 cm, F. 5 cm, and F. 2 cm.

Where nothing is stated to the contrary the types all belong to the Palaeontological Museum of the University, Oslo.

### Pl. 1.

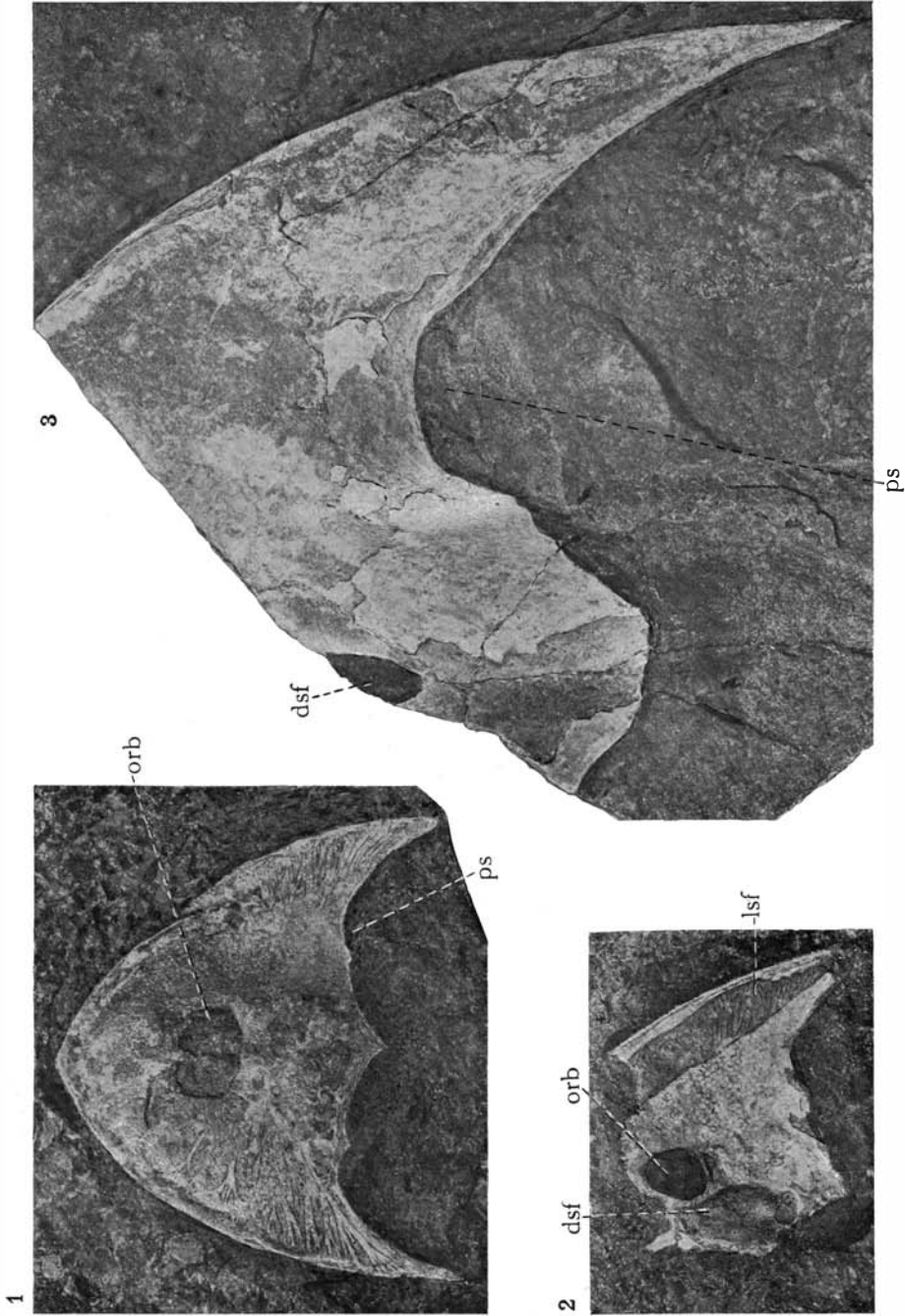
Fig. 1. *Cephalaspis watneliei* n. sp. Cephalic shield in dorsal view. Specimen no. 1.  $\frac{1}{1}$ .

Fig. 2. *Cephalaspis watneiliei* n. sp. Part of the exoskeleton of the dorsal side of a shield. Counterpart of the shield in fig. 1, imperfectly preserved.  $\frac{1}{1}$ .

Fig. 3. *Cephalaspis borealis* n. sp. Postero-lateral part of the left half of a shield. Exoskeleton from the medial side. Specimen no. 2.  $\frac{1}{1}$ .

#### Explanation of index letters.

*dsf*, dorsal electric field; *lsf*, lateral electric field; *orb*, orbital opening and orbit; *ps*, pectoral sinus.





## Pl. 2.

Fig. 1. *Cephalaspis* sp. Fragment of the exoskeleton of a shield in ventral aspect. Tuberculation of the ventral side of the cornu partly shown. (The spot with the tuberculation denoted by an white arrow.) Specimen no. 16. <sup>3</sup>/<sub>4</sub>.

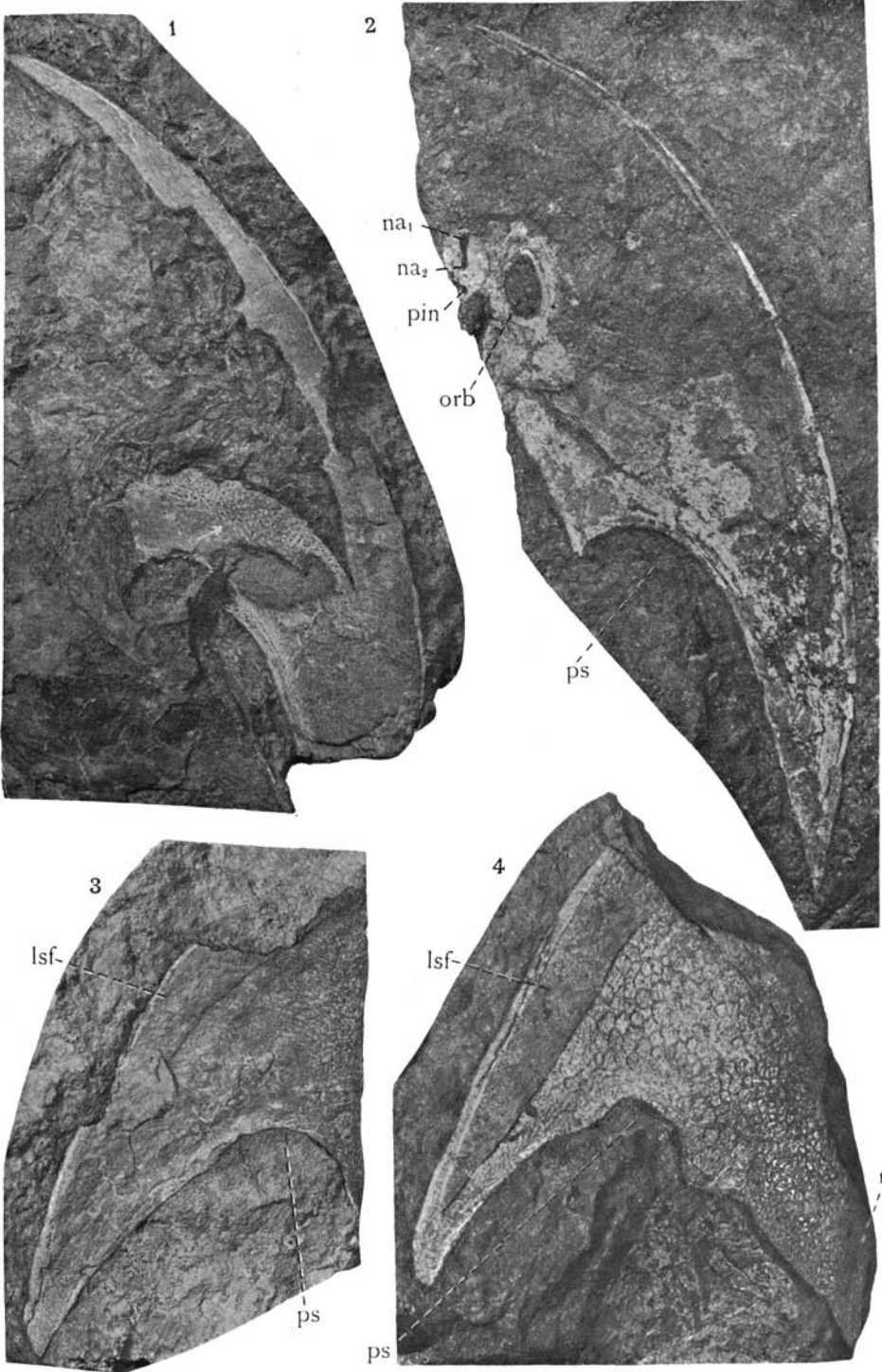
Fig. 2. *Cephalaspis oblongus* n. sp. Part of the exoskeleton of the dorsal side of a shield in ventral view; partly abraded. Specimen no. 3. <sup>1</sup>/<sub>1</sub>.

Fig. 3. *Cephalaspis* sp. Exoskeleton of the upper side of the right cornu in ventral aspect. Partly abraded. Specimen no. 15. <sup>1</sup>/<sub>1</sub>.

Fig. 4. *Cephalaspis acuticornis* n. sp. Part of exoskeleton of the dorsal side of a shield. Preserved as impression of the dorsal surface. Specimen no. 55. <sup>1</sup>/<sub>1</sub>.

### Explanation of index letters.

*lsf*, lateral electric field; *na*<sub>1</sub>, anterior division of the nasal opening forming the external opening of the hypophyseal sac; *na*<sub>2</sub>, posterior division of the nasal opening, the nasal opening proper; *orb*, orbital entrance; *pin*, pineal opening; *ps*, pectoral sinus; *r*, dorsal median ridge.



### Pl. 3.

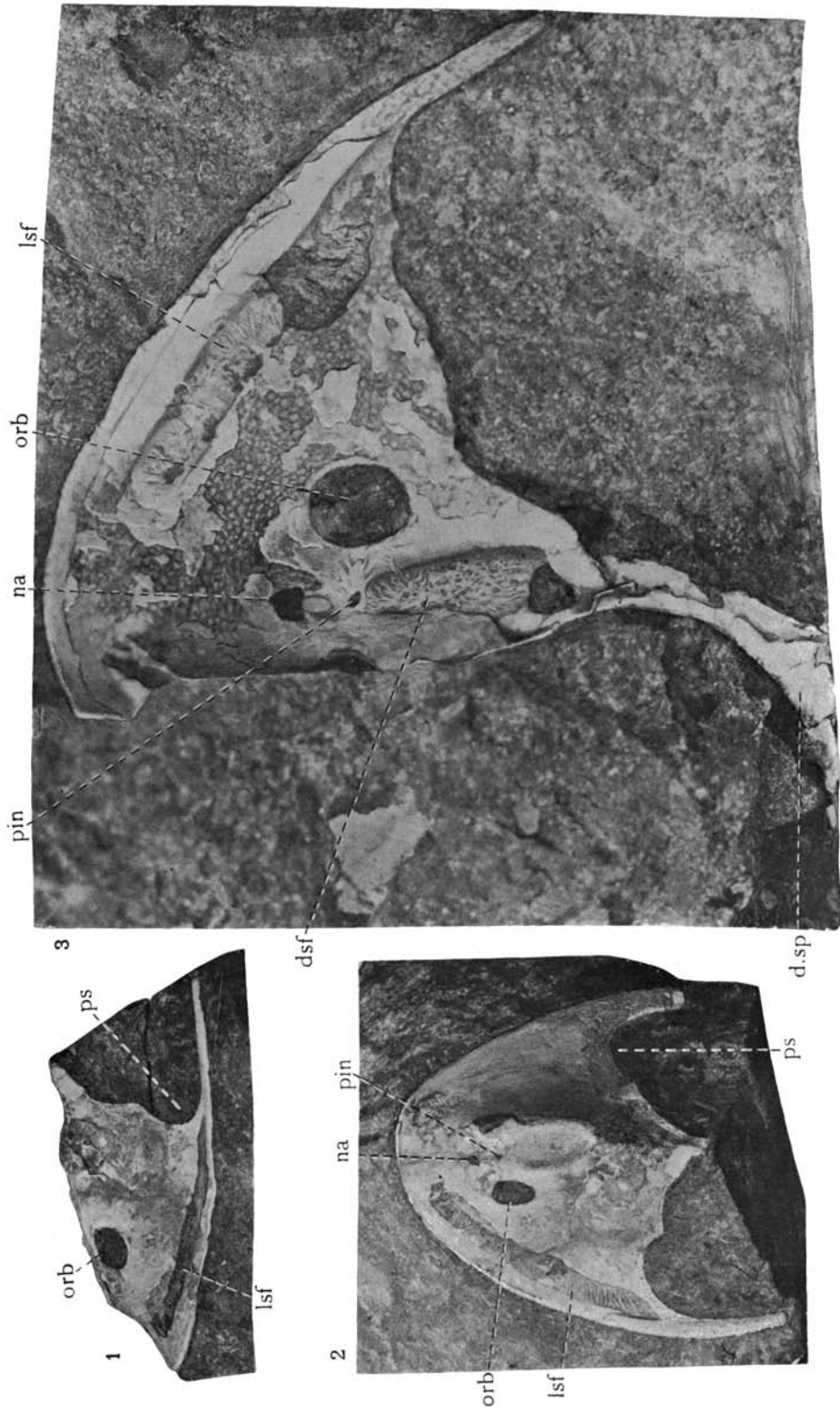
Fig. 1. *Cephalaspis isachseni* n. sp. Shield in lateral aspect with the dorsal spine missing. Specimen no. 4.  $\frac{1}{1}$ .

Fig. 2. *Cephalaspis isachseni* n. sp. Same shield in dorsal aspect.  $\frac{1}{1}$ .

Fig. 3. *Cephalaspis isachseni* n. sp. Part of the exoskeleton of a cephalic shield in ventral view. Counterpart of the specimen in the two preceding figures displaying a considerable part of the dorsal spine (*d. sp.*). Approximate magnification  $\frac{5}{2}$ .

#### Explanation of index letters.

*dsf*, dorsal electric field; *d. sp.*, dorsal spine; *lsf*, lateral electric field; *na*, nasal opening and opening of the hypophyseal sac, both imperfectly preserved, so that they are not bounded off from each other; *orb*, orbital entrance; *pin*, pineal opening; *ps*, pectoral sinus.



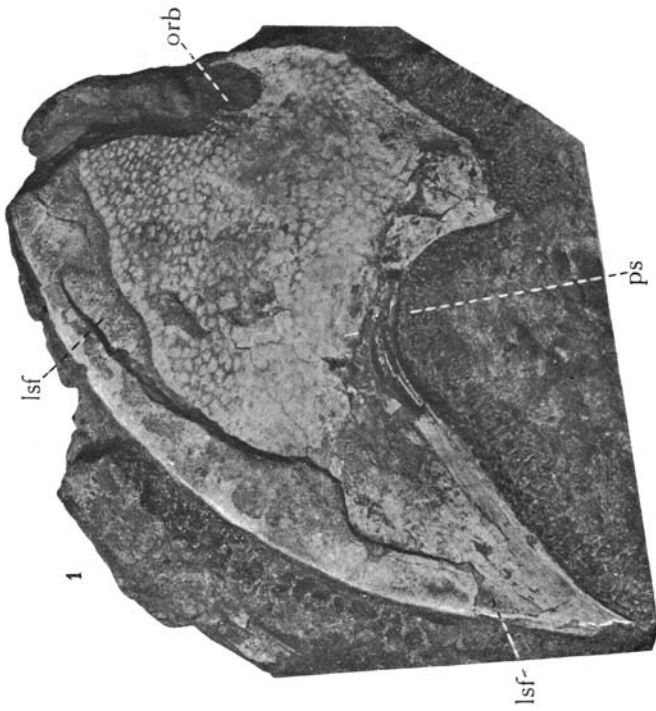
**Pl. 4.**

Fig. 1. *Cephalaspis laticornis* n. sp. Postero-lateral part of a cephalic shield. Mainly the exoskeleton of the dorsal side of the shield (in ventral view). Specimen no. 6.  $\frac{1}{1}$ .

Fig. 2. *Cephalaspis brevicornis* n. sp. Postero-lateral part of the right half of a shield in dorsal view. The exoskeleton of the dorsal side has the superficial and middle layers abraded in most places, so that the basal layer has been exposed to a large extent. Specimen no. 7.  $\frac{1}{1}$ .

Explanation of index letters.

*lsf*, lateral electric field (in fig. 1 to a large extent covered by the exoskeleton of ventral side of the cornu); *orb*, orbit; *ps*, pectoral sinus.



**Pl. 5.**

Fig. 1. *Cephalaspis brevicornis* n. sp. Part of the right half of a shield in ventral aspect. The ventral rim imperfectly preserved and the exoskeleton of the ventral side of the cornu as well as that of the ventral side of the interzonal part entirely abraded. Pectoral sinus (*ps*) well shown. Specimen no. 8. Less than  $\frac{2}{3}$  of the nat size.

Fig. 2. *Cephalaspis brevicornis* n. sp. Fragment of the ventral rim displaying the ornamentation. Specimen no. 56.  $\frac{1}{1}$ .

Fig. 3. *Cephalaspis* sp. Portion of the ventral rim. Specimen no. 83.  $\frac{2}{1}$ .





**Pl. 6.**

Fig. 1. *Cephalaspis lata* n. sp. Imperfect impression of the ventral surface of a shield. Specimen no. 10. <sup>1</sup>/<sub>1</sub>.

Fig. 2. *Cephalaspis* sp. Anterior portion of the exoskeleton of the upper side of a shield. Specimen no. 17. <sup>1</sup>/<sub>1</sub>.

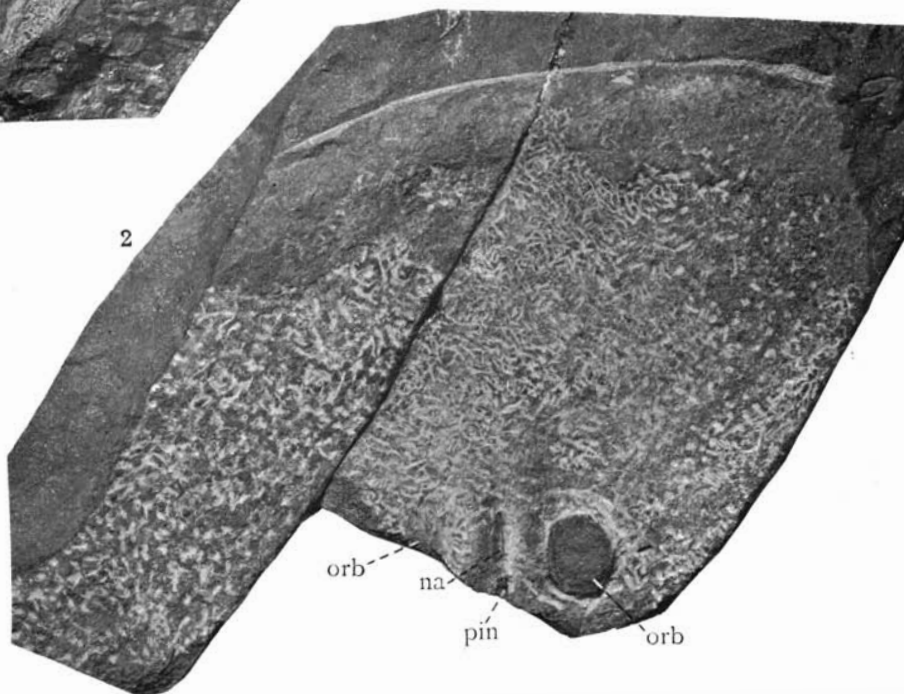
Explanation of index letters.

*na*, nasal opening and opening of the hypophyseal sac (here imperfect and therefore not well bounded; *obr. f.*, oralo-branchial fenestra; *orb*, orbital opening; *pin*, pineal foramen.

1



2



**Pl. 7.**

*Cephalaspis lata* n. sp. Exoskeleton of the lower side of a shield; rather imperfectly preserved in certain parts. The oralo-branchial fenestra (*obr.f*) well displayed. Specimen no. 9. Somewhat less than  $\frac{2}{3}$  of the nat. size.



## Pl. 8.

*Cephalaspis höegi* n. sp. Exoskeleton of the dorsal side of a shield in ventral view preserved as impression of the dorsal surface. The portions which pertained to the cornua missing. Besides the exoskeleton of the dorsal side there are preserved a part of the postbranchial wall and a part of the orbital bone-layer. Specimen no. 11. <sup>1</sup> 1.

### Explanation of index letters.

*lsf*, lateral electric field; *my*, myodome (small portion only preserved); *na<sub>1</sub>*, opening of the hypophyseal sac; *na<sub>2</sub>*, nasal opening proper; *orb*, orbit; *p. brw*, postbranchial wall; *pin*, pineal foramen; *ps*, pectoral sinus; *sel<sub>1</sub>*, canal for the first nerve to the lateral electric field.



**Pi. 9.**

*Cephalaspis höegi?* n. sp. Fragmentary cephalic shield in dorsal aspect. The exoskeleton of the dorsal side abraded and certain parts split off of so, that a stretch of the ventral rim and the postbranchial wall are shown (of the latter the upper part is lacking). Specimen no. 12. <sup>1/1</sup>.

Explanation of index letters.

*c*, cornu; *fy*, canal for the vena superficialis longitudinalis ventralis; *oes*, oesophagus division of the common foramen for the oesophagus and the truncus arteriosus; *p. brw*, postbranchial wall; *p. sh*, endoskeletal shoulder-girdle; *r. subcl*, subclavian ridge; *tr*, truncus arteriosus division of the common foramen for the oesophagus and the truncus arteriosus; *v<sub>7</sub>* and *v<sub>8</sub>*, canals for the ventral transversal superficial veins 7 and 8; *vs. marg*, widened part of the canal for the marginal vein.



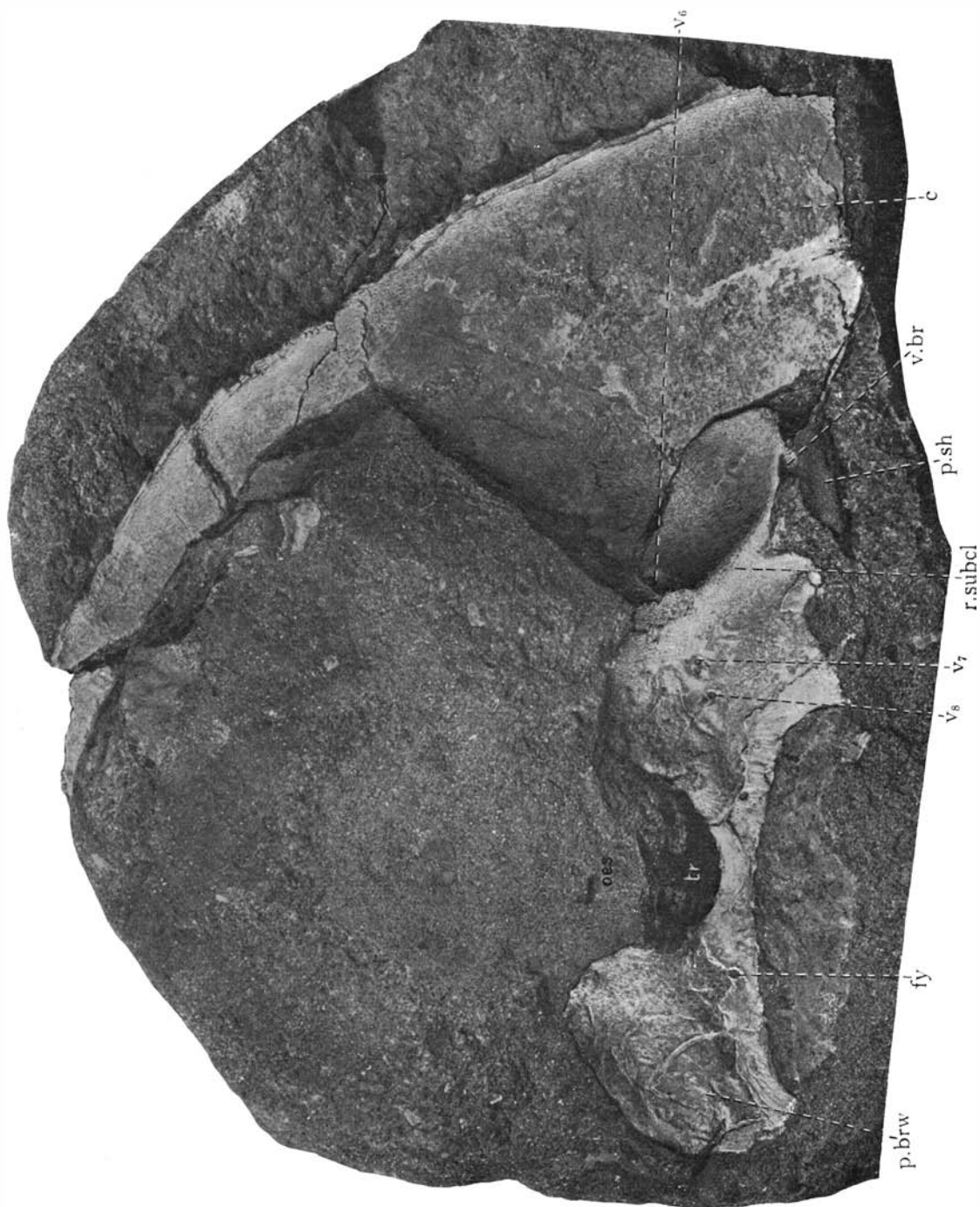


**Pl. 10.**

*Cephalaspis höegi?* n. sp. Same specimen as in pl. 9, but with a posterolateral part of the right side removed in order to expose the endoskeletal shouldergirdle (*p. sh*) and the exoskeleton on the ventral side of the right cornu and the adjacent part of the ventral rim. Specimen no. 12. <sup>1</sup>/<sub>1</sub>.

Explanation of index letters.

*c*, cornu; *fy*, foramen probably for a ventral superficial longitudinal vein; *oes + tr*, foramen for the oesophagus and the truncus arteriosus; *p. brw*, postbranchial wall; *p. sh*, endoskeletal shoulder-girdle; *r. subcl*, subclavian ridge; *v. br*, foramen (imperfectly preserved) for the v. brachialis; *v<sub>6</sub>—v<sub>8</sub>*, canals for the ventral transversal superficial veins.



**Pl. 11.**

*Cephalaspis* n. sp. Exoskeleton of the upper side of a right cornu in ventral view. As is easily seen the exoskeleton has to a great extent weathered away. Antero-laterally to the oralo-branchial fenestra (*obr.f*) a part of the ventral rim is preserved. Specimen no. 14. <sup>1</sup>/<sub>1</sub>.

Explanation of index letters.

*lsf*, lateral electric field; *obr.f*, oralo-branchial fenestra; *ps*, pectoral sinus.



**Pl. 12.**

*Cephalaspis brevicornis* n. sp. Impression of the ventral rim of a big specimen. Specimen no. 13. Somewhat less than natural size.



### Pl. 13.

Fig. 1. *Boreaspis rostrata* n. g., n. sp. Fig. 1 shows the specimen in dorsal view in the first stage of preparation. Note that the division of the labyrinth cavity for the posterior semicircular canal is very distinct. Specimen no. 97. <sup>2</sup>/<sub>1</sub>.

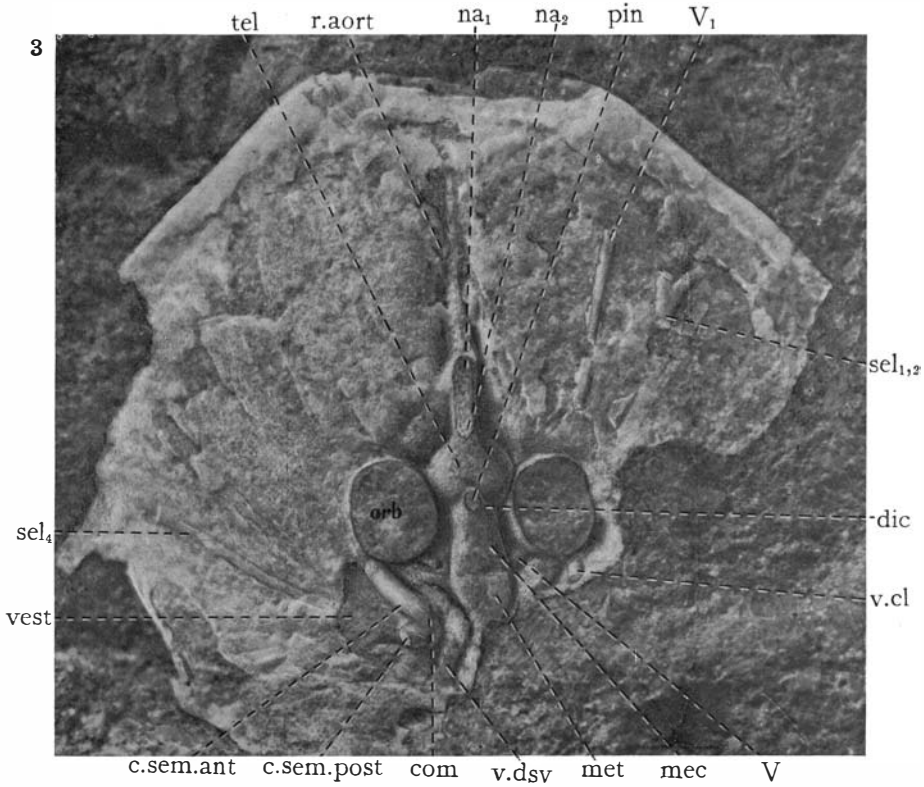
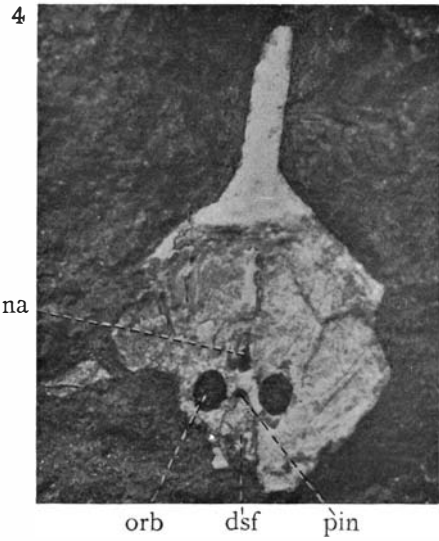
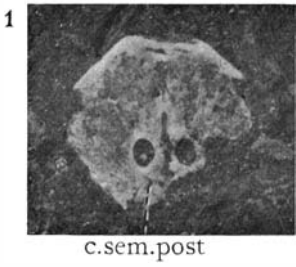
Fig. 2. *Boreaspis rostrata* n. g., n. sp. The same specimen as in fig. 1, but further prepared. The division for the posterior semicircular canal lacking, as it was destroyed during the preparation. <sup>3</sup>/<sub>1</sub>.

Fig. 3. *Boreaspis rostrata* n. g., n. sp. Same specimen as in the two preceding figures. Prepared as much as in fig. 2 but more magnified. <sup>8</sup>/<sub>1</sub>.

Fig. 4. *Boreaspis rostrata* n. g., n. sp. Counterpart of the specimen shown in figs. 1—3. <sup>3</sup>/<sub>1</sub>.

#### Explanation of index letters.

*com*, commissural division of the labyrinth cavity; *c. sem. ant.*, division of the labyrinth cavity for the canalis semicircularis anterior; *c. sem. post.*, division for the labyrinth cavity for the canalis semicircularis posterior (imperfect in figs. 2 and 3); *dsf*, dorsal electric field; *dic*, division of the cavum cerebrale cranii for the diencephalon; *mec*, division of the cavum cerebrale for the mesencephalon; *met*, division of the cavum cerebrale for the metencephalon; *na*, naso-hypophysial opening; *na<sub>1</sub>*, *na<sub>2</sub>*, anterior and posterior divisions of the naso-hypophysial opening; *orb*, orbital opening; *pin*, pineal canal and foramen; *r. aort*, aortal ridge (chiefly seen as impression and thus as a groove; *sel<sub>1,2</sub>*, common canal for the two most anterior electric nerves for the lateral electric field; *tel*, division of the cavum cerebrale cranii for the telencephalon; *v. cl*, canal for the v. capitis lateralis; *v. dsv*, canal for the otical vein and in addition probably for the ductus endolymphaticus; *vest*, vestibular division of the labyrinth cavity; *V*, either the myodome or the canal for the majority of the trigeminus-profundus roots; *V<sub>1</sub>*, canal for the n. profundus (imperfect).



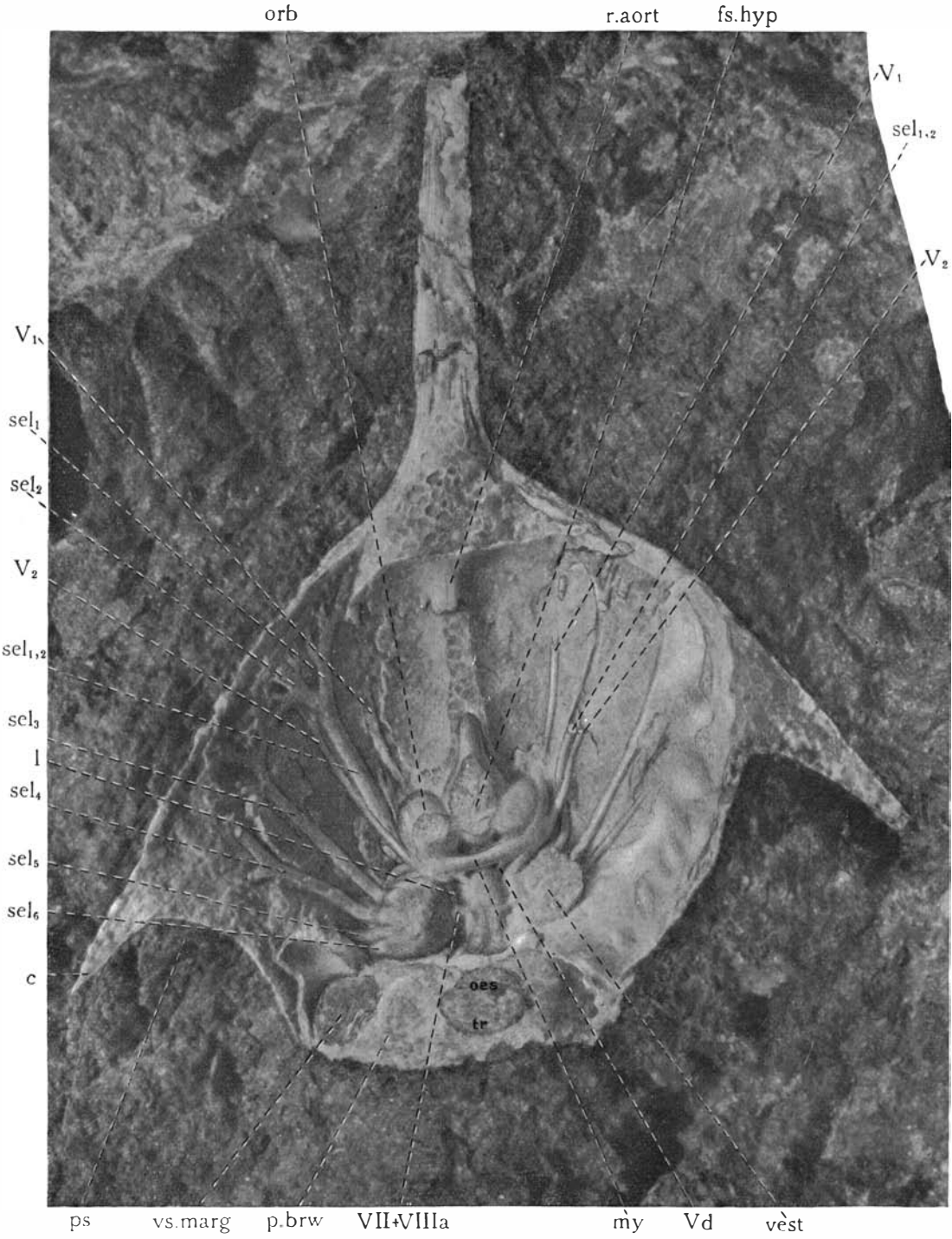


**Pl. 14.**

*Boreaspis rostrata* n. g., n. sp. Cephalic shield in ventral view with certain parts removed in order to show the main cavities in it, such as the cavum cerebrale cranii, the orbits and the labyrinth cavities. Specimen no. 96. Magnification about  $10_{,1}$ .

Explanation of index letters.

*c*, cornu; *fs. hyp*, fossa hypophyseos (most basal part lacking); *l*, canal for the lateralis fibres which associated with the n. trigeminus proper and with the n. profundus; *my*, myodome (continuous with its fellow of the opposite side); *orb*, orbit; *oes. + tr*, oesophagus-truncus arteriosus foramen (the bone trabecle separating this foramen into two foramina one for the oesophagus and the other for truncus arteriosus not preserved); *p. briv*, postbranchial wall; *ps*, pectoral sinus; *r. aort*, aortal ridge (only an anterior part preserved); *sel<sub>1,2</sub>*, common canal for the two most anterior electric nerves to the lateral electric field; *sel<sub>1-6</sub>*, canal for the electric nerves 1—6 for the lateral electric field; *vest*, vestibular division of the labyrinth cavity (the left one — right in the figure — destroyed in its ventral part); *vs. marg*, widened posterior division of the canal for the marginal vein; *Vd*, canal for the visceromotor root of the n. trigeminus proper; *V<sub>1</sub>*, canal for the n. profundus; *V<sub>2</sub>*, canal for the n. trigeminus proper; *VII + VIII a*, canal for the roots of the n. facialis, for the anterior branch of the n. acusticus, for all the prootic lateralis fibres and probably for all the electric nerve fibres.



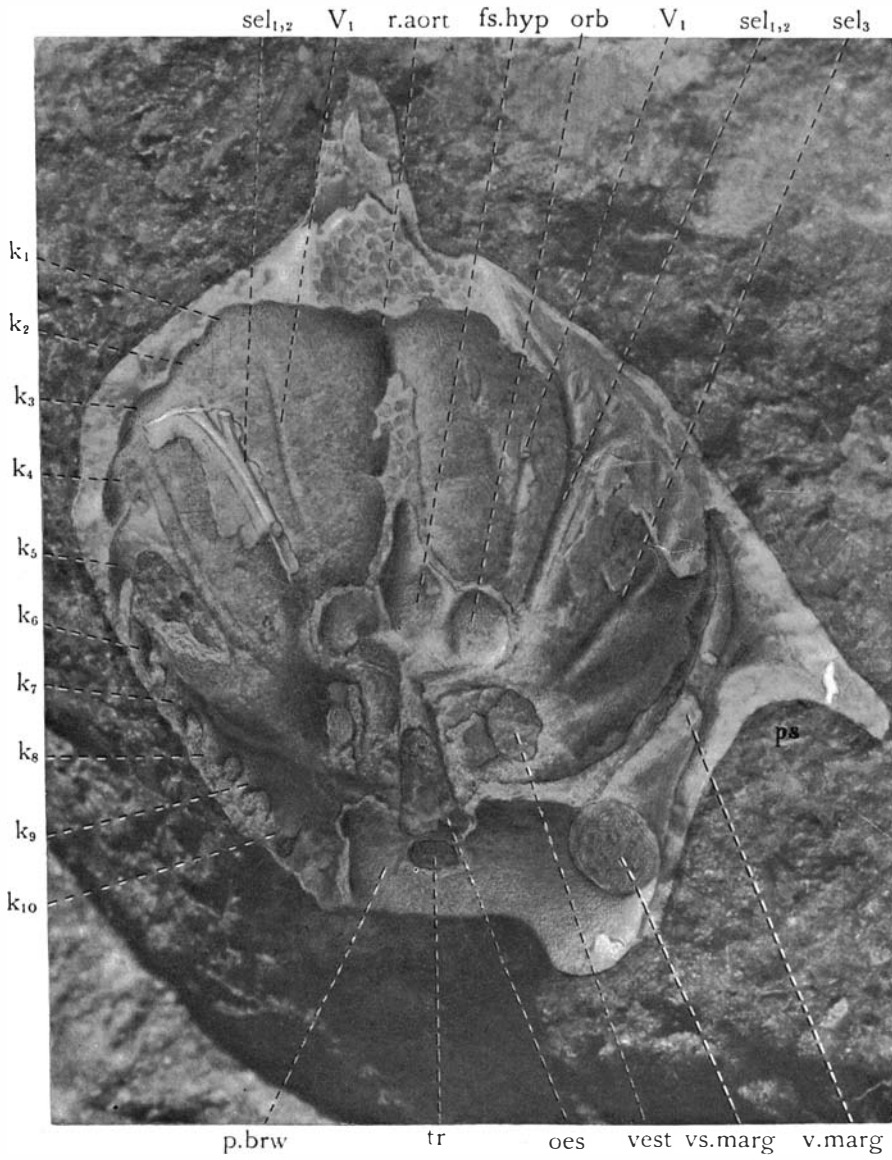
ps vs.marg p.brw VII+VIIIa my Vd vèst

## Pl. 15.

*Boreaspis rostrata* n. g., n. sp. Cephalic shield. Counterpart of the shield shown in pl. 14. What is seen is mainly an impression of the oralo-branchial chamber, but there are also parts of bone tissue bounding that chamber, particularly posteriorly and ventro-laterally. Specimen no. 96. Magnification about  $10\times$ .

### Explanation of index letters.

*fs. hyp*, fossa hypophyseos (basal part);  $k_1-k_{10}$ , branchial fossae 1—10 (ventro-lateral parts); *orb*, orbit (floor); *oes*, foramen for the oesophagus; *p. brw*, postbranchial wall; *ps*, pectoral sinus; *r. aort*, aortal ridge (impression); *sel<sub>1,2</sub>*, common canal for the two most anterior nerves for the lateral electric field; (on the right side only an impression of this canal is found); *sel<sub>3</sub>*, the canal for the third nerve for the lateral electric field; *tr*, foramen for the truncus arteriosus; *vest*, vestibular division of the labyrinth cavity (basal part); *v. marg*, canal for the marginal vein; *vs. marg*, widened posterior part of the canal for the marginal vein;  $V_1$ , impression of the canal for the n. profundus.



**Pl. 16.**

Fig. 1. *Cephalaspis* sp. Impression of a postero-lateral part of the exoskeleton of the lower side of a cephalic shield. Specimen no. 86. Slightly diminished.

Fig. 2. *Cephalaspis* sp. Part of the exoskeleton of the dorsal side of a shield preserved in part as impression of the external surface. Specimen no. 106. <sup>2</sup>/<sub>1</sub>.

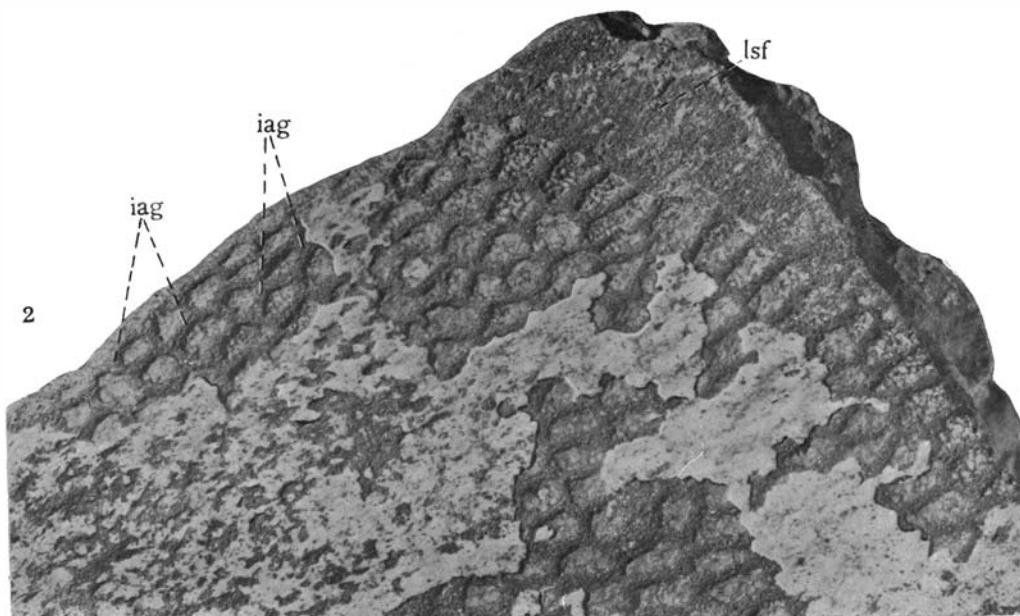
Explanation of index letters.

*c*, cornu; *iag*, interareal grooves (impressions, and therefore appearing as ridges); *lsf*, lateral electric field; *ps*, pectoral sinus.

1



2

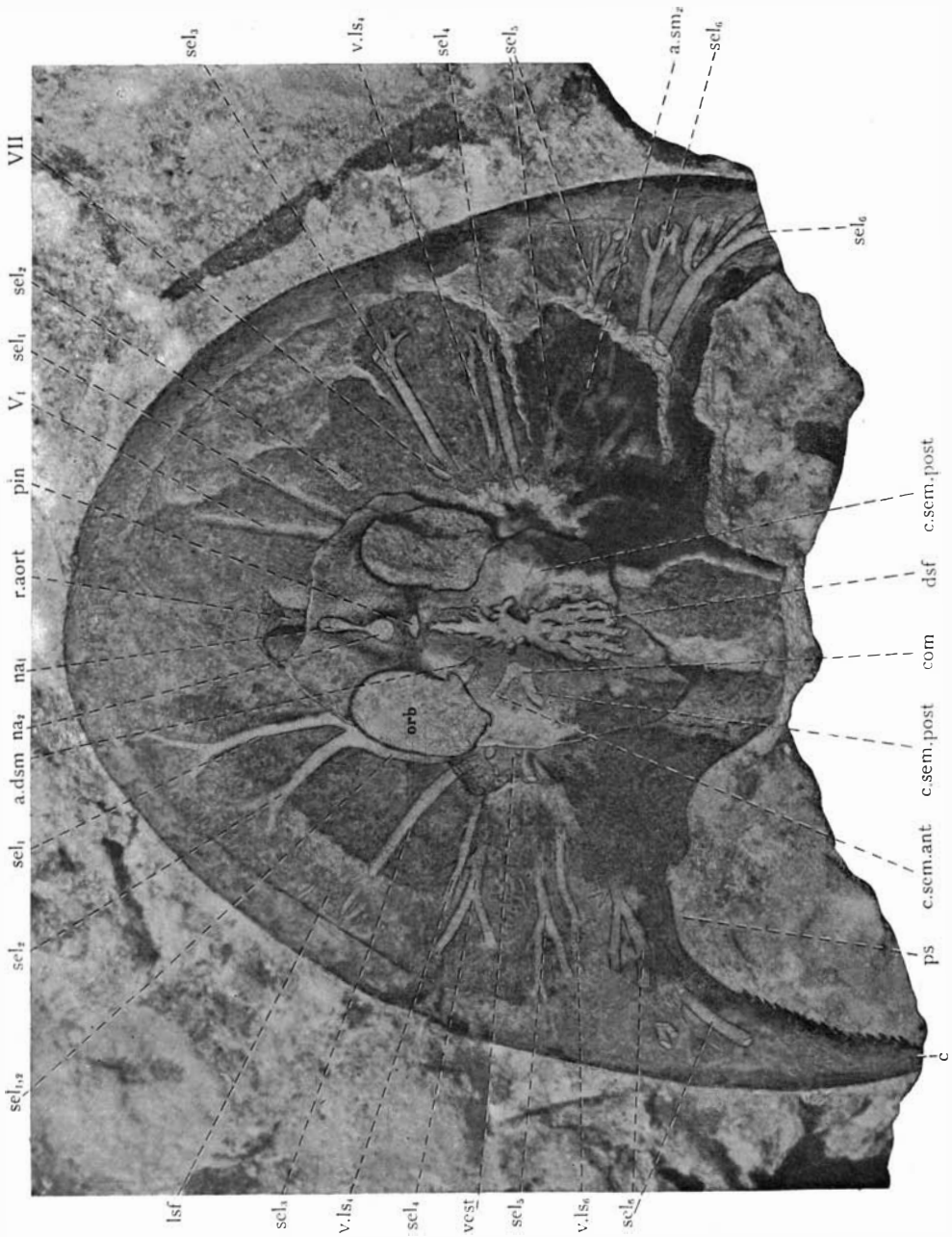


## Pl. 17.

*Cephalaspis hoeli* n. sp. Cephalic shield in dorsal view. Owing to the fact that the exoskeleton of the dorsal side has been partly removed several of the canals for nerves and vessels are clearly conspicuous. Specimen no. 22. <sup>4</sup>/<sub>1</sub>.

### Explanation of index letters.

*a. dsm*, branches of the canal for the postorbital superficial artery; *a. sm<sub>2</sub>*, canal for the dorso-lateral superficial artery 3; *c*, cornu; *com*, commissural division of the labyrinth cavity, *c. sem. ant*, *c. sem. post*, divisions of the labyrinth cavity for the anterior and posterior semicircular canals respectively; *dsf*, dorsal electric field; *lsf*, lateral electric field; *na<sub>1</sub>*, *na<sub>2</sub>*, anterior and posterior divisions of the naso-hypophyseal opening; *orb*, orbital opening; *pin*, pineal opening; *ps*, pectoral sinus, *r. aort*, aortal ridge (shown only as impression for a short distance); *sel<sub>1,2</sub>*, common canal for the two most anterior nerves for the lateral electric field; *sel<sub>1</sub>—sel<sub>6</sub>*, canals for the electric nerves 1—6 for the lateral electric field; *vest*, vestibular division of the labyrinth cavity (only a lateral part exposed); *v. ls<sub>4</sub>*, *v. ls<sub>6</sub>*, canals for the dorso-lateral superficial veins 4 and 6; *V<sub>1</sub>*, canal for the n. profundus (preserved only as impression); VII, canal for the n. facialis.



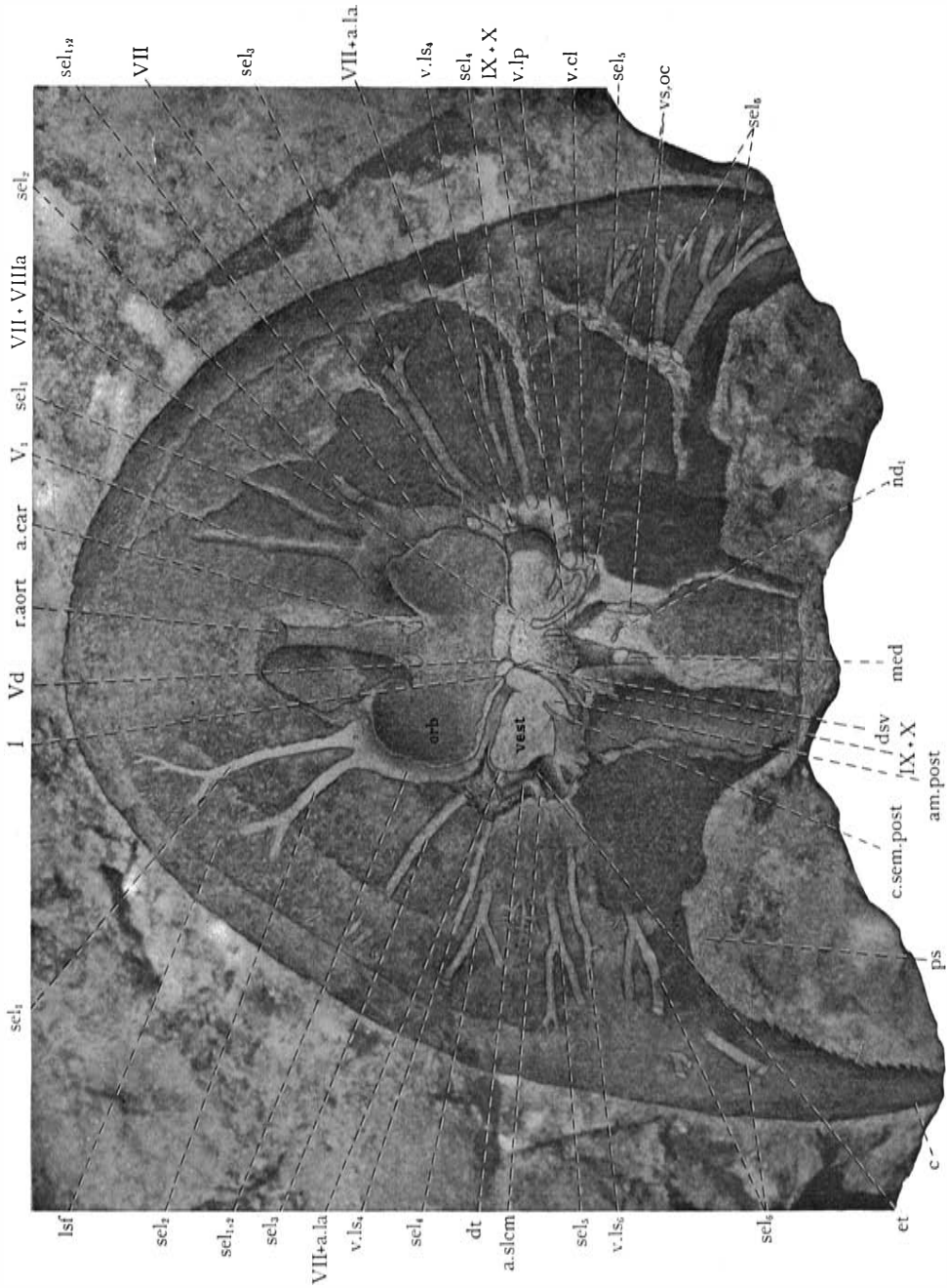


## Pl. 18.

*Cephalaspis hoeli* n. sp. Same cephalic shield as in pl. 17, but with a dorso-medial part removed in order to show certain interior details. Specimen no. 22. <sup>4</sup>/1.

### Explanation of index letters.

*a. car*, canal for the carotid artery; *am. post*, swelling for the ampulla posterior (section); *a. slcm*, canal, which distally divides in the canals for the two posterior dorso-lateral superficial arteries; *c*, cornu, *c. sem. post*, division of the labyrinth cavity for the canalis semicircularis posterior (section); *dsv*, groove on the medial side of the labyrinth cavity for the electric nerve for the dorsal electric field; *dt*, *et*, canals for the posterior two dorso-lateral superficial arteries. These canals issue from the labyrinth cavity; *l*, canal for the lateralis fibres which accompanied the n. trigeminus proper and the n. profundus. Only a fragment of the canal to be seen here; *lsf*, lateral electric field; *med*, division of the cranial cavity for the medulla (here in section and to a large extent filled by matrix); *nd<sub>1</sub>*, canal for the myelonal vein 1 and in addition also for the dorsal root of spino-occipital nerve 1 (its connection with the cranial cavity not to be seen here, but it is distinctly seen in pl. 19, fig. 1, which shows a counterpart of the specimen figured here); *orb*, orbit (only the floor seen here); *r. aort*, aortal ridge shown as impression and therefore appearing as a groove; *sel<sub>1,2</sub>*, canal for the two most anterior nerves for the lateral electric field; *sel<sub>1</sub>—sel<sub>6</sub>*, canals for the nerves for the lateral lateral electric field (in part preserved only as impressions); *v. cl*, canal for the v. capitis lateralis (only a posterior part preserved); *vest*, vestibular division of the labyrinth cavity (in part in section); *v. lp*, canal for a tributary to the v. capitis lateralis, a tributary arisen probably by the confluence of the two or three most posterior dorso-lateral superficial veins; *v. ls<sub>4</sub>*, *v. ls<sub>6</sub>*, canals for the dorso-lateral superficial veins 4 and 6; *vs. oc*, occipital vein sinus; *Vd*, canal for the visceromotor root of the n. trigeminus proper (fragment of the ventral wall); *VII*, canal for the passage of the n. facialis from the labyrinth cavity to the oralo-branchial chamber; *VII + a. la*, proximal part of the canal for the passage of the n. facialis from the labyrinth cavity; this proximal part was traversed not only by the n. facialis but also by a superficial arterial trunk, which gave rise to at least the first dorso-lateral superficial artery, and perhaps also to the second dorso-lateral superficial artery; *VII + VIIIa*, canal which transmitted to the labyrinth cavity the following nerves and nerve-roots: the anterior branch of the n. acusticus, the facialis roots proper, all the prootic lateralis roots and the electric nerve fibres; *IX + X*, division of the vagus canal for the glossopharyngeus and vagus roots.



## Pl. 19.

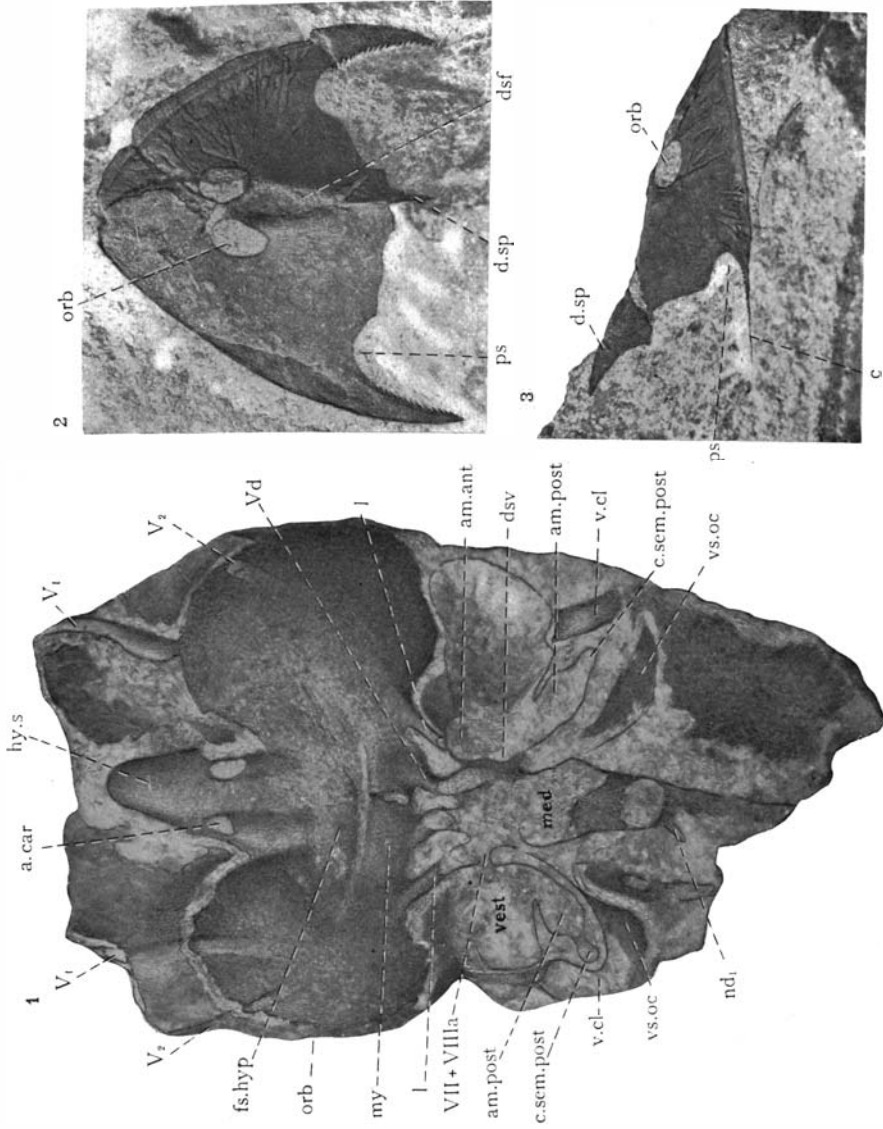
Fig. 1. *Cephalaspis hoeli* n. sp. Dorso-medial part of the shield shown in pls. 17, 18. The part in question is seen from the ventral side in order to show the orbits, the cranial cavity, the labyrinth cavities etc. Specimen no. 22.  $\frac{8}{1}$ .

Fig. 2. *Cephalaspis hoeli* n. sp. Cephalic shield in dorsal view. Specimen no. 26.  $\frac{3}{2}$ .

Fig. 3. *Cephalaspis hoeli* n. sp. Cephalic shield in lateral view. Specimen no. 26.  $\frac{3}{2}$ .

### Explanation of index letters.

*a. car*, canal for the arteria carotis; *am. ant*, swelling for the ampulla anterior (section); *am. post*, swelling for the ampulla posterior (section); *c*, cornu; *c. sem. ant*, division of the labyrinth cavity for the canalis semicircularis anterior (section); *c. sem. post*, division of the labyrinth cavity for the canalis semicircularis posterior (section); *dsf*, dorsal electric field; *d. sp*, dorsal spine; *dsv*, groove for the electric nerves for the dorsal electric field; *fs. hyp*, fossa hypophyseos; *hy. s*, division of the ethmoidal cavity for the hypophyseal sac; *l*, canal for the lateralis nerve fibres which accompanied the n. trigeminus proper and the n. facialis; *med*, division of the cranial cavity for the medulla oblongata (in part in section); *my*, myodome (note that the myodome halves of both sides are very wide medially and that they probably were continuous with each other most medially); *nd<sub>1</sub>*, canal for the myelonal vein 1 and in addition probably also for the spino-occipital nerve 1; *orb*, orbit and orbital opening; *ps*, pectoral sinus; *v. cl*, canal for the v. capitis lateralis (a posterior part); *vest*, vestibular division of the labyrinth cavity (in section); *vs. oc*, occipital vein sinus; *Vd* canal for the visceromotor root of the trigeminus proper; *V<sub>1</sub>*, canal for the n. profundus; *V<sub>2</sub>*, canal for the n. trigeminus proper; *VII + VIIIa*, canal which transmitted to the vestibular division of the labyrinth cavity the following structures: the roots of the n. facialis, the prootic lateralis roots, the electric nerve-fibres and the anterior branch of the n. acusticus.



## Pl. 20.

*Cephalaspis hoeli* n. sp. Cephalic shield in a dorsal view. A dorsal part of the shield removed so that the postbranchial wall and certain other structures are seen. In one place we see also an impression of the dorsal surface of the oralo-branchial chamber. Specimen no. 23. <sup>5</sup>. 1.

### Explanation of index letters.

*a. car*, canal for the carotid artery; *a. iol?*, probably the canal for the lateral infraorbital branch of the arteria facialis; *a. marg.* canal for the a. marginalis. Only a posterior part of the canal is shown; *a. sm<sub>1</sub>*, canal for the dorso-lateral superficial artery 2; *a. subcl.* canal for the a. subclavia; *c*, cornu; *fy*, foramen probably for a ventral longitudinal superficial vein; *hy. s.* division of the ethmoidal cavity for the hypophyseal sac; *lsf*, lateral electric field; *p. brw.* postbranchial wall; *pr. orb.* impression of the orbital prominence; *ps*, pectoral sinus; *sel<sub>1</sub>—sel<sub>6</sub>*, canals for the nerves for the lateral electric field; *v<sub>4</sub>—v<sub>9</sub>*, canals for the ventral transversal superficial veins 4—9; *vest*, vestibular division of the labyrinth cavity (part of the floor); *v. ls<sub>1</sub> v. ls<sub>5</sub>*, canals for the dorso-lateral superficial veins 1—5; *v. marg.* canal for the marginal vein (a posterior part in section with the stone filling it partly removed); *V<sub>1</sub>*, canal for the n. profundus; *VII*, canal for the passage of n. facialis from the vestibular division of the labyrinth cavity to the oralo-branchial chamber; *IXa*, canal for the passage of the n. glossopharyngeus from the vestibular division of the labyrinth cavity to the oralo-branchial chamber.

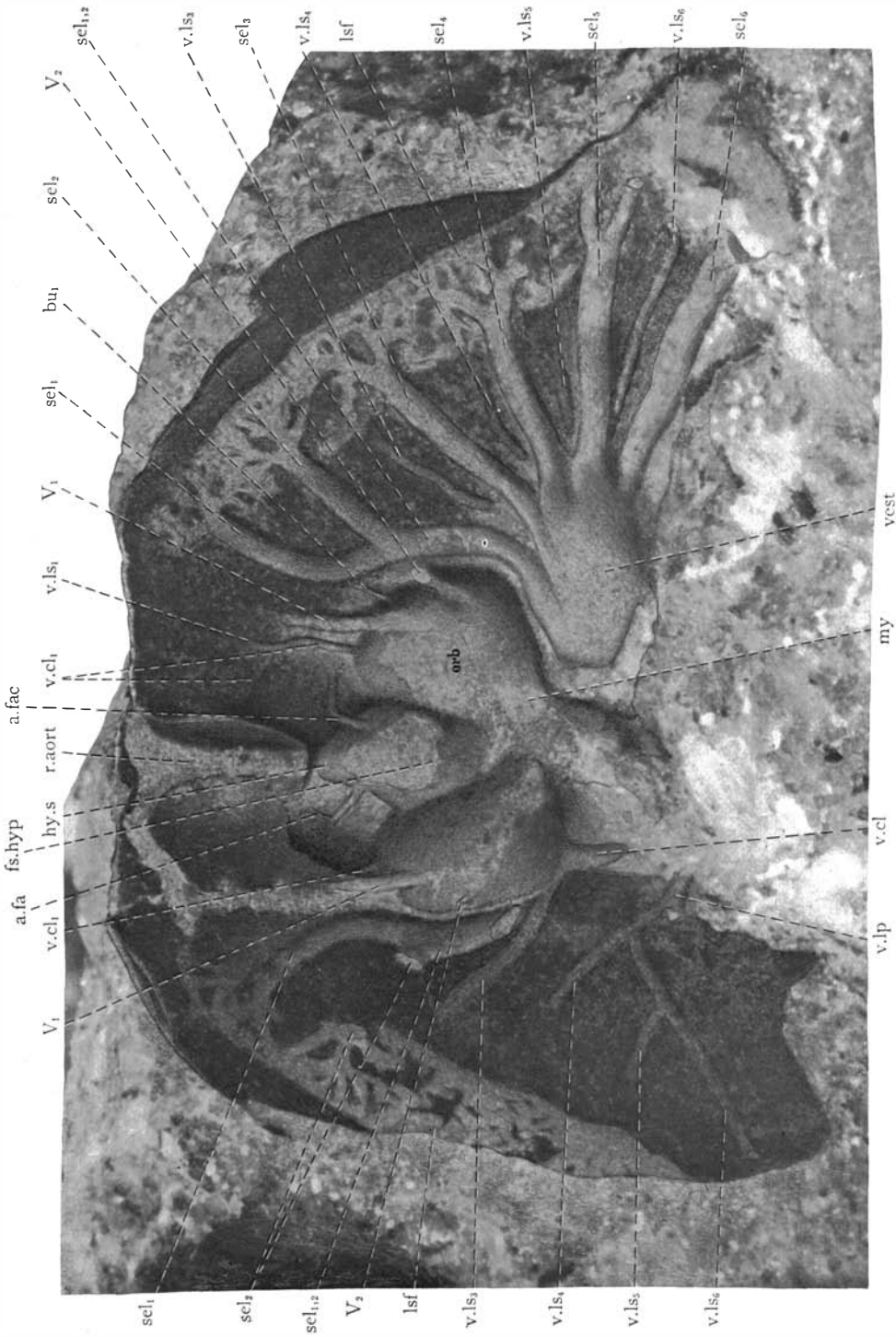


## Pl. 21.

*Cephalaspis hoeli* n. sp. Cephalic shield in ventral view. Prepared so as to show certain of the cavities and canals. Specimen no. 24. 11/1.

### Explanation of index letters.

*a. fa*, canal for an anterior branch of the a. facialis; *a. fac*, canal for the a. facialis; *bu*<sub>1</sub>, canal for a branch of the n. buccalis lateralis or for vessels or for both; *fs. hyp*, fossa hypophyseos (ventral part destroyed); *hy. s.*, part of the ethmoidal cavity that lodged the hypophyseal sac; *lsf*, lateral electric field; *my*, myodome (imperfectly preserved); *r. aort* aortal ridge (imperfectly preserved); *sel*<sub>1, 2</sub>, common canal for the two most anterior nerves for the lateral electric field; *sel*<sub>1</sub>—*sel*<sub>6</sub>, canals for the nerves for the lateral electric field; *v. cl*, canal for the v. capitis lateralis (anterior part); *v. cl*<sub>1</sub>, canal for the preorbital division of the v. capitis lateralis; *vest*, vestibular division of the labyrinth cavity; *v. lp*, canal for a venus trunk arisen by the confluence of the dorso-lateral superficial veins 4—6; *v. ls*<sub>1</sub>—*v. ls*<sub>6</sub>, canals for the dorso-lateral superficial veins 1—6; *V*<sub>1</sub>, canal for the n. profundus; *V*<sub>2</sub> canal for the n. trigeminus proper.



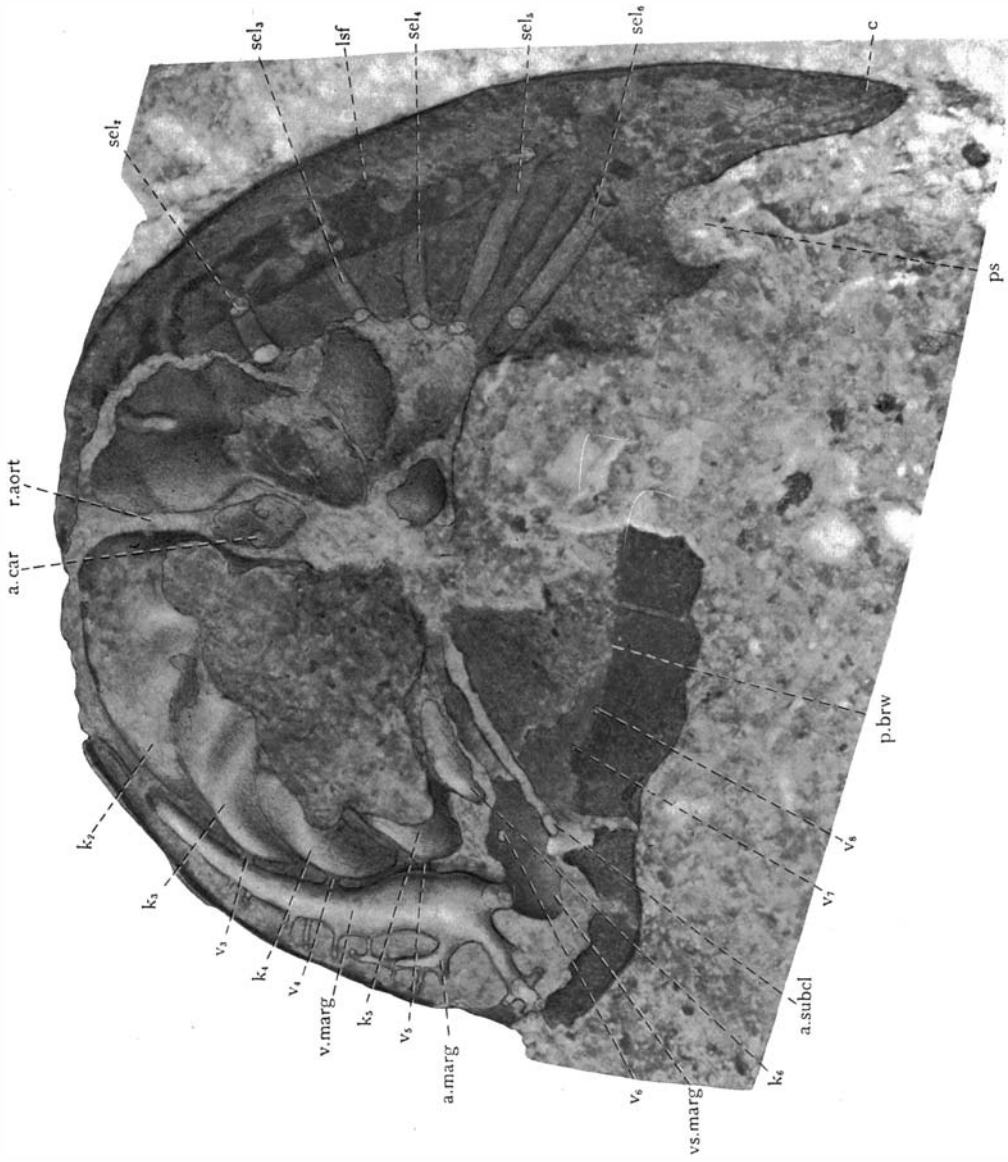


## Pl. 22.

*Cephalaspis hoeli* n. sp. Cephalic shield preserved mainly in the ventral parts and as an impression of the oralo-branchial chamber. Counterpart of the shield figured in pl. 21. Specimen no. 24. <sup>8</sup>/<sub>1</sub>.

### Explanation of index letters.

*a. car*, canal for the carotid artery (dorsal opening in the fossa hypophyseos); *a. marg*, canal for the marginal artery (posterior part); *a. subcl*, canal for the a. subclavia; *c*, cornu; *k<sub>2</sub>—k<sub>6</sub>*, branchial fossae 2—6 (impressions); *lsf*, lateral electric field; *p. brw*, postbranchial wall; *ps*, pectoral sinus; *r. aort*, aortal ridge (section); *sel<sub>2</sub>—sel<sub>6</sub>*, canals for the electric nerves 2—6 for the lateral electric field; *v<sub>3</sub>—v<sub>8</sub>*, canals for the ventral transversal superficial veins 3—8; *v. marg*, canal for the marginal vein; *vs. marg*, widened posterior part of the canal for the marginal vein (only a part of the ventral wall preserved).



## Pl. 23.

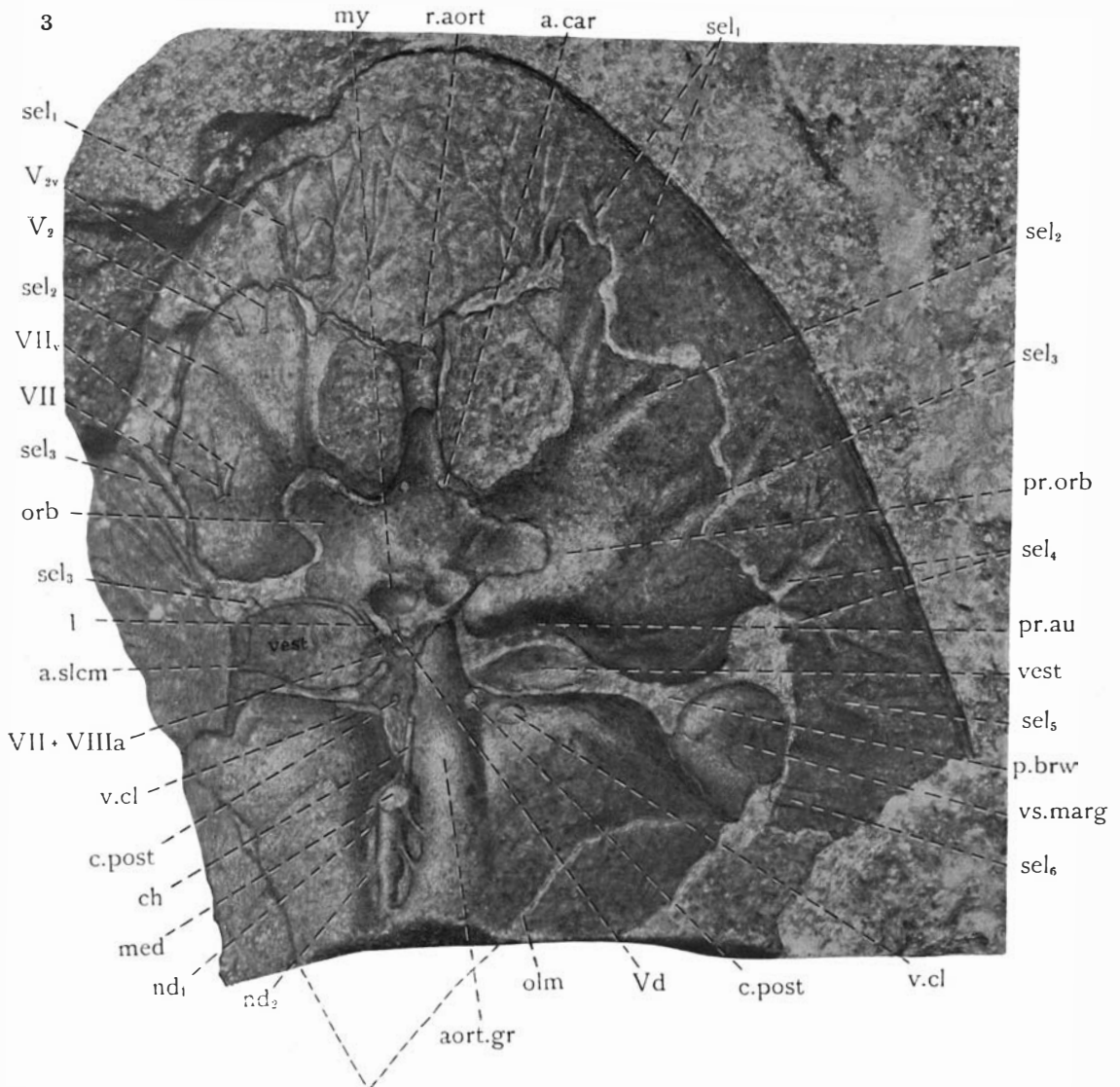
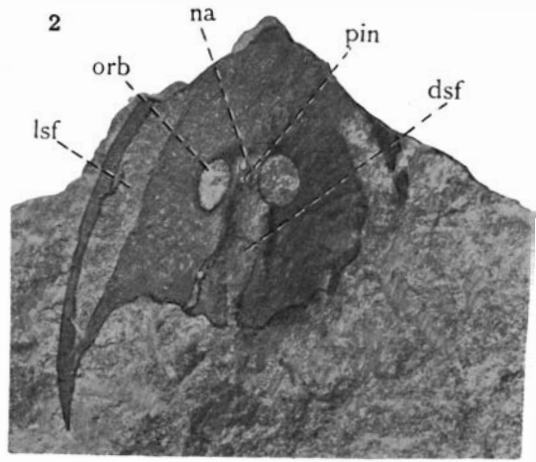
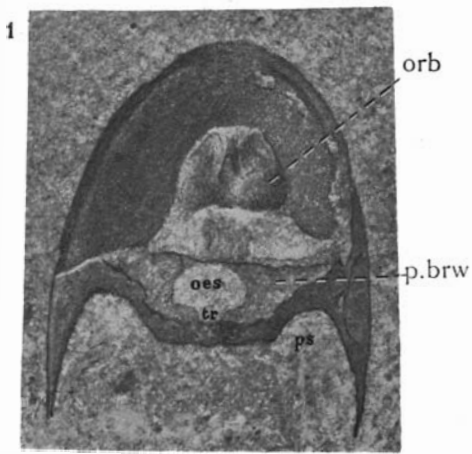
Fig. 1. *Cephalaspis hoeli* n. sp. Cephalic shield in ventral view. The oralo-branchial chamber destroyed and the endoskeleton dorsally and laterally to it, to a considerable extent lacking. Specimen no. 21. Magnification about  $5\frac{1}{2}$ .

Fig. 2. *Cephalaspis hoeli* n. sp. Fragmentary cephalic shield in dorsal view. Specimen no. 25. Magnification about  $3\frac{1}{2}$ .

Fig. 3. *Cephalaspis hoeli* n. sp. Fragmentary cephalic shield in dorsal view. With the exception of certain basal parts, the endocranium has been removed so that the impression of its lower side (the upper surface of the oralo-branchial chamber) and the dorsal part of the postbranchial wall are displayed. Specimen no. 41. Magnification somewhat less than  $7\frac{1}{1}$ .

### Explanation of index letters.

*a. car*, canal for the a. carotis (dorsal orifice on the bottom of the fossa hypophyseos); *aort. gr*, aortal groove, impression of the occipital part. Note the asymmetric position on the right side of the cranial cavity (*med*); *a. slcm*, canal for an arterial trunk, which laterally bifurcated into the two posterior dorso-lateral superficial arteries, thus the dorso-lateral superficial arteries 3 and 4; *ch*, canal for the notochord; *c. post*, canal for the posterior encephalic artery; *dsf*, dorsal electric field; *l*, canal for the lateralis fibres, which accompanied the n. trigeminus proper and the n. profundus; *lsf*, lateral electric field; *med*, division of the cranial cavity for the medulla oblongata (most posterior part); *my*, myodome (only a part of the floor preserved); *na*, naso-hypophyseal opening; *nd<sub>1</sub>*, canal for the myelonal vein 1 and in addition for the dorsal root of spino-occipital nerve 1; *nd<sub>2</sub>*, canal for the myelonal vein 2 and in addition for the dorsal root of spino-occipital nerve 2; *oes+tr*, oesophagus-truncus arteriosus foramen; *olm*, line which shows how far laterally the occipital region extended (in its present state this region is represented mainly by an impression of the ventral side); *orb*, orbit and orbital opening (in fig. 3 the orbital floor); *p. brw*, postbranchial wall (section through the dorsal part); *pr. au*, impression of the otical prominence; *pr. orb*, impression of the orbital prominence; *ps*, pectoral sinus; *r. aort*, aortal ridge (in section); *sel<sub>1</sub>—sel<sub>6</sub>*, the canals or impressions of the canals for the electric nerves for the lateral electric field; *vest*, vestibular division of the labyrinth cavity (basal part and floor); *v. cl*, canal for the v. capitis lateralis (posterior opening only preserved); *vs. marg*, marginal vein sinus, a posterior widened part of the canal for the marginal vein; *Vd*, canal for the visceromotor root of the n. trigeminus proper; *V<sub>2</sub>*, canal for the n. trigeminus proper (distal part); *V<sub>2v</sub>*, canal for the visceral branch of the n. trigeminus proper (distal part); *VII*, canal for the n. facialis from the labyrinth cavity to the oralo-branchial chamber (distal part); *VII<sub>v</sub>*, canal for the visceral branch of the n. facialis; *VII+VIIIa*, canal which transmitted to the vestibular division of the labyrinth cavity the following nerves and nerve-roots; the roots of the n. facialis, the prootic lateralis roots, the electric nerve-fibres to the electric fields, and the anterior branch of the n. acusticus. (The canal is seen in horizontal section.)



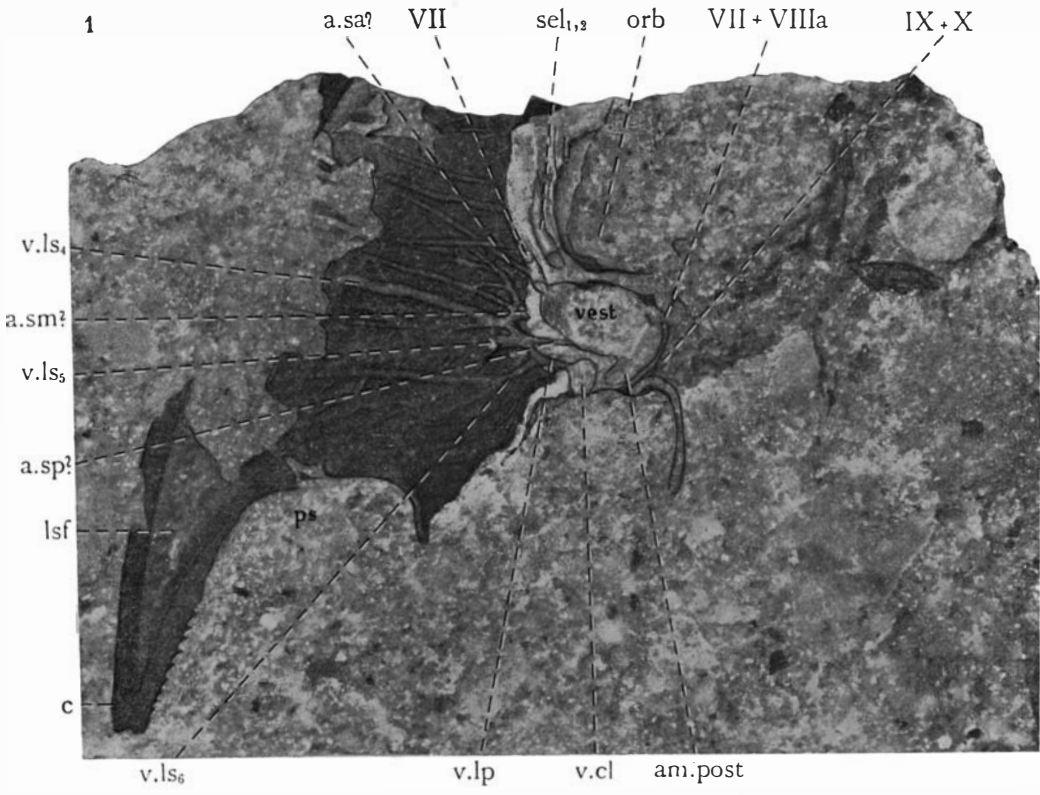
## Pl. 24.

Fig. 1. *Cephalaspis hoeli* n. sp. Postero-lateral part of a cephalic shield in ventral view. The shield prepared so as to show certain of the canals for superficial vessels in the visceral endoskeleton laterally to the orbito-temporal and otic regions. Specimen no. 32. <sup>6</sup>/<sub>1</sub>.

Fig. 2. *Cephalaspis arcticus* n. sp. Cephalic shield in ventral view prepared so as to show the majority of canals in its interior. Same specimen as that figured in pl. 28 and pl. 37, fig. 4. Specimen no. 67. <sup>3</sup>/<sub>2</sub>.

### Explanation of index letters.

*a. sa?*, *a. sm?*, *a. sp?*, canals probably for the dorso-lateral superficial arteries; *am. post*, cavity for the ampulla posterior (section); *c*, cornu; *lsf*, lateral electric field; *orb*, orbit (in fig. 1 in section); *ps*, pectoral sinus; *sel*<sub>1,2</sub>, common canal for the two most anterior nerves for the lateral electric field; *v. cl*, canal for the *v. capitis lateralis* (posterior end, in section); *v. est*, vestibular division of the labyrinth cavity (in fig. 1 in section); *v. lp*, canal for a venous trunk arisen by the confluence of the three most posterior dorso-lateral superficial veins; *v. ls*<sub>4</sub>—*v. ls*<sub>6</sub>, canals for the three most posterior dorso-lateral superficial veins; VII, canal for the passage of the n. facialis from the vestibular division of the labyrinth cavity to the oralo-branchial chamber; VII+VIII*a*, canal for the passage of the facialis roots, the prootic lateralis fibres, the electric nerve-fibres and the anterior branch of the n. acusticus to the labyrinth cavity; IX+X, proximal end of the vagus canal.



## Pl. 25.

*Cephalaspis vogti* n. sp. Posterior part of a cephalic shield in dorsal view. The exoskeleton has been removed so as to show a part of the superficial system of vascular canals and the wider canals of the subaponeurotic (subcutaneous) vascular plexus. Specimen no. 49. Magnification about  $9/2$ .

### Explanation of index letters.

*a. iom*, canal probably for a ramus of the medial infraorbital branch of the a. facialis; *a. la*, canal for an arterial trunk, which distally divided in the two first dorso-lateral superficial arteries; *a. sa*, *a. sm<sub>1</sub>*, *a. sm<sub>2</sub>*, *a. sp*, canals for the dorso-lateral superficial arteries; *a. slcm*, canal for an arterial trunk which bifurcated in the two most posterior dorso-lateral superficial arteries; *c*, cornu; *l*, canal for the lateralis fibres which accompanied the n. trigeminus proper and the n. profundus (ventral wall); *med*, division of the cranial cavity for the medulla oblongata (section); *my*, myodome (ventral wall); *orb*, orbit (only a part of the posterior wall preserved); *ps*, pectoral sinus; *sel<sub>1,2</sub>*, common canal for the two most anterior nerves for the lateral electric field (only a posterior part seen); *sel<sub>3</sub>—sel<sub>6</sub>*, canals for the electric nerves 3—6 for the lateral electric field; *v. cl*, canal for the v. capitis lateralis (posterior part); *vest*, vestibular division of the labyrinth cavity (on both sides in section); *v. lp*, canal for a venous trunk arisen by confluence of the dorso-lateral superficial veins 4—6; *v. ls<sub>3</sub>—v. ls<sub>6</sub>*, canals for the dorso-lateral superficial veins 3—6; *vs. oc*, occipital vein sinus (lateral part); *Vd*, canals for the visceromotor root of the n. trigeminus proper (ventral part only); *VII + VIIIa*, canal for the passage of the facialis roots, the prootic lateralis fibres, the electric nerve fibres and the anterior branch of the n. acusticus to the labyrinth cavity (only a proximal part of the canal to be seen in the figure); *VIIIp*, canal for the posterior branch of n. acusticus; *IXp*, canal for the n. glossopharyngeus leading from the posterior side of the post-branchial wall to the vestibular division of the labyrinth cavity; *IX + X + X vcp*, vagus canal.



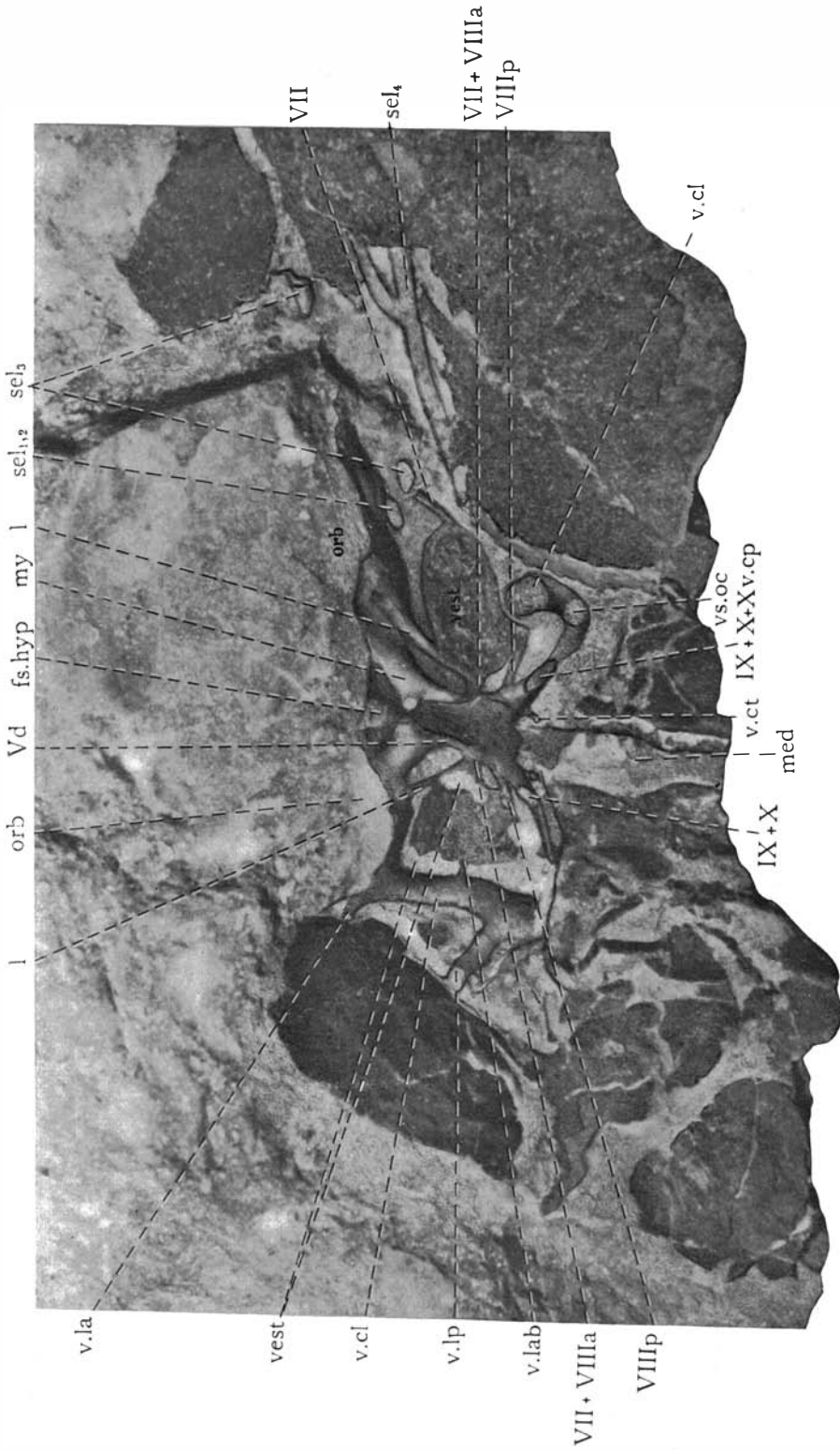


## Pl. 26.

*Cephalaspis vogti* n. sp. Part of a cephalic shield from the ventral side prepared so as to show parts of the cranial cavity and of the labyrinth cavities and certain canals. Counterpart of the specimen figured in pl. 25. Specimen no. 49. Magnification somewhat more than  $\frac{5}{1}$ .

### Explanation of index letters.

*fs. hyp*, fossa hypophyseus (only a posterior part preserved); *l*, canal for the lateralis fibres which accompanied the n. trigeminus proper and the n. profundus; *med*, division of the cavum cerebrale for the medulla oblongata (in section); *my*, myodome; *orb*, orbit (only the posterior wall preserved); *sel<sub>1,2</sub>*, common canal for the two most anterior nerves for the lateral electric field; *sel<sub>3</sub>*, *sel<sub>4</sub>*, canals for the electric nerves 3 and 4 for the lateral electric field; *v. cl*, canal for the v. capitis lateralis; *v. ct*, canal probably for a vein; *vest*, vestibular division of the labyrinth cavity (on one side chiefly the roof preserved; on the other side in section); *v. la*, canal for the proximal part of the dorso-lateral superficial vein 3; *v. lab*, canal either for a vein or for nerves from the labyrinth cavity or for both; *v. lp*, canal for a venous trunk arisen by the confluence of the dorso-lateral superficial veins 4—6; *vs. oc*, occipital vein sinus (mainly only the dorsal wall preserved); *Vd*, canal for the visceromotor root of the n. trigeminus proper; *VII*, canal for the n. facialis from the vestibular division of the labyrinth cavity to the oralo-branchial chamber; *VII+VIIIa*, canal through which the facialis root, the prootic lateralis fibres, the electric nerve fibres and the anterior branch of the n. acusticus left the cranial cavity and entered the labyrinth cavity; *VIIIp*, canal for the posterior branch of the n. acusticus; *IX+X+Xvcp*, vagus canal.

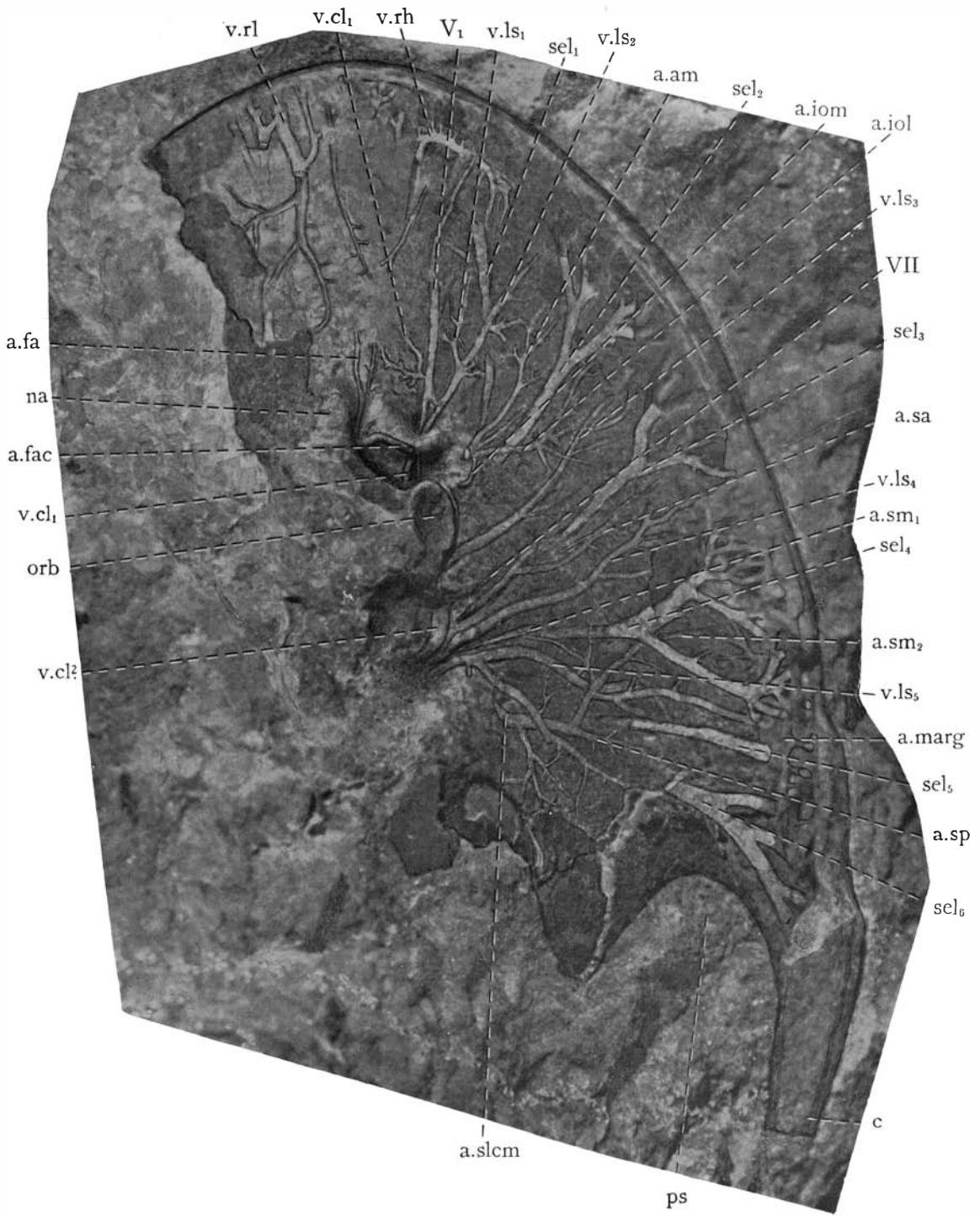


## Pl. 27.

*Cephalaspis vogti* n. sp. Right half of a cephalic shield in dorsal view. The exoskeleton has been removed almost entirely, so that the canals for the superficial vessels are clearly seen. Specimen no. 46. <sup>4</sup>/<sub>1</sub>.

### Explanation of index letters.

*a.am*, canal for the mandibular branch of a. facialis; *a.fa*, canal for an anterior branch of the a. facialis; *a.fac*, canal for the a. facialis; *a.iol*, canal for the lateral infraorbital branch of the a. facialis; *a.iom*, canal for the medial infraorbital branch of the a. facialis; *a.sa*, *a.sm<sub>1</sub>*, *a.sm<sub>2</sub>*, *a.sp*, canals for the dorso-lateral superficial arteries; *a.sbcm*, canal for an arterial trunk which laterally bifurcated into the two posterior dorso-lateral superficial arteries; *c*, cornu; *na*, naso-hypophyseal opening; *orb*, orbital opening; *ps*, pectoral sinus; *sel<sub>1</sub>—sel<sub>6</sub>*, canals for the electric nerves for the lateral electric field; *v.cl?*, perhaps the canal for the v. capitis lateralis; *v.cl<sub>1</sub>*, canal for the preorbital division of the v. capitis lateralis; *v.ls<sub>1</sub>—v.ls<sub>5</sub>*, canals for the dorso-lateral superficial veins 1—5, the canal for the sixth of these veins also seen but not denoted (cf. text-fig. 47); *v.rh*, *v.rl*, canals for the rostral veins, asymmetrically developed; *V<sub>1</sub>*, canal for the n. profundus; *VII*, canal for the n. facialis from the vestibular division of the labyrinth cavity to the oralo-branchial chamber.



## Pl. 28.

*Cephalaspis arcticus* n. sp. Cephalic shield in ventral view. The shield prepared so that the main cavities and canals are exposed more or less completely. Specimen no. 67 (same specimen as in pl. 24, fig. 2, and pl. 37, fig. 4).  $\frac{4}{1}$ .

### Explanation of index letters.

*a. car*, canal for the a. carotis (dorsal part, imperfectly preserved); *a. eff. com*, space which lodged the arteria branchialis efferens communis (section through the anterior end which is filled by matrix); *a. eff.?*, canal perhaps for the efferent branchial artery 7; *a. fa*, canal for an anterior branch of the a. facialis; *a. fac*, canal for the a. facialis; *aort. gr*, aortal groove (section through the groove which is filled by matrix; behind this groove lies the big oesophagus-truncus-arteriosus-foramen, which is not denoted by any letters, but which is clearly seen surrounded by a black bone-layer); *a. subcl*, canal for the a. subclavia; *bu<sub>1</sub>—bu<sub>3</sub>*, canals for branches from the n. buccalis lateralis or for vessels or for both; *fs. hyp*, fossa hypophyseos; *r. aort*, aortal ridge (anterior part partly crushed and badly preserved and to a great extent removed by preparation); *lsf*, lateral electric field; *orb*, orbit; *sel<sub>1,2</sub>*, common canal for the two most anterior nerves for the lateral electric field; *sel<sub>1</sub>—sel<sub>5</sub>*, canals for the nerves 1—5 for the lateral electric field; *v. cl<sub>1</sub>*, canal for the preorbital part of the v. capitis lateralis; *v. ls<sub>1</sub>—v. ls<sub>3</sub>*, canals for the dorso-lateral superficial veins 1—3; *vz*, canal of uncertain importance; *V<sub>1</sub>*, canal for the n. profundus; *V<sub>2</sub>*, canal for the n. trigeminus proper; *V<sub>2v</sub>*, canal for the visceral branch of the n. trigeminus proper; *VII*, canal for the n. facialis leading from the labyrinth cavity to the oralo-branchial chamber; *IXa*, canal for the passage of the n. glossopharyngeus from the labyrinth cavity to the oralo-branchial chamber; *IXav*, canal for the visceral branch of the n. glossopharyngeus; *Xbr*, canal for the first branchial branch of the n. vagus.

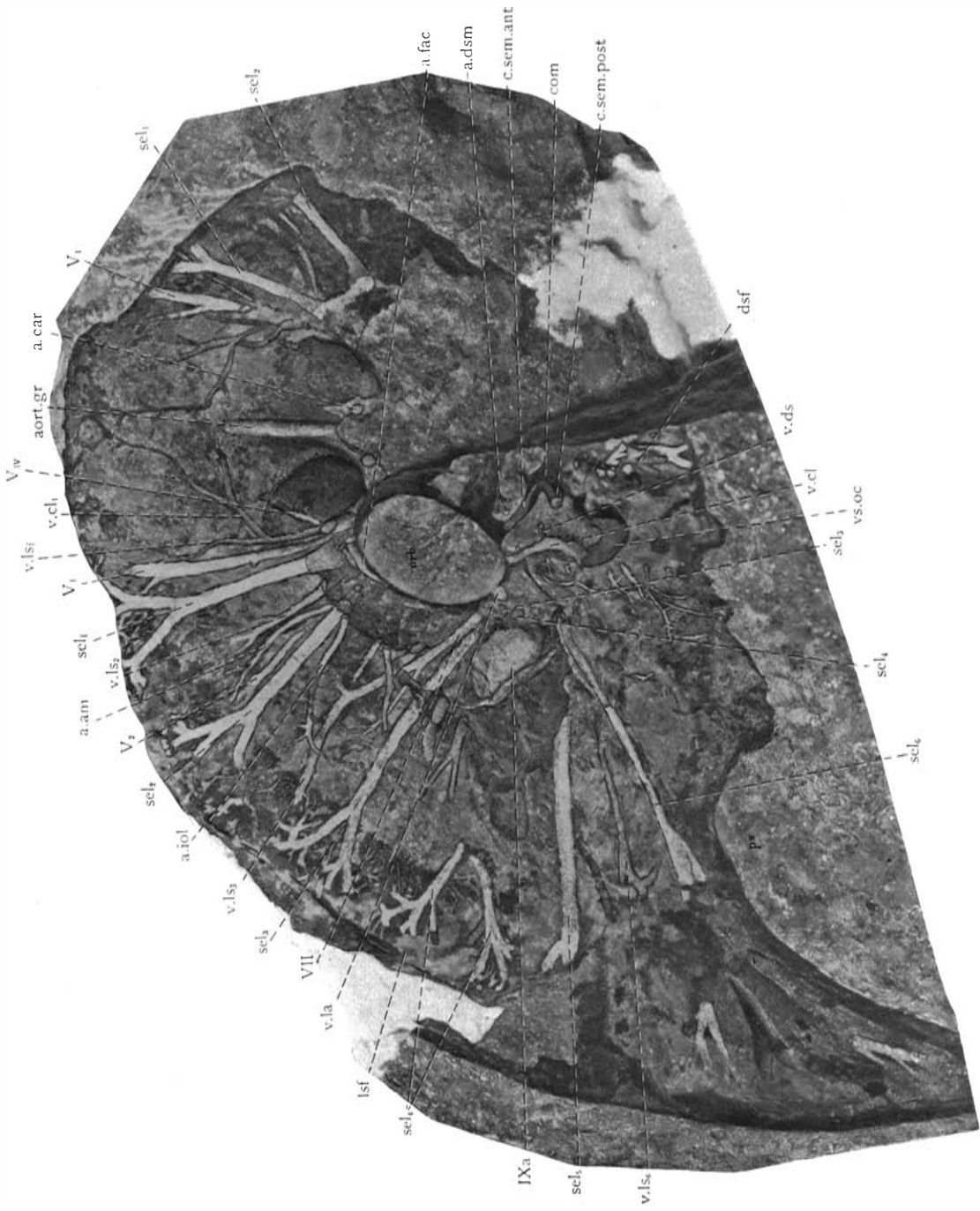


### **Pis. 29, 30.**

*Cephalaspis heintzi* n. sp. Cephalic shield, part and counterpart. In pl. 29 in dorsal view with the exoskeleton removed. In pl. 30 the exoskeleton in ventral view with several of the canals for the superficial vessels etc. adhering to the the ventral surface. Specimen no. 68. Magnification somewhat more than  $2/1$ .

#### Explanation of index letters.

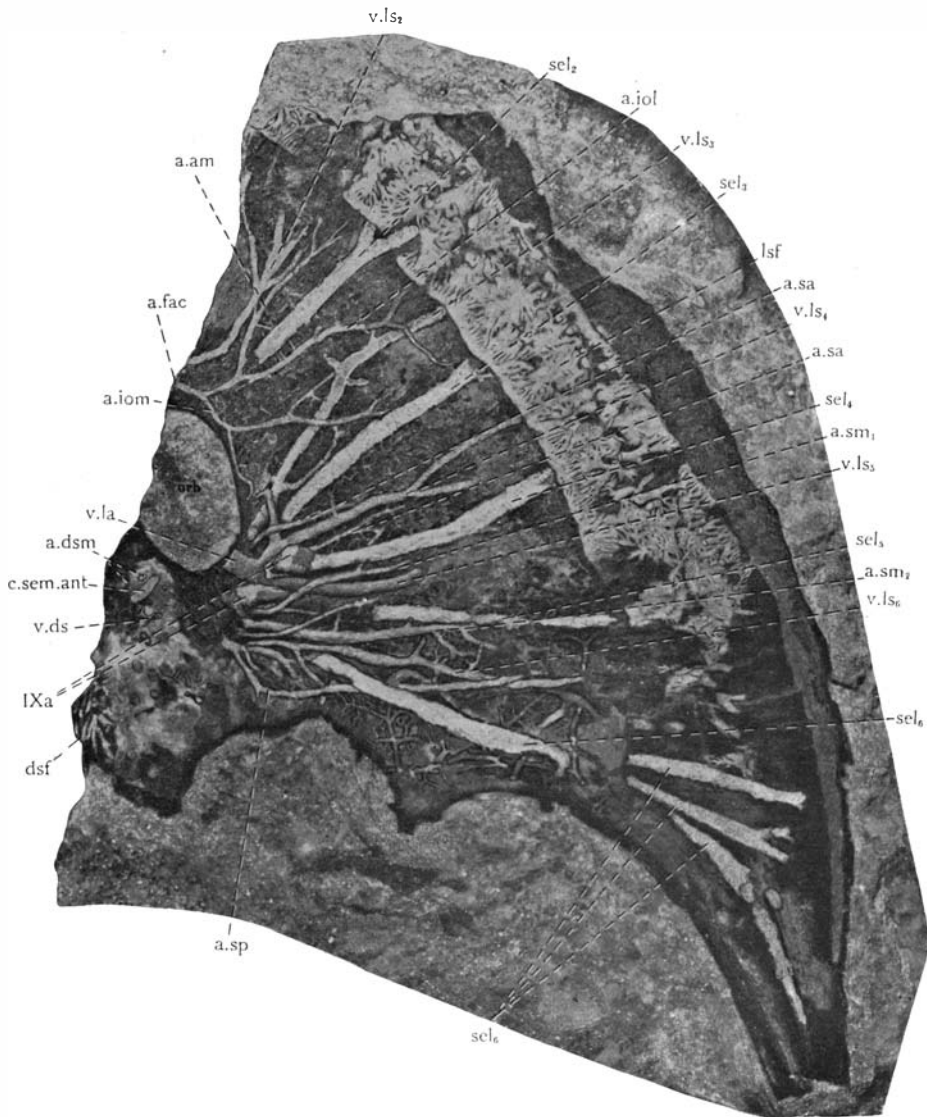
*a.am*, canal for the mandibular branch of the a. facialis; *a.car*, canal for the a. facialis (basal part in section; wrongly denoted here as canal for the carotid artery); *a.dsm*, branches of the canal for the a. superficialis postorbitalis; *a.fac*, canal for the a. facialis; *a.iol*, canal for the lateral infraorbital branch of the a. facialis; *a.iom*, canal for the medial infraorbital branch of the a. facialis; *aort.gr*, aortal groove (impression); *a.sa*, *a.sm<sub>1</sub>*, *a.sm<sub>2</sub>*, *a.sp*, canals for the dorso-lateral superficial arteries 1—4; *com*, commissural division of the labyrinth cavity; *c.sem.ant*, *c.sem.post*, divisions of the labyrinth cavity for the canalis semicircularis anterior and the canalis semicircularis posterior respectively; *dsf*, dorsal electric field (basal part); *lsf*, lateral electric field. Note the branching of the canals for the electric nerves; *orb*, orbital opening; *ps*, pectoral sinus; *sel<sub>1</sub>—sel<sub>6</sub>*, canals for the electric nerves for the lateral electric field; *v.cl*, canal for the v. capitis lateralis; *v.cl<sub>1</sub>*, canal for the preorbital division of the v. capitis lateralis; *v.ds*, canal for a dorsal superficial vein and branches of this canal; *v.la*, canal for a venous trunk arisen by the union of the dorso-lateral superficial veins 3—5; *v.ls<sub>1</sub>—v.ls<sub>6</sub>*, canals for the dorso-lateral superficial veins 1—6; *vs.oc*, occipital vein sinus; *V<sub>1</sub>*, canal for the n. profundus; *V<sub>iv</sub>*, canal-branch probably for the visceral ramus of the n. profundus; *V<sub>2</sub>*, canal for the n. trigeminus proper; *VII*, canal for the passage of the n. facialis from the labyrinth to the oralo-branchial chamber; *IXa*, canal for the passage of the n. glossopharyngeus from the labyrinth to the oralo-branchial chamber.





**Pl. 30.**

For explanation see pl. 29.



### Pl. 31.

Fig. 1. *Cephalaspis vogti* n. sp. Part of the exoskeleton of the upper side of a shield in dorsal view. In the places denoted by the letters *sl*, the superficial layer is preserved and exhibits clearly its pores. Specimen no. 47. <sup>11</sup>/<sub>1</sub>.

Fig. 2. *Cephalaspis kollerii* n. sp. Part of the exoskeleton of the ventral side of the right cornu. Specimen no. 64. Approximately. <sup>1</sup>/<sub>2</sub>.

Fig. 3. *Cephalaspis heintzi* n. sp. Part of the lateral electric field of the specimen in pl. 30. Magnified in order to show more in detail the branching of the canals for the electric nerves. The photograph is taken so that the ventral sides of the canals are displayed. Specimen no. 68. <sup>6</sup>/<sub>1</sub>.

#### Explanation of index letters.

*lsf*, lateral electric field; *obr.f*, oralo-branchial fenestra; *sel<sub>3</sub>*, *sel<sub>4</sub>*, canals for the nerves 3 and 4 for the lateral electric field (impression, the canals themselves to be seen in pl. 29); *sl*, superficial layer of the exoskeleton; *v. ls<sub>3</sub>*, *v. ls<sub>4</sub>*, canals for the dorso-lateral superficial veins 3 and 4 (mainly impressions).

1

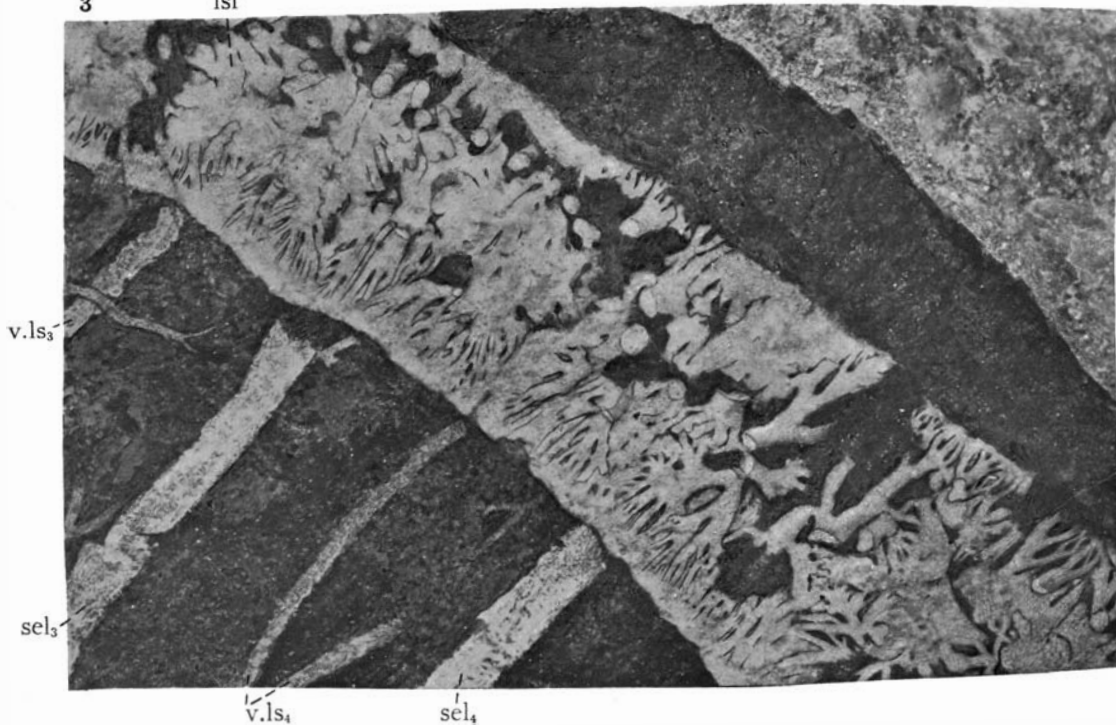


2



3

lsf



### Pl. 32.

Fig. 1. *Cephalaspis eukeraspidoides* n. sp. Cephalic shield in dorsal view. Specimen no. 43. Slightly magnified.

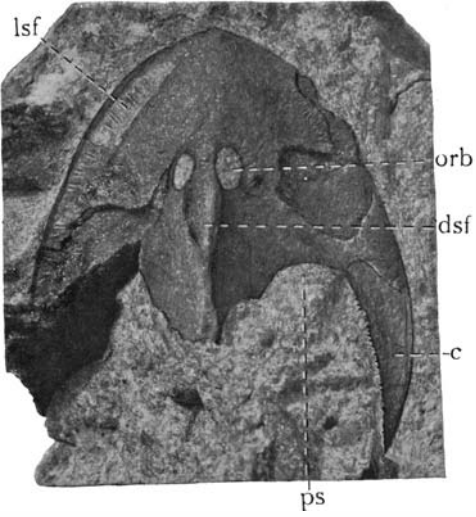
Fig. 2. *Cephalaspis* sp. Part of a cephalic shield in dorsal view. Note the opening of the canal  $d_1$  for the ductus endolymphaticus. Specimen no. 79. <sup>3</sup>/<sub>2</sub>.

Fig. 3. *Cephalaspis kollerii* n. sp. Part of a cephalic shield in ventral view. Specimen no. 60. Diminished.

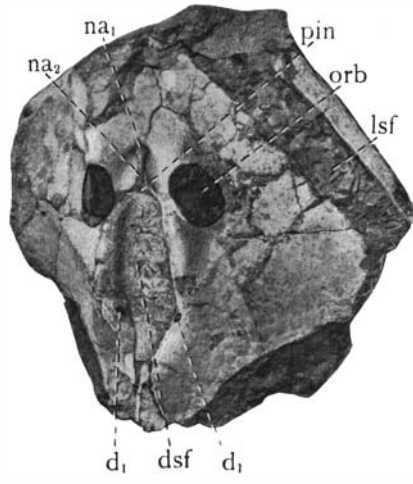
#### Explanation of index letters.

*c*, cornu;  $d_1$ , canal for the ductus endolymphaticus and in addition probably for a vein from the dorsal electric field; *dsf*, dorsal electric field; *lsf*, lateral electric field;  $na_1$ ,  $na_2$ , anterior and posterior divisions of the nasohypophyseal aperture; *orb*, orbital opening; *pin*, pineal opening; *ps*, pectoral sinus.

1



2



3



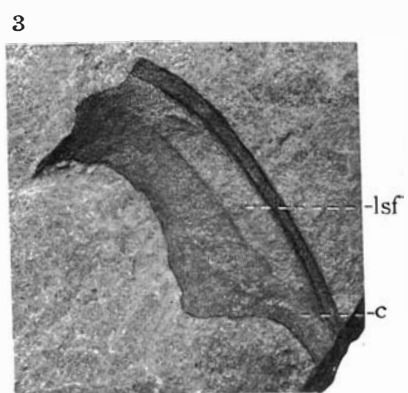
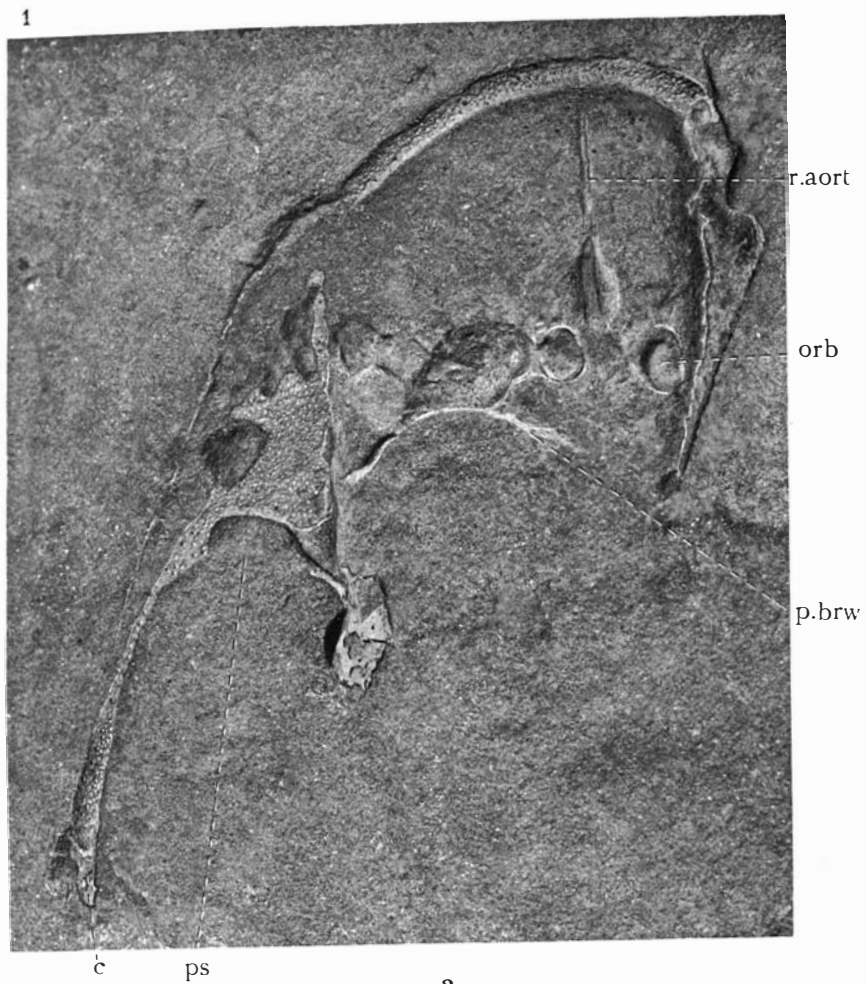
**Pl. 33.**

Fig. 1. *Cephalaspis spitsbergensis* n. sp. Part of cephalic shield in dorsal view. The exoskeleton almost entirely weathered away so that parts of the endoskeleton are distinctly seen. Specimen no. 58. Slightly diminished.

Figs. 2, 3. *Cephalaspis* sp. Fragmentary cephalic shield. Part and counterpart. Specimen no. 88. <sup>1</sup>/<sub>1</sub>.

Explanation of index letters.

*c*, cornu; *lsf*, lateral electric field; *orb*, orbit; *p. brw*, postbranchial wall; *r. aort*, aortal ridge.





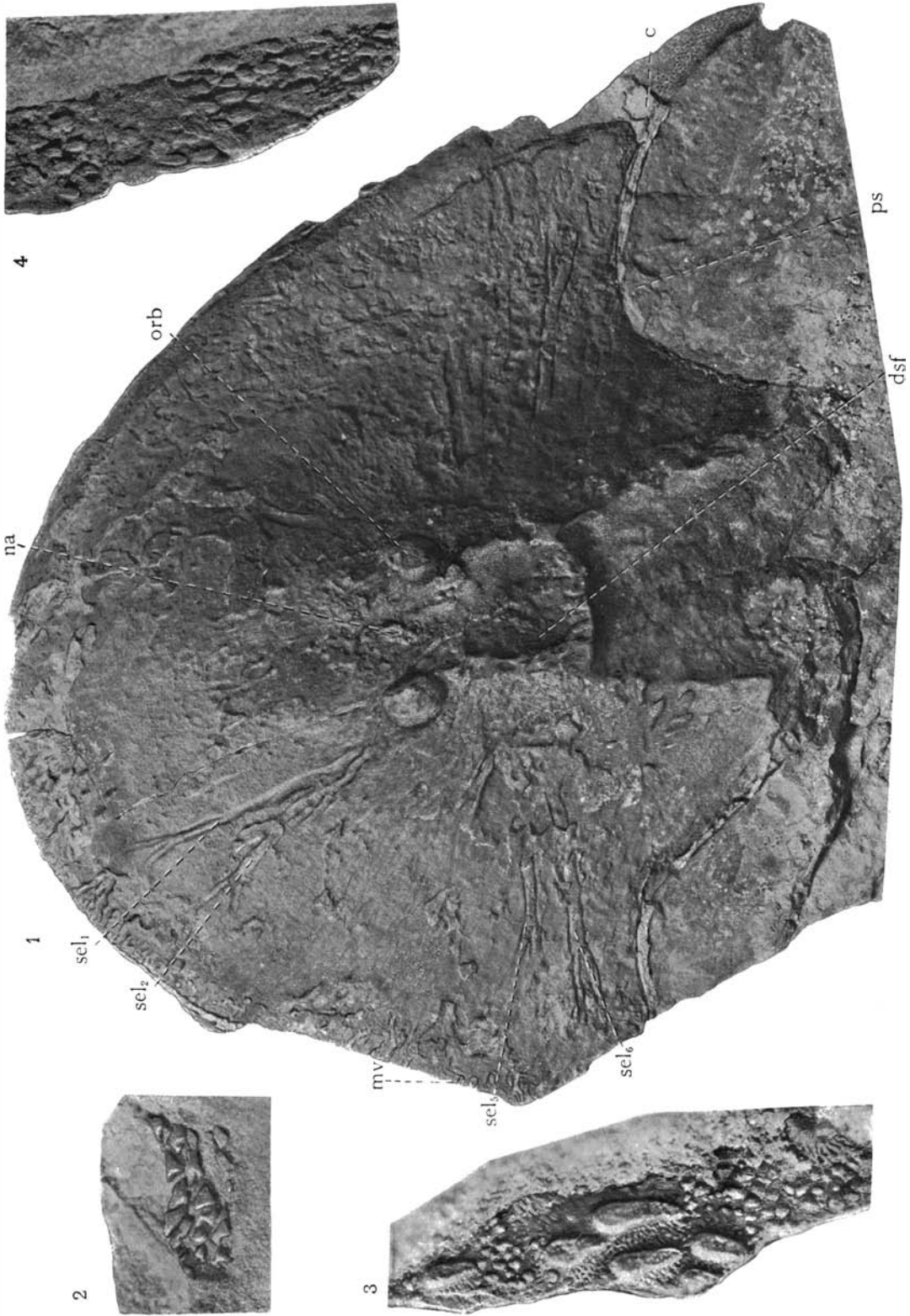
**Pl. 34.**

Fig. 1. *Cephalaspis staxrudi*? n. sp. Cephalic shield in dorsal view. The exoskeleton of the dorsal side weathered away. Specimen no. 57. About  $\frac{4}{5}$  of the nat. size.

Figs. 2—4. *Cephalaspis staxrudi*? n. sp. Ornamentation of the ventral rim of the specimen in fig. 1. Magnification  $\frac{3}{1}$  (fig. 4) and about  $\frac{4}{1}$  (figs. 2, 3).

Explanation of index letters.

*c*, cornu; *dsf*, dorsal electric field; *mv*, canals for marginal superficial vessels; *na*, naso-hypophyseal opening; *orb*, orbital opening; *ps*, pectoral sinus; *sel*<sub>1</sub>, *sel*<sub>2</sub>, *sel*<sub>5</sub>, *sel*<sub>6</sub>, canals 1, 2, 5 and 6 for electric nerves for the lateral electric field.



### Pl. 35.

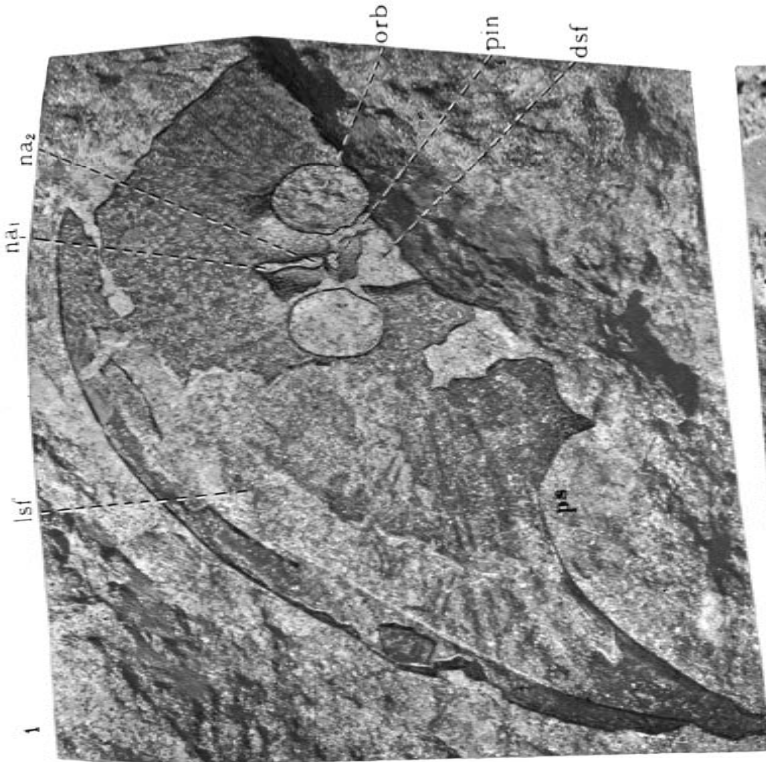
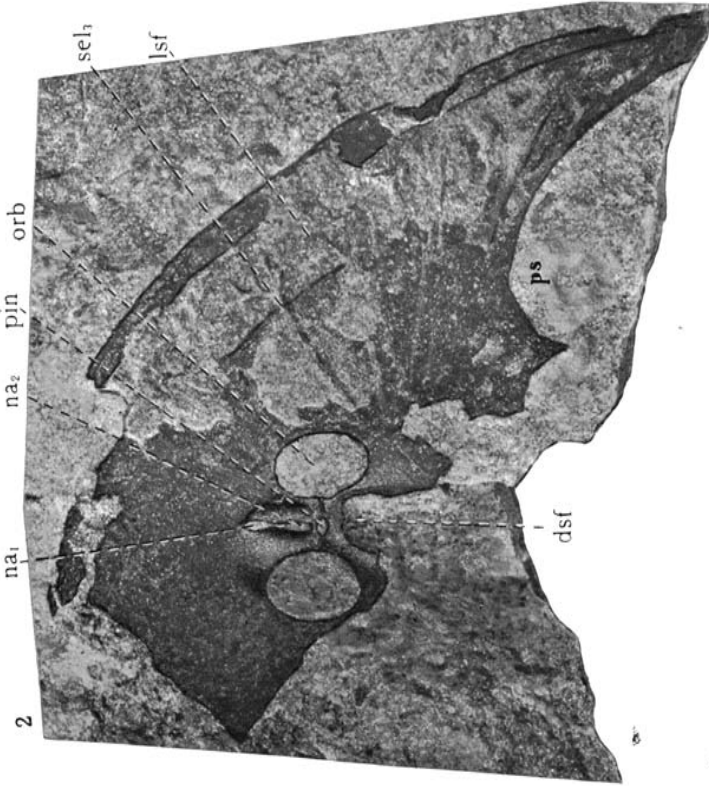
Figs. 1, 2. *Cephalaspis heintzi* n. sp. Cephalic shield. Part and counterpart. Fig. 1 in dorsal view. Fig. 2 impression of the dorsal side. Specimen no. 54.  $\frac{2}{1}$ .

Fig. 3. *Cephalaspis spitsbergensis* n. sp. Ornamentation of the ventral rim. Specimen no. 59. (Same specimen as in pl. 39). Magnification  $\frac{4}{1}$ .

Fig. 4. *Cephalaspis* sp. Ornamentation of the ventral rim. Specimen no. 80. Magnification about  $\frac{5}{1}$ .

#### Explanation of index letters.

*dsf*, dorsal electric field; *lsf*, lateral electric field; *na*<sub>1</sub>, *na*<sub>2</sub>, anterior and posterior division of the naso-hypophyseal aperture; *orb*, orbital opening; *pin*, pineal opening; *ps*, pectoral sinus; *sel*<sub>3</sub>, canal for the electric nerve 3 for the lateral electric field.



### Pl. 36.

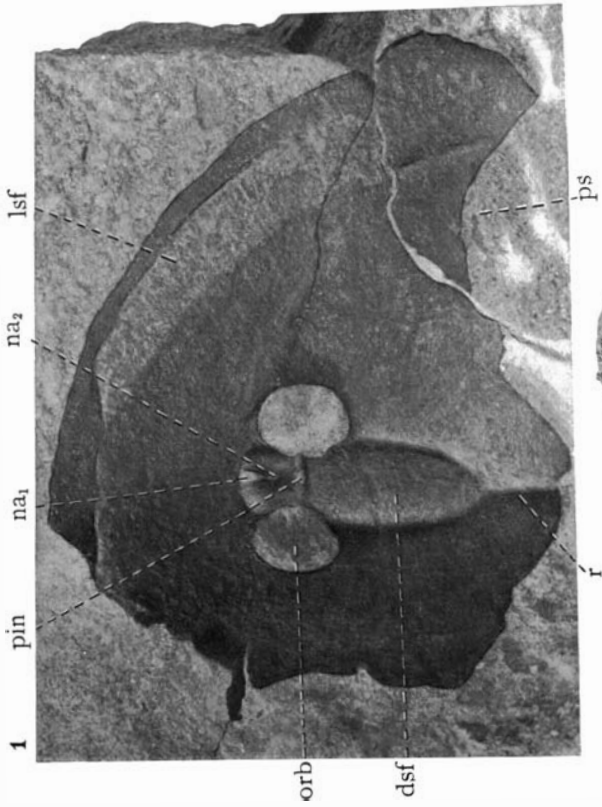
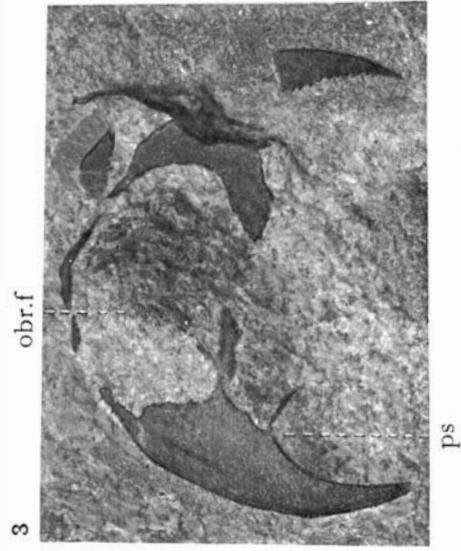
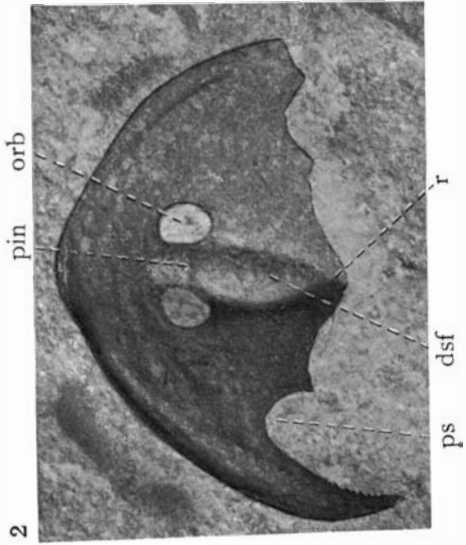
Fig. 1. *Cephalaspis heintzi* n. sp. Impression of a cephalic shield. Specimen no. 53.  $\times 1$ .

Figs. 2, 3. *Cephalaspis heintzi* n. sp. Cephalic shield. Part and counterpart. Specimen no. 52.  $\times 1$ .

Fig. 4. *Cephalaspis staxrudi* n. sp. Part of the squamation of the anterior portion of the trunk. The lateral scales exposed from the medial side, the latero-ventral scales (the fringe-scales) chiefly in section. Specimen no. 57 (the specimen figured in pl. 34). Slightly diminished.

#### Explanation of index letters.

*dsf*, dorsal electric field; *ls*, lateral scales; *lsf*, lateral electric field; *lvs*, latero-ventral scales, so-called fringe-scales; *na<sub>1</sub>*, *na<sub>2</sub>*, anterior and posterior divisions of the nasal aperture; *obr. f.*, oralo-branchial fenestra; *orb*, orbital opening; *pin*, pineal foramen; *ps*, pectoral sinus; *r*, median dorsal ridge (impression).



### Pl. 37.

Fig. 1. *Cephalaspis staxrudi* n. sp. Cephalic shield in dorsal view. The exoskeleton imperfectly preserved. Specimen no. 56. Magnification about  $\frac{3}{2}$ .

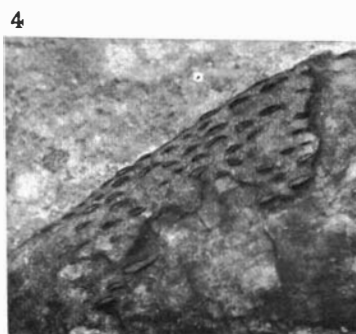
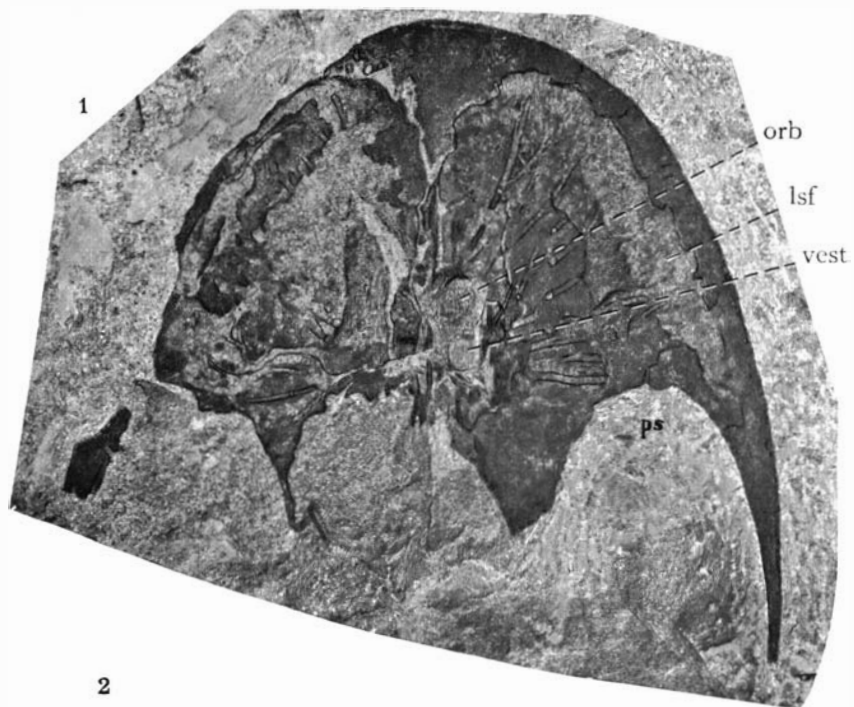
Fig. 2. *Cephalaspis staxrudi* n. sp. Ornamentation of the lower side of the cornu. Same specimen as in the preceding figure. Magnification about  $\frac{12}{1}$ .

Fig. 3. *Cephalaspis apicalis* n. sp. Rostral part of a cephalic shield in dorsal view. The exoskeleton weathered away. Specimen no. 75. Magnification about  $\frac{5}{2}$ .

Fig. 4. *Cephalaspis arcticus* n. sp. Ornamentation of the lower side of the cornu. Specimen no. 67 (same specimen as in pl. 24, fig. 2 and in pl. 28). Magnification about  $\frac{5}{1}$ .

#### Explanation of index letters.

*lsf*, lateral electric field; *orb*, orbital opening; *ps*, pectoral sinus; *vest*, vestibular division of the labyrinth cavity.





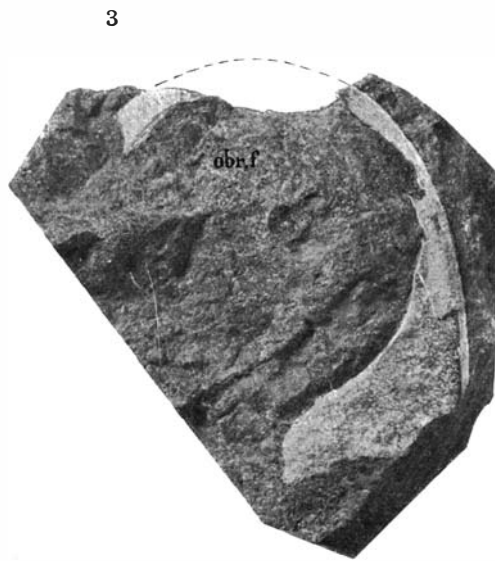
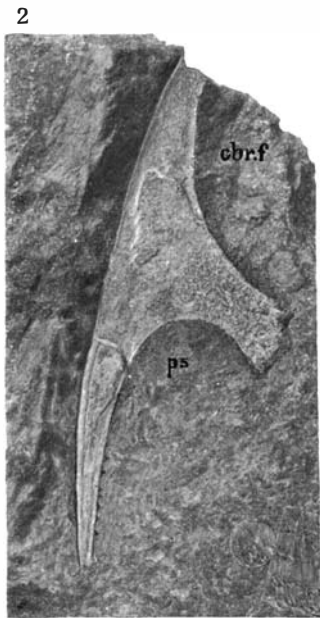
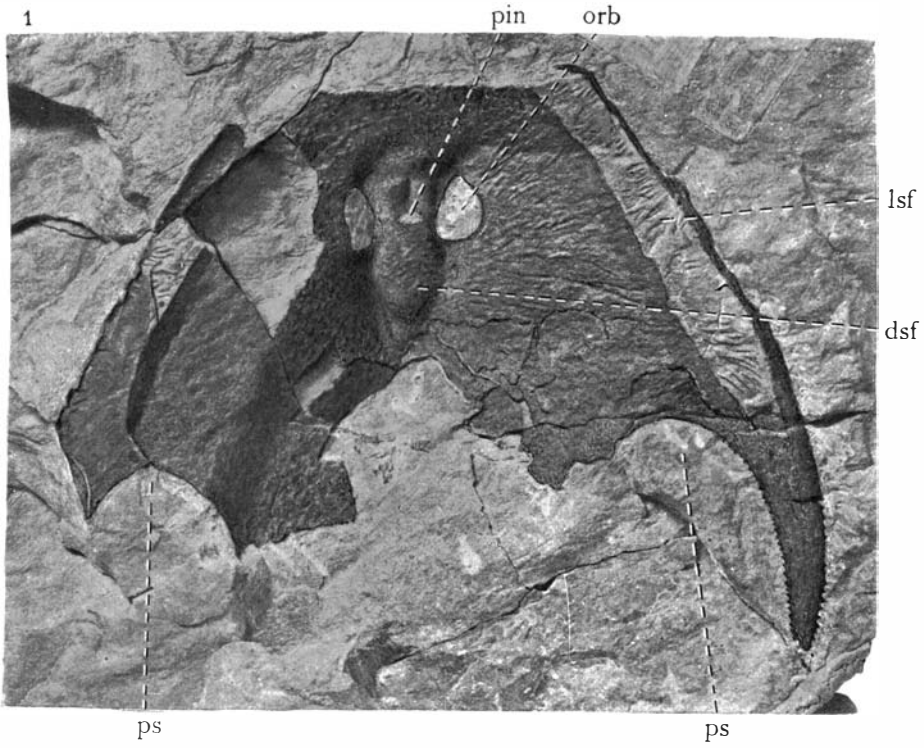
**Pl. 38.**

Fig. 1. *Cephalaspis arcticus* n. sp. Impression of the dorsal side of a cephalic shield. Specimen no. 66. Magnification about  $\frac{3}{2}$ .

Figs. 2, 3. *Cephalaspis gracilis* n. sp. Ventral parts of a cephalic shield. Specimen no. 65. Slightly diminished.

Explanation of index letters.

*dsf*, dorsal electric field; *lsf*, lateral electric field; *obr.f*, oralo-branchial fenestra; *orb*, orbital opening; *pin*, pineal opening; *ps*, pectoral sinus.

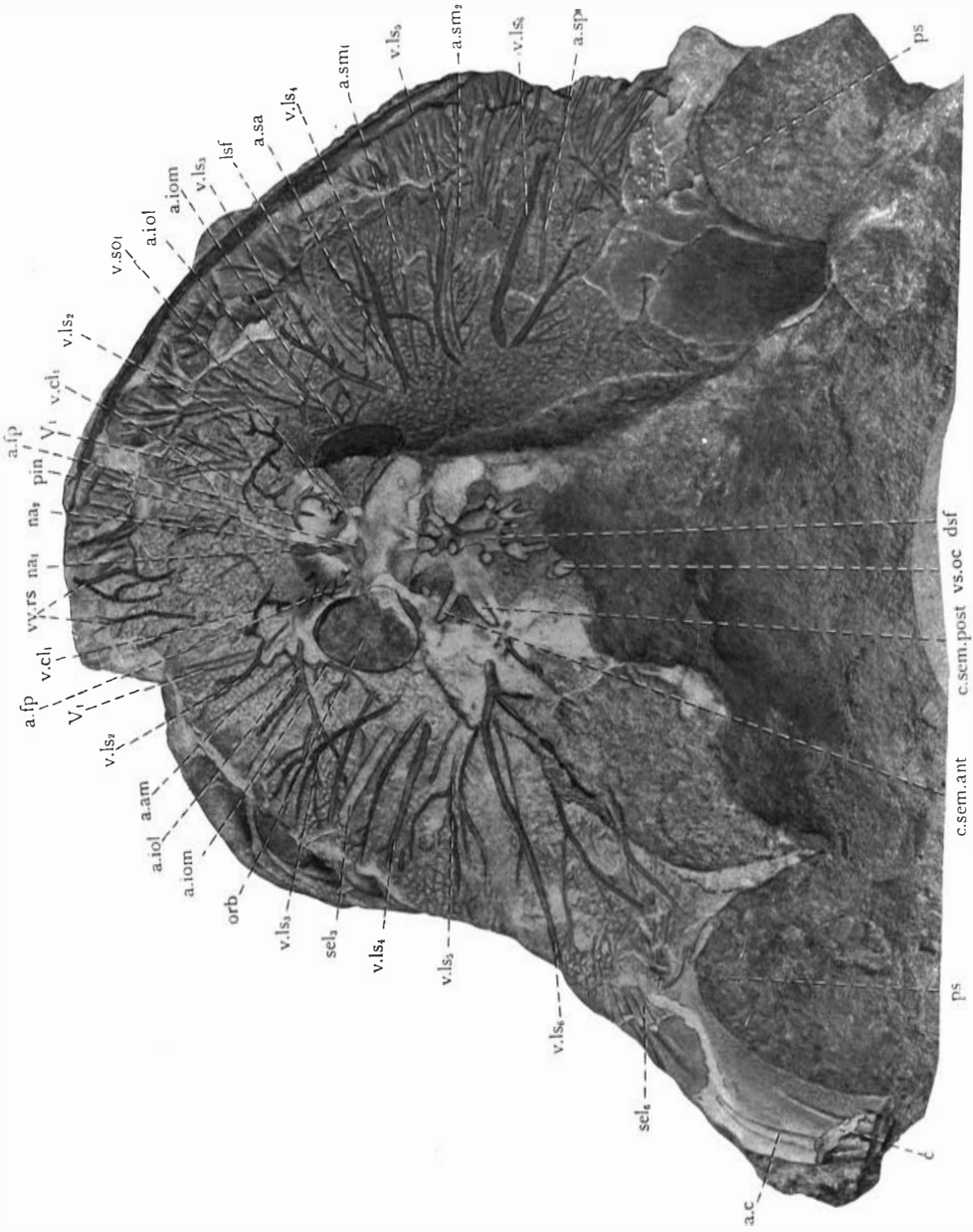


### Pl. 39.

*Cephalaspis spitsbergensis* n. sp. Cephalic shield in dorsal view; a left lateral part and the main part of the cornua lacking. The exoskeleton has been removed so that the canals for the superficial vessels and the canals of the subaponeurotic (subcutaneous) vascular plexus are distinctly displayed. Specimen no. 59 (same specimen as in pl. 35, fig. 3 and pl. 40, fig. 2). Magnification somewhat more than  $2^2$  1.

#### Explanation of index letters.

*a. am*, canal for the mandibular branch of the a. facialis; *a. c.*, canal for the cornual artery; *a. fp*, canal for a posterior branch of the a. facialis, a branch which supplied the fossa circumnasalis; *a. iol*, canal for the lateral infraorbital branch of the a. facialis; *a. iom*, canal for the medial infraorbital branch of the a. facialis; *a. sa*, *a. sm<sub>1</sub>*, *a. sm<sub>2</sub>*, *a. sp*, canals for the dorso-lateral superficial arteries; *c*, cornu; *c. sem. ant*, *c. sem. post*, divisions of the labyrinth cavity for the canalis semicircularis anterior and the canalis semicircularis posterior respectively; *dsf*, dorsal electric field; *lsf*, lateral electric field; *na<sub>1</sub>*, *na<sub>2</sub>*, anterior and posterior divisions of the naso-hypophyseal aperture; *orb*, orbital opening; *pin*, pineal opening; *ps*, pectoral sinus; *sel<sub>3</sub>*, *sel<sub>6</sub>*, canals for the electric nerves 3 and 6 for the lateral electric field; *v. cl<sub>1</sub>*, canal for the preorbital division of the v. capitis lateralis; *v. ls<sub>2</sub>*—*v. ls<sub>6</sub>*, canals for the dorso-lateral superficial veins 2—6; *vv. rs*, rostral superficial veins; *vs. oc*, occipital vein sinus (posterior corner); *V<sub>1</sub>*, canal for the n. profundus.



#### Pl. 40.

Fig. 1. *Cephalaspis* sp. Part of the ventral rim with ornamentation. Specimen no. 78. <sup>4</sup>/<sub>1</sub>.

Fig. 2. *Cephalaspis spitsbergensis* n. sp. Cephalic shield in ventral view. Specimen no. 59 (same specimen as in pl. 39). <sup>1</sup>/<sub>1</sub>.

Fig. 3. *Cephalaspis kollerii*? n. sp. Part of a cephalic shield in ventral view. Specimen no. 61. Slightly diminished.

Fig. 4. *Cephalaspis apicalis*? n. sp. Part of a cephalic shield from the ventral side. Specimen no. 76. Magnification about <sup>5</sup>/<sub>2</sub>.

Fig. 5. *Cephalaspis arcticus*? n. sp. Part of the exoskeleton of the upper side of a cephalic shield in ventral view. Certain of the canals for the superficial vessels and numerous canals of the subaponeurotic (subcutaneous) vascular plexus clearly seen. Specimen no. 69. <sup>2</sup>/<sub>1</sub>.

#### Explanation of index letters.

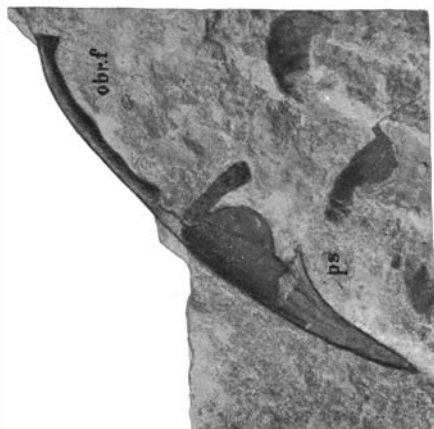
*a. am*, canal for the lateral infraorbital branch of the a. facialis or for the mandibular branch of same artery; *a. fa*, canal for an anterior branch of the a. facialis; *a. fac*, canal for the a. facialis; *a. iom*, canal for the medial infraorbital branch of the a. facialis; *dpr*, area which bounded the mouth cavity on the dorsal side; *dsf*, dorsal electric field; *na*, naso-hypophyseal opening; *obr. f*, oralo-branchial fenestra; *orb*, orbit and orbital opening; *pin*, pineal opening; *ps*, pectoral sinus; *r. aort*, aortal ridge (anterior part); *v. cl<sub>1</sub>*, canal for the preorbital division of the v. capitis lateralis. Anteriorly this canal merges into the canal for the first dorsolateral superficial vein which in its turn is continuous with the rostral veins; *v. ls<sub>3</sub>*, *v. ls<sub>4</sub>*, canals for the dorsolateral superficial veins 3 and 4.



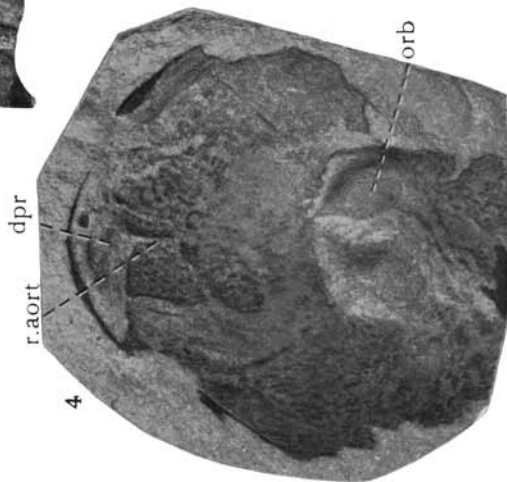
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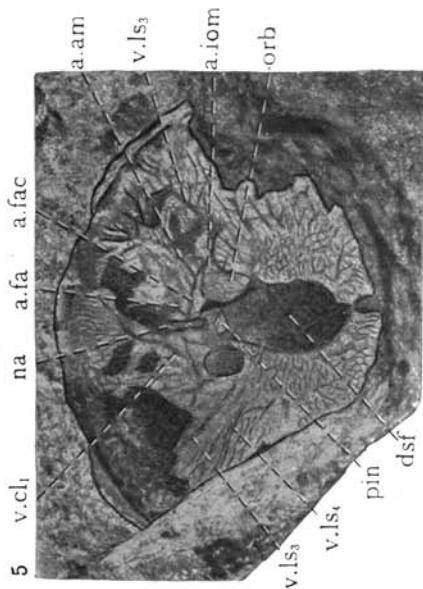
2



3



4



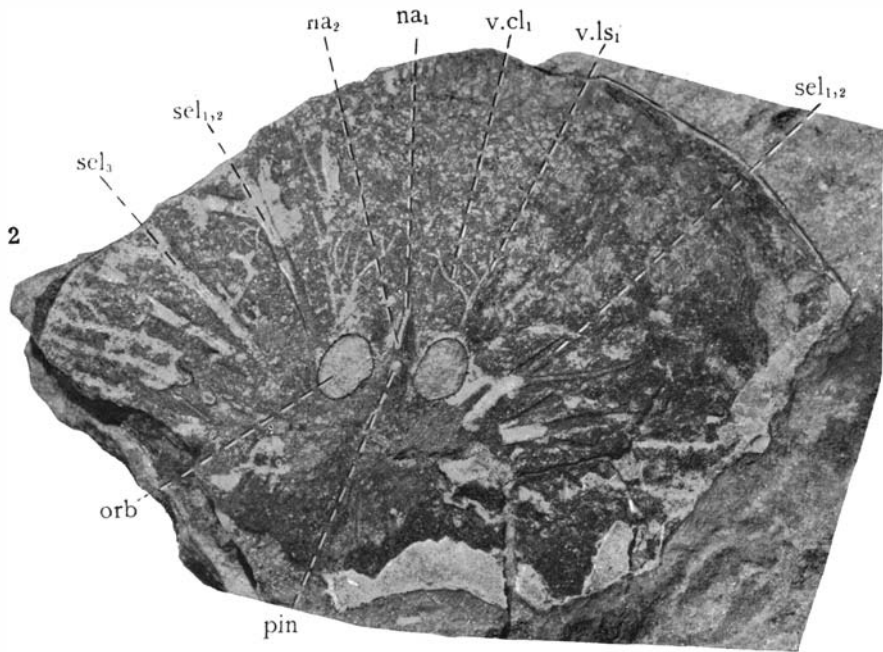
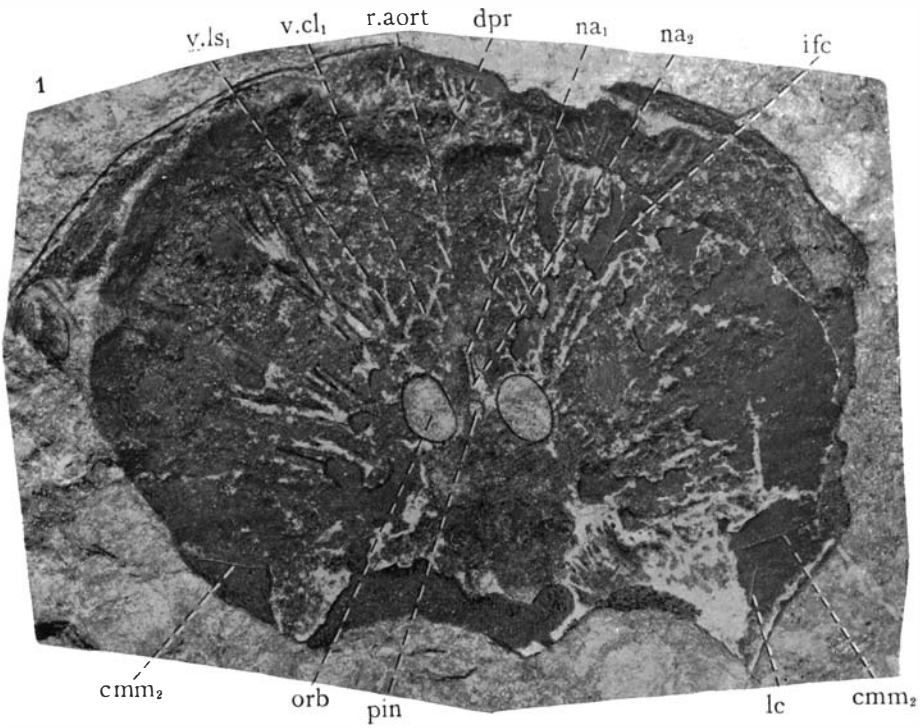
5

**Pl. 41.**

Fig. 1. 2. · *Beneviaspis hottedahli* n. g., n. sp. Fragmentary cephalic shield. Part and counterpart. Specimen no. 71. 2/1.

Explanation of index letters.

*cmm*<sub>2</sub>, transversal sensory canal groove, corresponding either to the posterior head-line of pit organs or to the supratemporal commissure of fishes (preserved as an impression); *dpr*, area which bounded the mouth cavity on the dorsal side; *ifc*, sensory canal groove corresponding to the infraorbital canal of fishes (preserved as an impression); *lc*, groove representing the cephalic division of the main lateral line of fishes (preserved as impression); *na*<sub>1</sub>, *na*<sub>2</sub>, anterior and posterior division of the naso-hypophyseal aperture; *orb*, orbital opening; *pin*, pineal opening; *r. aort*, aortal ridge (a fragment of the most rostral part); *sel*<sub>1,2</sub>, common canal of the two most anterior nerves for the lateral electric field; *sel*<sub>3</sub>, canal for the electric nerve 3 for the lateral electric field; *v. cl*<sub>1</sub>, canal for the orbital division of the v. capitis lateralis; *v. ls*<sub>1</sub>, canal for the dorso-lateral superficial vein 1.



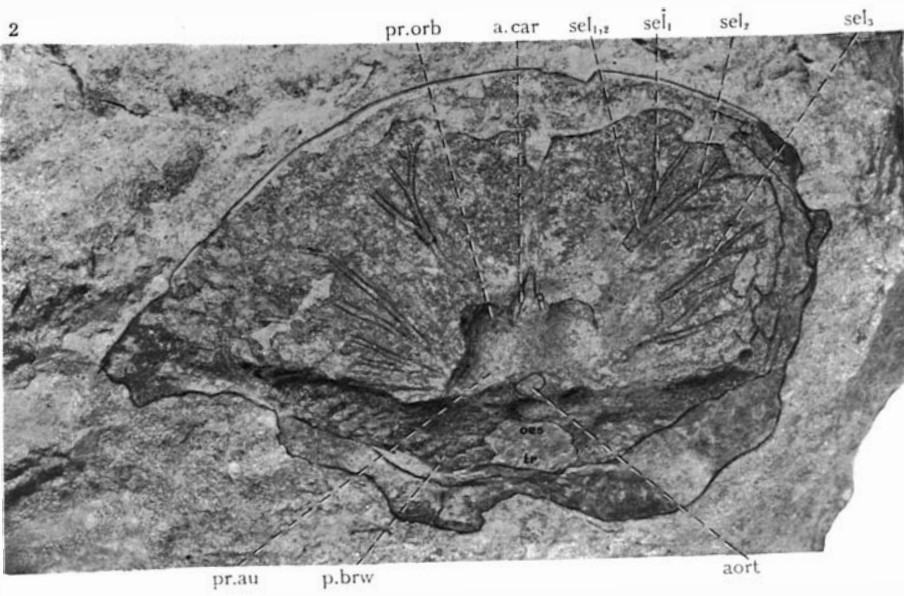
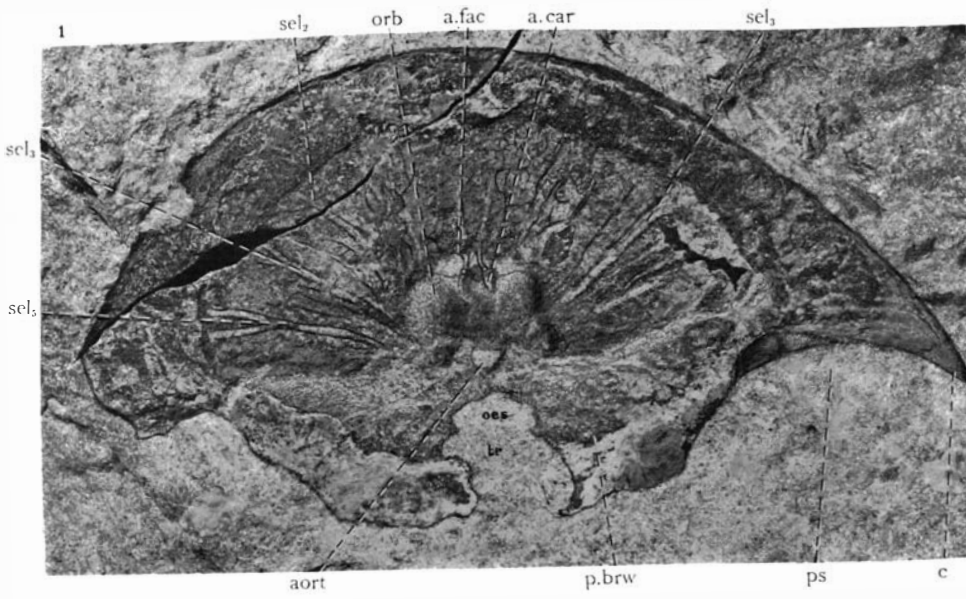


**Pl. 42.**

Figs. 1, 2. *Beneviaspis holtedahli* n. sp. Cephalic shield. Part and counterpart. The shield has split so that the postbranchial wall and certain interior parts are seen. Specimen no. 72. <sup>5</sup>/3.

Explanation of index letters.

*a. car*, canal for the carotid artery; *a. fac*, canal for the a. facialis; *aort*, canal for the aorta through the postbranchial wall; *c*, cornu; *oes + tr*, foramen for the oesophagus and the truncus arteriosus; *orb*, orbit (ventral view); *p. brw*, postbranchial wall; *pr. au*, *pr. orb*, impressions of the otical and orbital prominences respectively; *ps*, pectoral sinus; *sel<sub>1,2</sub>*, common canal for the electric nerves 1 and 2 for the lateral electric field; *sel<sub>1</sub>-sel<sub>3</sub>*, *sel<sub>5</sub>*, canals for the nerves 1, 2, 3 and 5 for the lateral electric field.



**Pl. 43.**

Fig. 1. *Benneviaspis holtedahli* n. sp. Cephalic shield in dorsal view. Specimen no. 70. Magnification  $\frac{3}{2}$ .

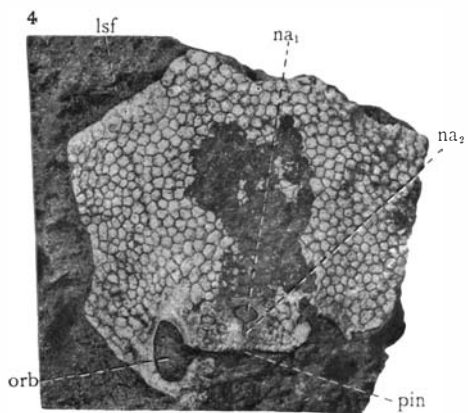
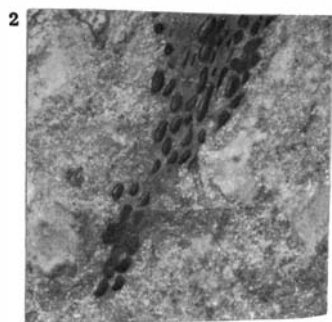
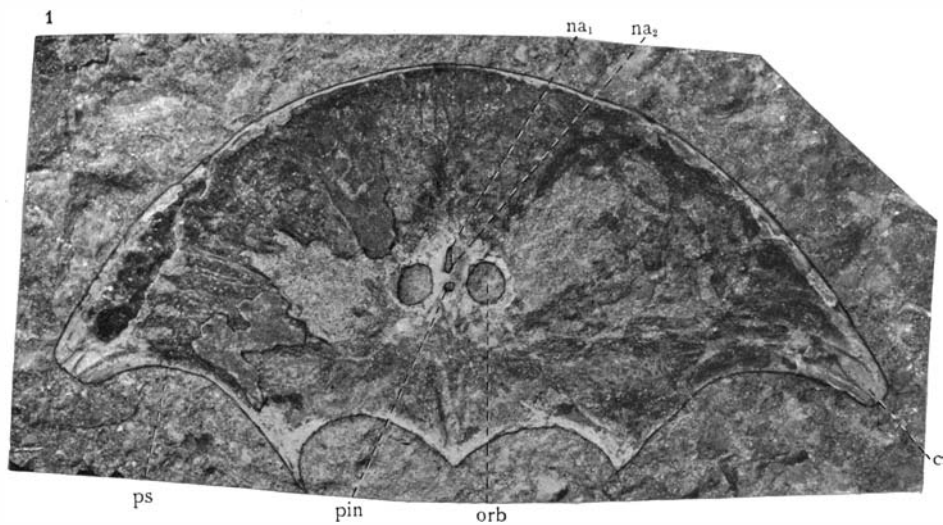
Fig. 2. *Cephalaspis kollerii* n. sp. Ornamentation on the posterior part of the lower side of the cornu. Specimen no. 64. (Same specimen as in pl. 31, fig. 2).  $\frac{3}{1}$ .

Fig. 3. *Cephalaspis* sp. Ornamentation on the lower side of the cornu. Specimen no. 87. Slightly enlarged.

Fig. 4. *Cephalaspis* sp. Dorso-median part of the exoskeleton of a cephalic shield in dorsal view. The subdivision of the external parts of the exoskeleton in polygonal areas very well shown. Specimen no. 113. Some what diminished.

Explanation of index letters.

*c*, cornu; *lsf*, lateral electric field; *na*<sub>1</sub>, *na*<sub>2</sub>, anterior and posterior division of the naso-hypophyseal aperture; *orb*, orbital opening; *pin*, pineal opening; *ps*, pectoral sinus.



## Pls. 44, 45.

*Hoelaspis angulata* ng. n. sp. Cephalic shield. Part and counterpart. Specimen no. 89. <sup>8</sup>/<sub>1</sub>.

Pl. 44 shows the cephalic shield in dorsal view, but with considerable parts of the skeleton removed so that an impression of a part of the dorsal side of the oralo-branchial chamber is seen.

Pl. 45 shows the cephalic shield from the ventral side with certain parts removed so that the cavities and canals in the interior are well displayed. Note that a considerable part of the main vascular canals of the subaponeurotic (subcutaneous) vascular plexus are exposed.

### Explanation of index letters.

*a. car*, canal for the carotid artery (in pl. 44 it is well seen how it leaves the aortal groove); *a. eff<sub>1</sub>*—*a. eff<sub>3</sub>*, grooves for the efferent branchial arteries 1—3 (preserved as impressions and therefore appearing as ridges); *a. fa*, canal for an anterior branch from the a. facialis; *a. fac*, canal for the a. facialis; *a. marg*, canal for the marginal artery; *am. post*, cavity for the ampulla posterior (section); *aort. gr*, aortal groove (in pl. 44 impression, and it is clearly seen that posteriorly it lies asymmetrically on the right side of the median line); *a. sa?*, canal probably for the dorso-lateral superficial artery 1; *a. slcm*, canal for an arterial trunk, which laterally divided in the two most posterior dorso-lateral superficial arteries; *a. sm*, canal probably for the third dorso-lateral superficial artery; *a. sp*, canal for the most posterior dorso-lateral superficial artery (in pl. 44 on the right side probably the proximal end of the canal shown); *bu<sub>2</sub>*, canal probably for a branch from the n. buccalis lateralis or for vessels or for both); *c*, cornu (only a proximal part preserved); *c. post*, canal for the posterior encephalic artery; *c. sem. post*, division of the labyrinth cavity for the canalis semicircularis posterior; *fs. hyp*, fossa hypophyseos (the internal perichondral bone-layer destroyed ventrally so, that the stone-filling of the cranial cavity and thus also the filling of the fossa hypophyseos is clearly seen); *hy. s*, division of the ethmoidal cavity for the hypophyseal sac; *k<sub>1</sub>*—*k<sub>3</sub>*, branchial fossae 1—3 (ventro-lateral parts); *l*, canal for the lateralis fibres, which accompanied the n. trigeminus proper and the n. profundus; *med*, division of the cavum cerebrale for the medulla oblongata (in pl. 44 only a posterior part. Anteriorly to that we see in pl. 44 a ventral portion of the internal bone-layer that lined a ventral part of the cranial cavity); *my*, myodome (mainly only the matrix filling it seen); *nd<sub>1</sub>*, canal for a dorsal myelonal vein and in addition for a dorsal root of a spino-occipital nerve; *orb*, orbit (mainly the stone-filling of it preserved); *pr. orb*, impression of the orbital prominence; *ps*, pectoral sinus; *r. pm*, prebranchial ridge (in section and as impression); *sel<sub>1,2</sub>*, common canal for the two most anterior nerves for the lateral electric



field;  $sel_1$ — $sel_6$ , canals for the electric nerves for the lateral electric field;  $va$ , canal probably for an arterial branch from the truncus arteriosus;  $v. cl$ , canal for the v. capitis lateralis (in pl. 44 the posterior part and the posterior orifice; in pl. 45 rather completely preserved);  $v. cl_1$ , canal for the preorbital division of the v. capitis lateralis;  $vest$ , vestibular division of the labyrinth cavity (in pl. 44 section; in pl. 45 a part of the dorsal wall);  $v. lp$ , canal for a venous trunk arisen by the confluence of the dorso-lateral superficial veins 5 and 6;  $v. ls_1$ — $v. ls_4$ , canals for the dorso-lateral superficial veins 1—4;  $v. marg$ , canal for the marginal vein;  $v. rm$ , median rostral vein;  $vs. r$ , rostral vein sinus; V, canal probably for the visceromotor roots of the n. trigeminus proper (or perhaps for all the roots of the trigeminus-profundus ganglionic complex);  $V_1$  canal for the n. profundus (in pl. 44 only impression);  $V_{1v}$ , short branch from the canal  $V_1$  probably for a visceral branch from the n. profundus; VII, canal for the passage of the n. facialis from the labyrinth cavity to the oralo-branchial chamber (in pl. 44 the distal part and the opening in the oralo-branchial chamber);  $VIIv$ , canal for the visceral branch of the n. facialis;  $IXa$ , canal for the passage of the n. glossopharyngeus from the labyrinth cavity to the oralo-branchial chamber (it is distinctly seen here how it crosses the canal  $sel_4$  on the ventral side);  $IX + X + Xvcp$ , vagus canal.

#### Pl. 45.

For explanation see pl. 44.





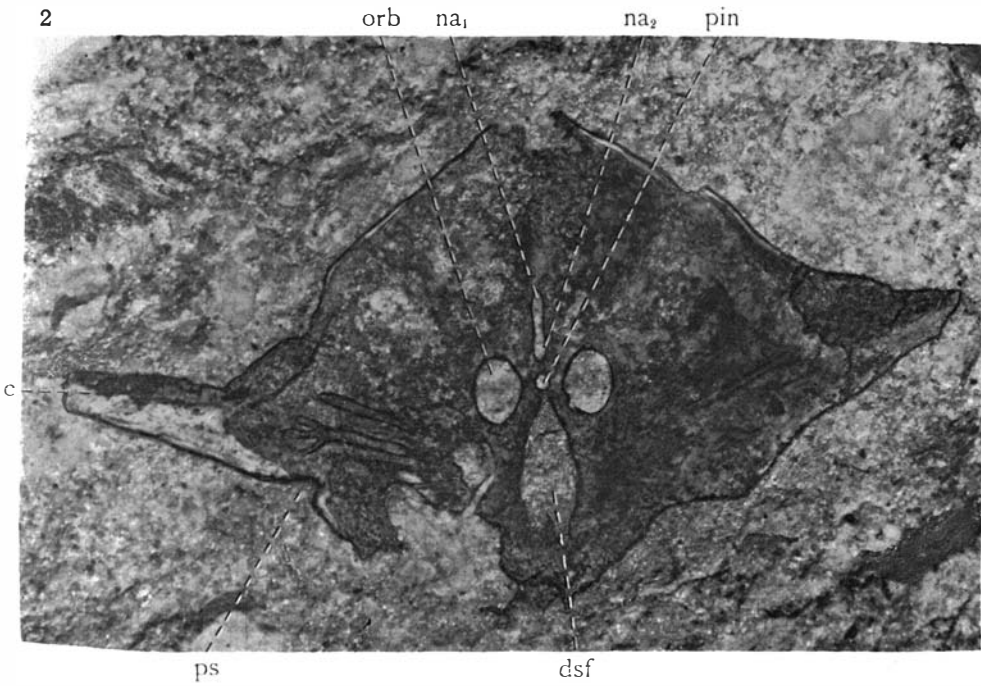
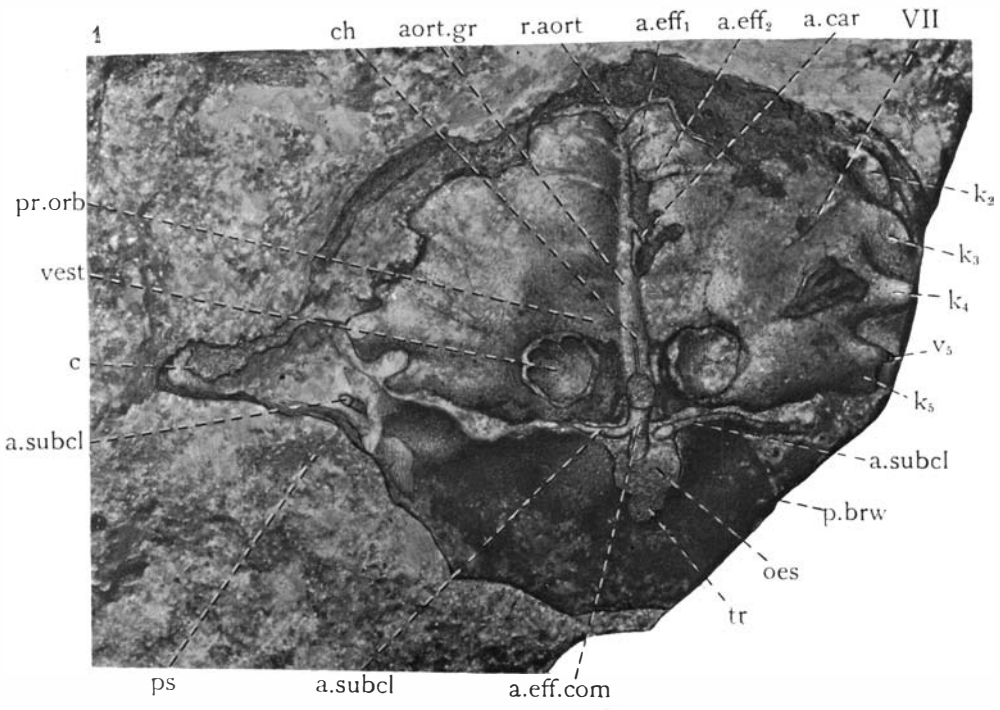
## Pl. 46.

Fig. 1. *Hoelaspis angulata* n. g. n. sp. Cephalic shield in dorsal view. The dorso-medial part represented mainly only by an impression of the ventral side, that is to say by an impression of the dorsal surface of the oralo-branchial chamber. The postbranchial wall is also well displayed. Specimen no. 91. About  $\frac{6}{1}$ .

Fig. 2. *Hoelaspis angulata* n. g. n. sp. Cephalic shield in dorsal view. Specimen no. 92. About  $\frac{5}{1}$ .

### Explanation of index letters.

*a. car*, canal for the a. carotis (preserved only on the right side); *a. eff<sub>1</sub>—a. eff<sub>2</sub>*, grooves for the efferent branchial arteries 1 and 2 (preserved as impressions); *a. eff. com*, canal for the a. branchialis efferens communis, a vessel arisen by the confluence of the efferent branchial arteries 4—6; *aort. gr*, aortal groove (impression); *a. subcl*, canal for the a. subclavia; *c*, cornu; *ch*, canal for the notochord; *dsf*, dorsal electric field; *k<sub>2</sub>—k<sub>5</sub>*, branchial fossa 2—5 (ventro-lateral part); *na<sub>1</sub>, na<sub>2</sub>*, anterior and posterior divisions of the naso-hypophyseal opening; *oes+tr.* foramen for the oesophagus and for the truncus arteriosus; *orb*, orbital opening; *p. brw*, postbranchial wall (posterior surface displayed); *pin*, pineal opening; *ps*, pectoral sinus; *pr. orb*, impression of the orbital prominence; *r. aort*, aortal ridge (impression); *v<sub>5</sub>*, canal for the ventral transversal superficial vein 5; *vest*, vestibular division of the labyrinth cavity (a part of the floor); VII, canal for the n. facialis (distal part and opening in the oralo-branchial chamber).



## Pl. 47.

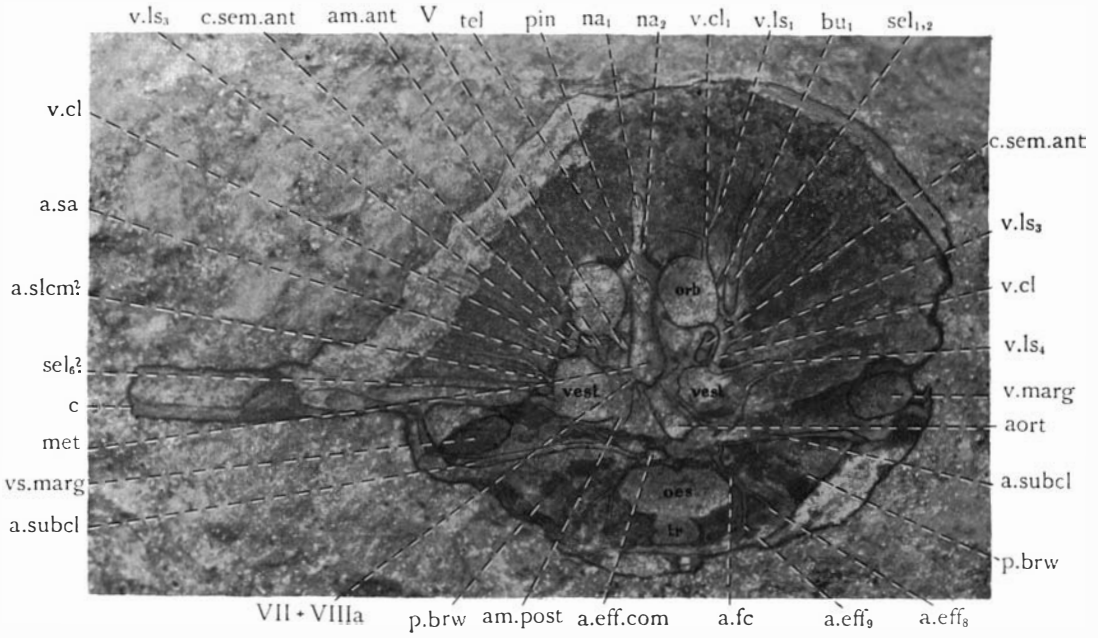
Fig. 1. *Hoelaspis angulata* n. g., n. sp. Cephalic shield in dorsal view. A posterior and dorsal part lacking and on account of this the cavum cerebrale cranii and the postbranchial wall (*p. brw*) exposed. Specimen no. 90. Somewhat less than  $\frac{6}{1}$ .

Fig. 2. *Trematraspis* sp. anterior part of the cephalic shield in dorsal view. The exoskeleton almost entirely removed and certain of the interior canals and cavities exposed. Specimen belonging to the Palaeontological institution of Upsala. Somewhat less than  $\frac{6}{1}$ .

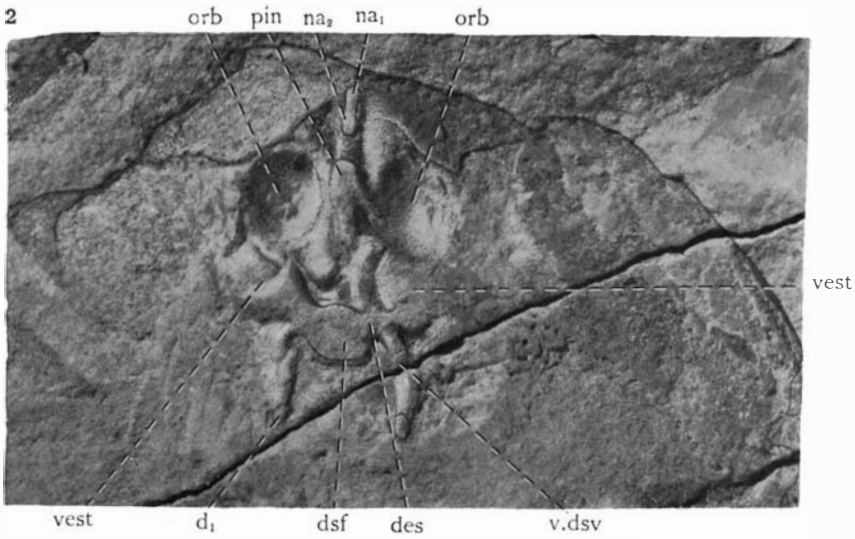
### Explanation of index letters.

*a. eff*<sub>8</sub>, *a. eff*<sub>9</sub>, canals for the efferent branchial arteries 8 and 9; *a. eff. com*, canal for the arteria branchialis efferens communis, a vessel arisen by the confluence of the efferent branchial arteries 4—6; *a. fc*, canal for an artery arisen by the confluence of the efferent branchial arteries 8 and 9; *am. ant*, cavity for the ampulla anterior (section); *am. post*, cavity for the ampulla posterior (section); *aort*, canal for the aorta through the postbranchial wall (note the very asymmetric position of the canal in question); *a. sa*, canal probably for the first dorso-lateral superficial artery; *a. slcm*?, canal which probably lodged an arterial trunk which bifurcated in the two most posterior dorso-lateral superficial arteries; *a. subcl*, canal for the a. subclavia; *bu*, canal for a branch from the n. buccalis lateralis or for vessels or for both; *c*, cornu; *c. sem. ant*, *c. sem. post*, divisions of the labyrinth cavity for the anterior and posterior semicircular canals respectively; *d*<sub>1</sub>, opening probably for the ductus endolymphaticus (the opening was situated on the external surface of the exoskeleton); *des*, canal for the nerve for the dorsal electric field; *dsf*, dorsal electric field (only the most basal part preserved); *met*, division of the cavum cerebrale cranii for the cerebellum; *na*<sub>1</sub>, *na*<sub>2</sub>, anterior and posterior divisions of the naso-hypophyseal aperture; *orb*, orbital opening and orbit; *p. brw*, postbranchial wall; *pin*, pineal canal; *sel*<sub>1,2</sub>, common canal for the two most anterior nerves for the lateral electric field; *sel*<sub>6</sub>, canal probably for the most posterior nerve for the lateral electric field; *tel*, division of the cavum cerebrale for the telencephalon; *v. cl*, canal for the v. capitis lateralis; *v. cl*<sub>1</sub>, canal for the preorbital division of the v. capitis lateralis; *v. dsv*, canal for the supposed otical vein and in addition probably for the ductus endolymphaticus; *vest*, vestibular division of the labyrinth cavity (in section); *v. ls*<sub>1</sub>, *v. ls*<sub>3</sub>, *v. ls*<sub>4</sub>, canals for the dorso-lateral superficial veins 1, 3, 4; *v. marg*, canal for the marginal vein; *vs. marg*, marginal vein sinus, a widened posterior part of the canal for the marginal vein; *V*, canal for one or for all of the trigeminus-profundus roots; *VII+VIII a*, canal which transmitted to the labyrinth cavity the facialis roots, all the prootic lateralis fibres, all the electric nerve fibrils and the anterior branch of the n. acusticus.

1



2



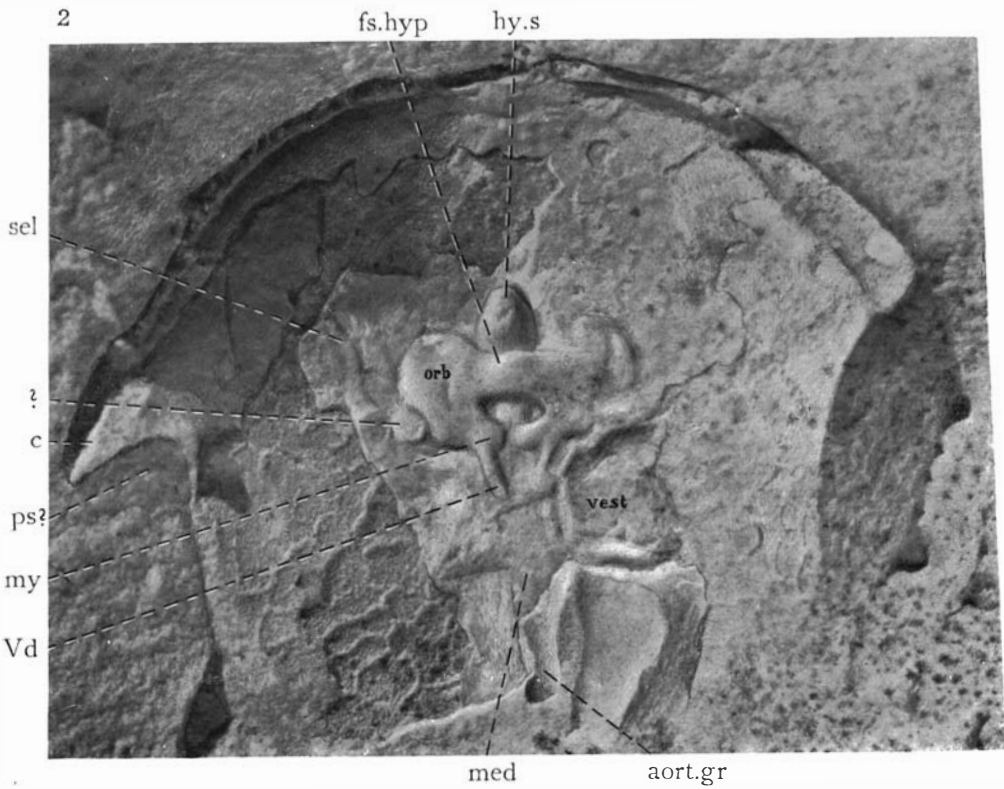
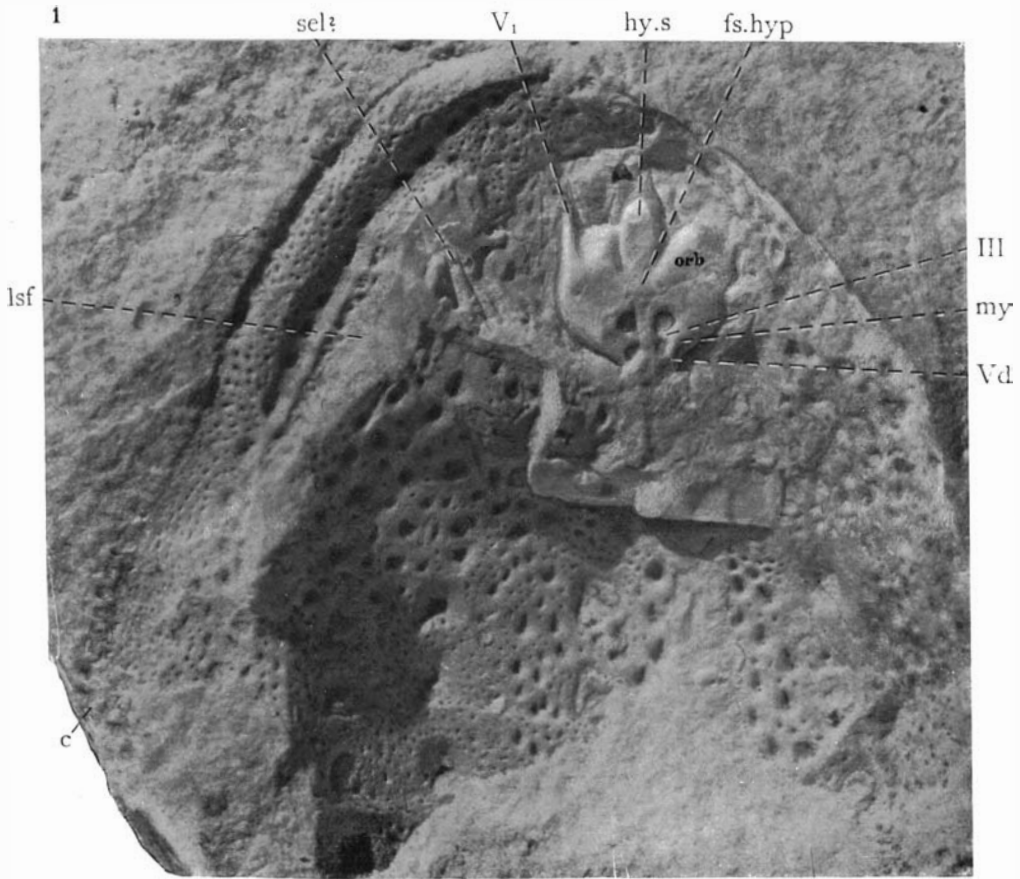
## Pl. 48.

Fig. 1. *Thyestes verrucosus* EICHWALD. Cephalic shield in ventral view with certain of the canals and cavities in the endocranium exposed. The shield to a large extent preserved only as an impression of the dorsal surface. Specimen belonging to the Palaeontological institution of Upsala. <sup>6</sup>/<sub>1</sub>.

Fig. 2. The so-called „*Cephalaspis schrencki*“. Cephalic shield in ventral view with certain of the cavities and canals of the endocranium exposed by preparing. Specimen belonging to the Palaeontological institution of Upsala. <sup>6</sup>/<sub>1</sub>.

### Explanation of index letters.

*aort. gr.*, aortal groove (a posterior part); *c*, probably the cornu of the right side; *fs. hyp.*, fossa hypophyseos; *hy. s.*, division of the ethmoidal cavity for the hypophyseal sac; *lsf*, lateral electric field; *med*, division of the cranial cavity for the medulla oblongata; *my*, myodome; *ps?*, perhaps the pectoral sinus; *sel*, *sel?*, probably a canal for an electric nerve for the lateral electric field; *vest*, vestibular division of the labyrinth cavity; *III*, canal for the n. oculomotorius; *Vd*, canal for at least the visceromotor root of the n. trigeminus proper (perhaps also for other trigeminus roots), perhaps an opening, if it was so, the importance of this opening uncertain.

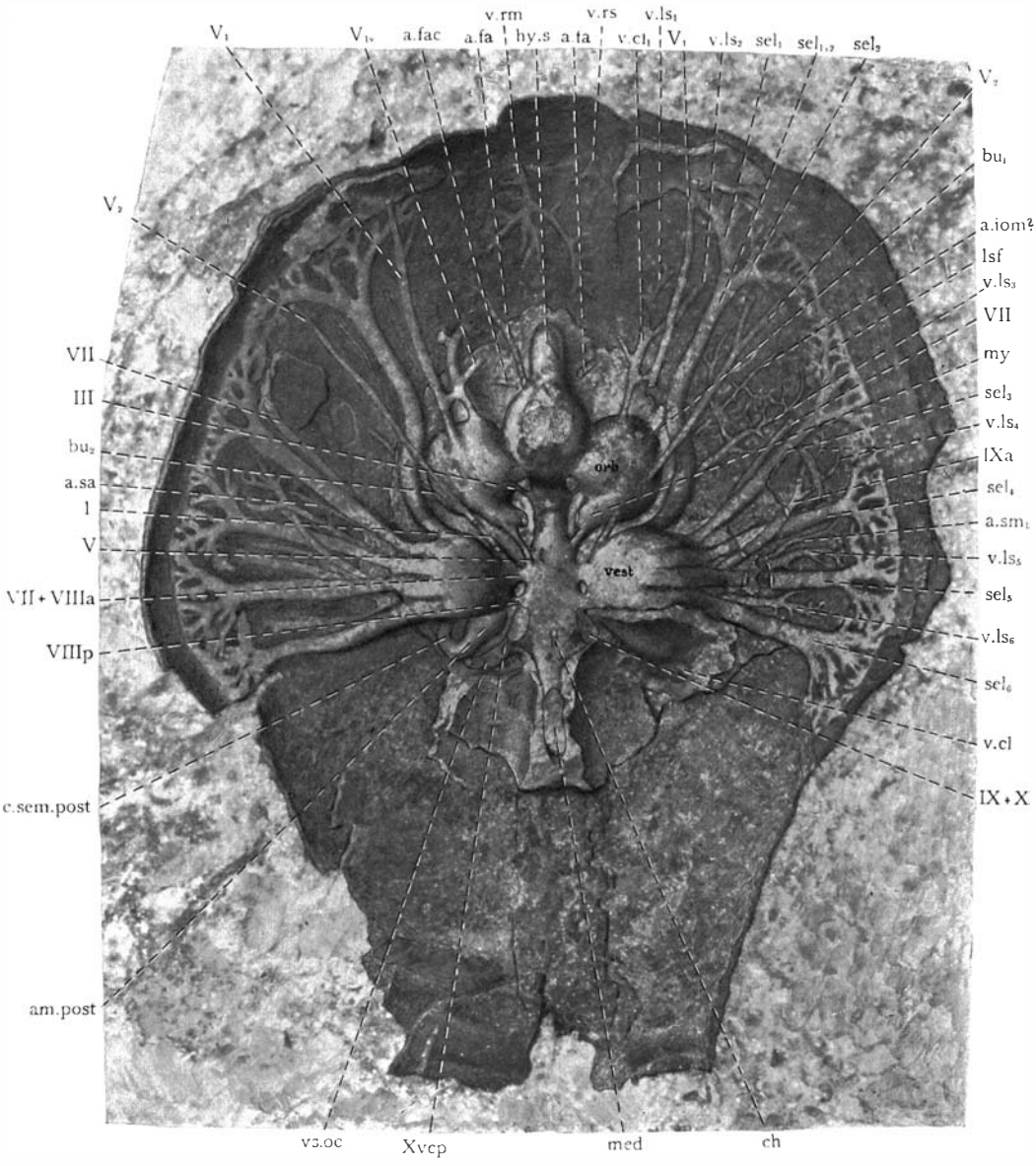


## Pls. 49.

*Kiaeraspis auchenaspidoides* n. g., n. sp. Cephalic shield in ventral view with the endoskeletal component prepared so as to show the cavities and canals in its interior. Specimen no. 99. Pl. 49 shows the the entire specimen with a magnification of about  $9/1$ , while pl. 50 displays a lateral part which is magnified about as much as  $15/1$ .

### Explanation of index letters.

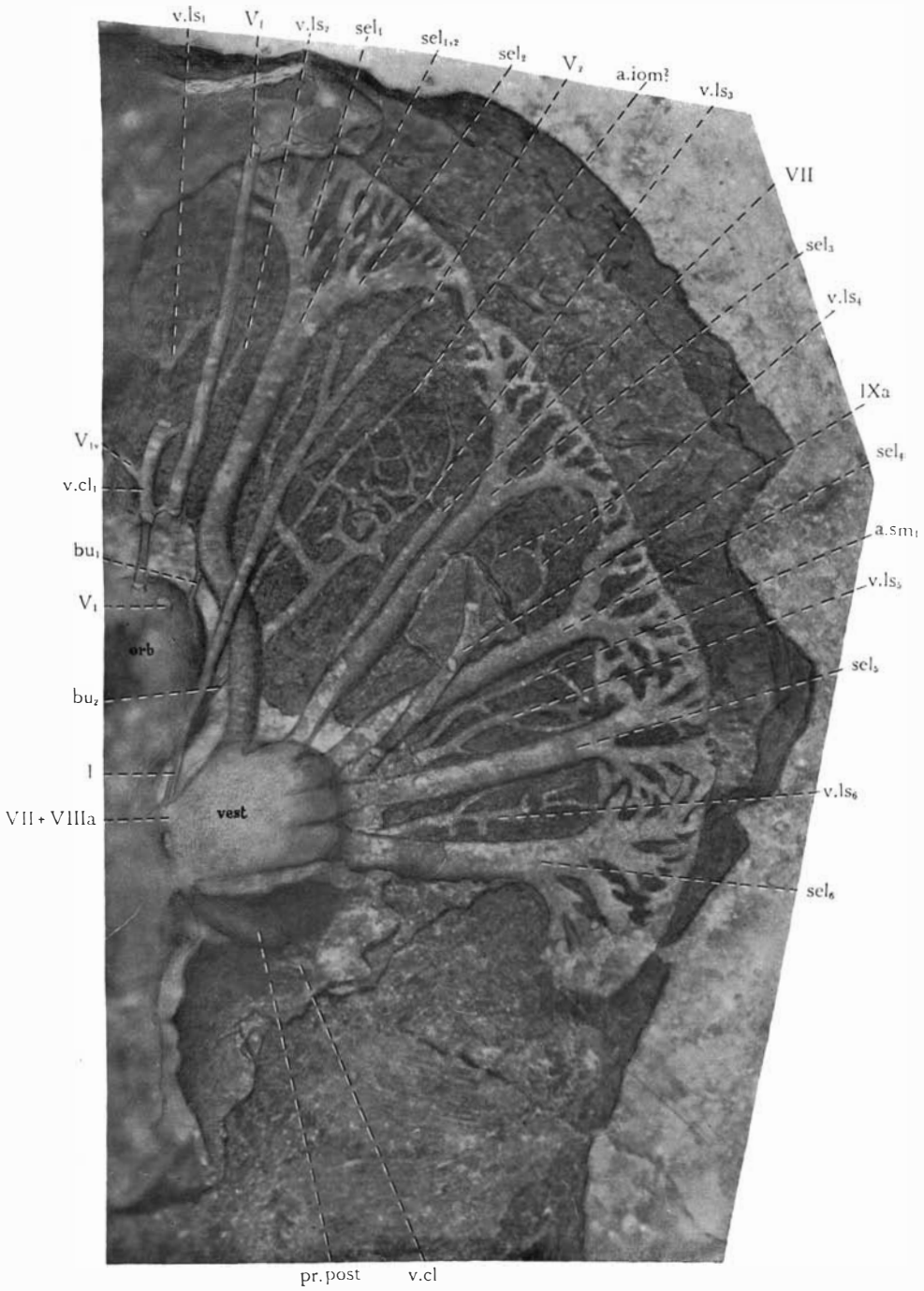
*a. fa*, canal for an anterior branch from the a. facialis; *a. fac*, canal for the arteria facialis; *a. iom?*, canal for a vessel, probably a branch from the medial infraorbital ramus of the a. facialis; *am. post*, swelling for the ampulla posterior; *a. sa*, canal for the most anterior dorso-lateral superficial artery; *a. sm<sub>1</sub>*, canal for the dorso-lateral superficial artery 2; *bu<sub>1</sub>*, *bu<sub>2</sub>*, canals probably for branches from the n. buccalis lateralis or for vessels or for both; *ch*, canal for the notochord (a small fragment); *c. sem. post*, division of the labyrinth cavity for the canalis semicircularis posterior; *hy. s*, division of the ethmoidal cavity for the hypophyseal sac; *l*, canal for the lateralis fibres which associated with the n. profundus and the n. trigeminus proper; *lsf*, lateral electric field; *med*, division of the cavum cerebrale for the medulla oblongata; *my*, myodome; *orb*, orbit; *pr. post*, ridge caused by the division of the labyrinth cavity for the canalis semicircularis posterior; *sel<sub>1, 2</sub>*, common canal for the two most anterior nerves for the lateral electric field; *sel<sub>1</sub>—sel<sub>6</sub>*, canals 1—6 for the nerves for the lateral electric field; *v. cl*, canal for the v. capitis lateralis; *v. cl<sub>1</sub>*, canal for the preorbital division of the v. capitis lateralis; *v. ls<sub>1</sub>—v. ls<sub>6</sub>*, canals for the dorso-lateral superficial veins 1—6; vestibular division of the labyrinth cavity; *v. rs*, canal for a lateral rostral vein; *v. rm*, canal for the median rostral vein; III, canal for the n. oculomotorius; V, canal probably for all the trigeminus-profundus roots; *V<sub>1</sub>*, canal for the n. profundus; *V<sub>1v</sub>*, canal perhaps for a visceral branch of the n. profundus; *V<sub>2</sub>*, canal for the n. trigeminus proper; VII, canal for the passage of the n. facialis from the labyrinth cavity to the oralo-brachial chamber (note the position in relation to the canal *sel<sub>1</sub>*); VII + VIIIa, canal for the facialis roots, the prootic lateralis fibres, the electric fibres, and the anterior branch of the n. acusticus; VIIIp, canal for the posterior branch of the n. acusticus; IXa, canal for the passage of the n. glosso-pharyngeus from the labyrinth cavity to the oralo-brachial chamber (note the position in relation to the canal *sel<sub>4</sub>*); IX + X, division of the vagus canal for the glossopharyngeus and vagus roots; Xvcp, division of the vagus canal for the v. cerebrealis posterior.





**Pl. 50.**

For explanation see pl. 49.



## Pis. 51.

*Kiaeraspis auchenaspidoides* n. g., n. sp. Cephalic shield. Part and counterpart. Specimen no. 100. Magnification about  $\frac{9}{1}$ .

Pl. 51 shows an impression of the oralo-branchial chamber with certain ventral parts of the shield containing the canals for the marginal vessels.

Pl. 52 shows the shield in a ventral view. As is seen the exoskeleton of the interzonal part (*iz*) has mainly split off. The ventral and lateral parts of the cephalic division proper are lacking, being in part preserved on the counterpart in pl. 51. The dorsal surface of the oralo-branchial chamber is rather completely displayed.

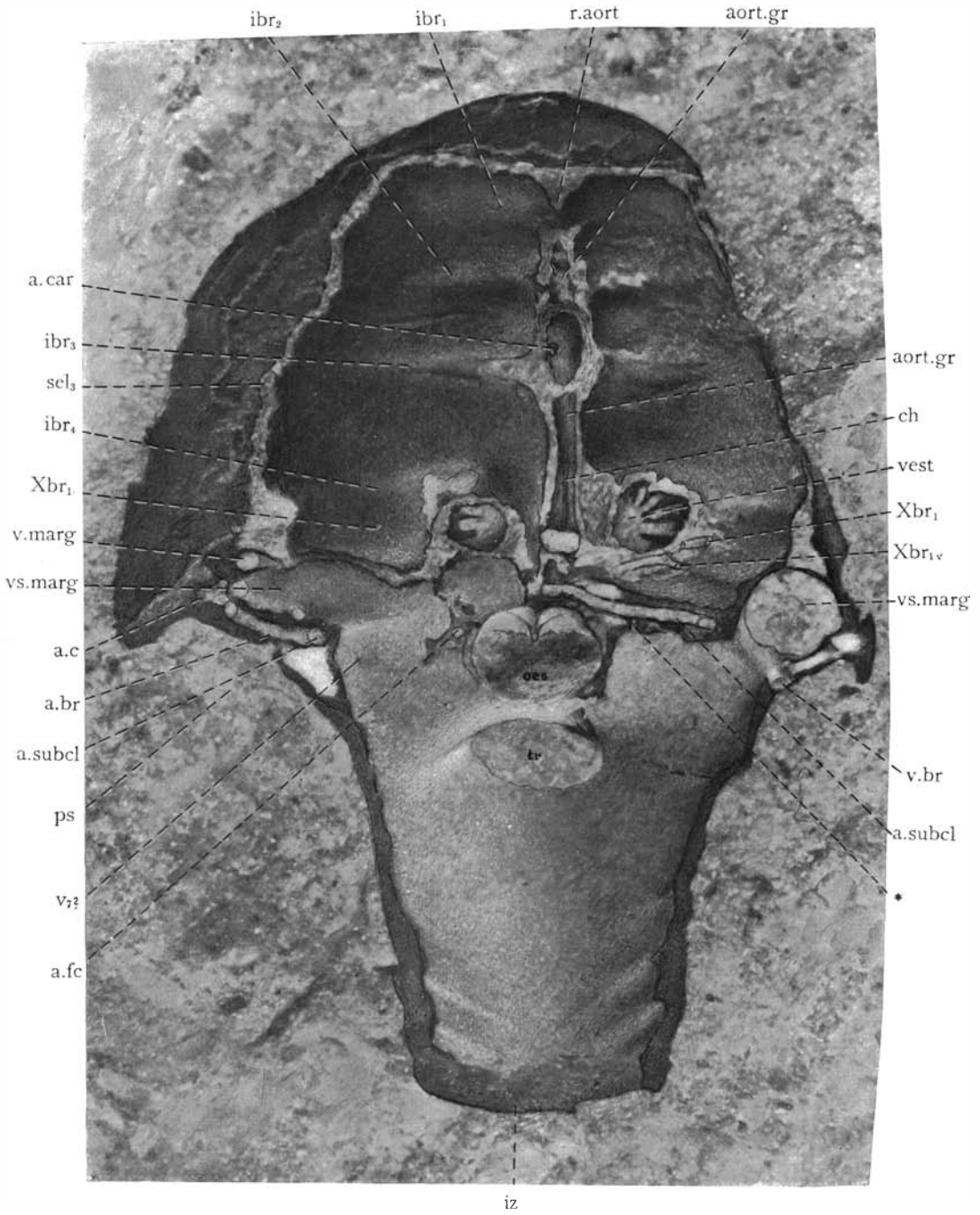
### Explanation of index letters.

*a. br*, canal for the a. brachialis (the interrupted line denoting this canal would rightly in pl. 51 have passed somewhat more ventrally than it actually does); *a. c*, part of the canal for the a. cornualis; *a. car*, canal for the a. carotis; *a. eff<sub>1</sub>*, *a. eff<sub>2</sub>*, grooves for the efferent branchial arteries 1 and 2; *a. eff<sub>7</sub>*, *a. eff<sub>9</sub>*, canals for the efferent branchial arteries 7—9 (only fragments preserved); *a. eff. com*, space for the arteria branchialis efferens communis, a vessel arisen by the confluence of the arteriae branchiales efferentes 4—6; *a. fc*, canal for a vessel formed by the union of the efferent branchial arteries 8 and 9; *a. marg*, canal for the marginal artery; *aort. gr*, aortal groove (in pl. 51 preserved as impression); *a. rostr*, groove for the rostral artery (the premandibular efferent branchial artery); *a. subcl*, canal for the a. subclavia; *c*, cornu; *ch*, canal for the notochord; *dpr*, area which formed the hard roof of the mouth cavity; *ibr<sub>1</sub>—ibr<sub>9</sub>*, interbranchial ridges 1—9; *ibs<sub>1</sub>—ibs<sub>4</sub>*, interbranchial septa 1—4; *iz*, interzonal part of the cephalic shield; *k<sub>1</sub>—k<sub>10</sub>*, branchial fossae 1—10 (only the ventro-lateral parts denoted); *oes*, oesophagus foramen; *p. brw*, postbranchial wall; *pr. au*, impression of the otical prominence; *pr. orb*, impression of the orbital prominence; *ps*, pectoral sinus; *r. aort*, aortal ridge; *r. pm*, prebranchial ridge (impression); *tr*, foramen for the truncus arteriosus; *v<sub>1</sub>—v<sub>9</sub>*, canals for ventral transversal superficial veins 1—9 (the tenth canal of this sort not distinctly preserved); *va*, canal probably for a branch from the truncus arteriosus; *vest*, vestibular division of the labyrinth cavity (exposed in part, from the ventral side); *v. marg*, canal for the marginal vein; *v. rm*, canal for the median rostral vein; *vv. rs*, canals for rostral veins; *vs. marg*, posterior widened part of the canal for the marginal vein; *V<sub>1</sub>*, canal for the n. profundus. *V<sub>2</sub>*, canal for the n. trigeminis proper; *IXa*, canal for the exit of the n. glossopharyngeus in the oralo-branchial chamber; *X<sub>br</sub>*, canal probably for a branchial branch from the n. vagus; *X<sub>br1</sub>*, canal for the first branchial branch of the n. vagus (like the vestibular division of the labyrinth cavity exposed by preparing); *X<sub>br1v</sub>*, a branch of the canal *X<sub>br1</sub>*, a branch which probably transmitted the visceral ramus of the first branchial branch of the n. vagus; \* canal of unknown importance.



**Pl. 52.**

For explanation see pl. 51.



### Pl. 53.

Figs. 1–3. *Kiaeraspis auchenaspidoides* n. g., n. sp. Specimen no. 98. Magnification somewhat less than  $\frac{5}{1}$ .

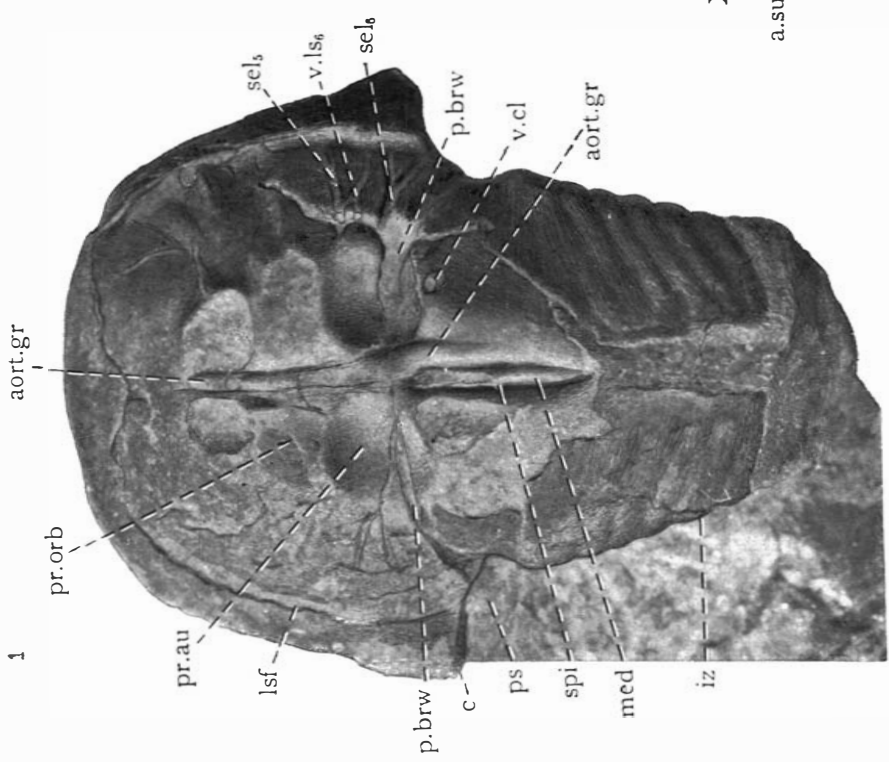
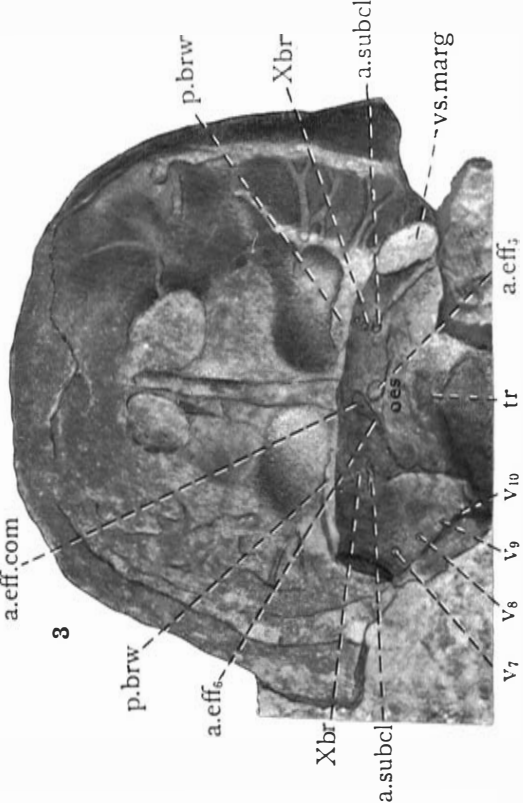
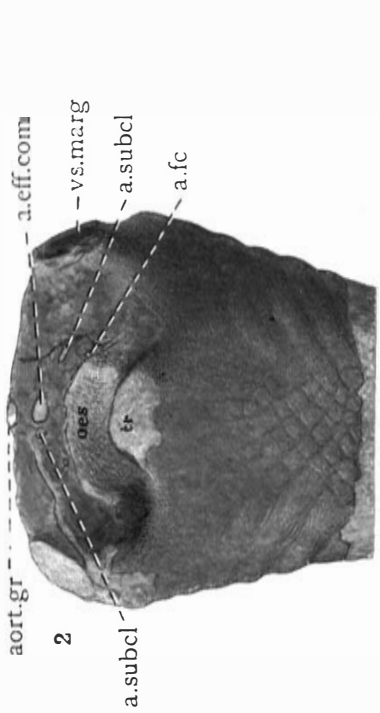
Fig. 1 shows the cephalic shield in dorsal view, but with the endocranial component split off so that this is represented only by the impression of its ventral side.

Fig. 2. Interzonal part of the shield in ventral view. Note the traces of fused scales.

Fig. 3. Cephalic division proper and shoulder girdle in dorsal view. The endocranial part removed and the postbranchial wall exposed.

#### Explanation of index letters.

*a. eff*<sub>6</sub>, canal for the efferent branchial artery 6; *a. fc*, canal for an arterial trunk arisen by the confluence of the efferent branchial arteries 8 and 9; *a. eff, com*, canal for the arteria branchialis efferens communis, a vessel arisen by the confluence of the efferent branchial arteries 4–6; *aort. gr*, aortal groove (impression); *a. subcl*, canal for the a. subclavia; *c*, cornu; *iz*, interzonal part of the cephalic shield; *lsf*, lateral electric field; *med*, division of the cavum cerebrale for the medulla oblongata (most posterior part); *oes*, oesophagus foramen; *p. brw*, postbranchial wall; *pr. au*, *pr. orb*, impressions of the otical and orbital prominences respectively; *ps*, pectoral sinus; *sel*<sub>5</sub>, *sel*<sub>6</sub>, canals for the nerves 5 and 6 for the lateral electric field; *spi*, canal for a myelonal vein and in addition for a dorsal root of a spino-occipital nerve; *tr*, foramen for the truncus arteriosus (distinct only in fig. 2); *v*<sub>7</sub>–*v*<sub>10</sub>, canals for the ventral transversal superficial veins 7–10; *v. cl*, canal for the v. capitis lateralis (solely the posterior opening preserved); *v. ls*<sub>6</sub>, canal probably for the dorso-lateral superficial vein 6; *vs. marg*, marginal vein sinus, a widened posterior part of the canal for the marginal vein; *Xbr*, canal for a branchial branch of the n. vagus.





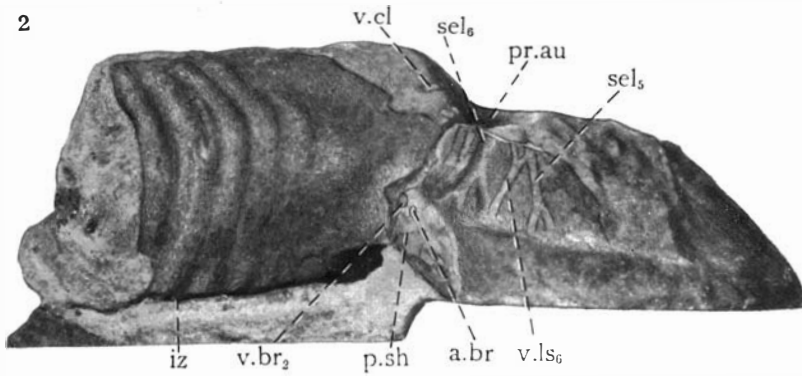
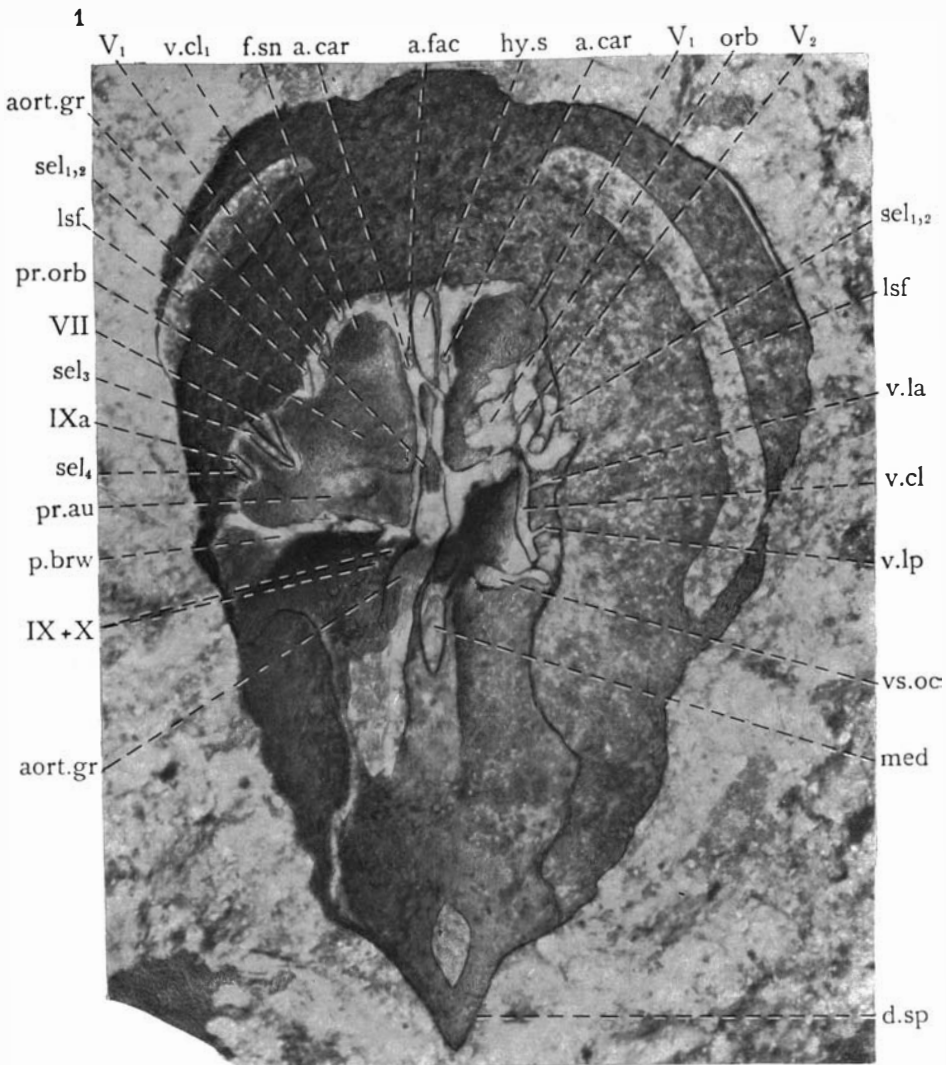
## Pl. 54.

Fig. 1. *Kiaeraspis auchenaspidoides* n. g., n. sp. Part of a cephalic shield in ventral view. The visceral part of the shield represented mainly only by an impression of the external surface of the exoskeleton. Specimen no. 101 (same shield as in pl. 57). Magnification somewhat more than  $\frac{6}{1}$ .

Fig. 2. *Kiaeraspis auchenaspidoides* n. g., n. sp. Cephalic shield in a lateral view. The endocranium removed. Specimen no. 98 (same specimen as in pl. 53). Magnification somewhat less than  $\frac{5}{1}$ .

### Explanation of index letters.

*a. br*, canal for the a. brachialis; *a. car*, canal for the carotid artery; *a. fac*, canal for the a. facialis; *aort. gr*, aortal groove (posteriorly where this groove is filled by matrix it is distinctly asymmetrical in its position); *d. sp*, dorsal spine; *f. sn*, fossa subnasalis; *hy. s*, division of the ethmoidal cavity for the hypophyseal sac; *iz*, interzonal part of the cephalic shield; *lsf*, lateral electric field; *med*, division of the cavum cerebrale for the medulla oblongata (most posterior part); *orb*, orbit (exposed from the ventral side); *p. brw*, postbranchial wall (a dorsal part); *pr. au*, *pr. orb*, otical and orbital prominences respectively (in fig. 2 impression only of the otical prominence); *p. sh*, endoskeletal shoulder-girdle; *sel<sub>1,2</sub>*, common canal for the two most anterior nerves for the lateral electric field; *sel<sub>3</sub>—sel<sub>6</sub>*, canals for the nerves 3—6 for the lateral electric field; *v. br<sub>3</sub>*, canal either for a nerve or a vein or perhaps for both; *v. cl*, canal for the v. capitis lateralis; *v. la*, canal for a tributary to the v. capitis lateralis, a tributary arisen by the confluence of the dorso-lateral superficial veins 3 and 4; *v. lp*, canal for a tributary to the v. capitis lateralis, a tributary arisen by the confluence of the dorso-lateral superficial veins 5 and 6; *v. ls<sub>6</sub>*, canal for the dorso-lateral superficial vein 6; *vs. oc*, occipital vein sinus; *V*, canal for the n. profundus; *V<sub>2</sub>*, canal for the n. trigeminus proper; *VII*, canal for the passage of the n. facialis to the oralo-branchial chamber; *IX+X*, glossopharyngeus and vagus branches of the vagus canal (external openings). For the roots of the n. glossopharyngeus and the n. vagus.

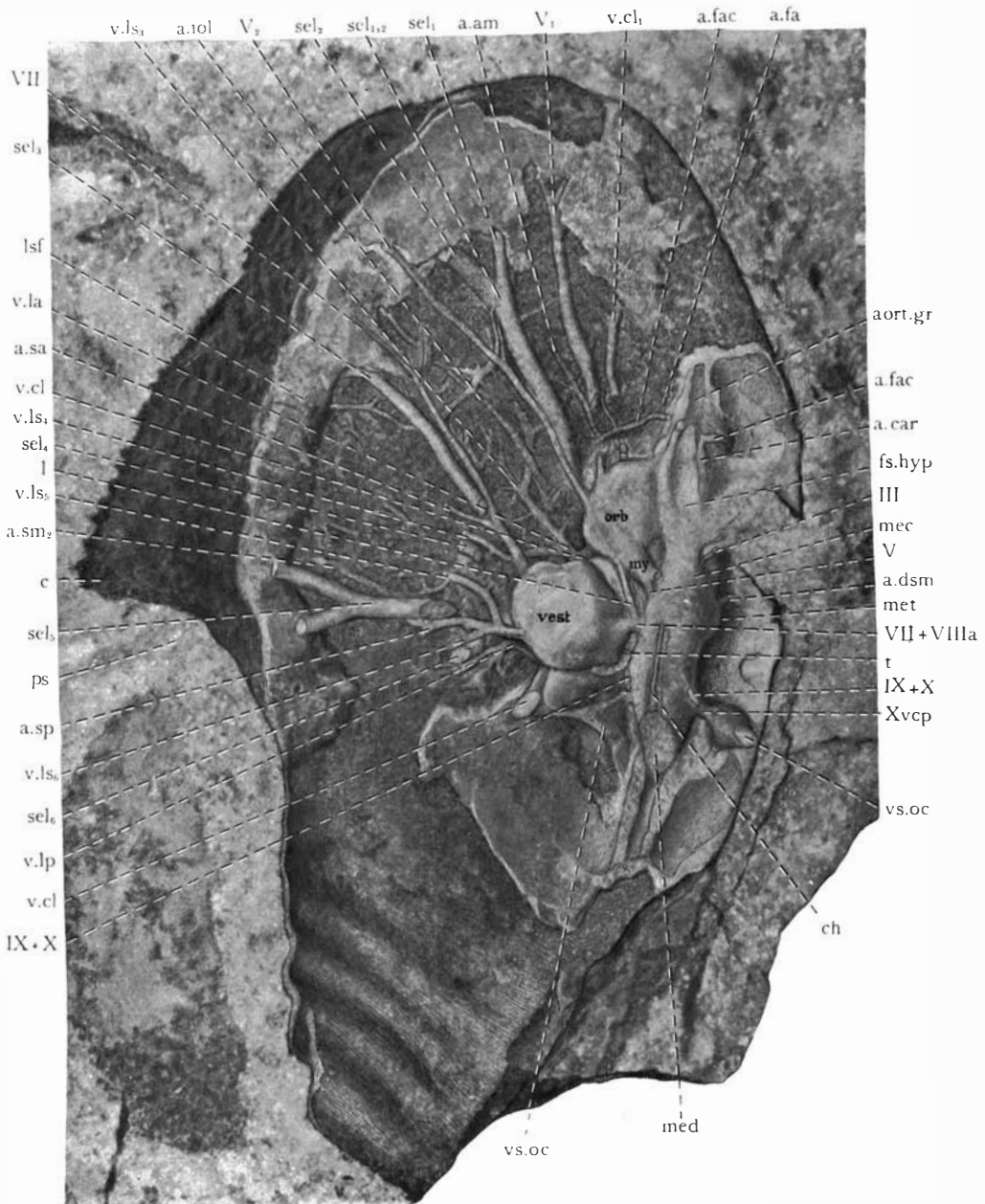


## Pl. 55.

*Kiaeraspis auchenaspidoides* n. g., n. sp. Part of cephalic shield in ventral view. The shield prepared so as to show the cavities of the endocranium and the main canals. Specimen no. 98 (counterpart of the specimen in pl. 53 and pl. 54, fig. 2). Magnification about  $\frac{8}{1}$ .

### Explanation of index letters.

*a. am*, canal for the mandibular branch of the a. facialis; *a. car*, canal for the carotid artery; *a. dsm*, canal for the postorbital superficial artery; *a. fa*, canal for an anterior branch of the a. facialis; *a. fac*, canal for the a. facialis; *a. iol*, canal probably for a branch from the lateral infraorbital ramus of the a. facialis; *a. sa*, *a. sm<sub>2</sub>*, *a. sp*, canals for the dorso-lateral superficial arteries 1, 3, 4; *c*, cornu; *ch*, canal for the notochord; *fs*, *hyp*, fossa hypophyseos; *l*, canal for the lateralis fibres, which associated with the n. trigeminus proper and the n. profundus; *lsf*, lateral electric field; *mec*, division of the cavum cerebrale cranii for the mesencephalon; *med*, division of the cavum cerebrale cranii for the medulla oblongata (posterior part preserved in the counterpart seen in pl. 53, fig. 1); *my*, myodome; *orb*, orbit; *ps*, pectoral sinus; *sel<sub>1,2</sub>*, common canal for the two most anterior nerves for the lateral electric field; *sel<sub>1</sub>—sel<sub>6</sub>*, canals for the electric nerves 1—6 for the latent electric field; *t*, canal probably for a vessel; *v. cl*, canal for the v. capitis lateralis; *v. cl<sub>1</sub>*, canal for the preorbital division of the v. capitis lateralis; *v. la*, canal for a venous trunk arisen by the confluence of the dorso-lateral superficial veins 3 and 4; *v. lp*, canal for a venous trunk arisen by the confluence of the dorso-lateral superficial veins 5 and 6; *v. ls<sub>3</sub>—v. ls<sub>6</sub>*, canals for the dorso-lateral superficial veins 3—6; *vs. oc*, occipital vein sinus; III, canal for the n. oculomotorius; V, canal for the profundus-trigeminus roots; V<sub>1</sub>, canal for the n. profundus; V<sub>2</sub>, canal for the n. trigeminus proper; VII, canal for the passage of the n. facialis to the oralo-branchial chamber; VII + VIIIa, canal for the exit into the labyrinth cavity of the facialis roots, the prootic lateralis fibres, the electric nerve-fibres and of the posterior branch of the n. acusticus; IX + X, division of the vagus canal for the glossopharyngeus and vagus roots; Xvcp, division of the vagus canal for the v. cerebialis posterior.



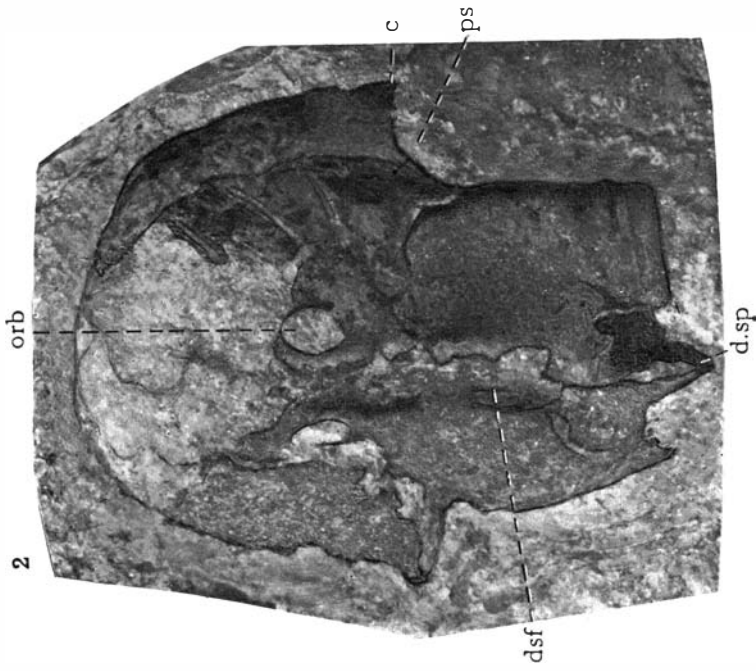
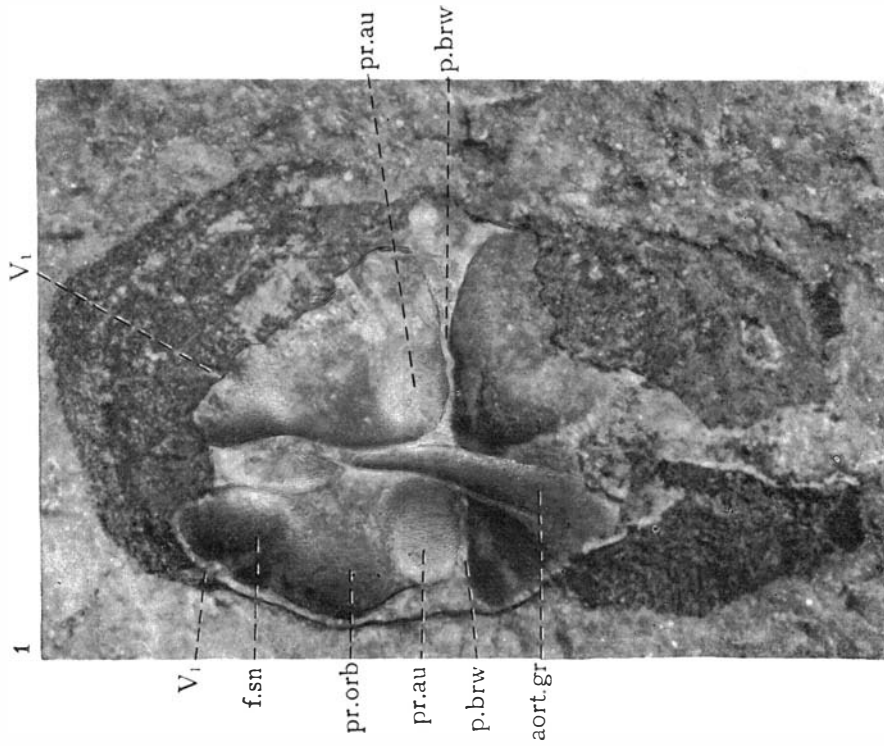
**Pl. 56.**

Fig. 1. *Kiaeraspis auchenaspidoides* n. g., n. sp. Part of a cephalic shield in ventral view. Specimen no. 102 (the specimen used for section series D, pls. 100—104). Magnification about  $\frac{6}{1}$ .

Fig. 2. *Kiaeraspis auchenaspidoides* n. g., n. sp. Cephalic shield in dorsal view. The left side imperfectly exposed. Specimen no. 104. Magnification about  $\frac{9}{2}$ .

Explanation of index letters.

*aort. gr*, aortal groove; *c*, cornu; *dsf*, dorsal electric field (extent backwards uncertain); *d. sp*, dorsal spine; *f. sn*, fossa subnasalis; *orb*, orbital opening; *p. brw*, postbranchial wall; *pr. au*, *pr. orb*, otical and orbital prominences respectively; *ps*, pectoral sinus;  $V_1$ , canal for the n. profundus.

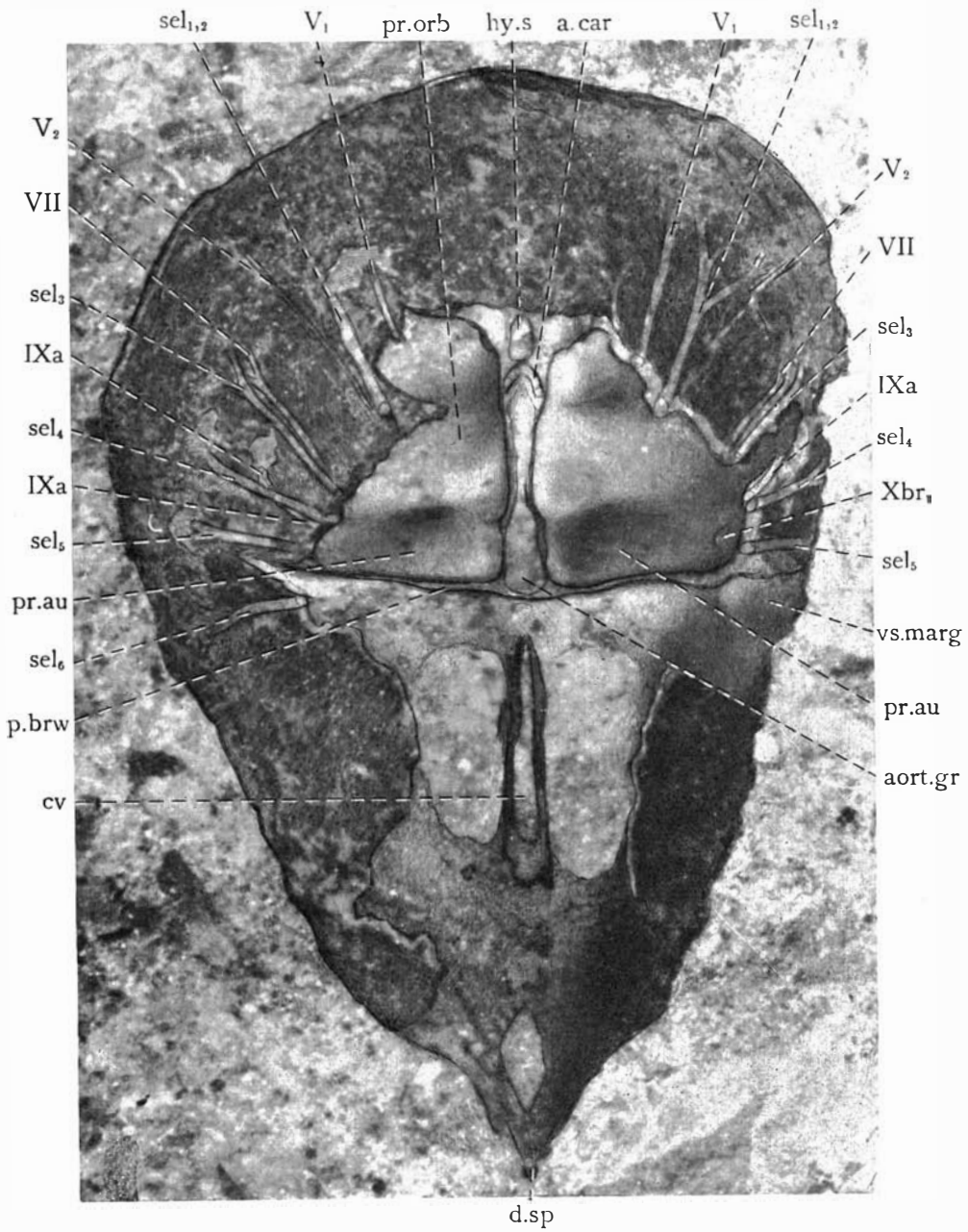


## Pl. 57.

*Kiaeraspis auchenaspidoides* n. g., n. sp. Cephalic shield in dorsal view with the neurocranial component removed and represented only by impression. Specimen no. 101 (counterpart of the specimen figured in pl. 54, fig. 1). Magnification about  $9.5/1$ .

### Explanation of index letters.

*a. car*, canal for the carotid artery; *aort. gr*, aortal groove (impression); *cv*, division of the cranial cavity for the medulla ablongata (most posterior narrow part); *d. sp*, dorsal spine; *hy. s*, portion of the division of the ethmoidal cavity for the hypophyseal sac; *p. brw*, postbranchial wall (dorsal part in section); *pr. au*, *pr. orb*, impressions of the otical and orbital prominences respectively; *sel<sub>1,2</sub>*, common canal for the two most anterior nerves for the lateral electric field; *sel<sub>3</sub>—sel<sub>6</sub>*, canals for nerves 3—6 for the lateral electric field; *vs. marg*, marginal vein sinus, a posterior widened part of the canal for the marginal vein; *V<sub>1</sub>*, canal for the n. profundus; *V<sub>2</sub>*, canal for the n. trigeminus proper; *VII* canal for the passage of the n. facialis to the oralo-branchial chamber; *IXa*, canal for the passage of the n. glossopharyngeus to the oralo-branchial chamber; *Xbr<sub>1</sub>*, canal for the first branchial branch of the n. vagus.



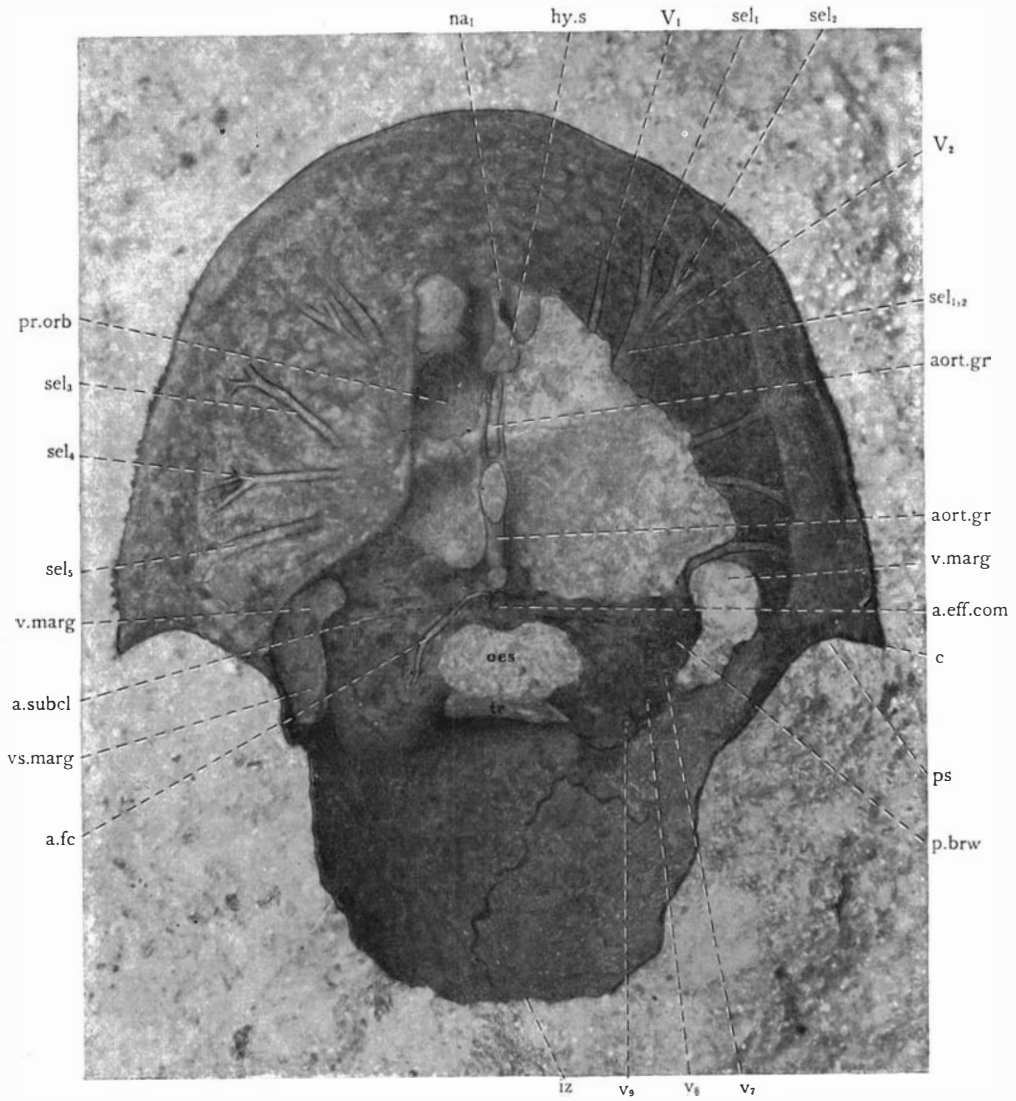


## Pl. 58.

*Kiaeraspis auchenaspidoides* n. g., n. sp. Cephalic shield in dorsal view, with certain dorsal parts removed so, that the postbranchial wall and the ventral wall of the interzonal part are exposed. The neurocranium also removed. Specimen no. 103. Magnification about  $7/1$ .

### Explanation of index letters.

*a. eff. com*, canal for the arteria branchialis efferens communis, a vessel arisen by the confluence of the efferent branchial arteries 4—6; *a. fc*, canal for an artery arisen by the confluence of the efferent branchial arteries 8 and 9; *aort. gr*, aortal groove (impression); *a. subcl*, canal for the a. subclavia (imperfectly exposed); *c*, cornu: *hy. s*, part of the division of the ethmoidal cavity for the hypophyseal sac; *iz*, interzonal part of the cephalic shield (ventral wall only preserved); *na<sub>1</sub>*, anterior division of the naso-hypophyseal opening; *oes*, foramen for the oesophagus (the bone septum separating it from the truncus arteriosus foramen not preserved); *p. brw*, postbranchial wall; *pr. orb*, impression of the orbital prominence; *ps*, pectoral sinus; *sel<sub>1,2</sub>*, common canal for the two most anterior nerves for the lateral electric field; *sel<sub>1</sub>—sel<sub>5</sub>*, canals for the nerves 1—5 for the lateral electric field; *tr*, truncus arteriosus foramen (see explanation of *oes*); *v<sub>7</sub>—v<sub>9</sub>*, canals for the ventral transversal superficial veins 7—9; *v. marg*, canal for the marginal vein; *vs. marg*, widened posterior part of the canal for the marginal vein, the marginal vein sinus; *V<sub>1</sub>*, canal for the n. profundus.



### Pl. 59.

*Tremataspis schmidti*. Certain of the internal parts of cephalic shield in dorsal view. The exoskeleton has weathered away. Note the traces of perichondral bone layers (dark lines) around certain of the cavities. Specimen belonging to the Palaeontological institution of Upsala and figured by Wiman in 1918 (fig. 1, p. 87). Magnification about  $\frac{4}{1}$ .

#### Explanation of index letters.

*cv*, most posterior division of the cranial cavity; *des*, part of the canal for the nerve for the dorsal electric field; *k*, branchial fossa; *mec*, division of the cavum cerebrale for the mesencephalon; *med*, division of the cavum cerebrale for the medulla oblongata; *met*, division of the cavum cerebrale for the metencephalon; *na*, naso-hypophyseal opening; *orb*, orbit; *pin*, pineal canal (on account of its much weathered condition indistinct); *p. brw*, post-branchial wall; *vest*, vestibular division of the labyrinth cavity.



## Pl. 60.

*Tremataspis schmidti*. Part of the cephalic shield in dorsal view, prepared so as to show several of the internal cavities and canals. Specimen belonging to the Paleontological institution of Upsala. Magnification about  $9\frac{1}{2}$ .

### Explanation of index letters.

*a.desm*, canal either for the n. trochlearis or for a branch of the post-orbital superficial artery; *k*<sub>1</sub>—*k*<sub>4</sub>, branchial fossae, perhaps the branchial fossae 1—4; *lsf*<sub>a</sub>, anterior lateral electric field; *med*, division of the cavum cerebrale cranii for the medulla oblongata; *met*, division of the cavum cerebrale cranii for the metencephalon; *na*, naso-hypophyseal aperture; *orb*, orbit (on the right side the stone filling entirely removed); *sel*<sub>a</sub>, *sel*<sub>m</sub>, *sel*<sub>p</sub>, canals for three electric nerves; *v*, canal for a ventral transversal superficial vein; *v.cl*, canal for the v. capitis lateralis; *vest*, vestibular division of the labyrinth cavity.



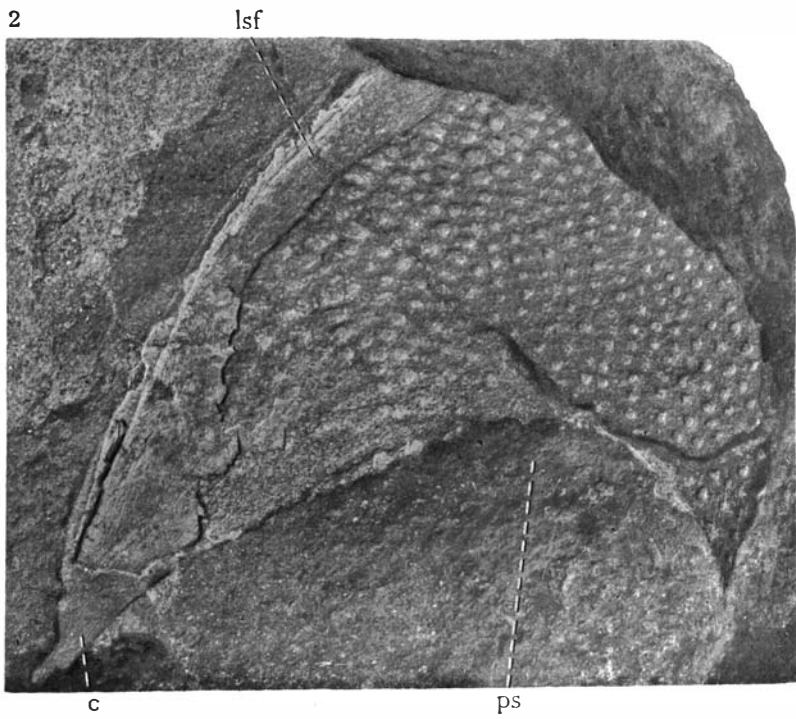
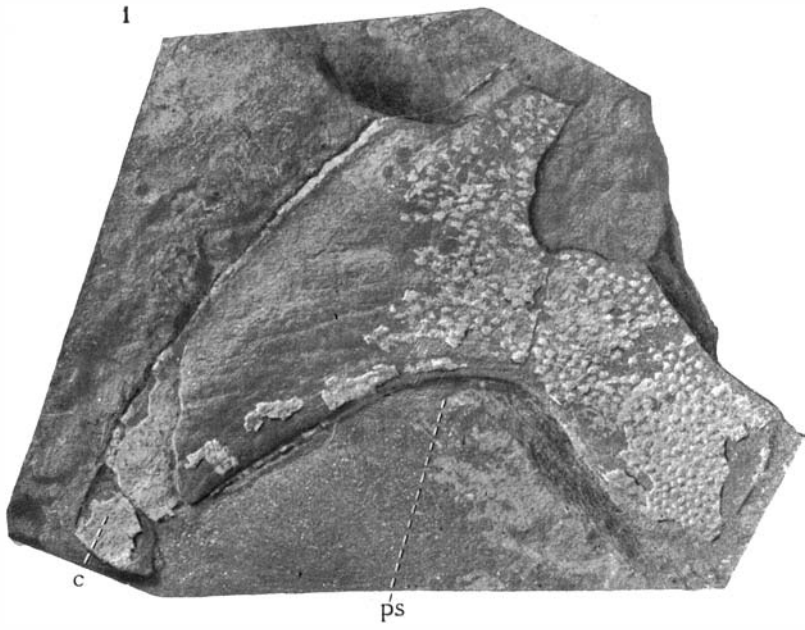
**Pl. 61.**

Fig. 1. *Cephalaspis* sp. Cornu and an adjacent part of a cephalic shield. Specimen no. 109. <sup>1</sup>/<sub>1</sub>.

Fig. 2. *Cephalaspis* sp. Cornu and an adjacent part of a shield preserved mainly as impression of the dorsal side of the exoskeleton. Specimen P. 550 in the Riksmuseum of Stockholm. Collected by A. G. NATHORST in 1882. <sup>1</sup>/<sub>1</sub>.

Explanation of index letters.

*c*, cornu; *lsf*, lateral electric field; *ps*, pectoral sinus.





## Pl. 62.

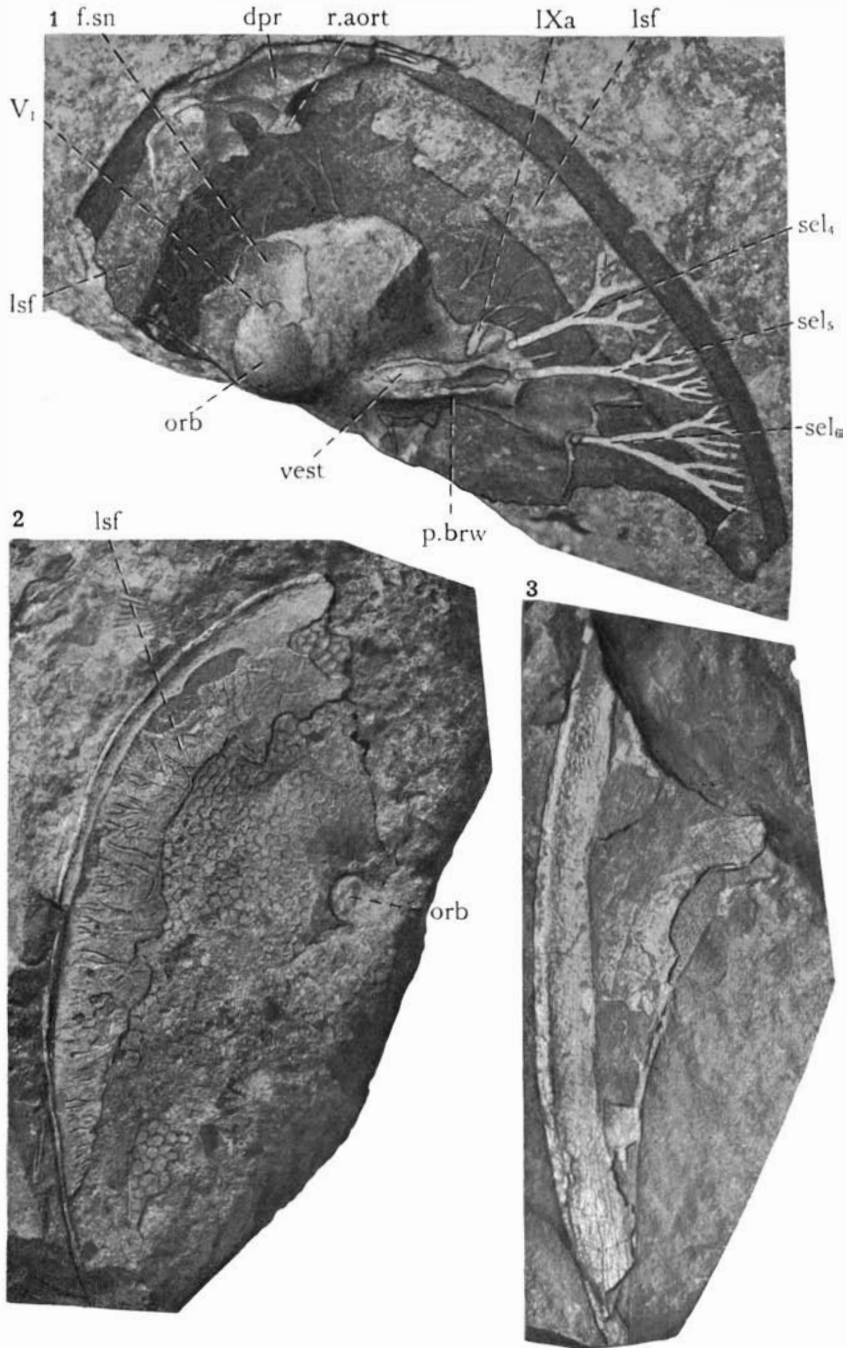
Fig. 1. *Cephalaspis hoeli* n. sp. Part of a cephalic shield in ventral view. Considerable part of the endoskeleton not preserved. Specimen no. 28. Magnification somewhat more than  $\frac{3}{1}$ .

Fig. 2. *Cephalaspis* n. sp.? Part of the exoskeleton of the dorsal side of a cephalic shield. Preserved in part as impression of the dorsal surface. Specimen no. 77.  $\frac{2}{3}$ .

Fig. 3. *Cephalaspis* sp. Exoskeleton of the ventral side of a left cornu. Specimen no. 110.  $\frac{1}{1}$ .

### Explanation of index letters.

*dpr*, area which formed the dorsal boundary of the mouth cavity; *f. sn*, part of the fossa subnasalis; *lsf*, lateral electric field; *orb*, orbit and orbital opening; *p. brw*, postbranchial wall (dorsal part); *r. aort*, aortal ridge (anterior part); *sel<sub>4</sub>—sel<sub>6</sub>*, canals for the nerves 4—6 for the lateral electric field; *vest*, vestibular division of the labyrinth cavity (only very imperfectly exposed); *V<sub>1</sub>*, canal for the n. profundus; *IXa*, canal for the passage of the n. glossopharyngeus to the oralo-branchial chamber (distal opening).



**Pl. 63.**

*Cephalaspis* sp. Section through the exoskeleton of the most proximal part of a cornu. Specimen no. 123. <sup>10</sup>/1.

Explanation of index letters.

*bl*, basal layer; *ml*, middle layer; *sl*, superficial layer.



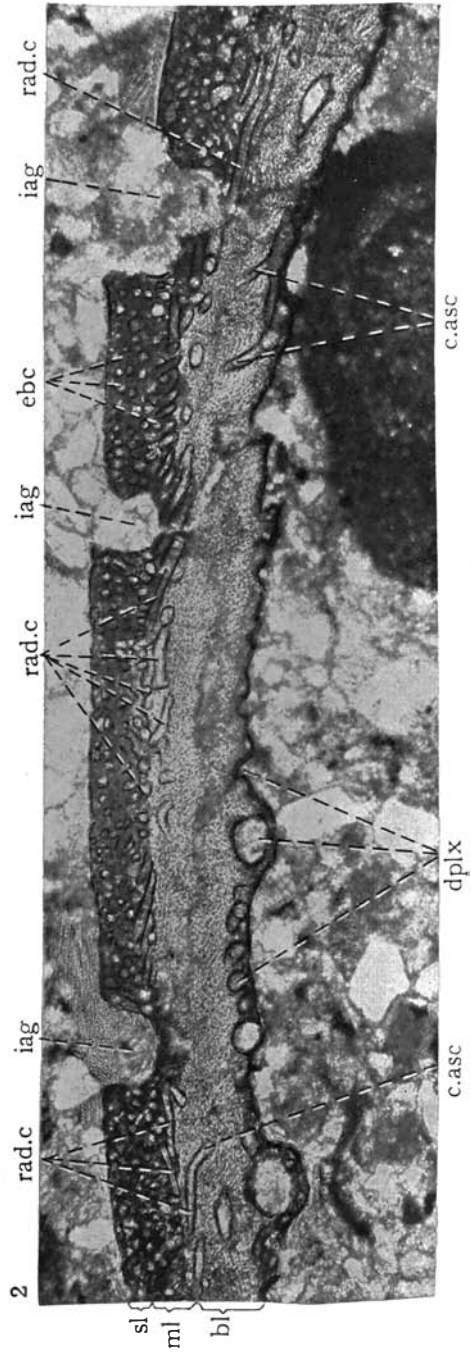
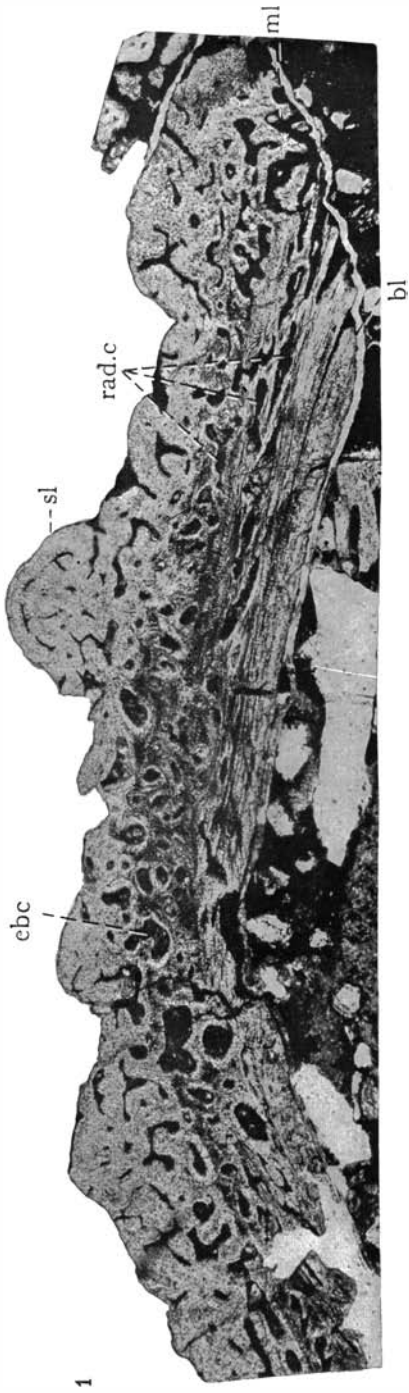
**Pl. 64.**

Fig. 1. *Cephalaspis* sp. Section through a strongly tuberculated part of the exoskeleton. Specimen no. 124. <sup>40</sup>/1.

Fig. 2. *Cephalaspis* sp. Section through a part of exoskeleton, which was smooth and covered by a continuous superficial layer, provided with interareal grooves. Specimen no. 120. <sup>35</sup>/1.

Explanation of index letters.

*bl*, basal layer; *c. asc*, ascending canals; *dplx*, canals of the subaponeurotic (subcutaneous) vascular plexus; *ebc*, external branches of the radiating canals; *iag*, interareal grooves; *ml*, middle layer; *rad. c*, radiating canals; *sl*, superficial layer.

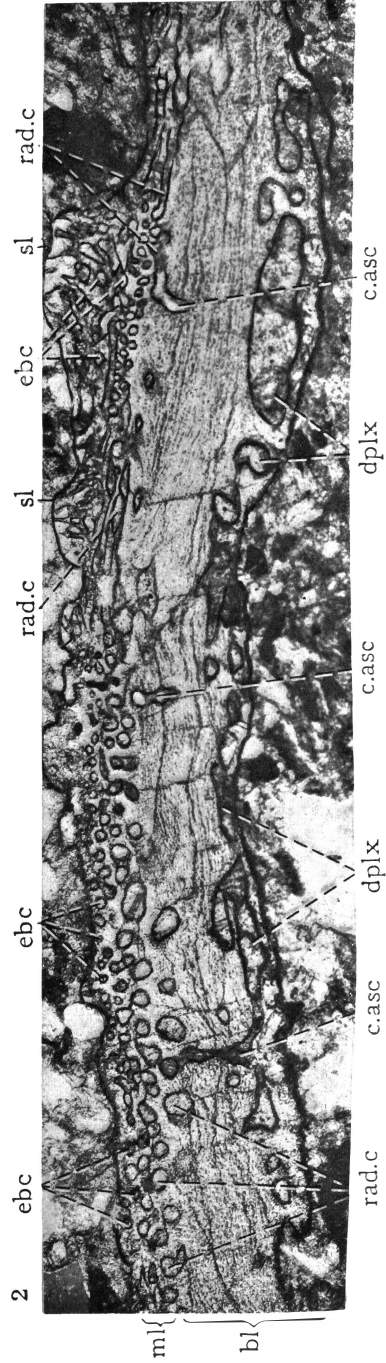
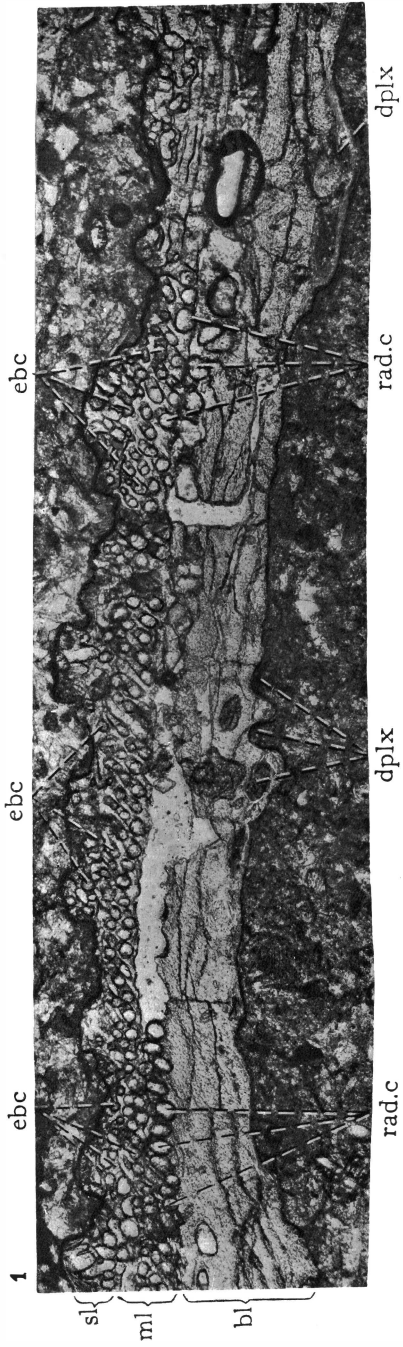


**Pl. 65.**

*Cephalaspis* sp. Sections through the exoskeleton of two tuberculated specimens. Specimens nos. 123, 125. Magnification about  $35/1$ .

Explanation of index letters.

*bl*, basal layer; *c. asc*, ascending canals; *dplx*, canals of the subaponeurotic (subcutaneous) vascular plexus; *ebc*, external branches of the radiating canals; *ml*, middle layer; *rad. c.*, radiating canals; *sl*, superficial layer.





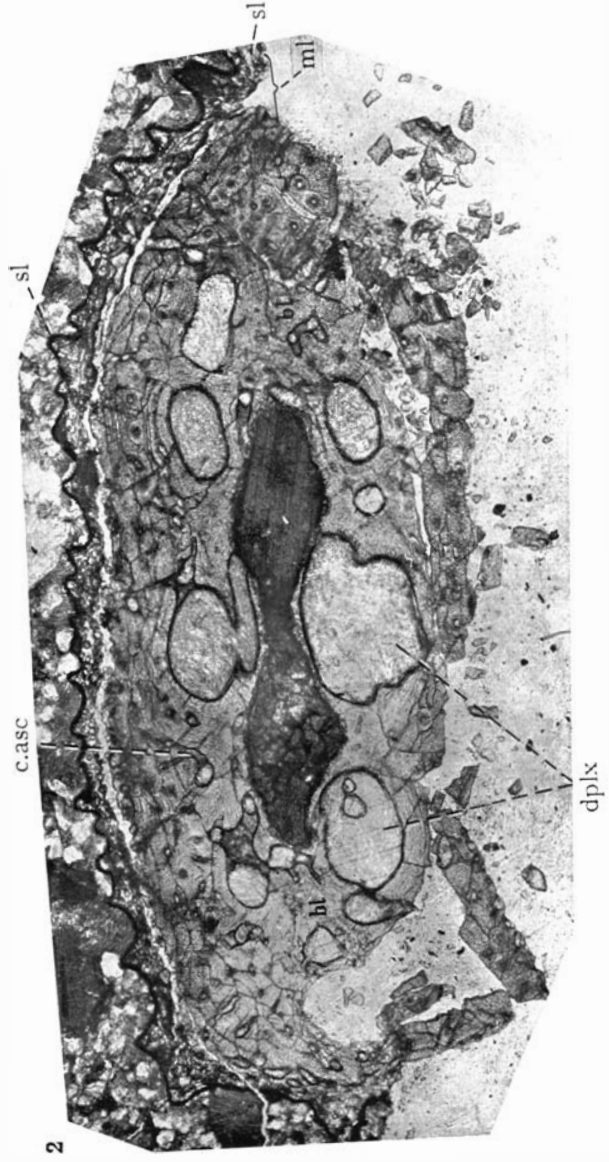
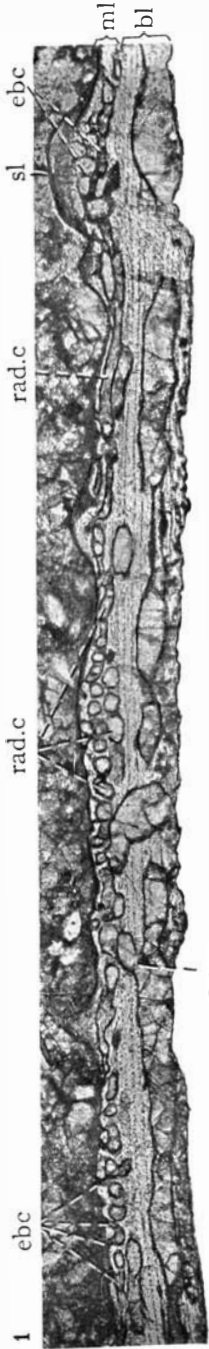
**Pl. 66.**

Fig. 1. *Cephalaspis* sp. Section through the exoskeleton of a tuberculated form from the lower Devonian. The basal layer somewhat imperfect most basally. The middle layer very thin and the superficial layer almost entirely absent. Specimen no. 127. <sup>50</sup>/1.

Fig. 2. *Cephalaspis* sp. Section through the posterior part of a cornu. Specimen no. 126. <sup>20</sup>/1.

Explanation of index letters.

*bl*, basal layer; *c. asc*, ascending canals; *dplx*, canals of the subaponeurotic (subcutaneous) vascular plexus; *ebc*, external branches of the radiating canals; *ml*, middle layer; *rad. c.*, radiating canals; *sl*, superficial layer.



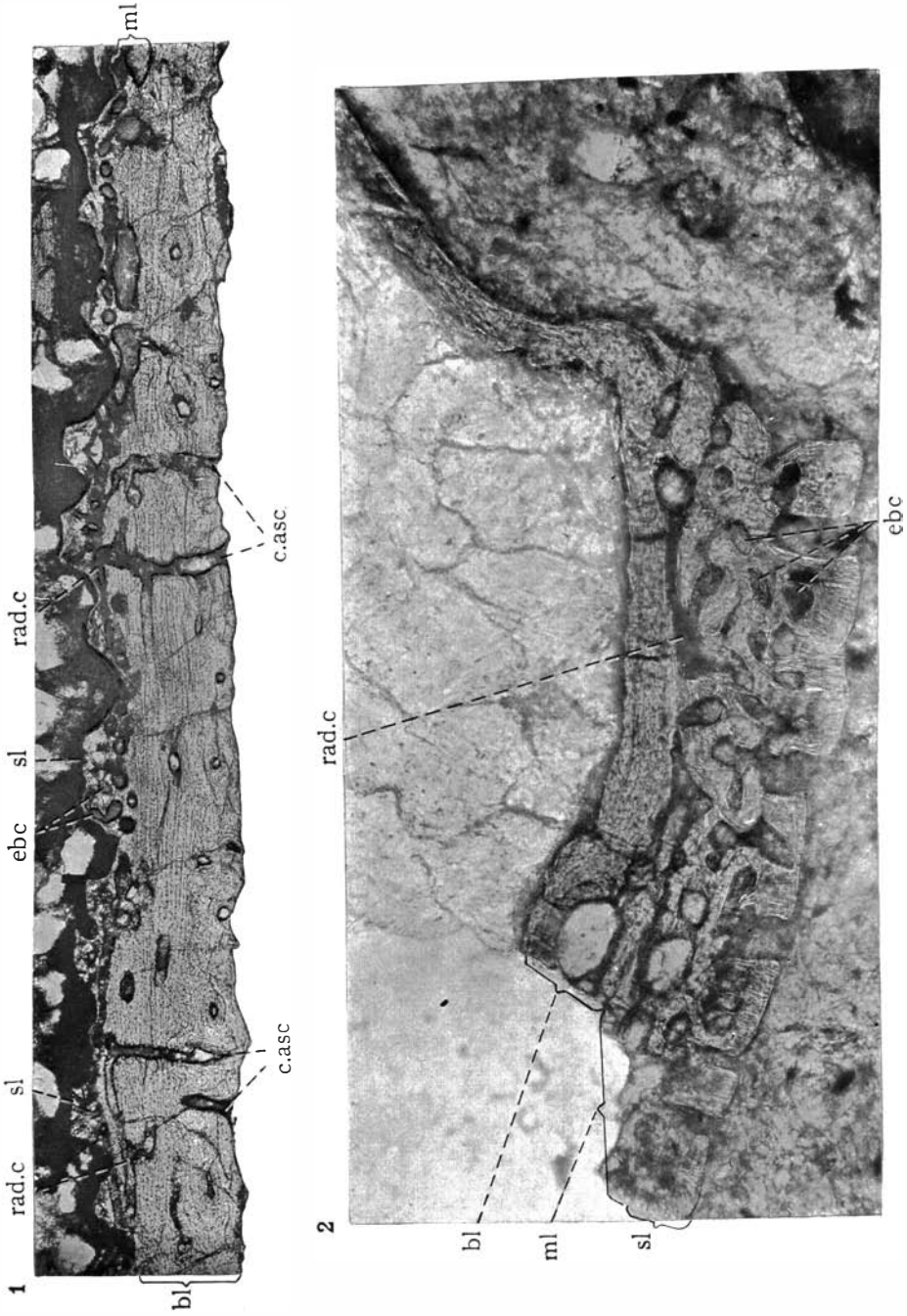
**Pl. 67.**

Fig. 1. *Cephalaspis* sp. Section through the exoskeleton of a form which has the middle layer very thin. Specimen no. 128. <sup>40</sup>/1.

Fig. 2. *Cephalaspis hoeli* n. sp. Section through the exoskeleton of the ventral rim. Specimen no. 30. (The specimen used for section series B). <sup>100</sup>/1.

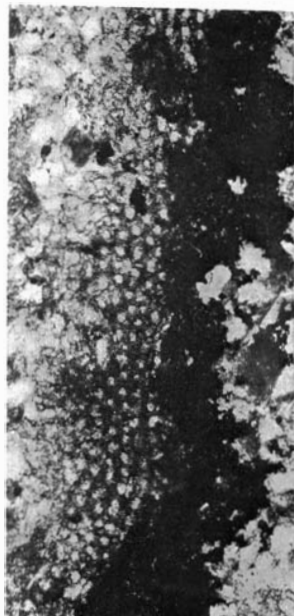
Explanation of index letters.

*bl*, basal layer; *c. asc*, ascending canals; *ebc*, external branches of the radiating canals; *ml*, middle layer; *rad. c.*, radiating canals; *sl*, superficial layer.

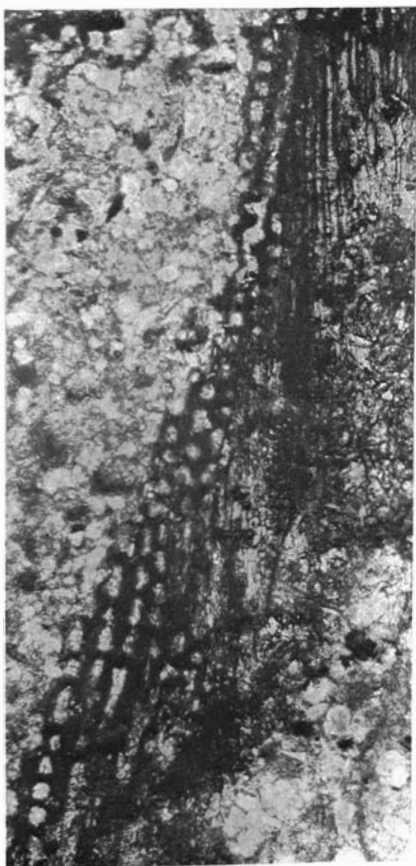


**Pl. 68.**

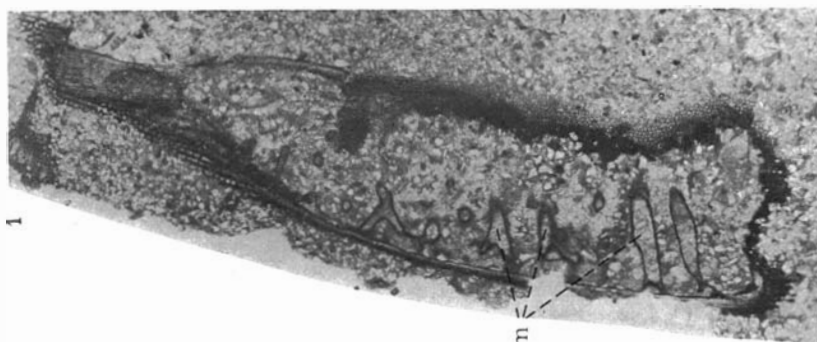
Figs. 1—3. *Cephalaspis hoeli* n. sp. Three horizontal sections through the ventral rim. Specimen no. 31. (The specimen used for section series F, cf. section no. 70, pl. 112). Fig. 1 magnification about  $10/1$ . Figs. 2 and 3 magnification about  $40/1$ . *avm*, canal for marginal vessels.



2



3



1

avm

**Pl. 69.**

*Cephalaspis* sp. Part of the exoskeleton which shows the character course and connections of the radiating canals of the middle layer. The superficial layer removed. Specimen no. 121. Magnification about  $25\times$ .  
*c. asc*, ascending canals; *rad. c*, radiating canals.





**Pl. 70.**

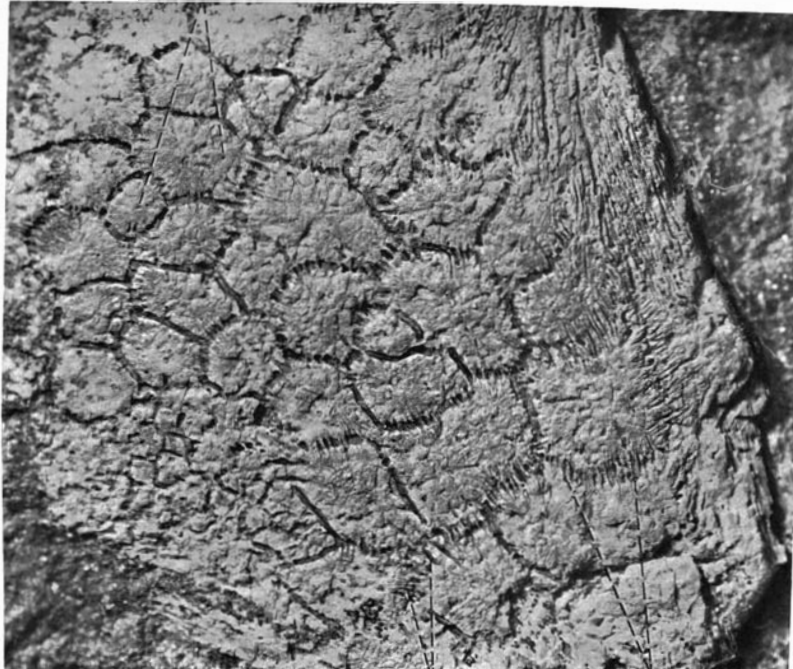
Fig. 1. *Cephalaspis* sp. Part of the exoskeleton in a much weathered condition. (Seen from the external surface). The superficial layer entirely destroyed and the middle layer also destroyed except in the vicinity of and basally to the interareal grooves. Specimen no. 122. <sup>5</sup>/1.

Fig. 2. *Cephalaspis vogti* n. sp. Part of the exoskeleton in surface view. The superficial layer preserved only in the places denoted *sl*, and the middle layer also lacking except its most basal part with radiating canals.

Explanation of index letters.

*c. asc*, ascending canals; *rad. c*, radiating canals; *sl*, superficial layer.

1 c.asc



rad.c rad.c

2 sl rad.c c.asc



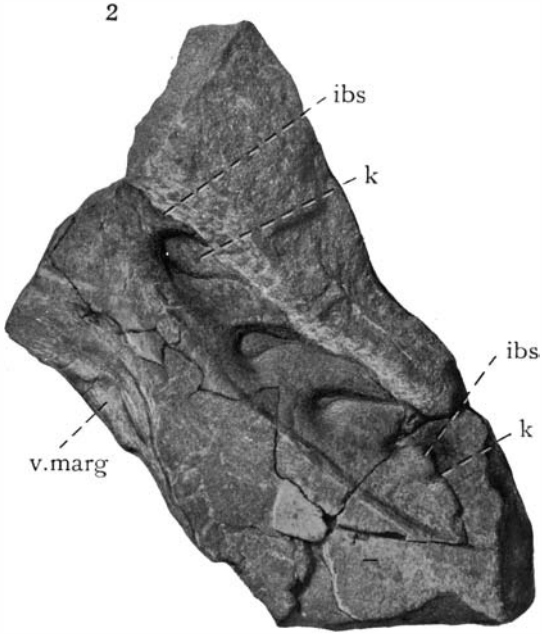
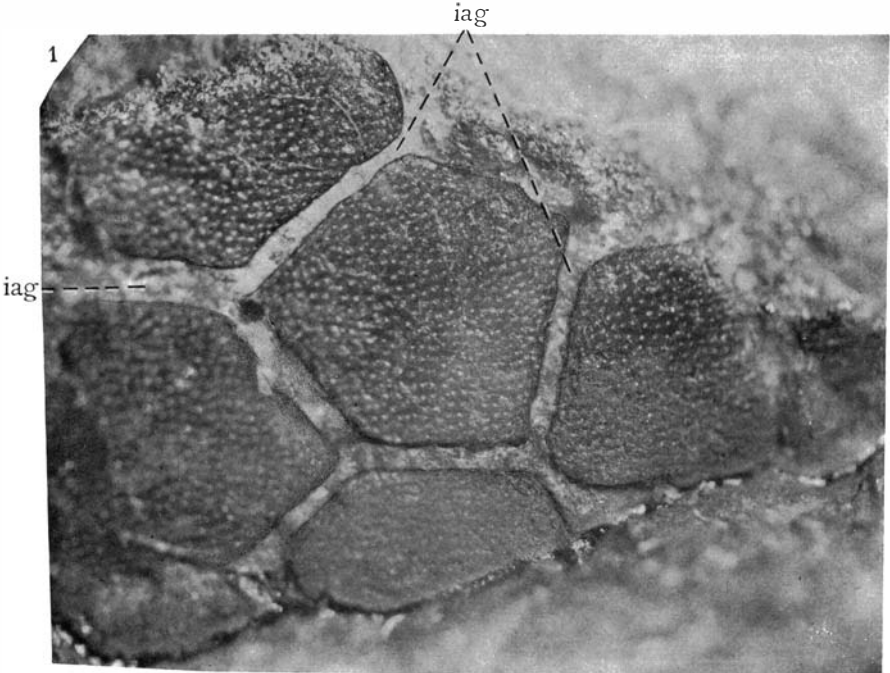
## Pl. 71.

Fig. 1. *Cephalaspis* sp. Part of the exoskeleton seen from the external surface. From a form with a continuous superficial layer and interareal grooves (*iag*). Specimen no. 120. (Seen in transverse section in pl. 64, fig. 2). <sup>16</sup>/1.

Fig. 2. *Cephalaspis* sp. Fragment of the ventral rim of the right side and an adjacent part of the oralo-branchial chamber. Ventral view. Specimen no. 130. <sup>1</sup>/1.

### Explanation of index letters.

*iag*, interareal groove; *ibs*, interbranchial septum; *k*, branchial fossa, ventral part; *v. marg*, canal for the marginal vein (represented only by a medial part).



## Pl. 72.

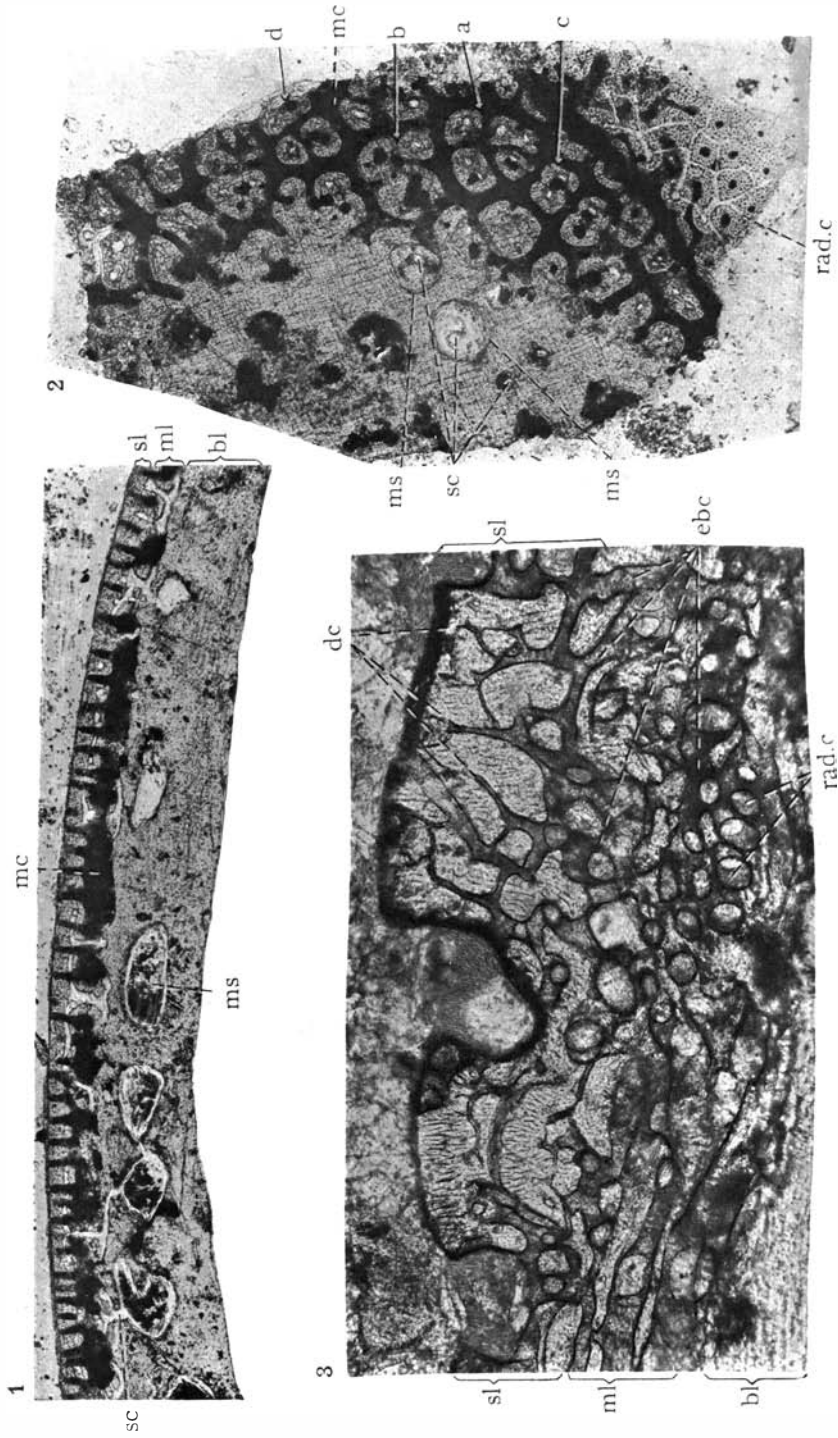
Fig. 1. *Tremataspis schmidtii*. Transverse section through the exoskeleton. Magnification about  $30/1$ .

Fig. 2. *Tremataspis schmidtii*. Somewhat obliquely horizontal section through the exoskeleton. Magnification about  $35/1$ .

Fig. 3. *Cephalaspis* sp. Transverse section through the exoskeleton of a tuberculated form showing the dentine structure of the tubercles. Specimen no. 123.  $100/1$ .

### Explanation of index letters.

*a, b, c, d*, different meshes of the mucous canal system; *bl*, basal layer; *dc*, canals perforating the dentine; *ebc*, external branches from the radiating canals; *mc*, mucous canals; *ml*, middle layer; *ms*, cavities for vascular sinus. *rad. c*, radiating canals; *sc*, ascending vascular canals; *sl*, superficial layer.



## List of Section Series

A Pls. 73—83    B Pls. 84—88    C Pls. 89—99  
D Pls. 100—104    E Pl. 105    F Pls. 106—112

### Pls. 73—83.

#### Section series A.

Transverse series of sections through the neurocranium and certain parts of the visceral skeleton of *Cephalaspis hoeli* n. sp. The postbranchial wall was lacking in the specimen used. The sections have been taken with intervals of about  $\frac{1}{15}$  mm. Specimen no. 27. Magnification approximately  $\frac{5}{1}$ .

Sections nos. 1—155 are through the neurocranium and are taken from the occipital region forwards as far as the anterior end of the nasohypophyseal opening. Sections nos. 156—158 are through the otic region and the visceral skeleton of the left side. Finally, sections nos. 159—167 are through the shoulder-girdle and the ventral part of the visceral skeleton immediately in front of the shoulder-girdle.

Exoskeleton denoted by thick black lines. Endoskeletal bone, that is to say the perichondral bone layers, denoted by thin lines. The spaces occupied by cartilage denoted by shading.

The models shown in text-figs. 15—18 and 23—26 were made after this section series.

#### Explanation of index letters in section series A—F.

*a. br.*, canal for the arteria brachialis; *a. c.*, canal for the a. cornualis; *a. dsm.*, canal for the a. postorbitalis superficialis; *a. dsm*<sub>1</sub>, *a. dsm*<sub>2</sub>, *a. dsm*<sub>3</sub>, canals for branches from the a. postorbitalis superficialis; *a. eff.*, canal for an efferent branchial artery (the canals for the efferent branchial arteries 7—9 denoted so in section series E); *a. eff*<sub>4</sub>—*a. eff*<sub>6</sub>, canals or foramina for the efferent branchial arteries 4—6; *a. eff*<sub>6</sub> *p.*, canal possibly for a posterior branch of the efferent branchial artery 6; *a. eff*<sub>7</sub>—*a. eff*<sub>9</sub>, canals for the efferent branchial arteries 7—9; *a. eff. com.*, canal or space for the arteria branchialis efferens communis, a vessel arisen by the confluence of the efferent branchial arteries 4—6, and which emptied in the cephalic division of the aorta; *a. fa.*, canal for an anterior branch of the arteria facialis; *a. fac.*, canal for the a. facialis; *a. fc.*, canal for an artery arisen by the union of the dorsal parts of the efferent branchial arteries 8 and 9; *a. fn.*, canal for a branch from the a. facialis to the fossa circumnasalis and the hypophyseal sac; *a. fp.*, canal for a posterior branch of the a. facialis; *a. iol.*, canal for the lateral infraorbital branch of the a. facialis; *a. iom.*, canal for the medial infraorbital branch of the a. facialis; *a. la.*, canal for an arterial trunk, which distally divided in the two anterior dorso-lateral superficial arteries; *a. la + VII.*, canal which lodged the n. facialis and the arterial trunk, which divided in the two anterior dorso-lateral superficial arteries; *am. ant.*, *am. post.*, cavities for the ampullae of the anterior and posterior semicircular canals respectively; *a. marg.*, canal for the marginal

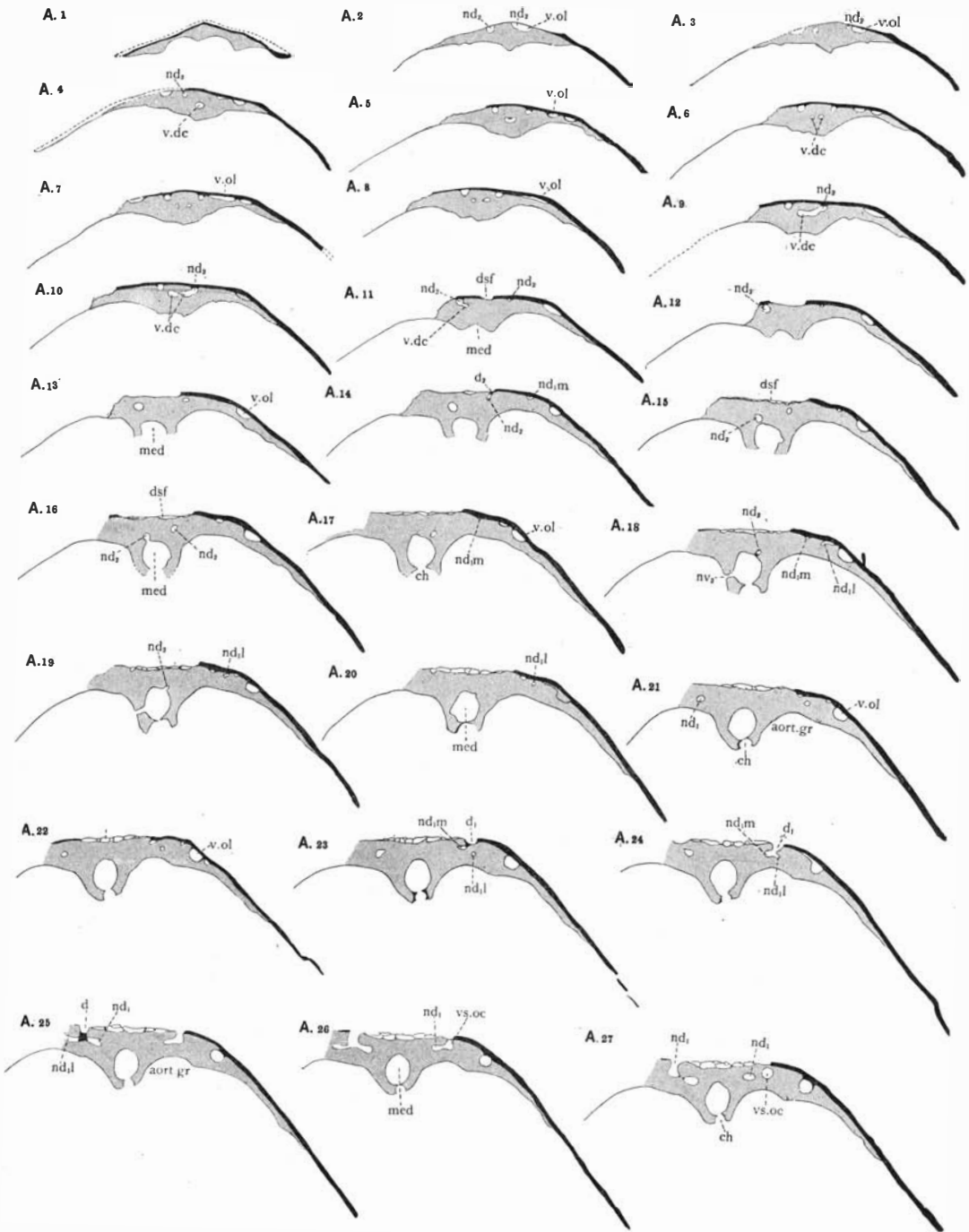
artery; *a. ob*, canal probably for an arterial branch; *aort*, canal or groove for the cephalic division of the aorta (the canal for the cephalic division of the aorta through the postbranchial wall is generally denoted so); *aort. gr*, aortal groove; *a. pbrw*, or *a. pbrw<sub>1</sub>*, canal for an arterial branch from the a subclavia to the posterior side of the postbranchial wall; *a. prn*, canal for an arterial branch to the pronephros space; *a. sa*, canal for the most anterior dorso-lateral superficial artery; *a. sa + VII*, common canal for a proximal part of the n. facialis and a proximal part of the most anterior dorso-lateral superficial artery; *a. slcm*, canal for an arterial trunk which distally bifurcated in the two posterior dorso-lateral superficial arteries; *a. sm*, canal for the second or third dorso-lateral superficial artery; *a. sm<sub>1</sub>*, canal for the second dorso-lateral superficial artery; *a. sm<sub>2</sub>*, canal for the third dorso-lateral superficial artery; *a. sp*, canal for the most posterior dorso-lateral superficial artery (in series C, no. 82 the canal denoted *a. sp* is in fact *v. lp*). The canal *a. sp* is represented in this section merely by a small notch in the postero-dorso-lateral margin of the vestibular division of the labyrinth cavity); *a. subcl*, canal for the a. subclavia; *at*, canal either for the n. facialis or for the arterial trunk, which divided in the two anterior dorso-lateral superficial arteries; *a. vs*, canal for a branch from the a. subclavia to the superficial portions of the posterior part of the ventral rim (posteriorly to the oralo-branchial fenestra). This anterior branch referred to as the r. superficialis ventralis of the a. subclavia; *ax*, *ax<sub>1</sub>* canals probably for arterial branches for the upper side of the neurocranium behind the pineal opening; *bt*, canal either for the n. facialis or for the arterial trunk which distally divided in the two anterior dorso-lateral superficial arteries; *bu*, *bu<sub>1</sub>—bu<sub>4</sub>*, canals probably for branches from the n. buccalis lateralis or for vessels or for both; *ch*, canal and groove for the notochord; *com*, commissural division of the labyrinth cavity; *c. post*, canal for the posterior encephalic artery; *c. sem. ant*, division of the labyrinth cavity for the canalis semicircularis anterior; *c. sem. post*, division of the labyrinth cavity for the canalis semicircularis posterior; *ct*, canal either for a branch from the n. facialis or for an arterial branch; *d*, *d<sub>1</sub>*, canal for the ductus endolymphaticus and probably also in most Cephalaspids for a vein from the dorsal electric field; *d<sub>2</sub>*, canal probably for a vein from the most posterior part of the dorsal electric field; *des*, canal for the electric nerve for the dorsal electric field; *dic*, division of the cavum cerebrale cranii for the diencephalon; *dpr*, area on the rostral part of the visceral skeleton that formed the dorsal boundary of the mouth cavity; *d. sell*, dorsum sellæ; *dsf*, dorsal electric field; *dsv*, groove for the electric nerve for the dorsal electric field; *dt*, canal for an artery, probably the dorso-lateral superficial artery 3; *dx*, canal for an artery or for a nerve to the dorsal electric field or for both an artery or a nerve for the said field; *et*, canal for an artery, probably the dorso-lateral superficial artery 4 (the most posterior dorso-lateral superficial artery); *ex*, canal perhaps for a vessel; *f. cn*, fossa circumnasalis; *f. opt*, fenestra optica; *fs. hyp*, fossa hypophyseos; *f. sn*, fossa subnasalis; *fy*, canal probably for a ventral longitudinal superficial vein; *fz*, canal probably for a vessel; *hab*, bulge for the habenular ganglia; *hab. r*, bulge for the right habenular ganglion; *hy. s*, division of the ethmoidal cavity for the hypophyseal sac; *ibr<sub>1</sub>—ibr<sub>9</sub>*, interbranchial ridges 1—9; *ibs<sub>1</sub>—ibs<sub>9</sub>*, interbranchial septa 1—9; *iz*, interzonal part of the cephalic shield (consists of exoskeletal bone); *k*, branchial fossa (ventro-lateral part); *k<sub>1</sub>—k<sub>10</sub>*, branchial fossae 1—10 (ventro-lateral part); *lsf*, lateral electric field; *mec*, division of the cavum



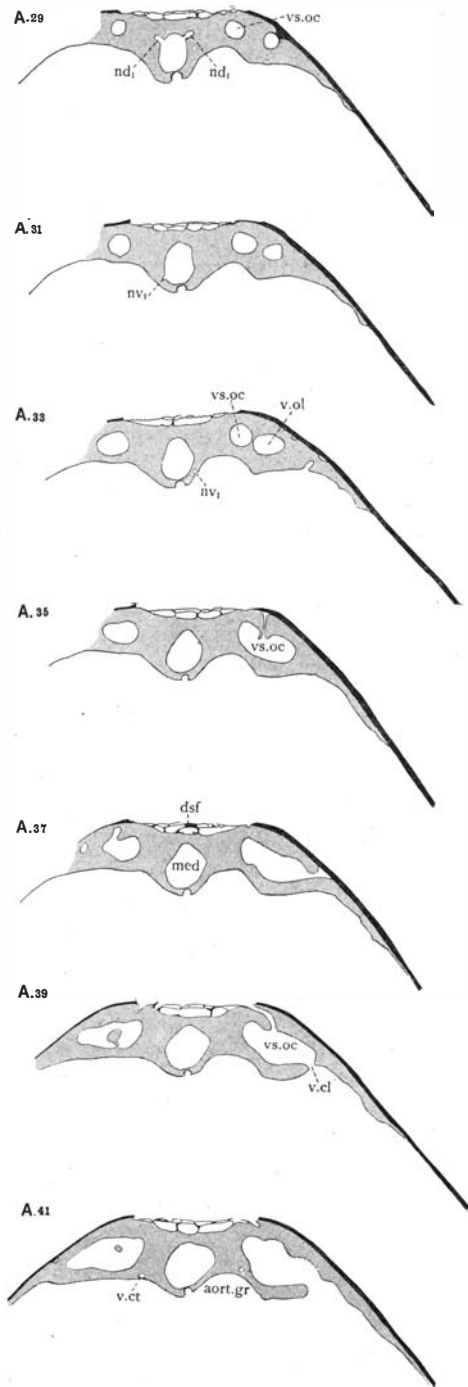
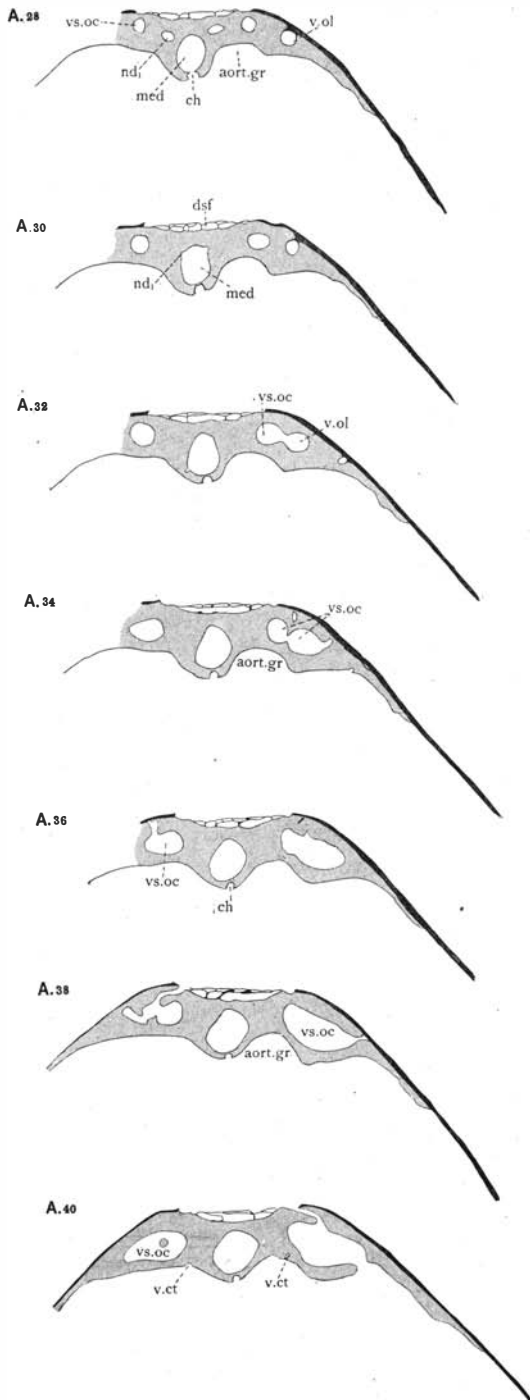
cerebrale cranii for the mesencephalon; *med*, division of the cavum cerebrale cranii for the medulla oblongata; *met*, division of the cavum cerebrale for the cerebellum; *my*, myodome; *na*, naso-hypophyseal aperture; *na*<sub>1</sub>, anterior division of the naso-hypophyseal aperture (for the external part of the hypophyseal sac); *na*<sub>2</sub>, posterior division of the naso-hypophyseal aperture, a division which formed the nasal opening proper; *nd*<sub>1</sub>, canal for the myelonal vein 1 and in addition for the dorsal root of the spino-occipital nerve 1; *nd*<sub>2</sub>, canal for the myelonal vein 2 and in addition for the dorsal root of the spino-occipital nerve 2; *nd*<sub>1</sub> *l*, lateral branch of the canal *nd*<sub>1</sub>, probably for a vein; *nd*<sub>1</sub> *m*, medial branch of the canal *nd*<sub>1</sub>, a branch which probably transmitted the dorsal root of the spino-occipital nerve 1; *n. lg*, canal or groove, in certain sections for the vagus roots or certain branches of the n. vagus, in other sections probably for the n. lineae lateralis; *nv*<sub>1</sub>, canal for the myelonal artery 1 and in addition probably for the ventral root of the spino-occipital nerve 1; *nv*<sub>2</sub>, canal for the myelonal vein 2 and in addition probably for the ventral root of the spino-occipital nerve 2; *nz*, *nz*<sub>1</sub>, canals probably for nerves for the pectoral fin; the canal *nz*<sub>1</sub> in addition probably gave passage also to a vein from the ventral and medial sides of the pectoral fin; *obr. ch*, oralo-branchial chamber; *oes*, foramen for the oesophagus or the division for the oesophagus in those cases when there is a common big foramen for the oesophagus and the truncus arteriosus; *oes + tr*, oesophagus-truncus arteriosus foramen; *olfc*, part of the ethmoidal cavity that lodged the olfactory organ; *orb*, orbit and orbital opening; *p. brv*, postbranchial wall; *pin*, pineal canal; *p. nl*, pronephros lamella, a skeletal lamella which protected the pronephros from the lateral side; *p. nm*, lamella which divided the pronephros space in right and left parts of unequal size; *pr. neph*, pronephros space; *ps*, pectoral sinus; *p. sh*, endoskeletal shoulder-girdle; *r. aort*, aortal ridge; *r. subcl*, subclavin ridge; *sel*<sub>1, 2</sub>, common canal for the two most anterior nerves for the lateral electric field; *sel*<sub>1</sub>—*sel*<sub>6</sub>, the canals for the electric nerves for the lateral field; *t*, canal probably for a vessel; *tel*, division of the cavum cerebrale cranii for the telencephalon; *tr*, foramen for the truncus arteriosus (the division for the truncus arteriosus in those cases, when the truncus arteriosus and the oesophagus foramina have fused into one; *u*, canal probably for a vessel; *v*<sub>1</sub>—*v*<sub>9</sub>, canals for the ventral transversal superficial veins; *va*, canal probably for a branch from the truncus arteriosus; *v. br*, canal for the branchial vein; *v. cl*, canal for the v. capitis lateralis; *v. cl*<sub>1</sub>, canal for the preorbital division of the v. capitis lateralis; *v. ct*, *v. ct*<sub>1</sub>, canals for veins; *v. cx*, posterior opening of the canal for the v. capitis lateralis (in series B, section no. 10); *v. d*<sub>1</sub>, canal for a supraorbital vein; *v. dc*, cavity for a vein sinus; *v. ds*<sub>1</sub>, *v. ds*<sub>2</sub>, canals for veins from the dorsal parts of the otic region; *v. dsv*, canal for the otical vein; *vest*, vestibular division of the labyrinth cavity; *v. ifc*, canal probably for a vein from the parts of the shield just ventrally and laterally to the orbital opening; *v. la*, canal for a venous trunk arisen by the union of the dorso-lateral superficial veins 3 and 4 or of the dorso-lateral superficial veins 3, 4 and 5; *v. lab*, *v. lab*<sub>1</sub>—*v. lab*<sub>4</sub>, canals for veins from the labyrinth cavity or for branches of the n. glosso-pharyngeus and the n. facialis to the dorsal side of the otic region; or else it is possible that the canals in question transmitted both the said veins and nerves and perhaps also arteries; *v. lp*, canal for a venous trunk arisen by the confluence of the dorso-lateral superficial veins 4, 5 and 6 or of the dorso-lateral superficial veins 5 and 6; *v. ls*?, canal perhaps

for a dorso-lateral superficial vein; *v. ls<sub>3</sub>*—*v. ls<sub>6</sub>*, canals for the dorso-lateral superficial veins 3—6; *v. marg*, canal for the marginal vein; *v. ol*, canal for the lateral occipital vein; *v. p*, canal of uncertain importance, perhaps for a vein (section series C, nos. 100—103); *v. pt*, canal probably for the pituitary vein; *vs. marg*, marginal vein sinus, a widened posterior part of the canal for the marginal vein; *v. so<sub>1</sub>*—*v. so<sub>4</sub>*, canals for supraorbital veins; *vs. oc*, occipital vein sinus; *vs. r*, rostral vein sinus; *vy*, canal for a vessel; III, canal for the n. oculomotorius; IV, canal for the n. trochlearis; IV + V*b*, recess from which the canals IV and V issue; V, canal for the trigeminus-profundus roots (in section series D, no. 9 the canal for the n. facialis from the labyrinth is erroneously denoted V); V*a*, canal probably for the supposed visceromotor root of the n. profundus; V*b*, canal for the general cutaneous root of the n. profundus; V*c*, canal for the general cutaneous root of the n. trigeminus proper; V*d*, canal for the visceromotor root of the n. trigeminus proper; V*x*, canal leading from the cranial cavity to the posterior part of the canal V*d*, probably for a bundle of nerve-fibres; V*xa*, canal connecting the cranial cavity with the anterior part of the canal V*d*, perhaps for the n. abducens; V<sub>1</sub>, canal for the n. profundus; V<sub>2</sub>, canal for the n. trigeminus proper; VII, canal for the n. facialis from the labyrinth cavity to the oralo-branchial chamber; VII + VIII*a*, facialis canal. This canal transmitted to the vestibular division of the labyrinth cavity the following nerves: the roots of the n. facialis, all the prootic lateralis roots, probably all the electric nerve fibres, and finally the anterior branch of the n. acusticus; VIII*p*, canal for the posterior branch of the n. acusticus; IX, branch of the vagus canal for the glossopharyngeus roots (in series E, however, IX means the canal through which the n. glossopharyngeus left the labyrinth cavity and arrived in the oralo-branchial chamber. In other cases this canal is lettered IX*a*); IX*a*, canal for the passage of the n. glossopharyngeus to the oralo-branchial chamber; IX*l*, canal probably for a dorsal branch of the n. glossopharyngeus; IX*p*, canal through which the n. glossopharyngeus entered the labyrinth cavity; IX + X, division of the vagus canal for the glossopharyngeus and vagus roots; IX + X + X*vcp*, vagus canal; X, branch of the vagus canal for the vagus roots (and in certain cases the canal for the truncus epibranchialis vagi); X*br*, canal for a branchial branch of the n. vagus; X*br<sub>1</sub>*, canal for the first branchial branch of the n. vagus; X*br<sub>2</sub>*—X*br<sub>6</sub>*, canals for the branchial branches 2—6 of the n. vagus; X*gn*, pit probably for the main part of the vagus ganglion complex; X*l*, canal probably for a dorsal branch for the n. vagus; X*vcp*, branch or division of the vagus canal for the v. cerebralis posterior.

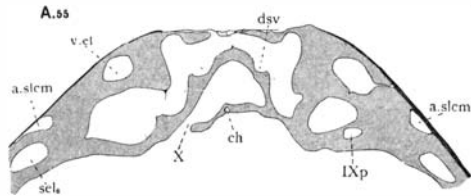
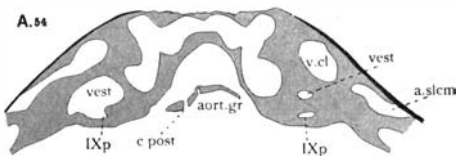
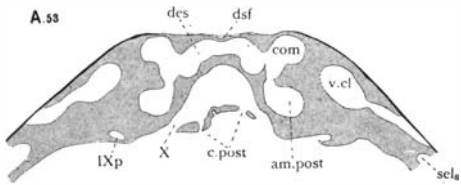
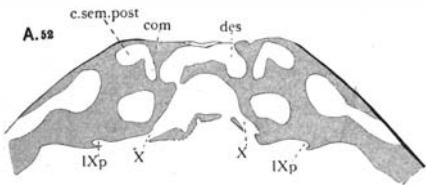
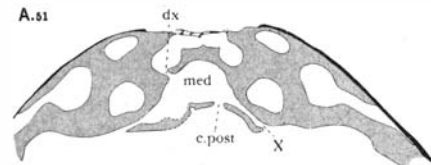
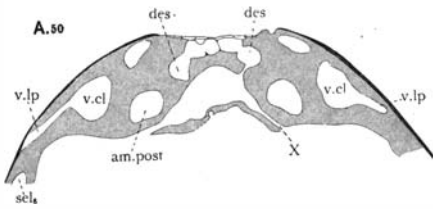
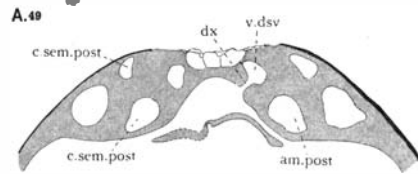
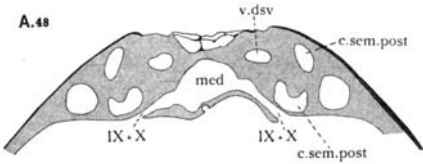
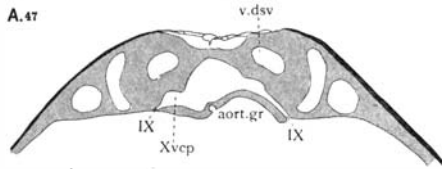
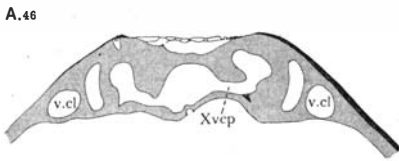
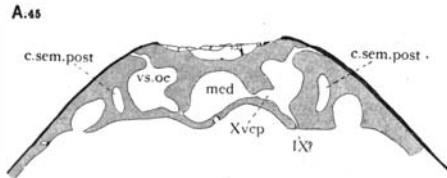
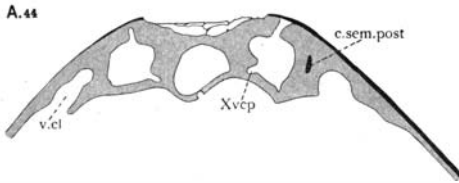
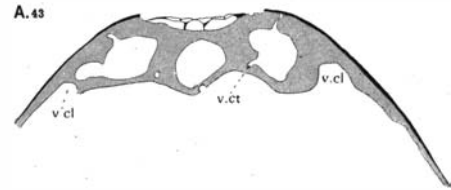
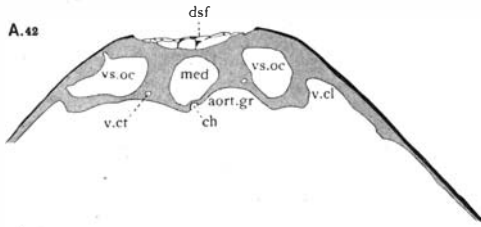
Ser. A.



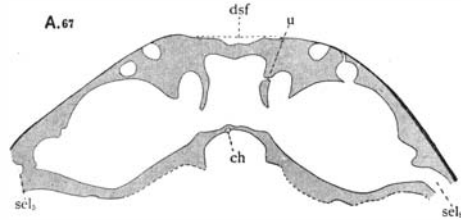
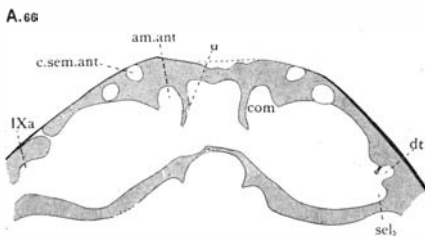
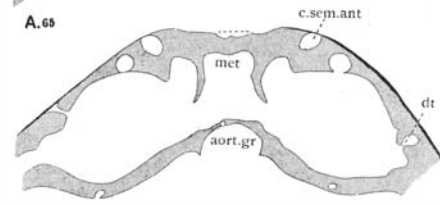
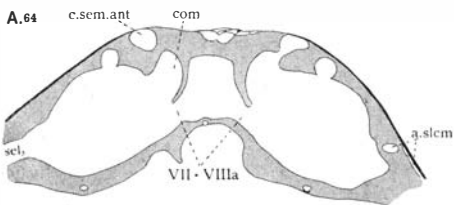
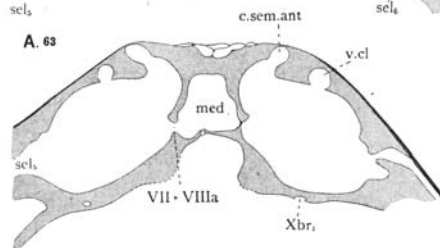
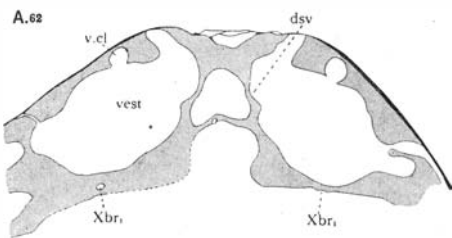
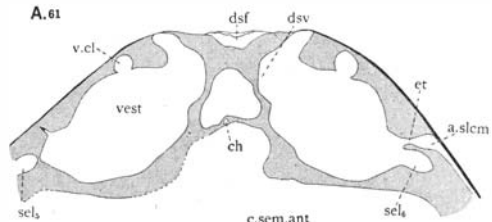
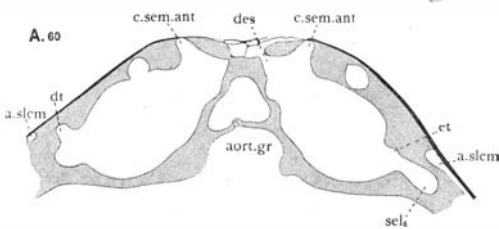
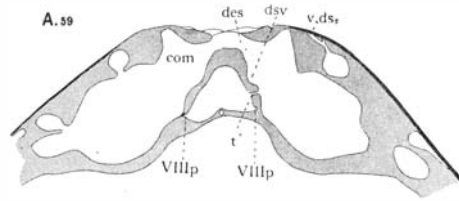
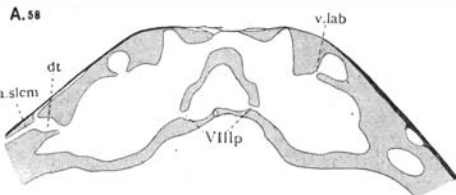
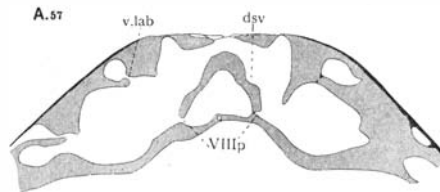
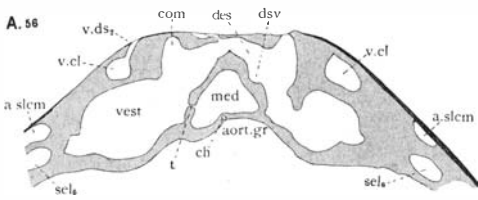
Ser. A.



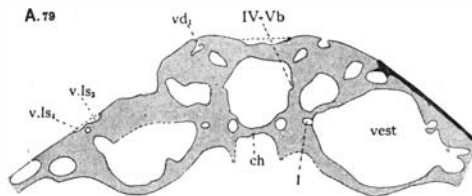
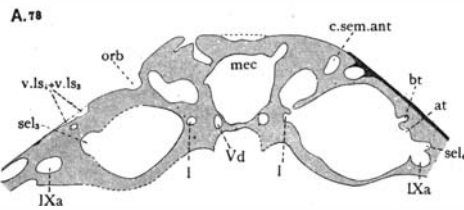
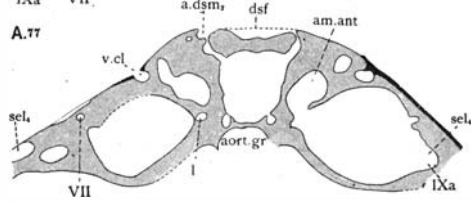
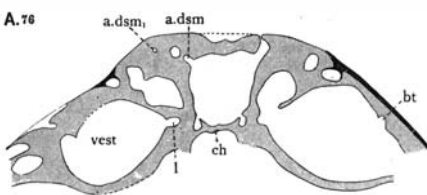
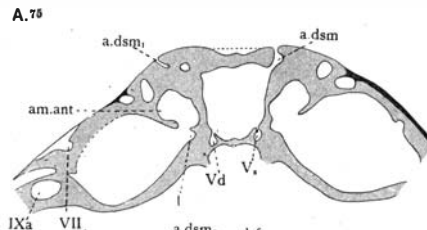
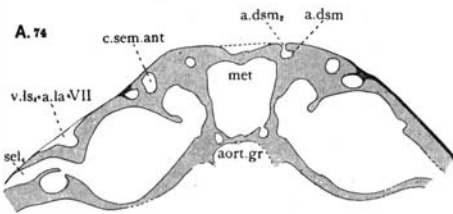
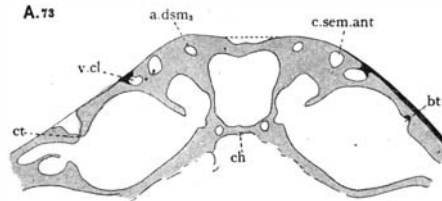
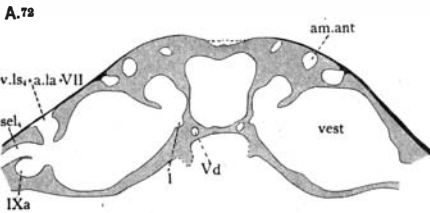
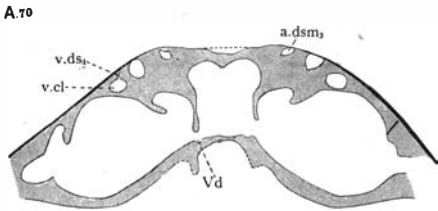
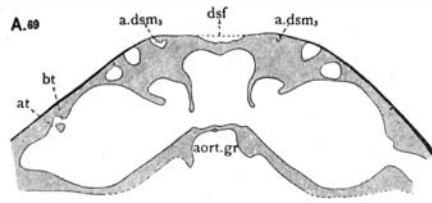
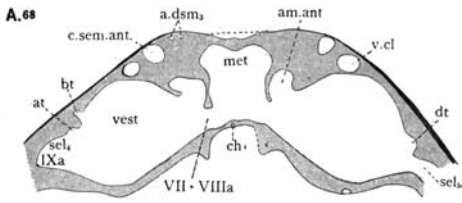
Ser. A.



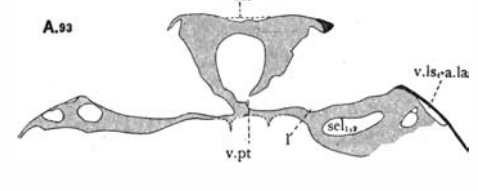
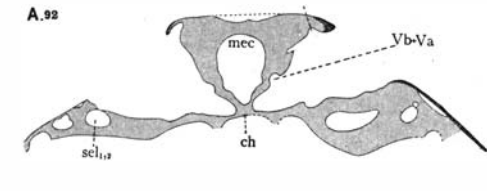
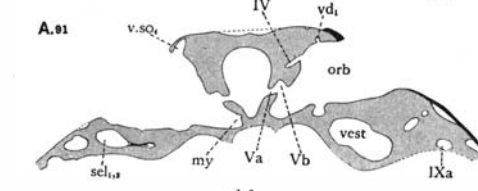
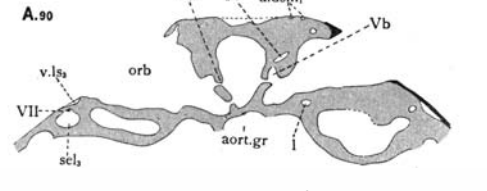
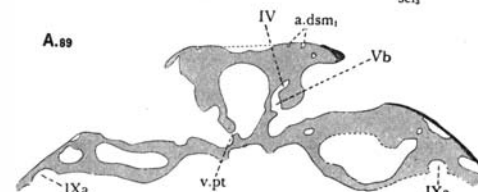
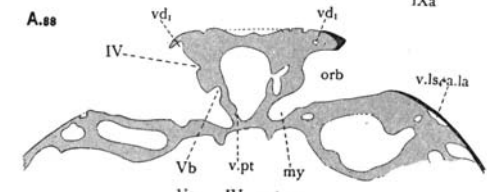
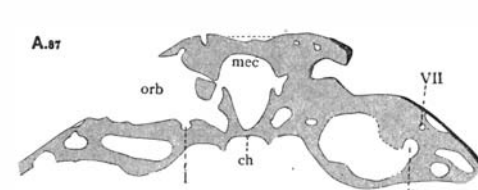
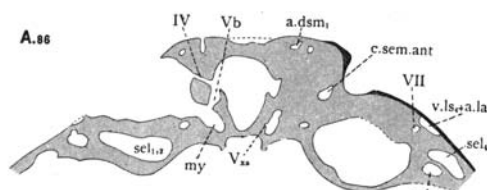
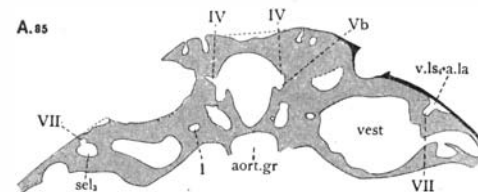
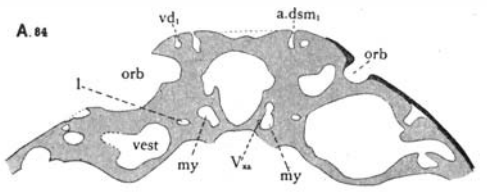
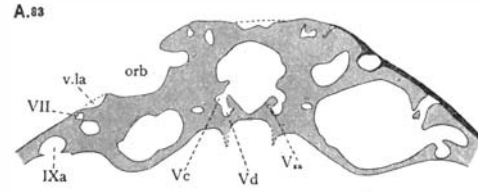
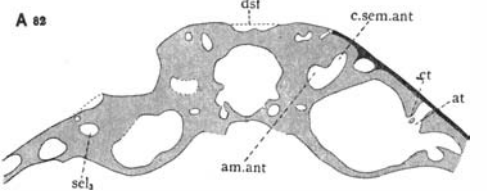
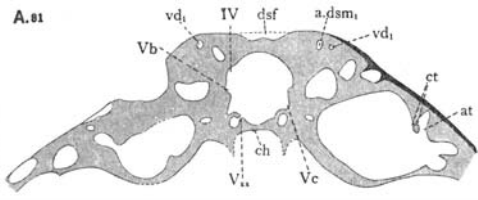
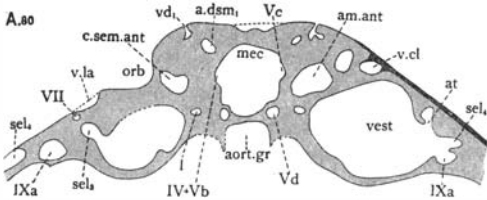
Ser. A.



Ser. A.

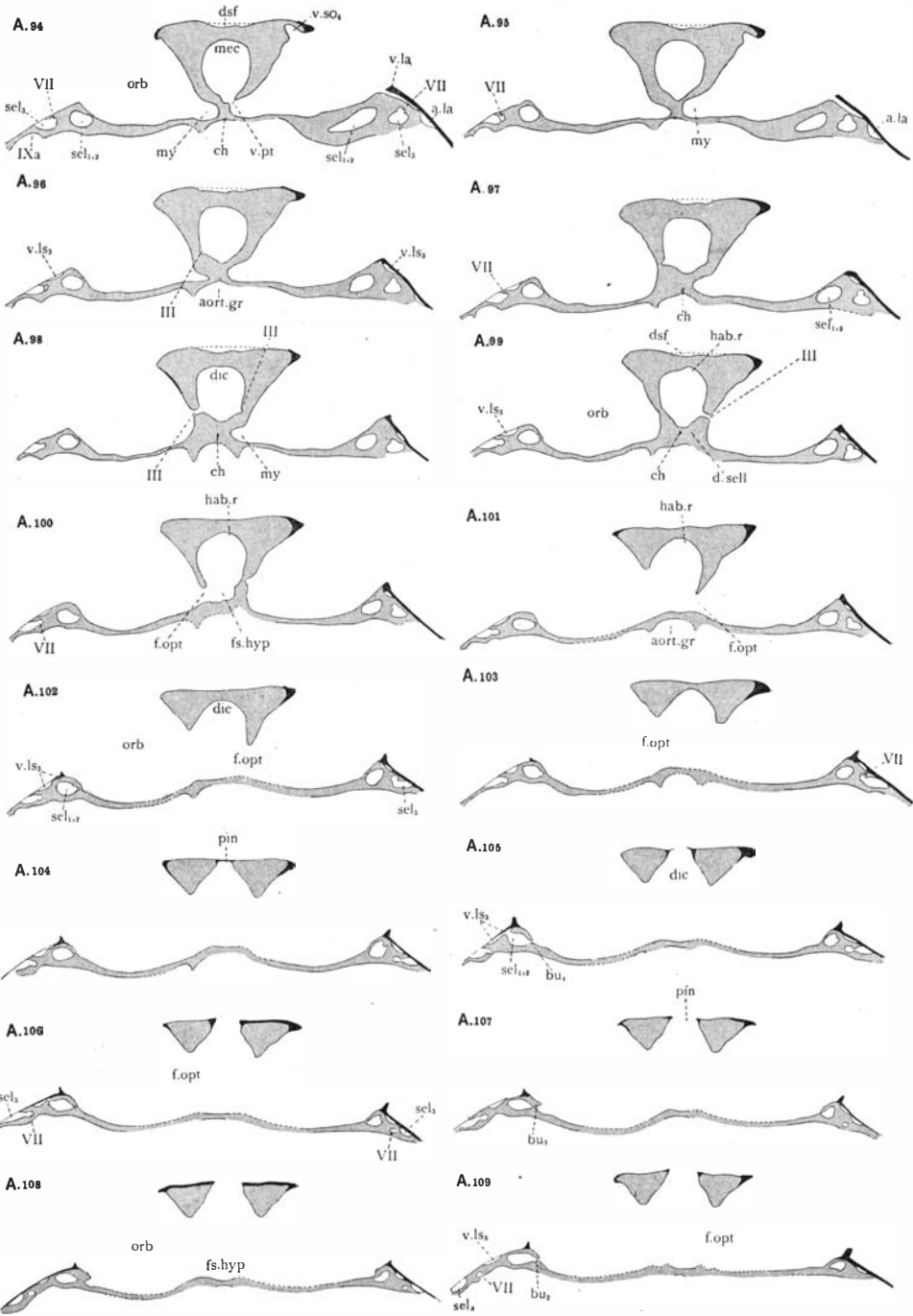


Ser. A.

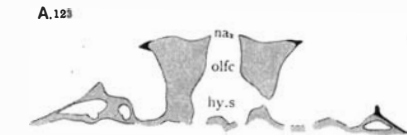
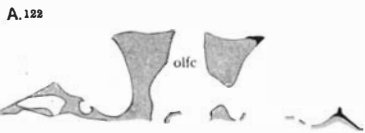
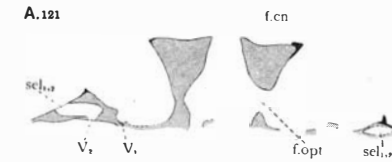
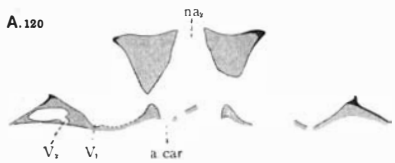
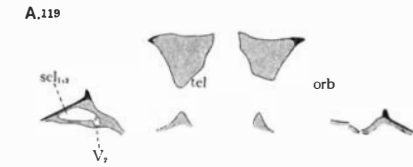
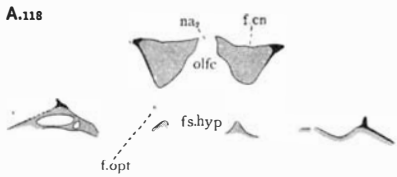
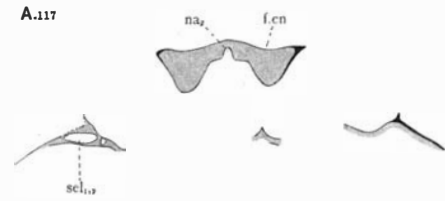
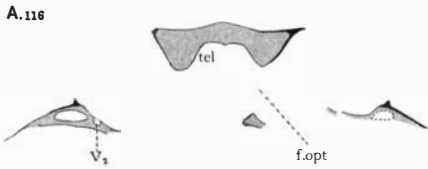
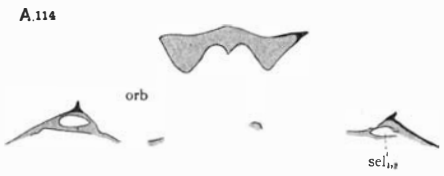
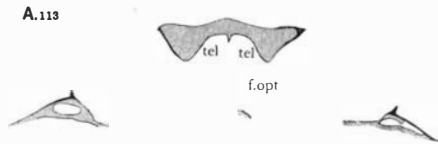
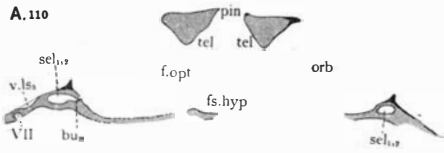




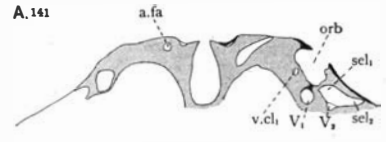
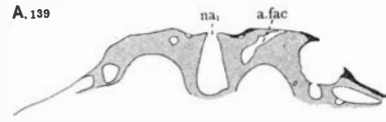
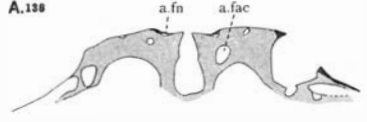
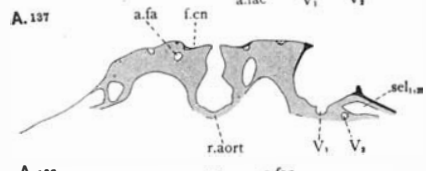
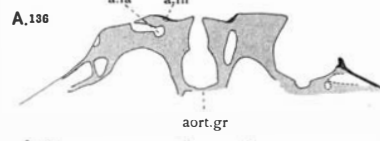
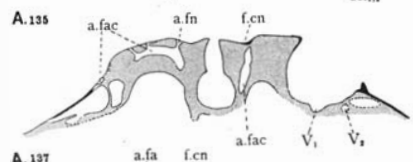
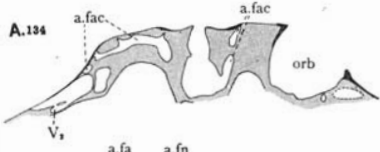
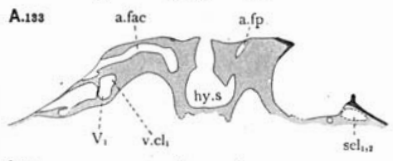
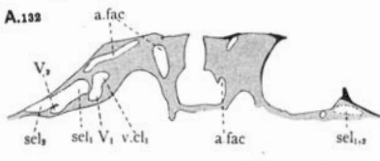
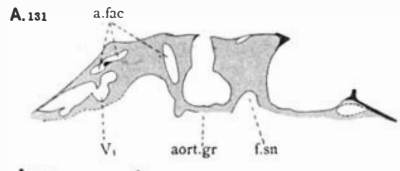
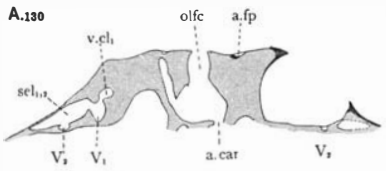
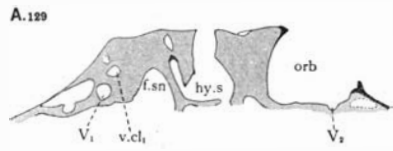
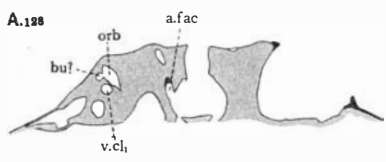
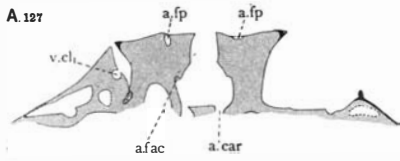
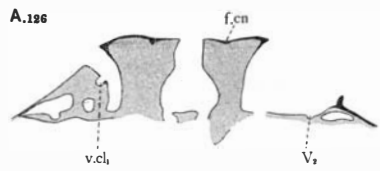
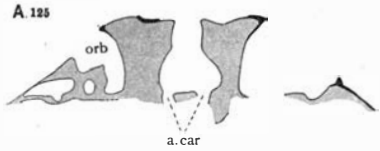
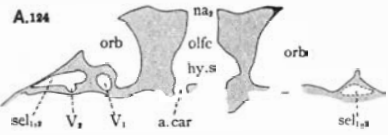
Ser. A.



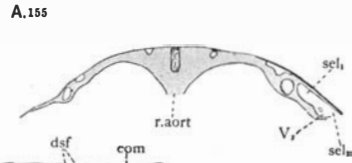
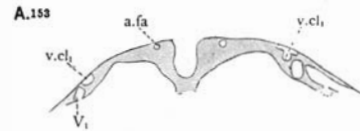
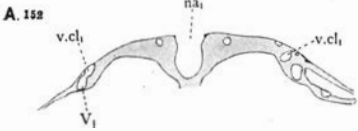
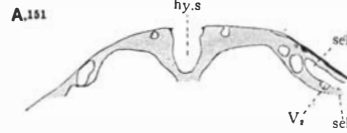
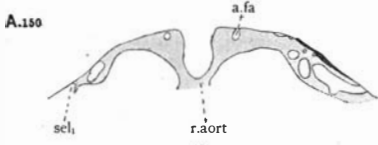
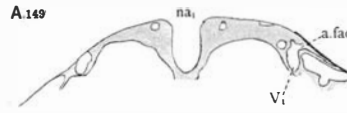
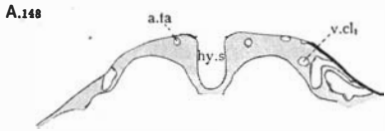
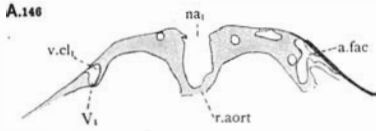
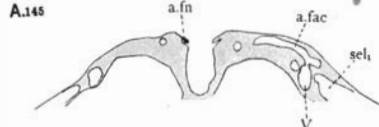
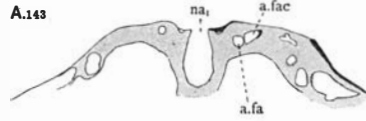
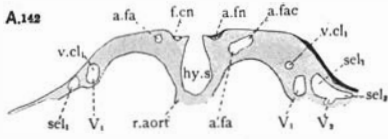
Ser. A.



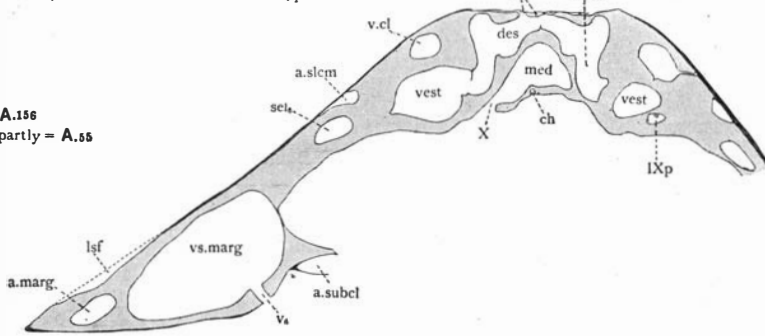
Ser. A.



Ser. A.

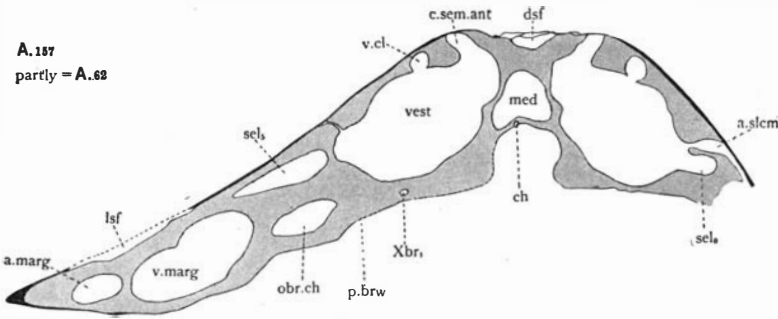


**A.156**  
partly = A.55

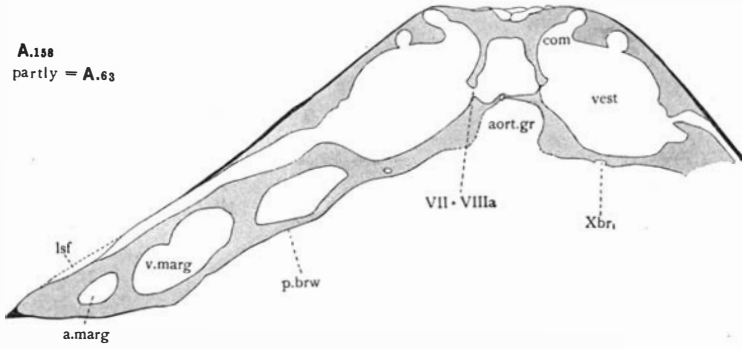


Ser. A.

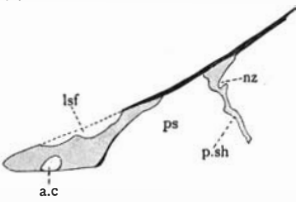
A.157  
partly = A.63



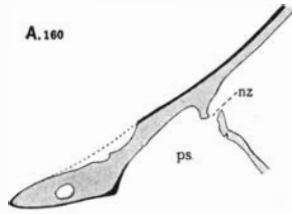
A.158  
partly = A.63



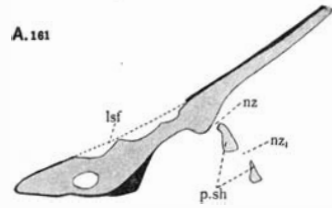
A.159



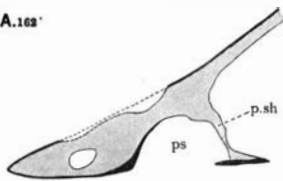
A.160



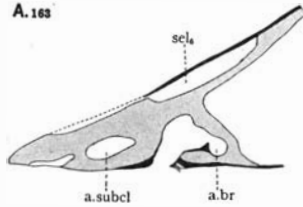
A.161



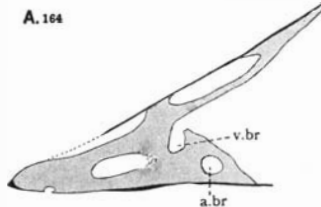
A.162



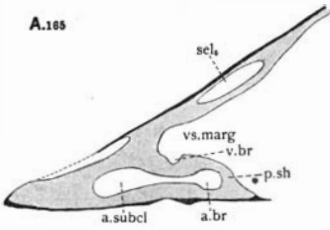
A.163



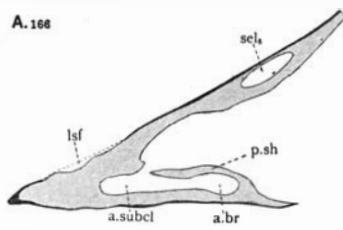
A.164



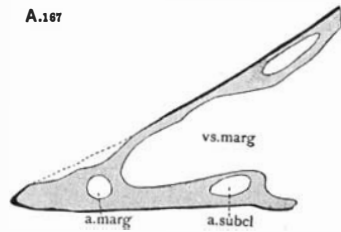
A.165



A.166



A.167



**Pls. 84—88.**

**Section series B.**

Transverse sections mainly through the neurocranium of *Cephalaspis hoeli* n. sp. The sections have been made with somewhat different intervals. Specimen no. 30. Magnification  $\frac{6}{1}$ .

As the posterior part of the occipital region was lacking in the specimen sectioned, the series begins only in the anterior part of the occipital region. In sections nos. 1 and 6 also the visceral skeleton of the left side is shown.

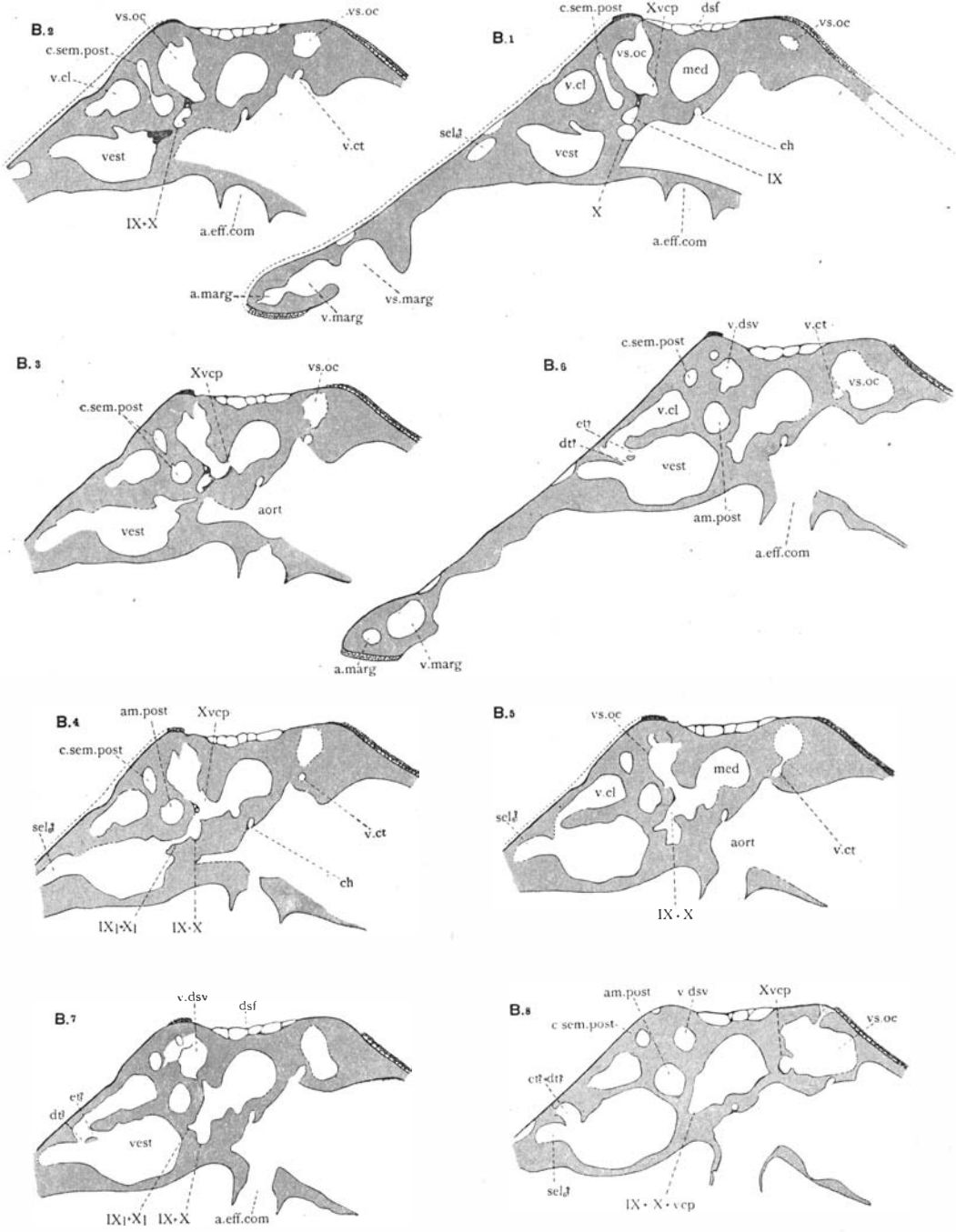
Exoskeleton denoted by thick black lines or else it is denoted by transversal striation. Endoskeletal bone denoted by thin lines. Spaces occupied by cartilage shaded.

The model shown in text-fig. 14 was made after this section series.

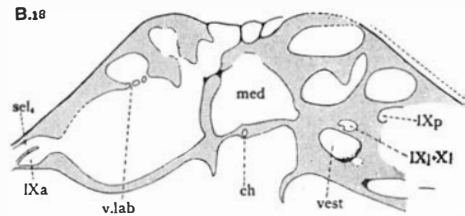
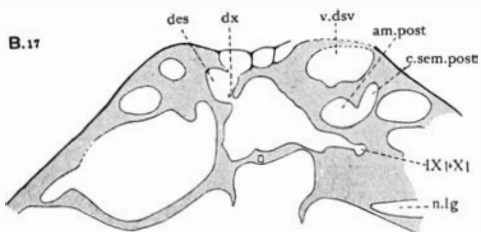
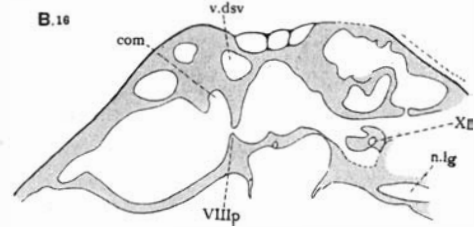
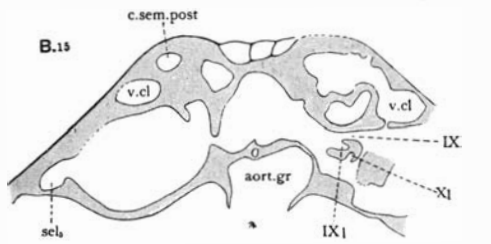
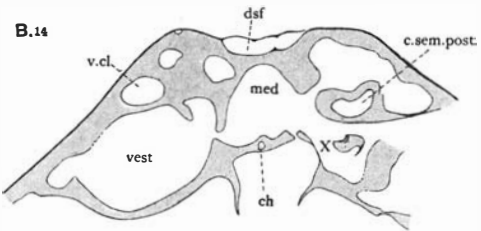
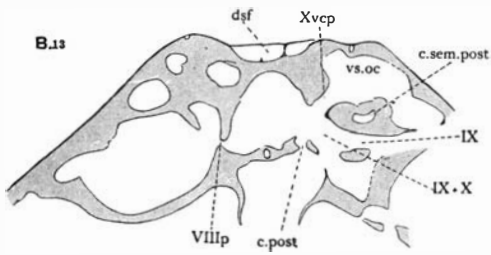
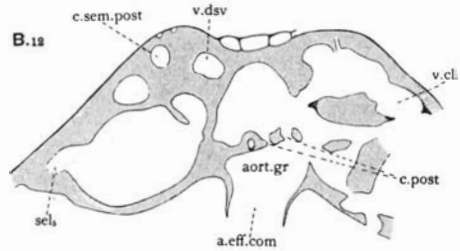
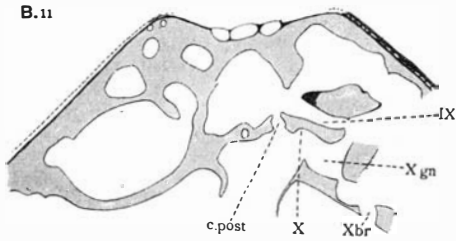
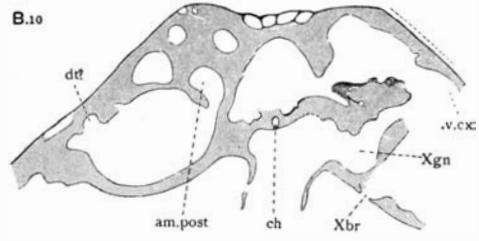
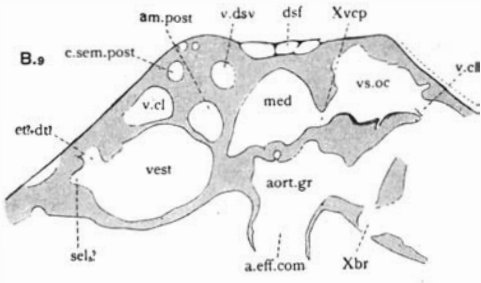
Explanation of index letters.

See section series A.

Ser. B.

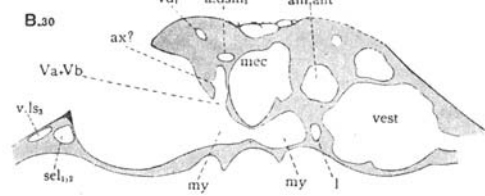
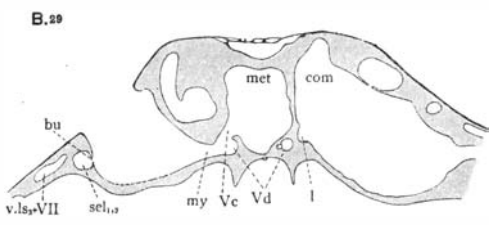
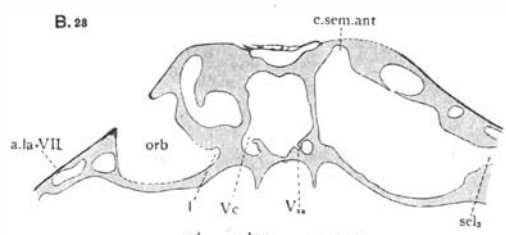
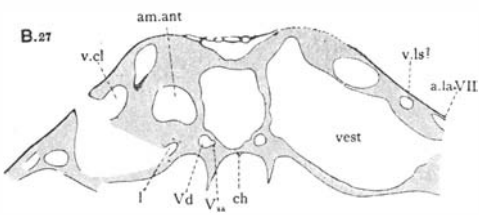
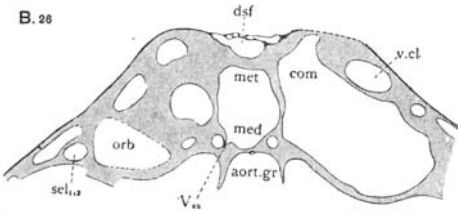
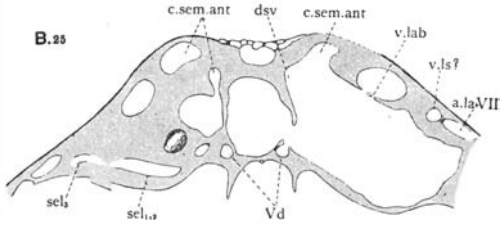
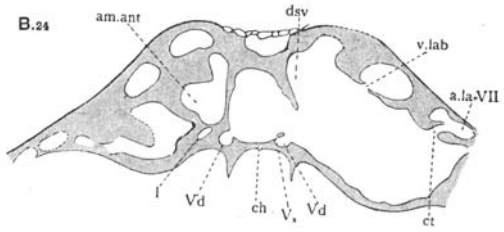
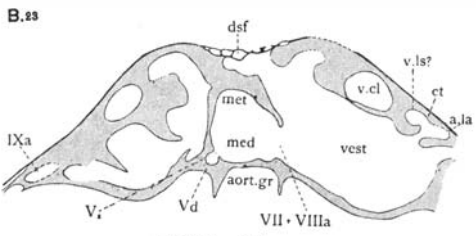
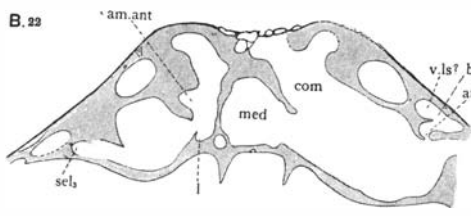
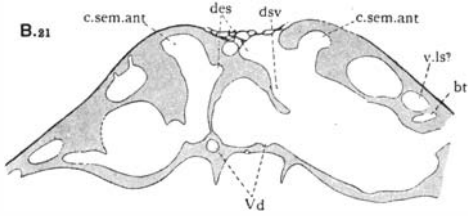
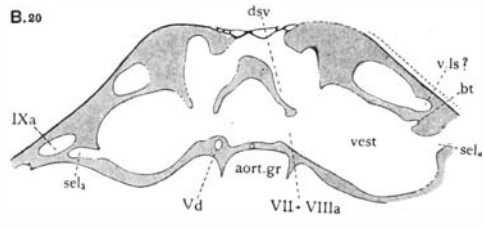
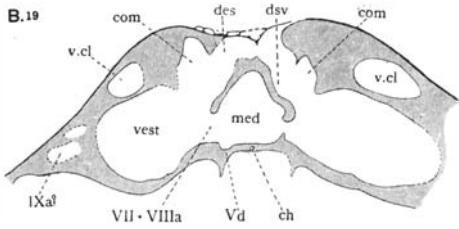


Ser. B.

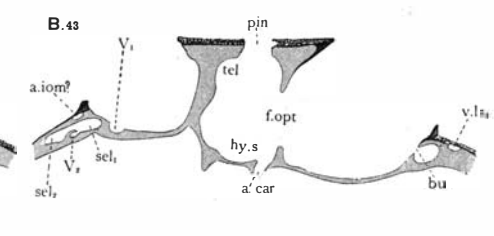
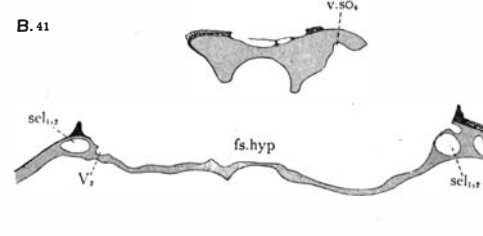
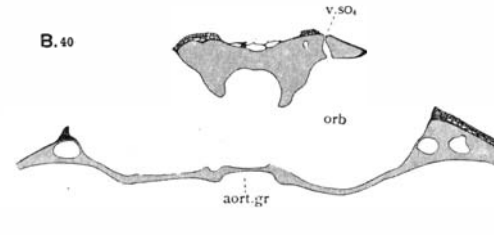
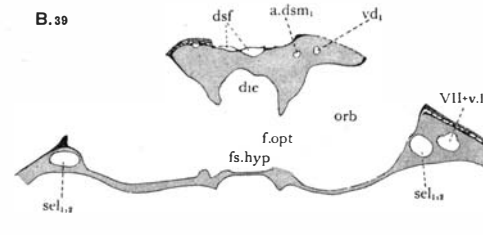
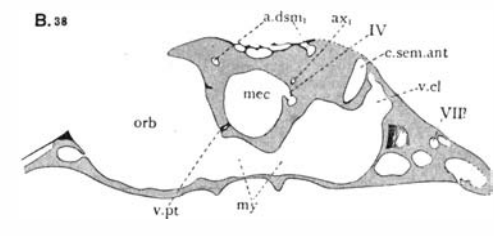
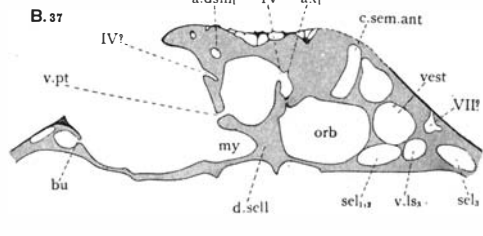
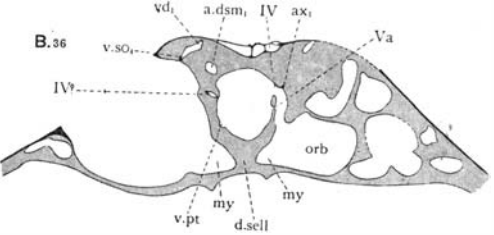
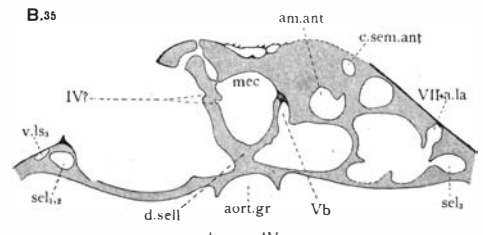
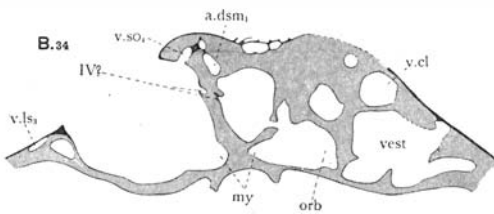
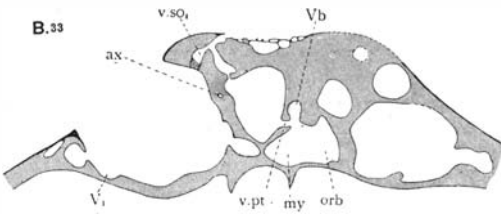
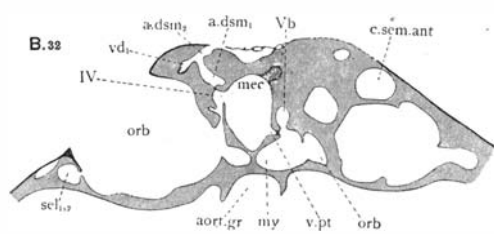
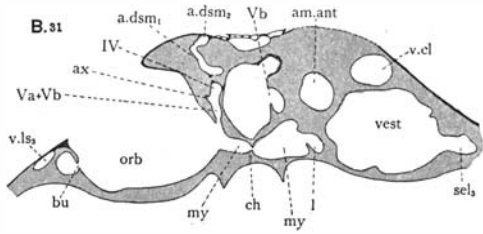




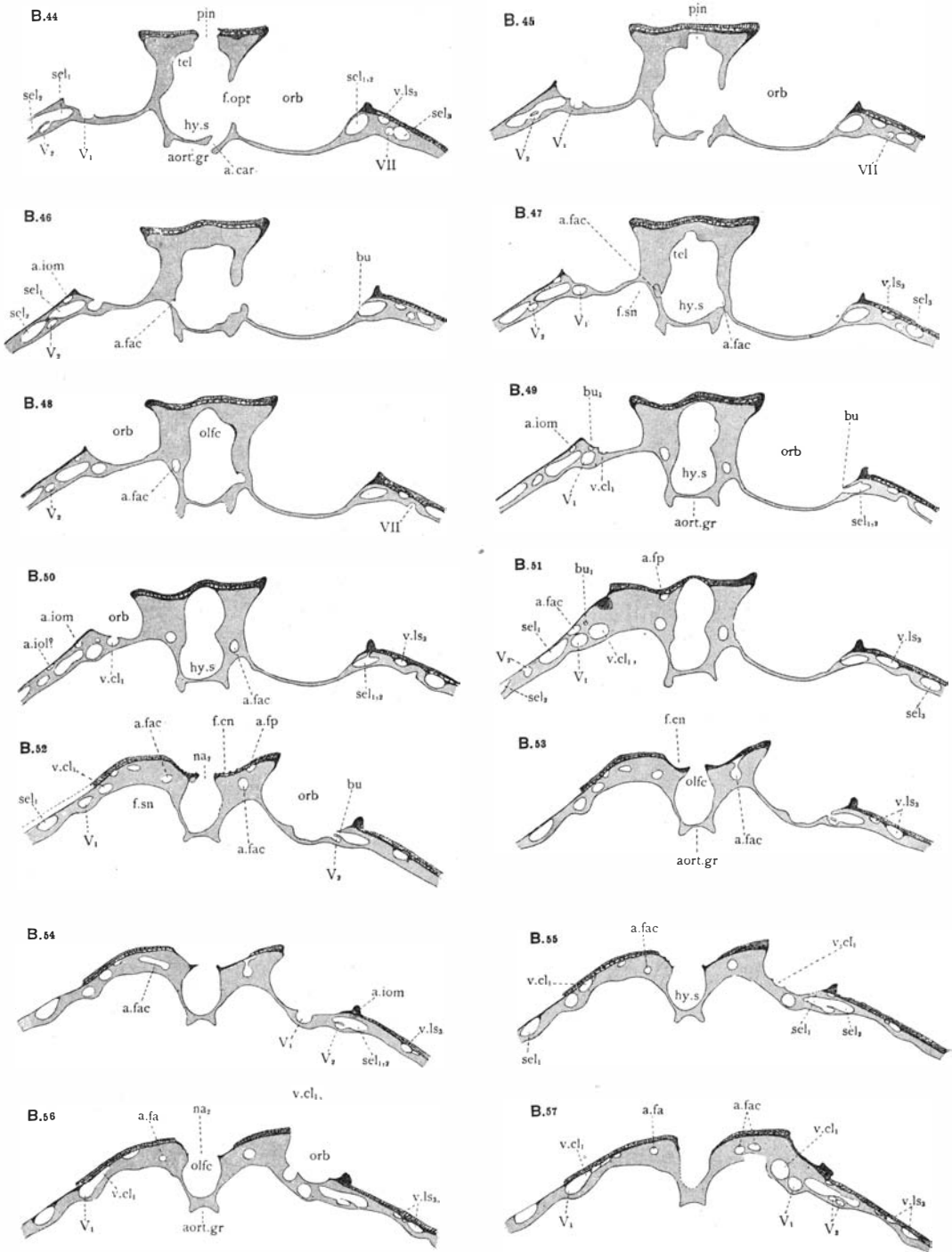
Ser. B.



Ser. B.



Ser. B.



**Pls. 89—99.**

**Section series C.**

Sagittal sections through the right half of a cephalic shield of *Cephalaspis hoeli* n. sp. The postbranchial wall much crushed in the specimen used. The sections taken with rather different intervals. Specimen no. 29. Magnification  $\frac{4}{1}$ .

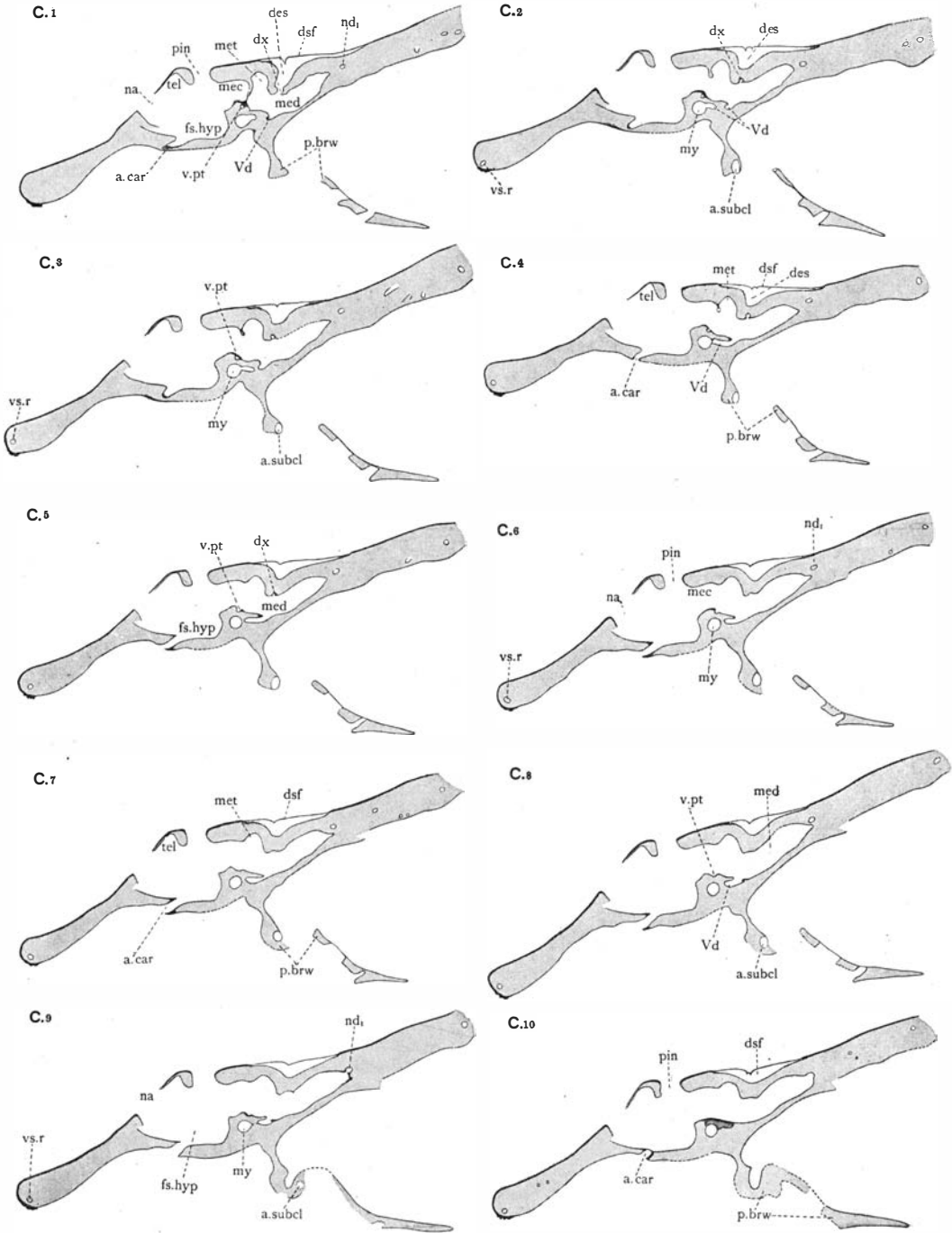
The section series begins somewhat to the left of the median line, and is thus in fact made through somewhat more than the right half of the specimen.

The exoskeleton of the upper side was to a great extent lacking, being represented mainly only by certain basal parts of the basal layer. In the most rostral part of the ventral rim and in the interzonal part of the shield (iz) it is, however, well preserved. In the first-mentioned place, where it was provided with small tubercles, it is denoted by a thick black line. On the other hand, in the interzonal part of the shield, it is denoted by a reticulation. Perichondral bone layers with thin lines. The spaces occupied by cartilage shaded.

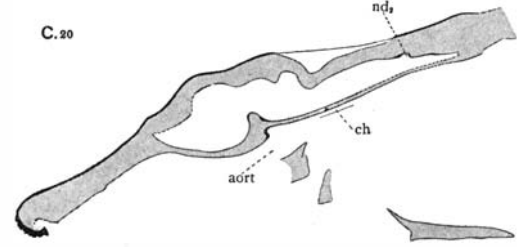
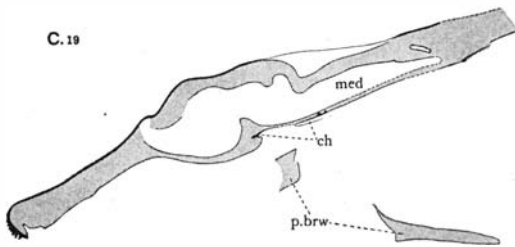
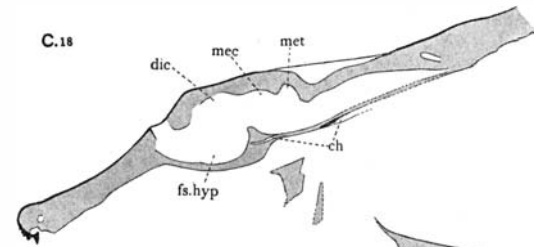
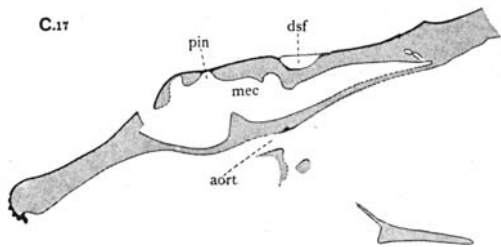
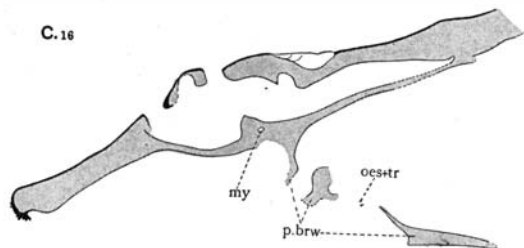
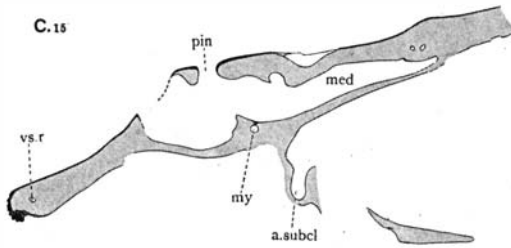
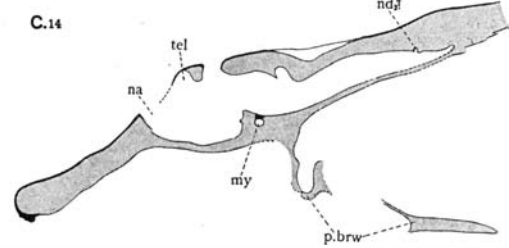
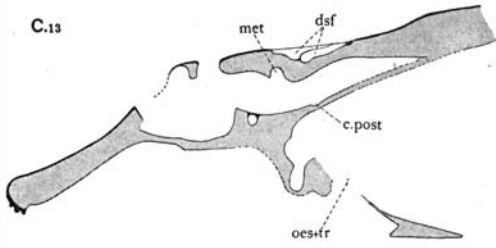
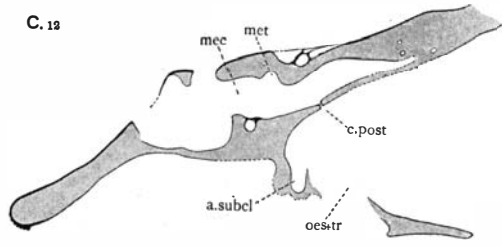
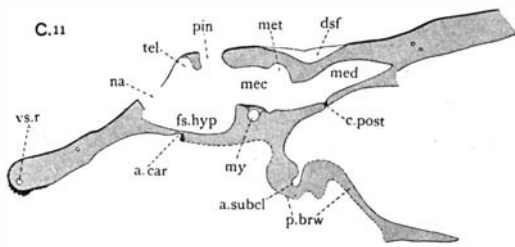
Explanation of index letters.

See section series A.

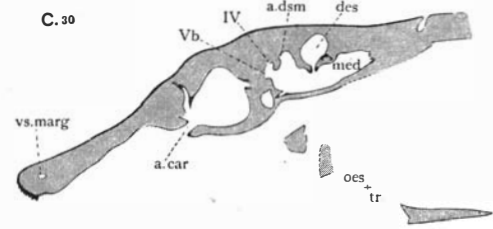
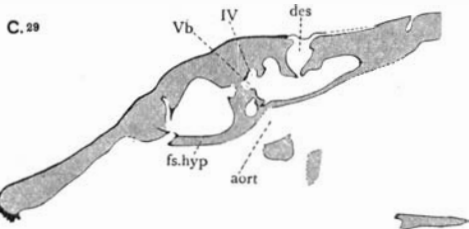
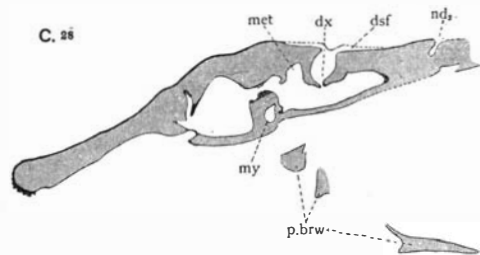
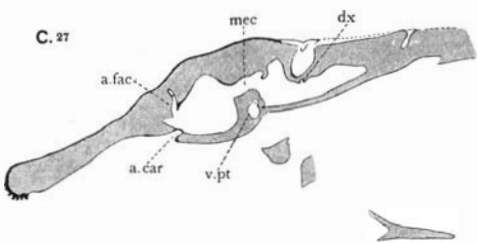
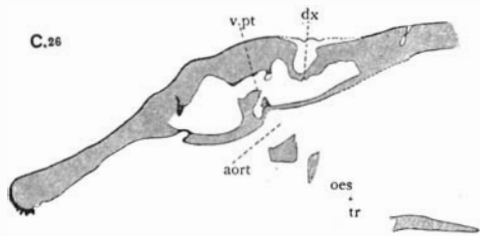
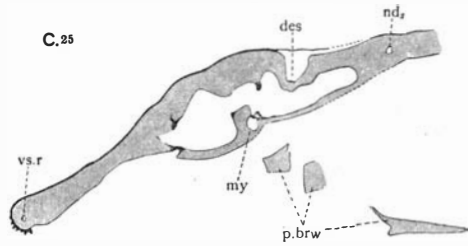
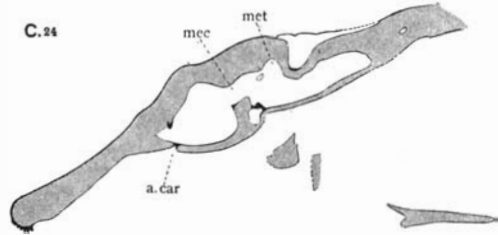
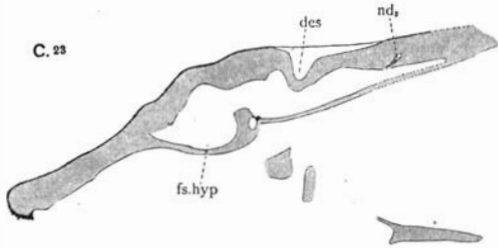
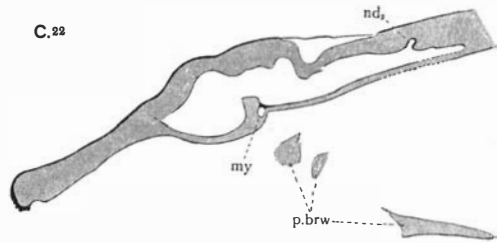
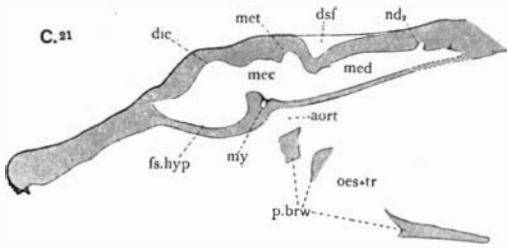
Ser. C.



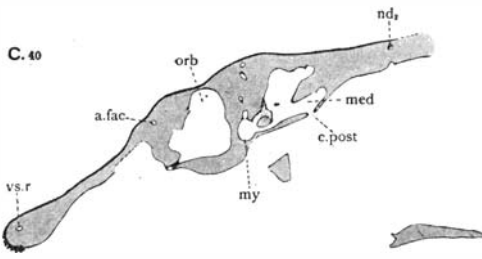
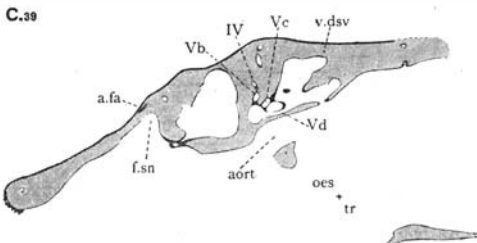
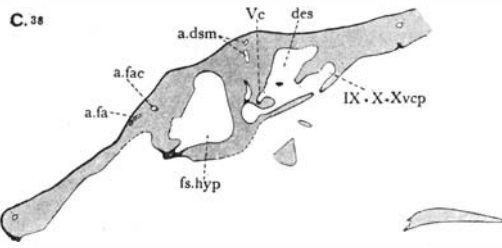
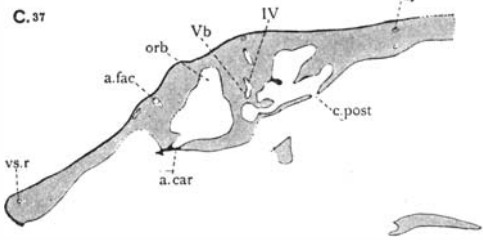
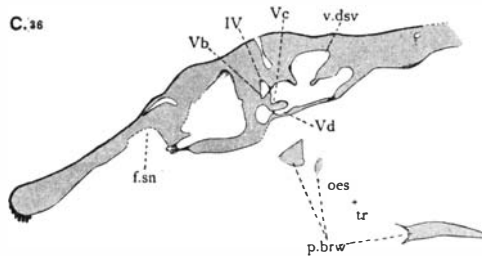
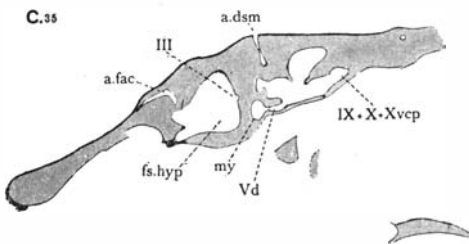
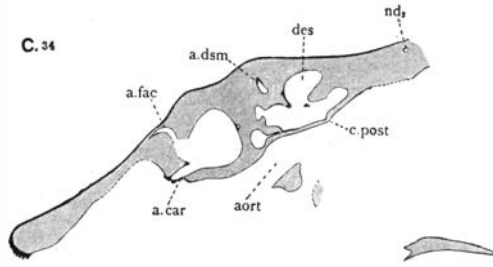
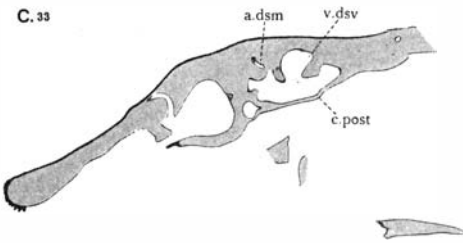
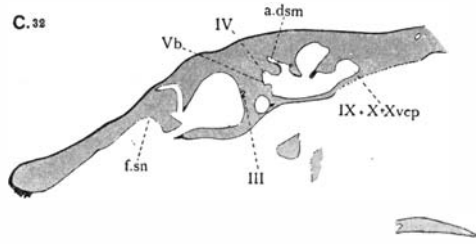
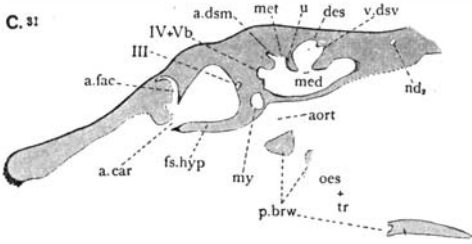
Ser. C.



Ser. C.

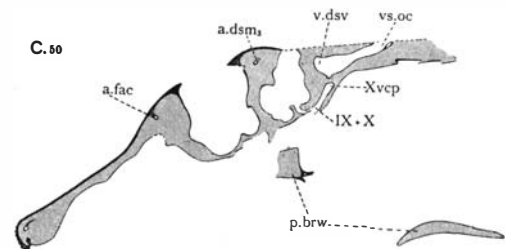
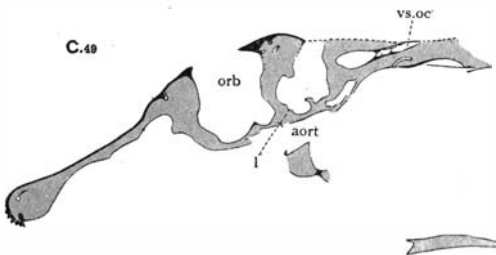
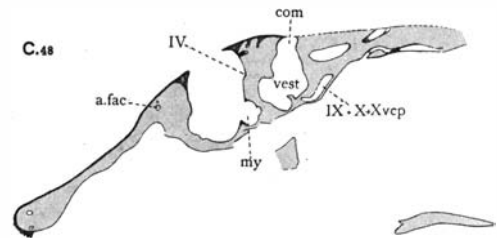
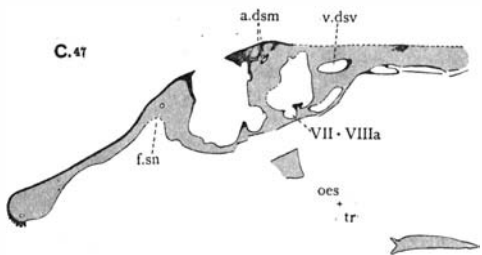
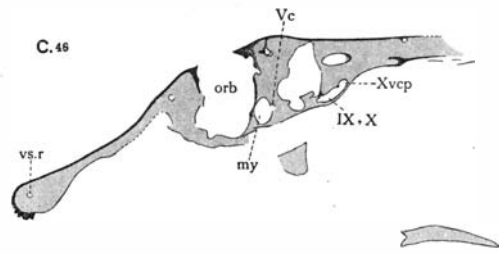
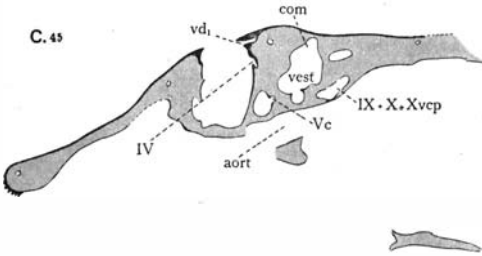
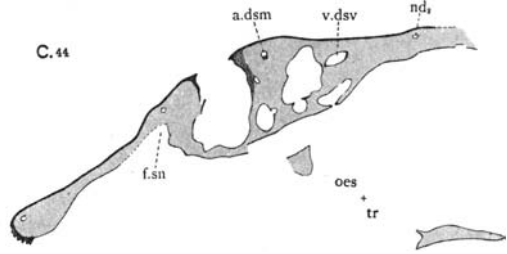
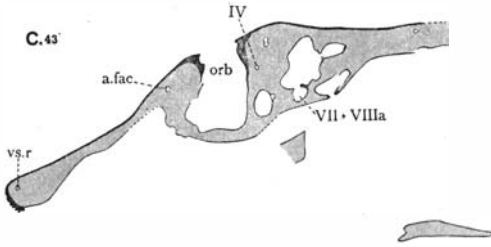
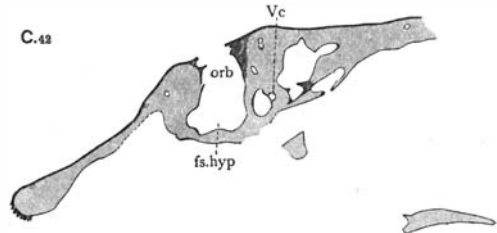
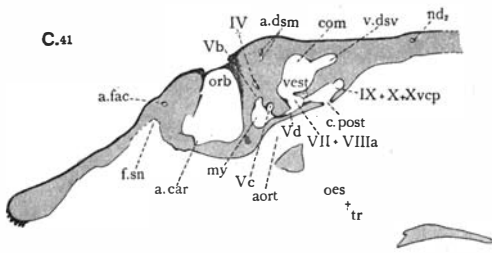


Ser. C.



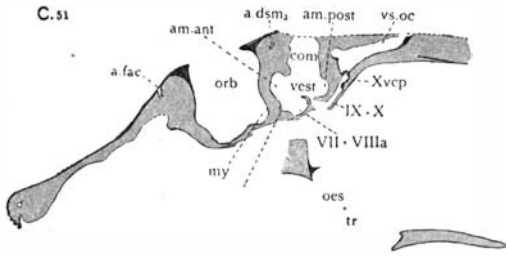


Ser. C.

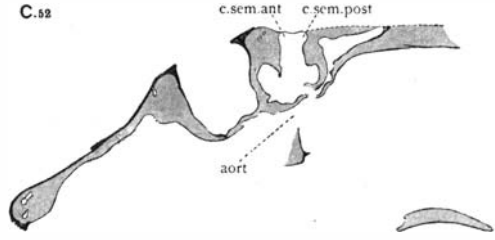


Ser. C.

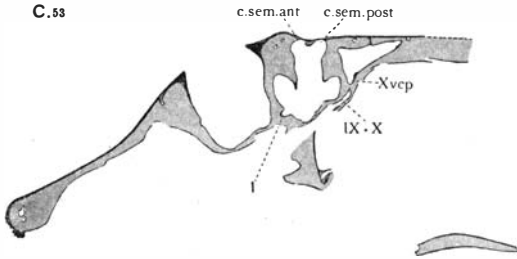
C. 51



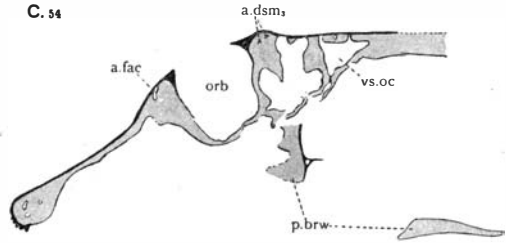
C. 52



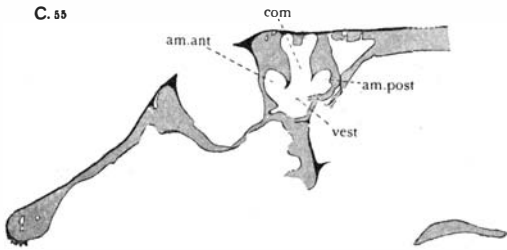
C. 53



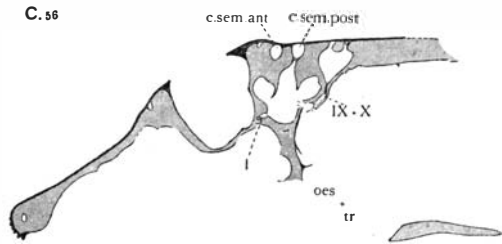
C. 54



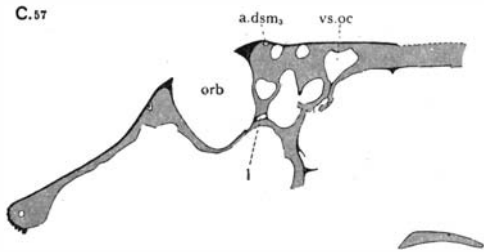
C. 55



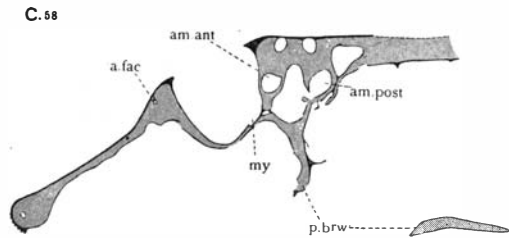
C. 56



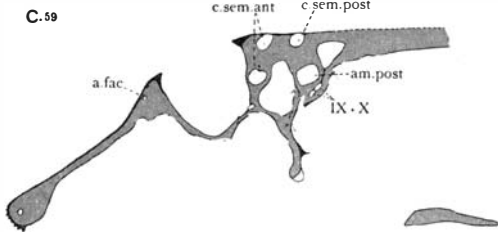
C. 57



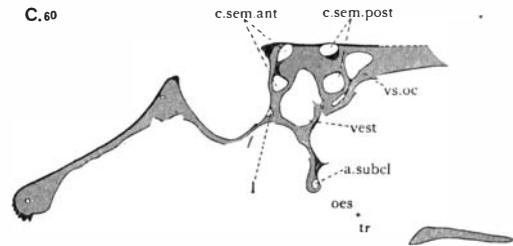
C. 58



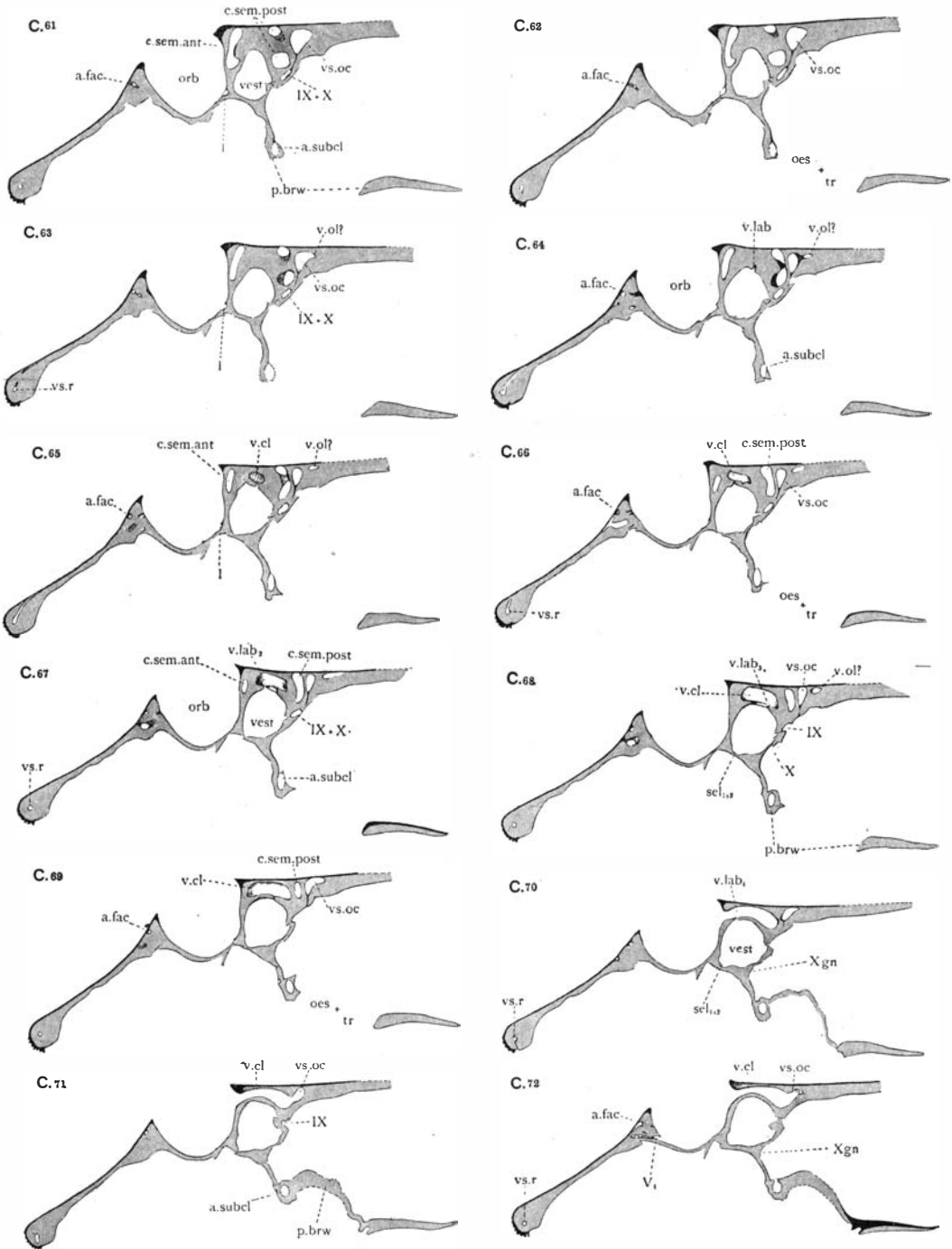
C. 59



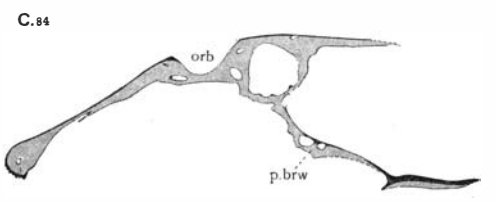
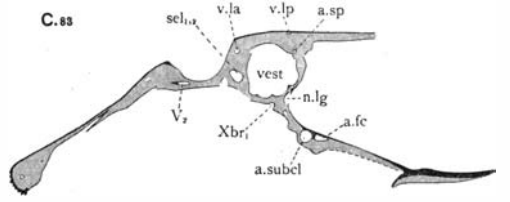
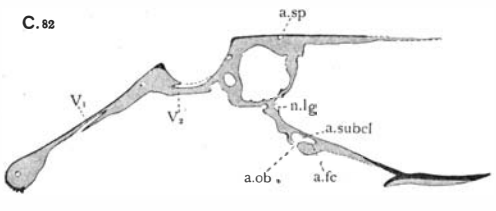
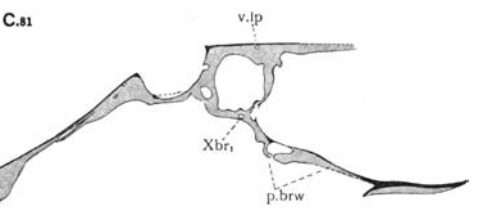
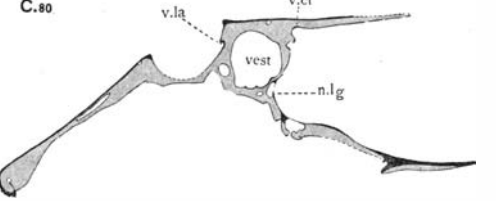
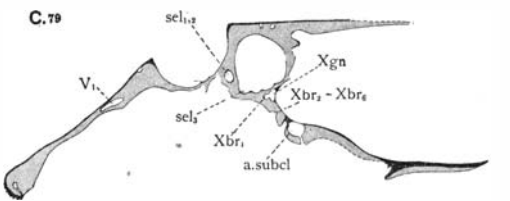
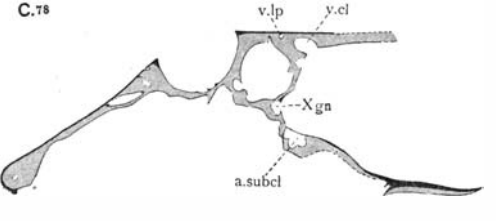
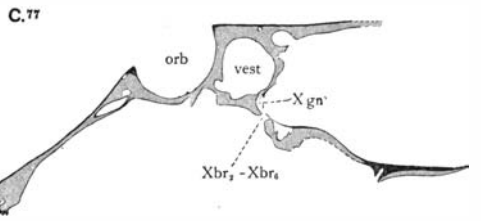
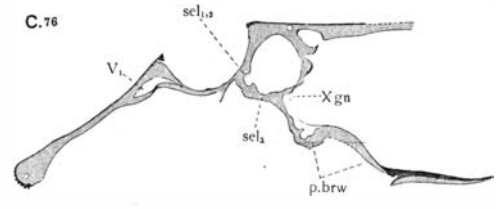
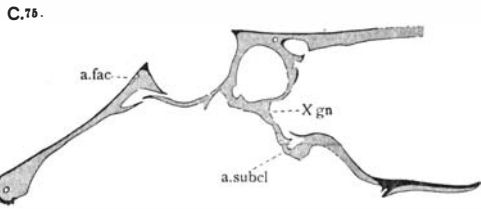
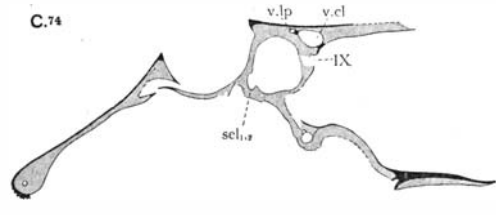
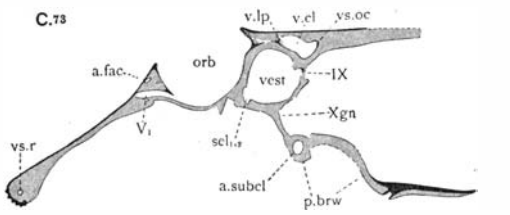
C. 60



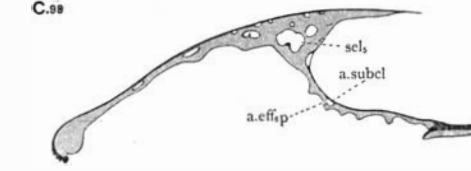
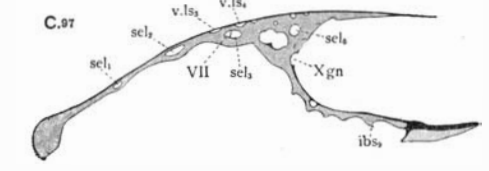
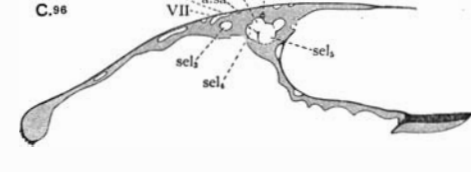
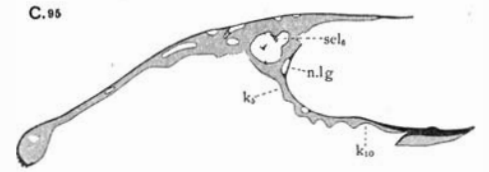
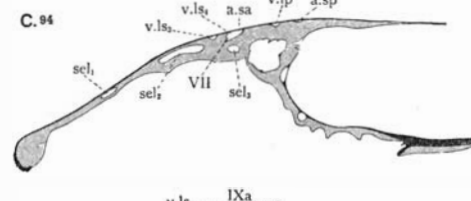
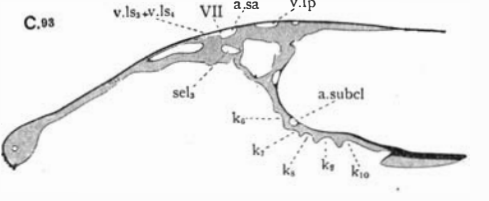
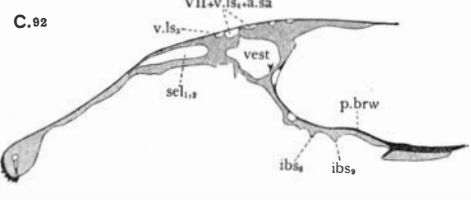
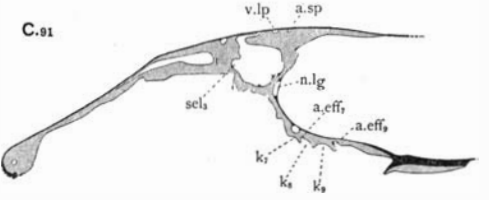
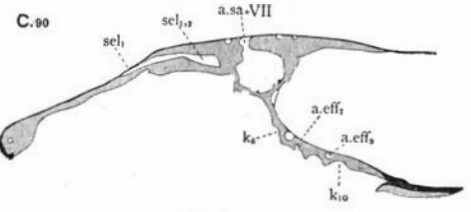
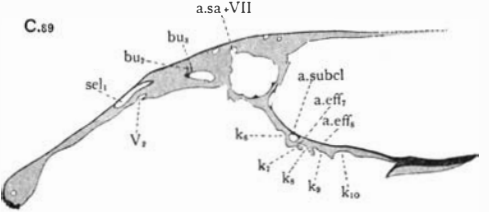
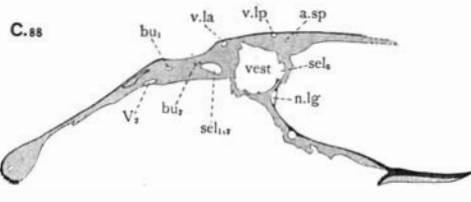
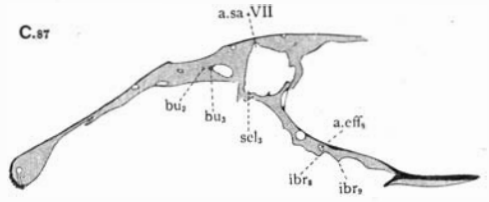
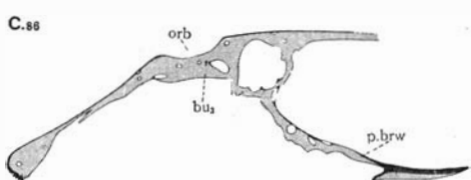
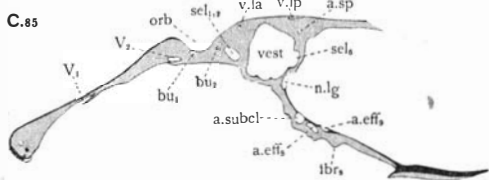
Ser. C.



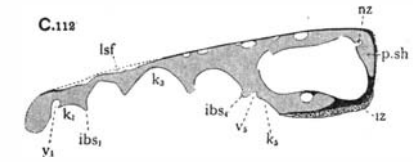
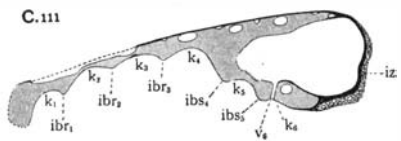
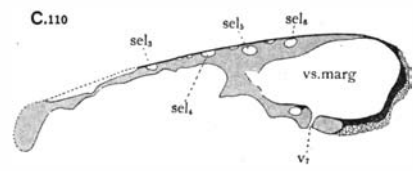
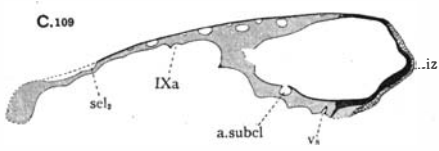
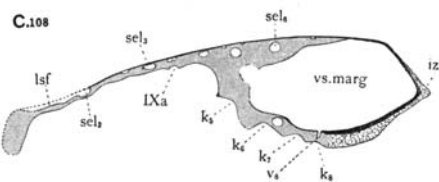
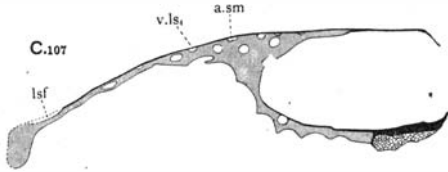
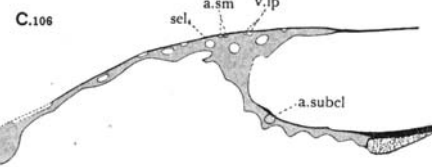
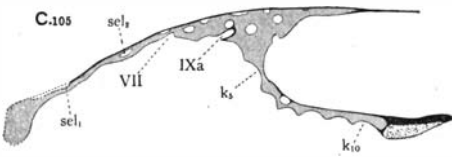
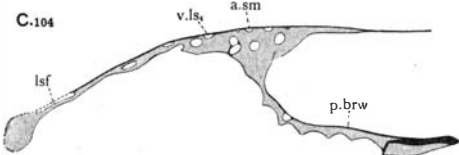
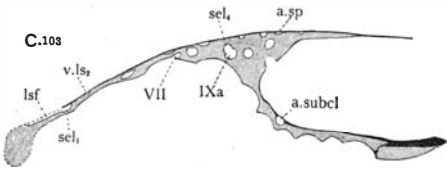
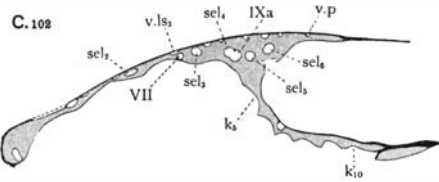
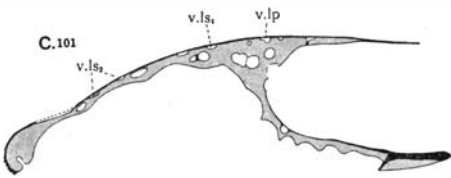
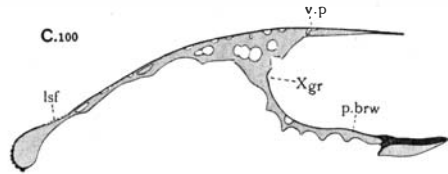
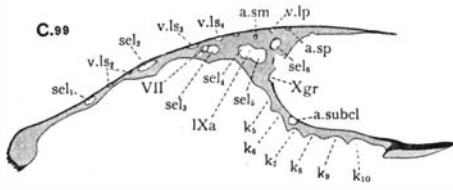
Ser. C.



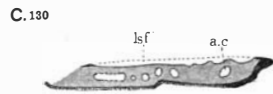
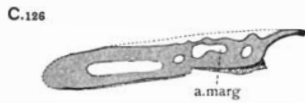
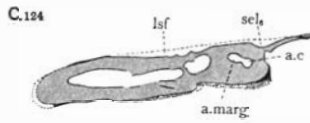
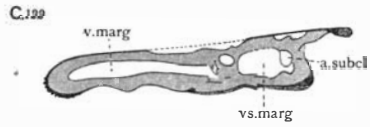
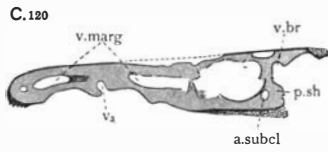
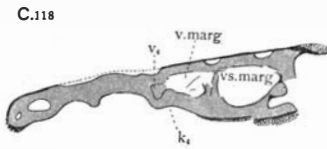
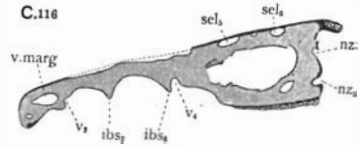
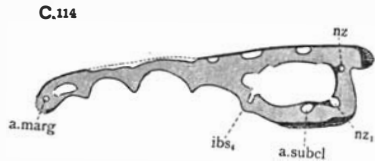
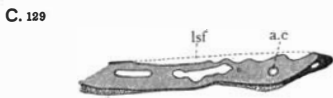
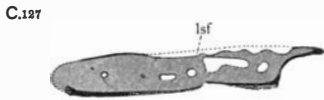
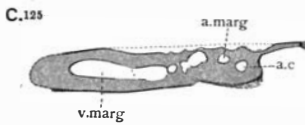
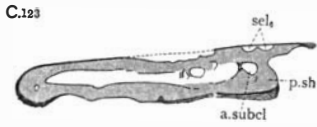
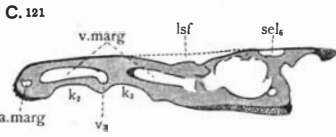
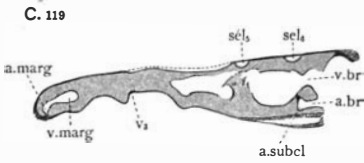
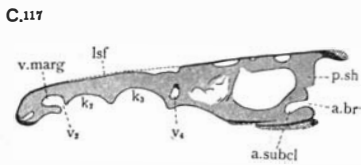
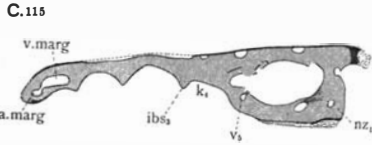
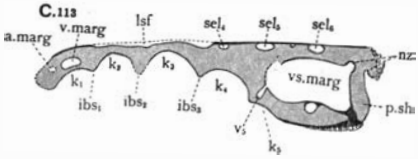
Ser. C.



Ser. C.



Ser. C.



**Pis. 100—104.**

**Section series D.**

Horizontal sections through the dorsal part of the cephalic shield of *Kiaeraspis auchenaspidoides* n. g., n. sp. The sections made with intervals of approximately  $\frac{1}{22}$  mm. Magnification about  $\frac{6}{1}$ .

The series begins through the ventral part of the endocranium and certain adjacent dorsal parts of the visceral endoskeleton and proceeds dorsally.

Exoskeleton shown as thick lines, perichondral bone layers as thin lines. Spaces occupied by cartilage denoted by shading.

The models shown in text-figs. 19—22 and 27 have been made entirely or chiefly after this section series.

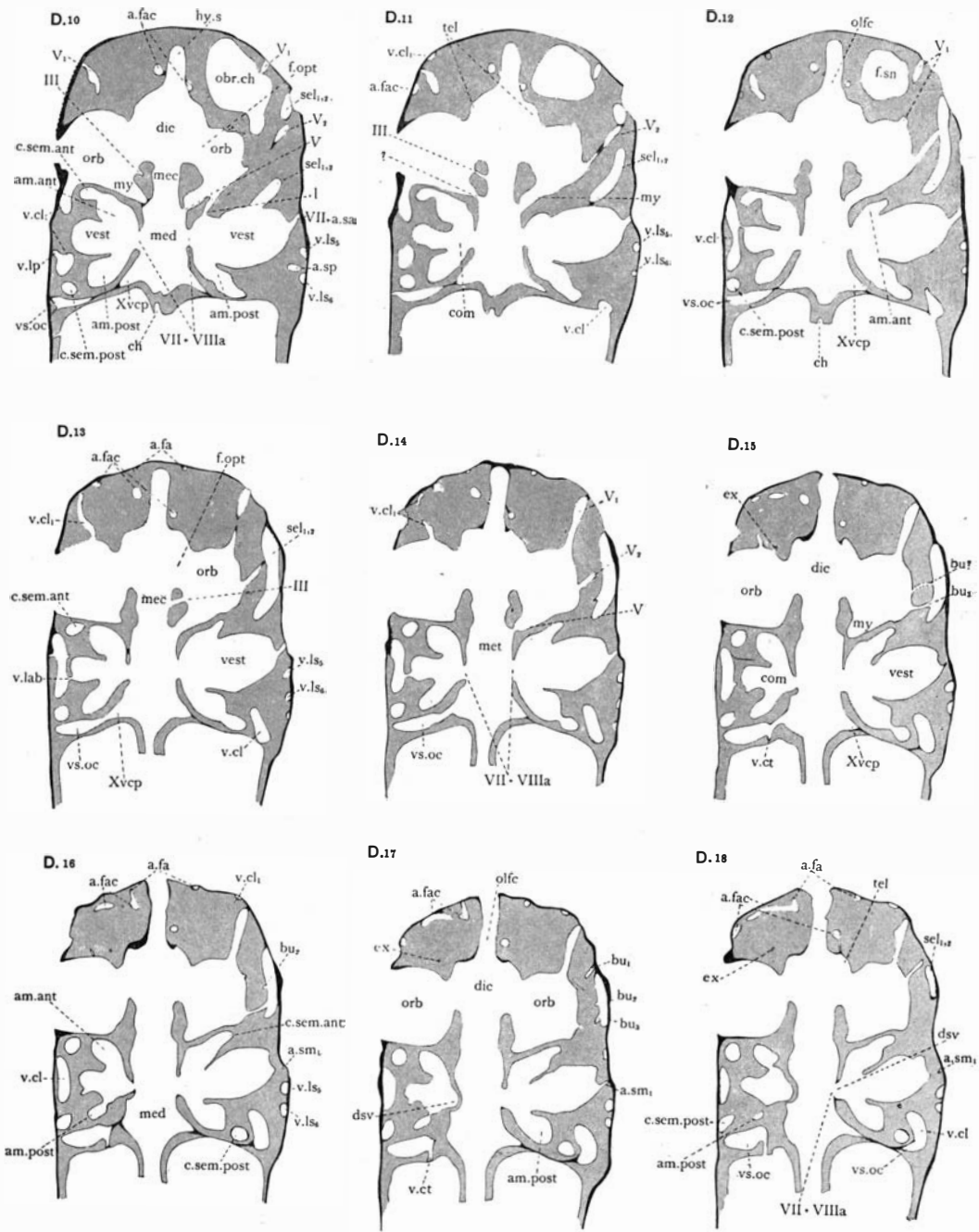
Explanation of index letters.

See section series A.

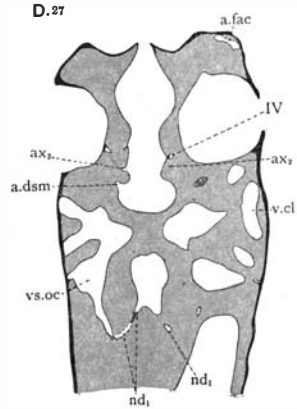
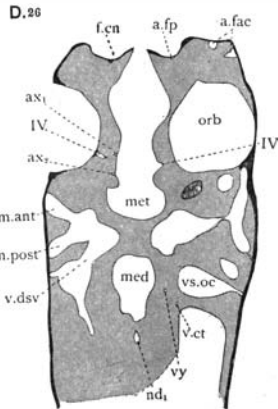
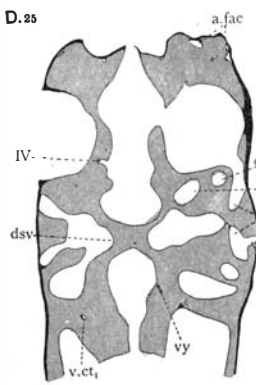
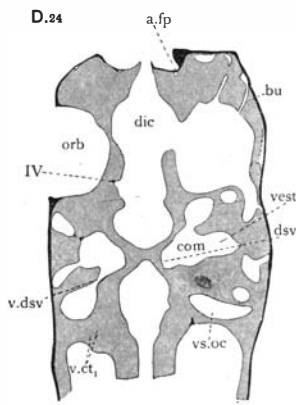
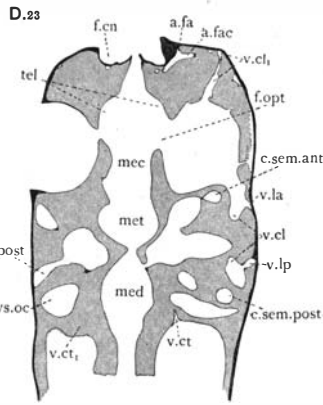
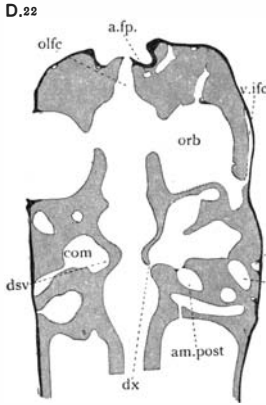
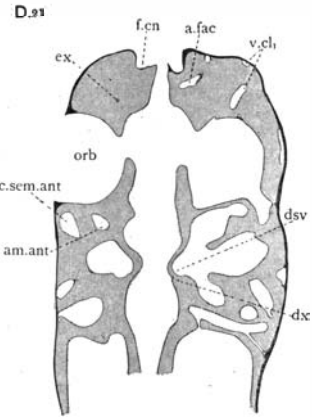
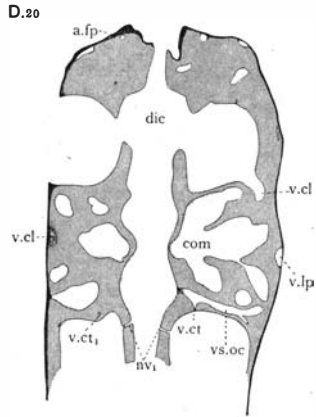
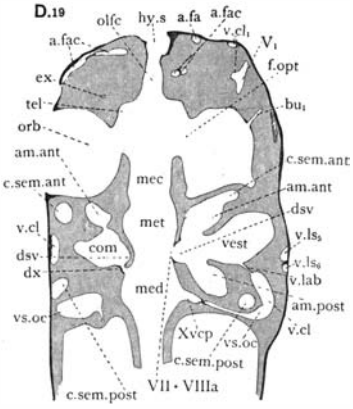




Ser. D.

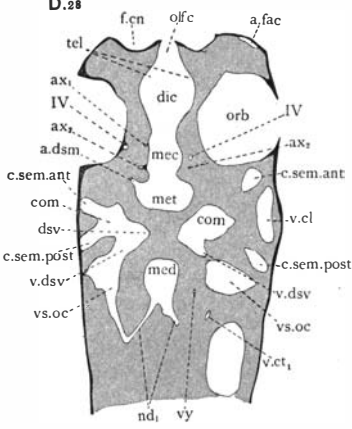


Ser. D.

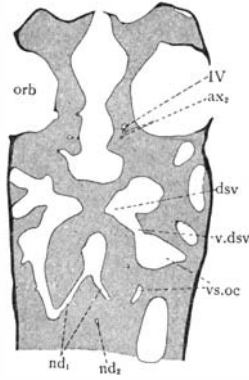


Ser. D.

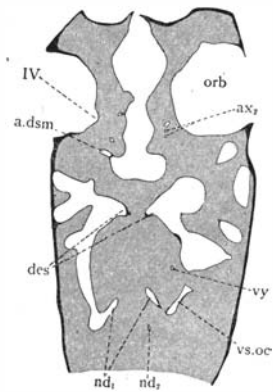
D.28



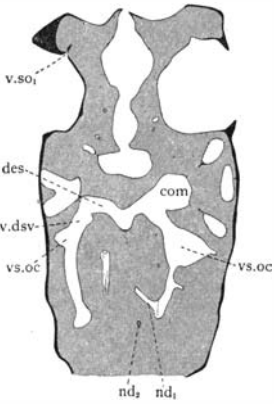
D.29



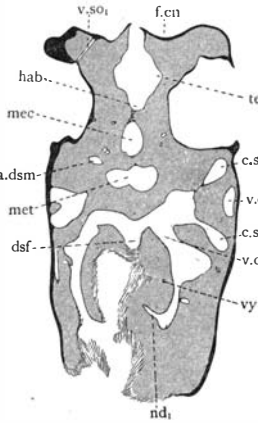
D.30



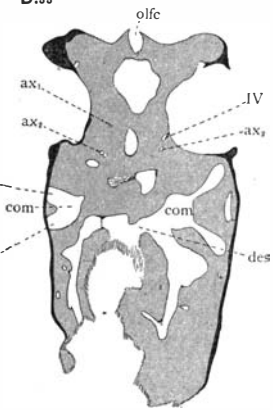
D.31



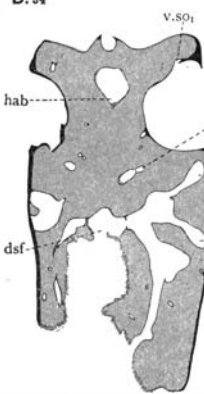
D.32



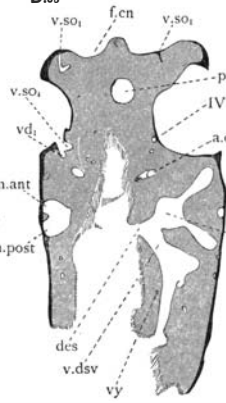
D.33



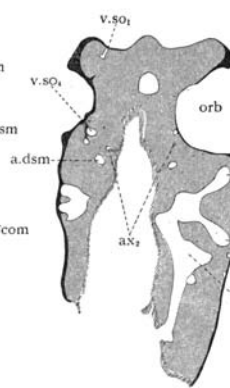
D.34



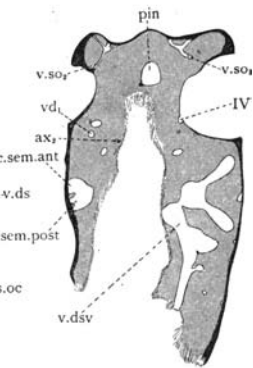
D.35



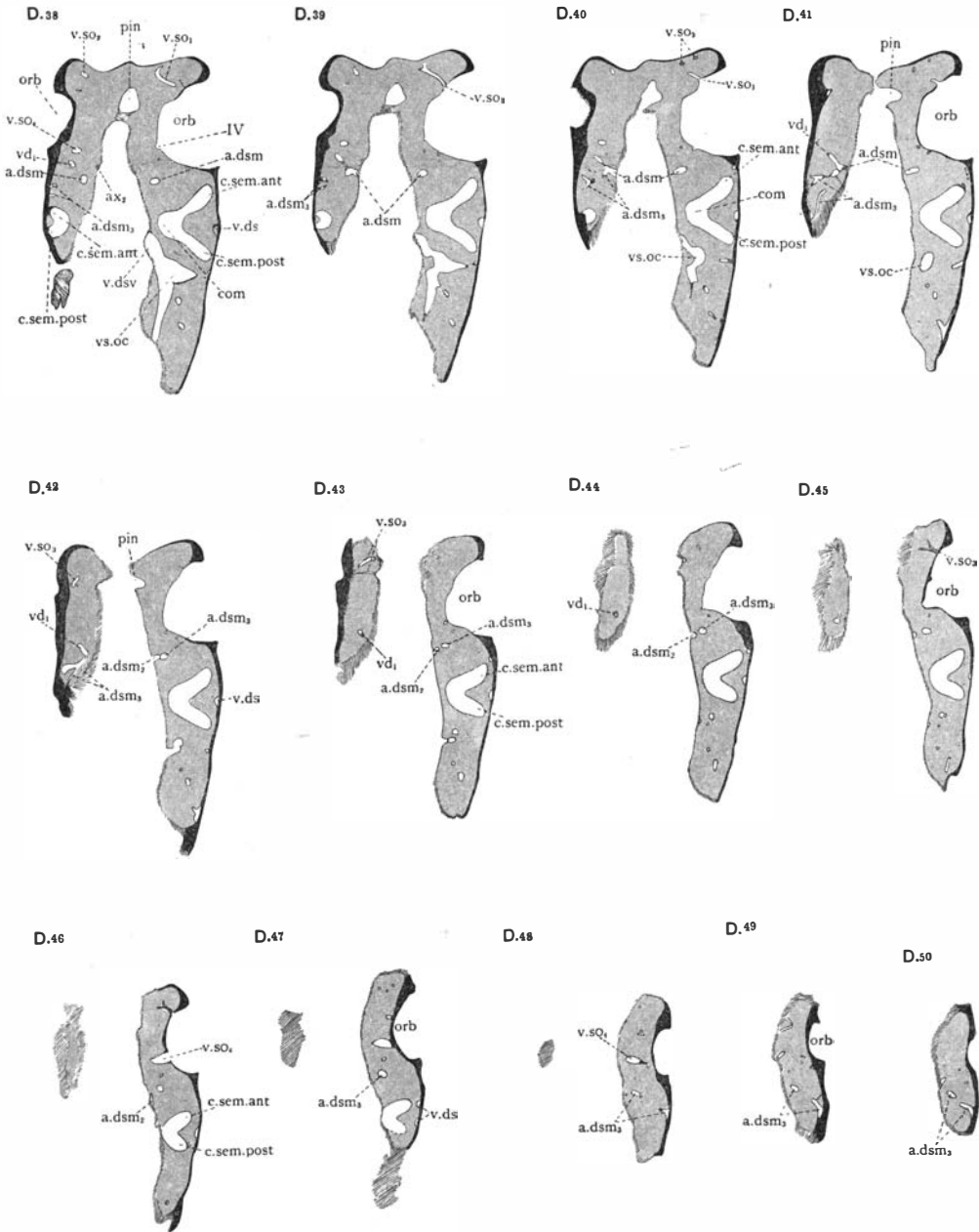
D.36



D.37



Ser. D.



## Pl. 105.

### Section series E.

Transverse sections through a part of the left half of a cephalic shield of *Cephalaspis hoeli* n. sp. The sections taken with somewhat different intervals. Specimen no. 29 (part of the specimen from which series C was made). Magnification approximately  $\frac{5}{1}$ .

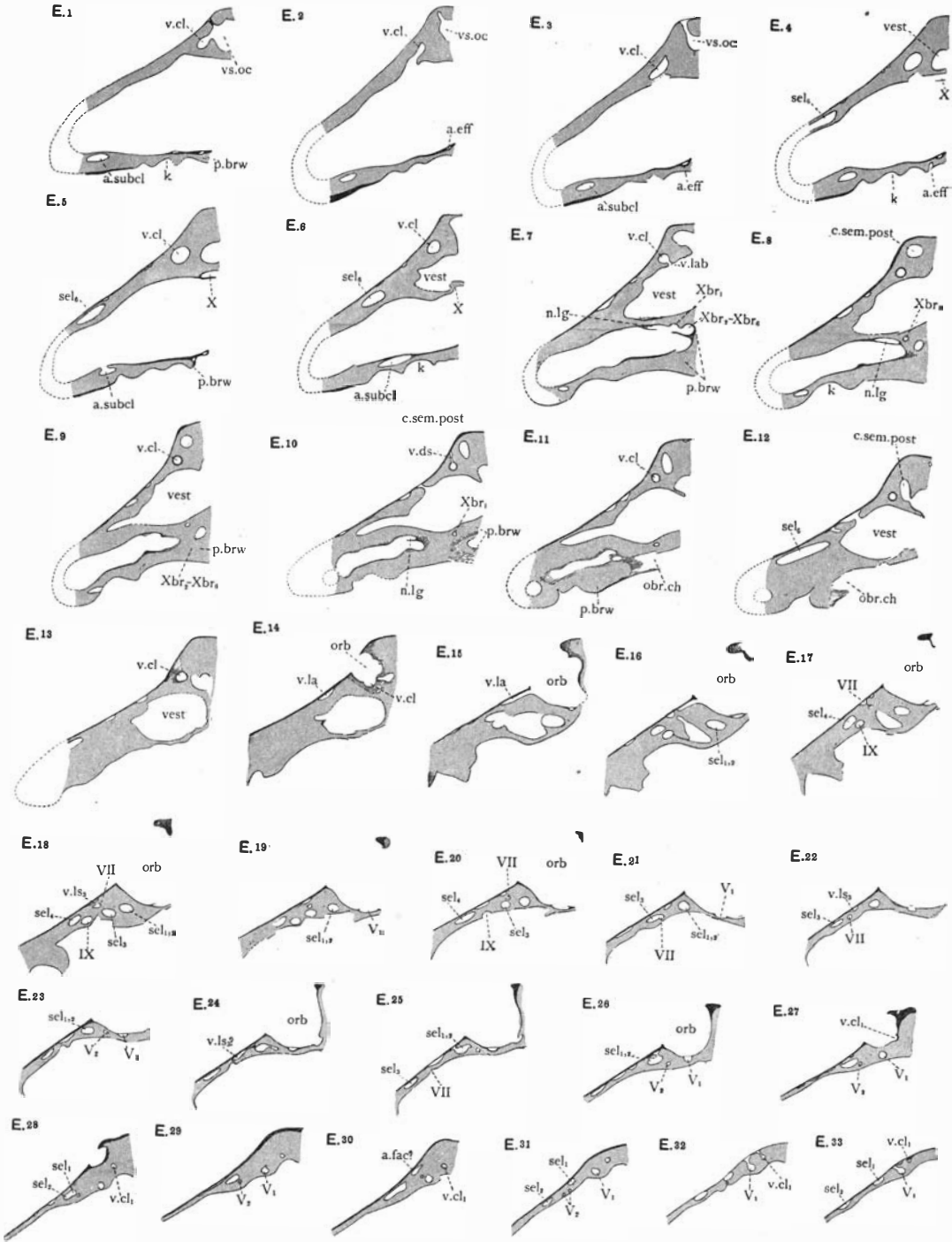
The series begins through the posterior part of the occipital region and the adjacent part of the visceral skeleton and continues as far forwards as somewhat in front of the orbit. Certain parts of the postbranchial wall are well displayed in sections 1—12.

Bone-layers denoted with lines; the space occupied by cartilage shown by shading.

Explanation of index letters.

See section series A.

Ser. E.



**Pl. 106—112.**

**Section series F.**

Horizontal sections through a fragmentary cephalic shield of *Cephalaspis hoeli* n. sp. Intervals between the different sections approximately  $\frac{1}{15}$  mm. Specimen no. 31. Magnification somewhat more than  $\frac{5}{2}$ .

The dorsal part of the cephalic shield was lacking in the specimen and the first section could therefore be laid only as far ventrally as through the most basal part of the neurocranium.

The exoskeleton was almost entirely lacking on the dorsal parts of the shield, and it is therefore in the dorsal sections denoted only by narrow lines. On the other hand it was preserved more basally, and in the more basal sections it is denoted with more or less broad black lines or areas. Perichondral bone layers denoted by thin lines. The spaces occupied by cartilage shaded.

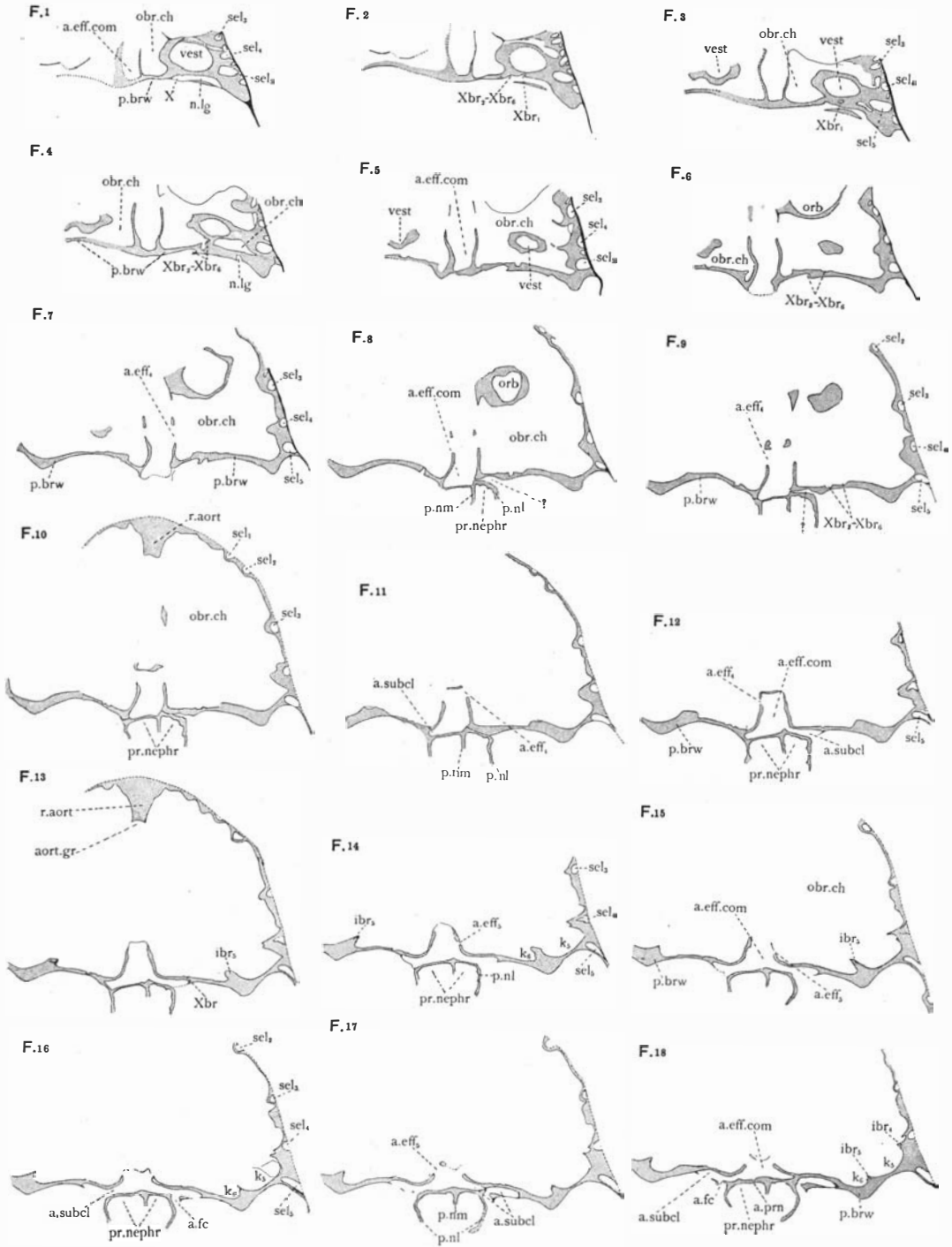
This section series has been used for making the models shown in text-figs. 33—35 and 39—41.

Explanation of index letters.

See section series A.



Ser. F.

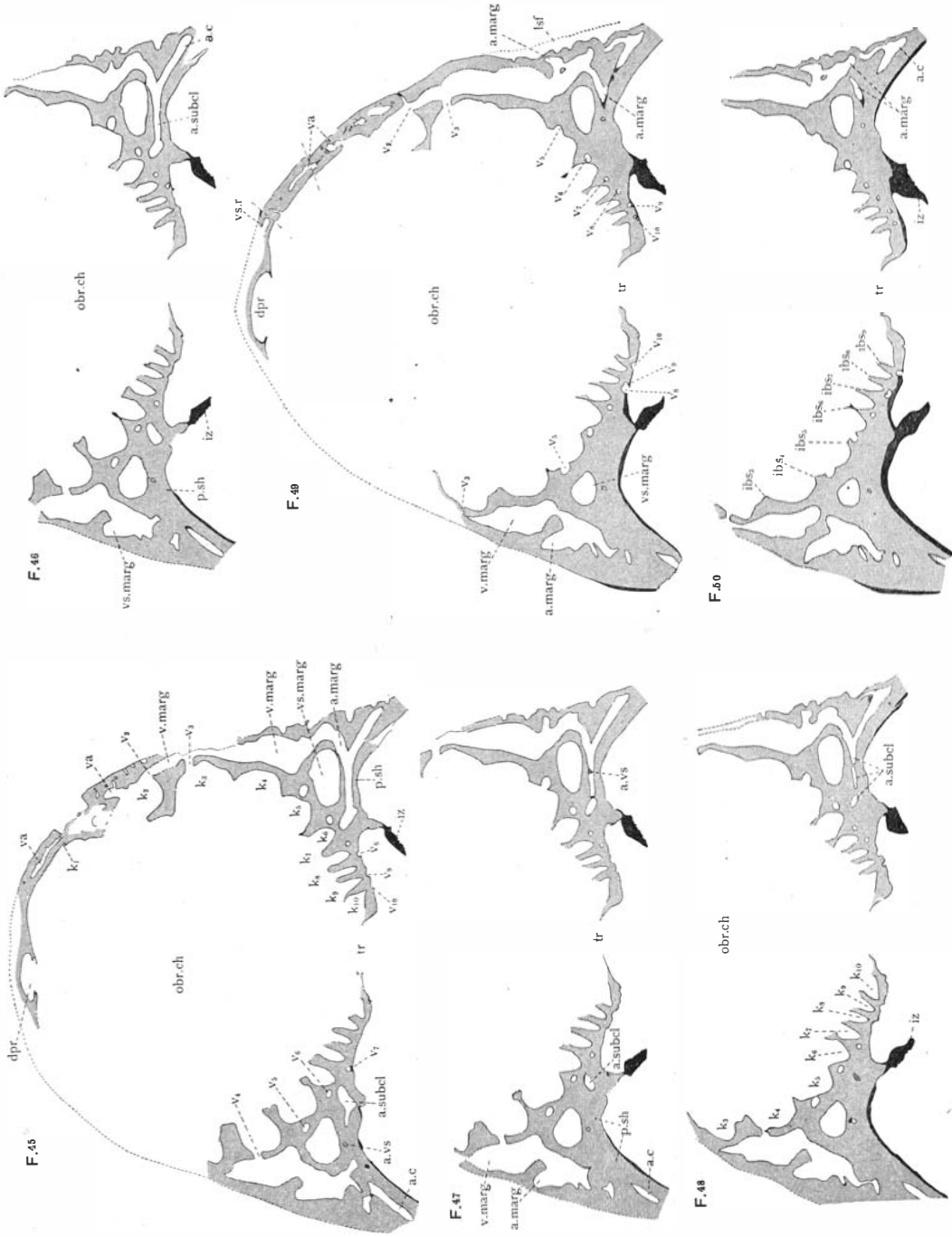




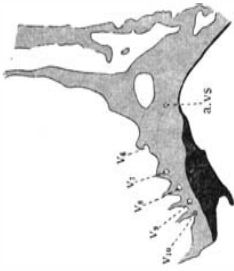




Ser. F.



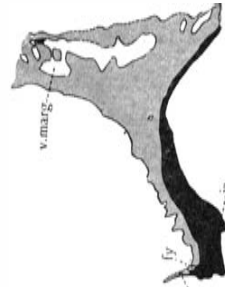
Ser. F.



F. 52



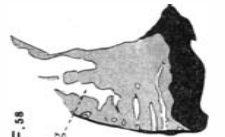
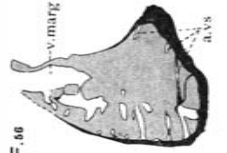
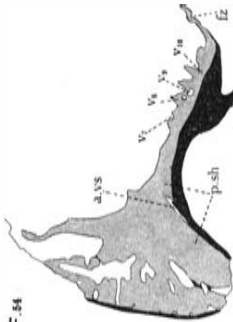
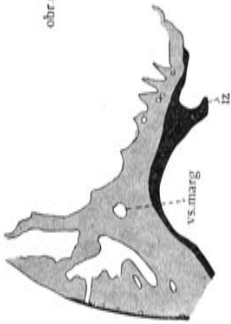
F. 54



F. 56



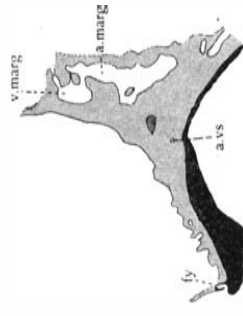
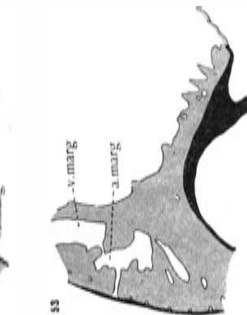
F. 58



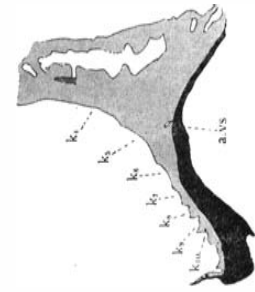
F. 51



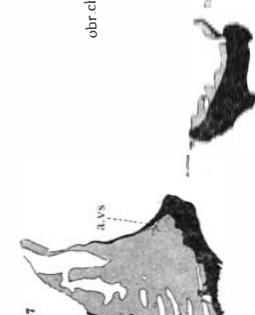
F. 53



F. 57

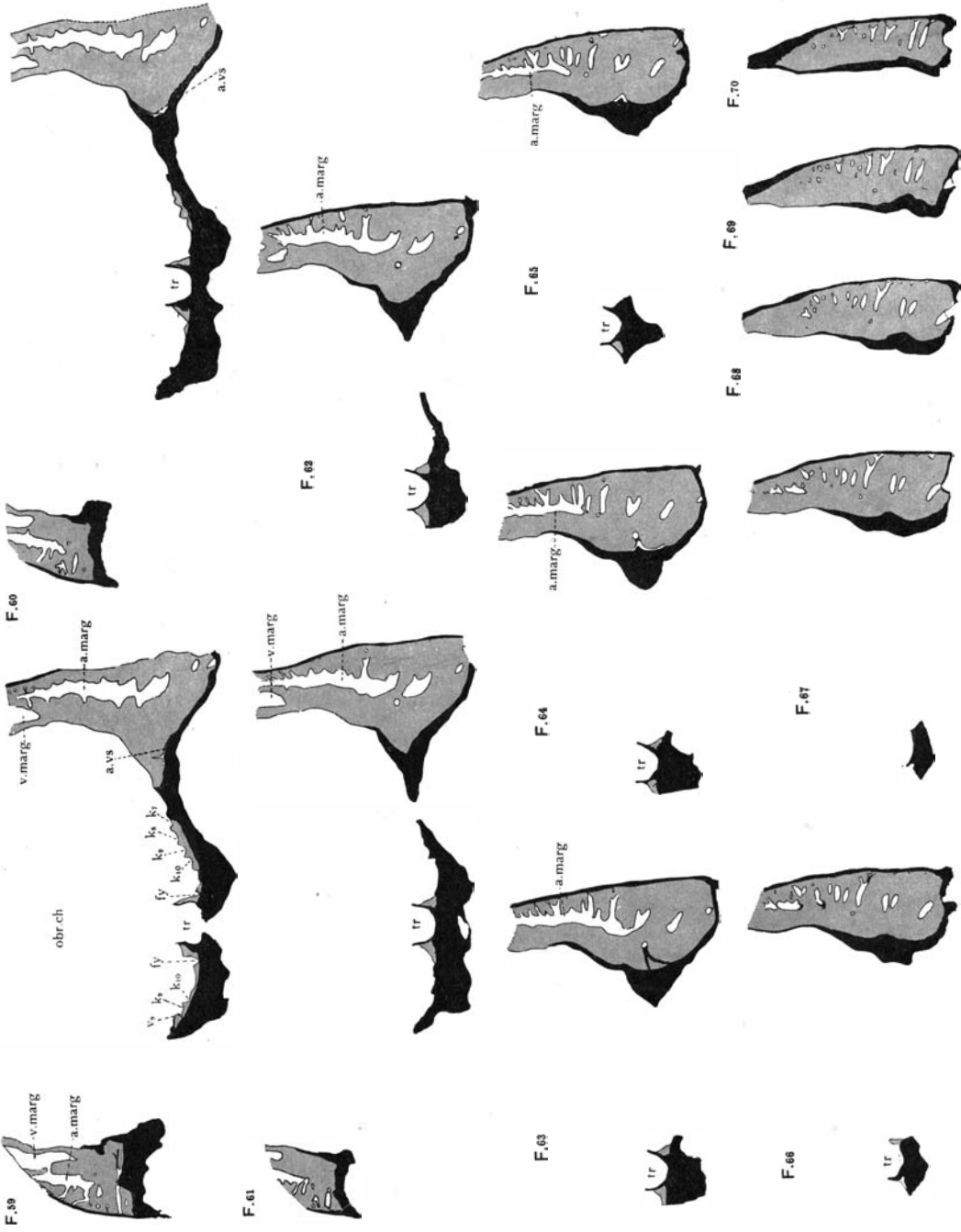


F. 59



F. 59

Ser. F.



## Results of the Norwegian expeditions to Svalbard 1906—1926 published in other series. (See No. 1 of this series.)

The results of the Prince of Monaco's expeditions (Mission Isachsen) in 1906 and 1907 were published under the title of 'Exploration du Nord-Ouest du Spitsberg entreprise sous les auspices de S. A. S. le Prince de Monaco par la Mission Isachsen', in *Résultats des Campagnes scientifiques*, Albert I<sup>er</sup>, Prince de Monaco, Fasc. XL—XLIV. Monaco.

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SKRIFTER  
OM SVALBARD OG NORDISHAVET  
RESULTATER AV DE NORSKE STATSUNDERSTØTTEDE  
SPITSBERGENEKSPEDITIONER

(RESULTS OF THE NORWEGIAN STATE-SUPPORTED  
SPITSBERGEN EXPEDITIONS)

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- No.12. STENSIÖ, ERIK A:SON, *The Downtonian and Devonian Vertebrates of Spitsbergen*. September 1927. Part I A, Tekst, and B. Plates. Kr. 60,00.