THE DANISH
INGOLF-EXPEDITION.

VOL. II, PART 4.

CONTENTS:

ADOLF SEVERIN JENSEN: THE NORTH-EUROPEAN AND GREENLAND LYCODINÆ.

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THE DANISH INGOLF-EXPEDITION.

VOLUME II.

4.

THE NORTH-EUROPEAN AND GREENLAND *LYCODINÆ.*

BY

ADOLF SEVERIN JENSEN.

WITH 10 PLATES, 1 CHART AND 33 FIGURES IN THE TEXT.

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The Lycodinæ of North Europe and Greenland.

By

Adolf Severin Jensen.

Whilst engaged in working at the section *Pisces* for the «*Conspectus Faunæ Groenlandicæ*», the present author undertook a more extended research into the Greenland species of *Lycodinæ*. This led quite naturally to a revision of the remaining Lycodes-material in the Zoological Museum, so that the work gradually developed into a systematic working out of all the species of North Europe and Greenland. From lack of material I was unfortunately obliged to omit the North American forms almost entirely.

It is right and fitting that the work in its entirety, as it now appears, should be published in the reports of »The Danish Ingolf-Expedition» as a supplement to »The Ichthyological Results», seeing that this Expedition has provided the greater proportion of the material for the research. It seems to me also that it would be an injustice to the Expedition, if its rich and valuable collection of fishes were not utilised scientifically in a greater degree than has hitherto been done, the late Prof. C. F. Lütken having been prevented by ill health from going deeper into the work.

Several zoologists in foreign countries have afforded very great assistance during the course of the work, by lending me specimens which it was of special interest to study anew; without this assistance various important questions would have remained unsolved, and I take this opportunity to express my warmest thanks to the following scientists: Conservator J. Grieg (Bergen), Prof. N. Knipowitsch (St. Petersburg), Dr. E. Lönnberg (Upsala), Geh. Regier.-Rat, Prof. K. Möbius (Berlin), Hofrat, Dr. F. Steindachner (Vienna) and Prof. T. Tullberg (Upsala).

I owe especial thanks to Prof. F. A. Smitt (Stockholm) and to Prof. R. Collett (Christiania).

Prof. Smitt with the utmost willingness, gave me the greatest possible freedom to study the rich collection of Lycodes in the Riks-Museum. This collection was of great value as it supplemented that of the Museum here in many ways.

Prof. Collett with rare generosity has sent me several of his type-specimens for examination, so that my determinations have attained a surety which otherwise would not have been reached. I have been permitted also, to study a large portion of the valuable Lycodes-material which has been received at the Christiania Museum within recent years. To Prof. Collett, who has laboured indefatigably throughout a long period of years, to increase our knowledge of the Lycodes-group and has enriched the literature with a series of fundamental papers on the subject, I feel myself in addition in a debt of a more personal character for the interest with which he has followed the progress of my work.

My manuscript was completed in early summer 1902, but the printing was delayed as, during that summer through the kindness of Dr. Johan Hjort, I got the opportunity to take part in the investigations of the steamer Michael Sars. An important collection of Lycodes was made during the expedition and I was permitted to include this material in my work. For this friendliness I would request Dr. Hjort to accept my best thanks.

Last but not least, to Mr. Th. Bloch my thanks are also due for the care with which he has executed all the figures of the 10 plates as well as most of the drawings in the text. If one has not made oneself familiar with the Lycodes through several years study, an exact determination of the species is often of great difficulty (insurmountable in many cases for the young stages), and one is frequently at a loss if descriptions only are given. I consider the many figures in this treatise to be of great value therefore, especially the series which illustrates the diverse appearances of certain species according to age, sex and individual variation.

Dr. H. M. Kyle has done me the favour of undertaking the translation into English.

Introductory Remarks.

Systematic.

The first certain knowledge concerning the group of fishes here dealt with, dates from 1831 when J. Reinhardt sen. formed the genus *Lycodes*. With regard to the systematic position of this new genus, the same author in 1838 expressed as his opinion that it was very closely allied to *Zoarces* on account of the slight developoment of the ventral fins, the lack of a swimbladder, the formation of the digestive organs, mode of fixation of the scales and the whole form of the body[1]). With regard to the structure of the skeleton also, the two genera agree as was shown much later by W. Lilljeborg[2]).

It must be accepted therefore as perfectly correct when the American ichthyologists D. S. Jordan & B. W. Evermann[3]) make the *Lycodinæ* a subdivision of the family *Zoarcidæ* Swainson (1839), characterised (as opposed to *Zoarcinæ*) by the unpaired fins being evenly developed all round, the dorsal fin having no lower spinous portion, and (as opposed to *Gymnelinæ*) by ventral fins being present.

As time went on, a considerable number of species has been described from Greenland and North Europe, and their authors have retained them within the original genus *Lycodes* Reinh. It seems to me more natural to subdivide the species of North Europe and Greenland into 3 genera: *Lycodes*, *Lycenchelys* and *Lycodonus*. Compared with some foreign (American) genera these have the following structural characters in common: teeth occur both on the intermaxillary and the mandible, and on the vomer and palatines; the mandible has no barbule. The relationships may be shortly displayed in the following manner[4]):

[1]) Kgl. D. Vidensk. Selsk. Skr. VII, 1838, p. 153.
[2]) Sveriges och Norges Fiskar, II, 1891, p. 4 & 13—18.
[3]) Jordan & Evermann: The Fishes of North and Middle America, Part III, 1898, p. 2456. (Washington).
[4]) A more detailed diagnosis of the genera will be given later.

Lycodes Reinhardt.

Lycodes Reinhardt, Overs. K. D. Videnskr. Selsk. Forhandl., 1830—31, p. 74 *(vahlii)*.

Body moderately elongated (zoarciform), height over the anus ca. 7—12 1/2 times in the total length. R. br. 6.

Lycenchelys Gill.

Lycenchelys Gill, Proc. Acad. Nat. Sci. Philad., 1884, p. 180 *(muræna)*.

Body very elongated (anguilliform), height over the anus ca. 16—24 times in the total length. R. br. 6.

Lycodonus Goode & Bean.

Lycodonus Goode & Bean, Bull. Mus. Comp. Zool., X, No. 5, 1883, p. 208 *(mirabilis)*.

Body very elongated (anguilliform), height over the anus ca. 21—30 times in the total length. R. br. 5.

In addition to being natural, such a division of the old genus *Lycodes* Reinh. contributes in an important manner to simplify a review of the species. In the present treatise 19 species are described in detail. Of these 6 can now be ascribed to the genera *Lycenchelys* and *Lycodonus*, which are characterised by a very elongated, eel-shaped body. The genus *Lycodes* thus limited contains the 13 species with a less elongated, zoarciform body.

We may now pass over in review the characters of importance for the distinction of the species, beginning with the genus *Lycodes*, which in spite of the reduction that has taken place contains a somewhat considerable number of very difficult and much disputed species.

Lycodes Reinhardt.

(cf. the synoptic table p. 11—12).

In a treatise on Grønlands og Islands Lycoder, C. F. Lütken has given a review of some species known to him and divides them into three subdivisions according to the course taken by the lateral line[1]). A foundation is thus laid, in my opinion, for a natural grouping of the species of *Lycodes*, on which one must build further.

The species dealt with in the present work may also be grouped according to Lütken's system, in the following manner[2]):

a) lateral line single, ventral:

L. vahlii Reinh.[3])

L. frigidus Coll.

L. atlanticus Jensen.

[1]) Lütken: Korte Bidrag til nordisk Ichthyographi. III. Videnskr. Meddel. Naturhist. Foren. Kbhvn., 1879—80 (p. 329).

[2]) A single species, *L. microcephalus* Jensen, cannot for the present be brought into any certain group, as it is only known from a quite small individual on which the course of the lateral line cannot be determined with certainty.

[3]) Concerning the proper place of this species Lütken has had some doubt, as he writes: «Lineæ medio-lateralis interdum vestigium?» but that has happened because he had assigned to *L. vahlii* a specimen of *L. eudipleurostictus* mihi which possesses a double lateral line.

b) lateral line double, ventral and mediolateral:

L. esmarkii Coll.

L. eudipleurostictus Jensen.

L. pallidus Coll.

L. platyrhinus Jensen.

c) lateral line single, mediolateral:

L. rossi Malmgr.

L. lütkenii Coll.

L. reticulatus Reinh.

L. seminudus Reinh.

L. agnostus Jensen.

With regard to the second group, it must be mentioned that the mediolateral branch of the lateral line is frequently indistinct in two of the species, namely *L. esmarkii* and *L. pallidus*, so that it is often only after a very careful study of a large number of specimens that one can rightly determine their position — this holds especially for *L. pallidus*, which stands as a sort of transition form between groups a and b, so far as the lateral line is concerned [1]).

For the rest, the groups a and b seem in other respects also, to stand near to one another and to form together a separate subdivision contrasted with group c. Thus, in groups a and b the tail is relatively long, whilst the head and trunk together (or the distance between the snout and the anus) most often amount only to 36,5—45 % of the total length (sometimes reaching 47 % in males of *L. frigidus)*; in group c on the other hand the tail is relatively short, whilst the head and trunk together amount to 43—52 % of the total length. Groups a and b may therefore be described as long-tailed, group c as short-tailed.

In close connection herewith is the number of rays in the unpaired fins. This is throughout larger in the long-tailed species than in the short-tailed, and very naturally so, since the anal fin entirely and the dorsal fin for the most part, belong to the tail. In groups a and b the number of rays in the dorsal fin is 94—118, in the anal fin 81—102 [2]), in group c the number is 90—97 for the dorsal fin, 70—78 for the anal [3]).

It will appear from the foregoing that the groups of Lütken based on the lateral line only, are not of equal value, but that the groups having the ventral and ventral-mediolateral lines form together one subdivision over against the group with the mediolateral lateral line. For practical

[1]) Whilst speaking of the lateral line, it should be mentioned that one finds in some of the species, and in all three groups, a shorter or longer series of pores placed relatively remote from one another on each side of the back an indication of a dorsal lateral line.

[2]) Both here and in the special portion of the work, the upper rays of the tail fin are reckoned with the dorsal fin, the lower rays with the anal fin, since the unpaired fins pass without break right round the tip of the tail. — I think it not unnecessary to remark that all my statements of the number of fin-rays are based on my own observations, which do not always agree with those given in the literature.

[3]) Probably the number of the vertebræ will also be greater in the long-tailed than in the short-tailed species, but the material in my hands is too little to allow any certain conclusions to be drawn in this regard; in four species of groups a and b I have counted 98—118 vertebræ (*L. vahlii* 98—116, *L. frigidus* 103—107, *L. eudipleurostictus* 106 and *L. esmarkii* 115—118), in two species of group c (*L. reticulatus* and *L. seminudus*) 93—96 vertebræ.

reasons however, it is convenient to again split up the first division according as the lateral line is ventral or ventral-mediolateral (cf. the table of analysis p. 11—12).

We may now refer to some of the characters which have special importance in distinguishing the species within the greater groups based on the course of the lateral line.

Scales. Of the present species two are perfectly devoid of scales, namely *Lycodes agnostus* Jensen (Tab. VI, fig. 1) and *L. platyrhinus* Jensen (Tab. VI, fig. 2). The well-known ichthyologist P. Bleeker has laid such great weight on the absence of scales that he has formed a special genus *Lycodalepis*[1]), which only differs from *Lycodes* in this one character, and the later American naturalists have followed him. It seems to me that *Lycodalepis* is an unnatural genus. If the two scaleless species mentioned are removed from the genus *Lycodes*, they are then separated from species to which in other respects they are closely allied. *L. agnostus* has its true place amongst the species of *Lycodes* with mediolateral lateral line, not only on account of the situation of the lateral line, but also on account of the relatively short tail (the head and trunk together are 46—52 % of the total length) and the number of rays in the unpaired fins (D. 90—93, A. 70—72). *L. platyrhinus* on the other hand, belongs rightly to the *Lycodes* with double lateral line, partly because of the ventral-mediolateral lateral lines, partly because of the long tail (head and trunk together are 37 % of the total length) and the number of rays in the unpaired fins (D. 99, A. 82). One must be content therefore, to regard the absence of scales as a good specific character and not ascribe to it any generic importance.

Of the remaining species of *Lycodes* dealt with in this treatise, there is one which in its slight development of the scaly covering, is a transition form to the naked species, namely *L. seminudus* Reinh. As the name denotes, it is only half covered with scales, on the tail namely[2]), and moreover the scaly area ends in front in the shape of a wedge leaving a naked part dorsally and ventrally (Tab. IX & Tab. X, fig. 1). Some variation appears in this species however, as the scaly wedge sometimes sends a portion forward on to the trunk; but as a rule the naked abdominal region is one of the characters which aids to a ready determination of *L. seminudus*.

The naked *L. agnostus* and the half naked *L. seminudus* belong, as mentioned, to the group with mediolateral lateral line. The remaining species of this group, *L. rossi* Malmgr., *L. lütkenii* Coll. and *L. reticulatus* Reinh. have the scaly covering developed almost to the same extent, and it extends forwards on the sides of the trunk to a point which lies under or a little in front of the beginning of the dorsal fin; but the front part of the back and the belly are always naked, and the fins are likewise devoid of scales.

Most of the species of the groups with ventral or ventral-mediolateral lateral lines are remarkable for the stronger development of the scaly covering. In adult individuals the scales cover the whole of the body (head excluded) and extend on to the unpaired fins. Such is the case in *L. vahlii* Reinh., *L. frigidus* Coll., *L. atlanticus* Jensen, *L. esmarkii* Coll. and *L. eudipleurostictus* Jensen. Of these species *L. frigidus* is easily recognisable by its extremely small scales (Tab. V, fig. 1 a). *L. pallidus*

[1]) Versl. K. A. W. 2e Rks. VIII, 1874, p. 369 *(mucosus)*.

[2]) Jordan & Evermann form a subgenus *Lycias* under *Lycodes*, characterised by the tail only being scaled; into this subgenus are brought *L. seminudus* Reinh. and the imperfectly described *L. nebulosus* of Kroyer, later lost and never rediscovered (Fishes of North and Middle America, III, 1898, p. 2463).

Coll. as a rule has a less developed scaly covering, as the anterior portion of the back and a large part of the belly are naked, and the scales (in general) do not extend on to the unpaired fins (Tab. IV, fig. 1 & Tab. V, fig. 2); in the variety *squamiventer* mihi however, the scales reach to the neck and to the underside of the belly, and appear as well on the unpaired fins (Tab. IV, fig. 2), but it is not excluded that I have made an error in considering this form as a variety of *L. pallidus;* it must perhaps be raised to a separate species. Lastly *L. platyrhinus*, as stated above, is entirely naked.

All in all, the extent of the scaly covering furnishes often a good specific character when adult individuals can be examined.

Colour. One species can be said with certainty to be uniformly coloured at all ages, without spots or bands, and that is *L. frigidus* Coll. (Tab. V, fig. 1 a, b). The reason for this, I presume, is that this species is restricted to great depths (450—1455 fathoms). *L. atlanticus* Jensen, *L. pallidus* Coll. var. (vel sp. n.) *squamiventer* mihi (Tab. IV, fig. 2 a, b), *L. microcephalus* Jensen (Tab. I, fig. 1) and *L. platyrhinus* Jensen (Tab. VI, fig. 2) have likewise no markings so far as one can judge from the present scarce material, and they all live at great depths (respectively 516—1423 f., 537—957 f., 799 f. and 1010 f.).

The remaining species which do not reach in general to so great depths, possess a more lively colouration as a rule, because dark and light alternate; dark and light cross-bands are the most frequent combination, but rings, network or festooned markings can also occur. Some examples may here be mentioned where the colour markings afford a method of determining certain species.

L. esmarkii Coll. is remarkable for a specially characteristic colouration. When quite young (Tab. III, fig. 2 a) it shows light, ⅄-shaped cross-bands, which in medium-sized individuals (Tab. III, fig. 2 b) enclose dark spots or stripes, and which finally in the adults (Tab. III, fig. 2 c) change to form festooned markings.

In all the remaining species, the body of the quite young is adorned with dark and light cross-bands (sometimes the one, sometimes the other is the more prominent), and this colouration is still retained essentially in the older individuals of the following species: *L. eudipleurostictus* Jensen, *L. rossi* Malmgr., *L. lütkenii* Coll. and *L. agnostus* Jensen, whereas *L. pallidus* Coll., *L. vahlii* Reinh., *L. reticulatus* Reinh., and *L. seminudus* Reinh. frequently assume another colouration with age. *L. pallidus* as a rule becomes uniformly coloured with age, and the same is often true of *L. seminudus*. In *L. vahlii* the bands disappear almost entirely in the adults or become resolved into ringshaped stripes and irregular spots; one, two or three black spots, the one behind the other, occur almost always on the anterior corner of the dorsal fin, so that the species can readily be recognised (Tab. I, fig. 2 & Tab. II, fig. 1). In *L. reticulatus* the bands change in the older individuals to form a characteristic network, especially on the anterior portion of the body (Tab. II, fig. 2 & Tab. VIII).

However variable the colour markings may on the whole seem to be, they frequently give good specific characters. On the other hand, it must not be forgotten that especially the young of various species are so similar to one another in colouration, that confusion may very readily occur.

The pectoral fins often give good specific characters. The number of rays in the present species varies from 15 to 23, but the variation within the individual species is sometimes very limited. The length of the pectoral fin also is sometimes a good determining character between nearly allied species. The posterior margin of the pectoral fin is in general rounded, but the condition in *L. eudipleurostictus* (Tab. III, fig. 1) is characteristic in that the lower rays are somewhat longer than the middle ones, so that an indentation occurs (the same may also occur in individuals of *L. frigidus*. see Tab. V, fig. 1 a).

Other characters which might be taken into consideration, though not to so great an extent, are the relative height of the body (the dimension chosen in this work for the greater or less elongation is always the height over the anus, which is to some extent independent of distension caused by food or sexual products), the relative length of the head (which is nevertheless rather variable within the individual species, the males as a rule having longer heads than the females or young), size of the eyes, condition of the teeth etc.

A gap in the present work is the almost entire absence of the structural anatomy; I must leave this aspect of the diagnosis of the Lycodinæ to others who can afford the necessary time. I have only been able to examine the *appendices pyloricæ*, which in the present species of the genus *Lycodes* are always two and very small, with exception of *L. esmarkii* Coll., where they are wanting altogether.

Geographical Distribution. A not unimportant factor to be taken into account in determining a specimen, is where it was found, each species having its characteristic, horizontal and vertical distribution, as will be mentioned in detail in the special part. A summary is given on p. 9—10 for orientating the species which inhabit the various seas within the entire area; but though this summary is based on a large amount of material, the possibility is of course not excluded that future investigations may still find new forms within these seas.

Lycenchelys Gill and **Lycodonus** Goode & Bean.

To the genus *Lycenchelys* I have referred 4 European and Greenland species: *L. muræna* Coll., *L. sarsii* Coll., *L. kolthoffi* Jensen and *L. ingolfianus* Jensen, the determination of which does not cause great difficulty. A good specific character is formed seemingly by the large pits of the lateral line along the upper jaw and under the eye. In *L. ingolfianus* their number is 8, in the others only 7. Other good characters are to be found in the distance of the dorsal fin from the snout, the relative length of the head and the number of rays in the pectoral fins. The colouration in *L. muræna* is uniform, and this species also is restricted to great depths (340—620 f.); what the condition is in *L. ingolfianus* is not known, as only one adult specimen (uniformly coloured) has been found; *L. kolthoffi* has a strongly spotted (marbled) colouration; *L. sarsii* has dark markings in the young becoming indistinct in the older stages. Each of these four species has its own separate area of the sea, so that one can conclude from the region alone which species is to hand. — Cf. for the rest, the synoptical table which is given later.

Of the genus *Lycodonus* only two species are present from the region here considered: *L. flagellicauda* Jensen which inhabits the polar depths from Spitsbergen down to Iceland and the Færoe Channel, and *L. ophidium* Jensen of which only a young specimen from the depths of the Atlantic Ocean (south from Iceland) has been found. Cf. for the rest, the synoptical table.

Biology.

The *Lycodinæ* are bottom-fishes which swim by vigorous movements of their strong tail. As the fishing apparatus often brings them up alive to the surface, even from great depths, one can well believe that they are tenacious of life. *Lycodes frigidus*, for example, which is essentially a deep water fish, was kept alive during the Norwegian North-Atlantic Expedition by being placed in some water in a tub; according to Collett, they generally remained at rest in a half coiled-up condition, somewhat like *Zoarces viviparus*. During the «Michael Sars» expedition of 1902 I placed two *Lycodes esmarkii*, taken from 275 fathoms depths, in a tub with water and they remained alive several hours; other individuals of the same species showed themselves extremely active on being preserved and remained living for a long time.

According to the observations of Collett, myself and others, the *Lycodinæ* live chiefly on crustacea: copepods *(Calanus)*, cumaceæ, isopods, amphipods and decapods (*Hippolyte, Hymenodora* etc.). In the alimentary canal of the following species only the remains of crustacea were found: *Lycodes rossi*, *L. reticulatus*, *L. seminudus*, *L. agnostus* and *Lycodonus flagellicauda*. *Lycodes vahlii* and *Lycenchelys sarsii* feed both on crustacea and small bivalves. *Lycodes frigidus* according to Collett, lives chiefly on crustacea, but he has also found in them the remains of a cephalopod; during the Ingolf Expedition a *Gonatus* was found in one, and I have taken from their stomachs the beaks of ink-fish and remains of fishes. Collett found fish remains in *Lycodes lütkenii*. *Lycodes eudipleurostictus* feeds on crustacea, but one just as frequently finds in them the tubes of tubicolous worms, and once I have taken a *Priapulus* from its stomach. *Lycodes esmarkii* seems to feed exclusively on echinoderms, especially ophiuroids, partly also on *Antedon* and *Echinus;* both Collett and I myself have found their stomachs and intestines crammed full of broken skeletons of these animals.

The *Lycodinæ* are not despised either by other fishes. At West Greenland they are found not rarely in the stomachs of the «Greenland shark» *(Somniosus microcephalus)*, and I have once taken a *Lycodes* (indeterminable) from the stomach of a cod.

Concerning the beginning of the spawning period but little is known. Collett says that *Lycodes esmarkii* spawns in the early winter months at Finmark, and that *L. vahlii* (= *L. gracilis)* spawns during July—October in the Skagerak; I have found the last named species with ripe roe in the beginning of July (Iceland). In the «cold area» (the Polar Depths) the breeding time may begin at the end of August, as I have observed the ripe roe at that time in *Lycodes frigidus* and *L. eudipleurostictus*.

The *Lycodinæ* are oviparous. The eggs are of considerable size and consequently relatively few in number. Collett has found ovarian eggs in *Lycodes esmarkii* which were 6 mm. in

diameter and he puts their number at about 1200. In a specimen of *Lycodes frigidus*, 500 mm. long, I have counted 500 eggs each ca. 7 mm. in diameter. The eggs are large also in the smaller species; in *Lycodes vahlii* (from Iceland) I have found them to be 4,5 mm. in diameter, in *L. eudipleurostictus* 5 mm. in diameter (the number ca. 250) and in *L. agnostus* 4,5 mm. in diameter.

The eggs are laid without doubt on the bottom, as no pelagic egg is known which could be ascribed to the *Lycodinæ*. The brood also must apparently live on the bottom; tolerably small young, for example, have often been taken in the trawl which is dragged on the bottom, never however in the pelagic net.

Distribution of the Species of Lycodinæ in the North European and Greenland Waters.

A. Species taken within the 300 fathom line.

1. Kattegat (as far as the deep channel E. from Læso):
   Lycodes vahlii Reinh. (= *L. gracilis* M. Sars).
2. Skager Rak:
   Lycodes vahlii Reinh. (= *L. gracilis* M. Sars).
   Lycenchelys sarsii Coll.
3. Norway:
   Lycodes vahlii Reinh. (= *L. gracilis* M. Sars).
   — *esmarkii* Coll. (Finmark and towards Bear Island).
   — *rossi* Malmgr. (Porsanger Fjord in East Finmark).
   Lycenchelys sarsii Coll.
4. Norway-Shetland Slope (Eggen):
   Lycodes esmarkii Coll.
5. Færoe Isles:
   Lycodes esmarkii Coll.
6. Færoe-Iceland Ridge:
   Lycodes esmarkii Coll.
7. Iceland:
   Lycodes vahlii Reinh. (= *L. lugubris* Lütk.).
   — *esmarkii* Coll. (E. from Iceland).
   — *pallidus* Coll. [N. from Iceland, in the «cold area»].
8. Kara Sea:
   Lycodes pallidus Coll.
   — *rossi* Malmgr.
   — *seminudus* Reinh.
   — *agnostus* Jensen.
9. Spitzbergen:
   Lycodes pallidus Coll.
   — *eudipleurostictus* Jensen.
   — *rossi* Malmgr.
   — *seminudus* Reinh.
10. Jan Mayen:
    Lycodes reticulatus Reinh. var. *macrocephalus* mihi.
11. Northerly East-Greenland:
    Lycodes pallidus Coll.
    — *eudipleurostictus* Jensen.
    — *reticulatus* Reinh. var. *macrocephalus* mihi.
    — *seminudus* Reinh.
    Lycenchelys kolthoffi Jensen.
12. West-Greenland:
    Lycodes vahlii Reinh. (S. W. Greenland).
    — *eudipleurostictus* Jensen.
    — *reticulatus* Reinh.
    — *seminudus* Reinh.

B. Species taken beyond the 300 fathom line.

1. Polar Depths or the cold area [1]):
   Lycodes frigidus Coll.
   (— *esmarkii* Coll. (juv.; Færoe-Channel)).
   — *eudipleurostictus* Jensen.
   — *pallidus* Coll.
   — *platyrhinus* Jensen (between Iceland and Jan Mayen).
   — *lütkenii* Coll. (W. from Spitzbergen).
   Lycodes seminudus Reinh.
   Lycenchelys muræna Coll.
   Lycodonus flagellicauda Jensen.
2. North Atlantic Ocean:
   Lycodes microcephalus Jensen. (S.W. from Iceland).
   Lycenchelys ingolfianus Jensen. (Davis Straits).
   Lycodonus ophidium Jensen. (S. from Iceland).

Systematic Part.

Fam. *Zoarcidæ* Swainson (1839).

Subfam. *Lycodinæ* Jordan & Evermann (1898).

Body elongated, zoarciform or anguilliform, covered to a more or less extent by small round, non-imbricate scales, which are sometimes wanting. Lateral line ventral, mediolateral or double, often less distinct. Fin-rays soft and jointed; the unpaired fins are continuous, and the dorsal fin has no depressed portion; pectoral fins well-developed; ventral fins present, with few short rays, jugular in position. Gill-membrane firmly united below to the throat. Teeth on the mandible and intermaxillary, often also on the vomer and palatal bones. Pseudobranchiæ present; no swimbladder; pyloric appendages rudimentary (2) or absent.

Key to the determination of the European and Greenland genera of Lycodinæ.

I. Body zoarciform, height over the anus contained ca. 7—12½ times in the total length. *Lycodes* Reinh. P. 10.

II. Body anguilliform, height over the anus contained ca. 16—30 times in the total length.
   A. Branchiostegal rays 6. *Lycenchelys* Gill. P. 82.
   B. Branchiostegal rays 5. *Lycodonus* Goode & Bean. P. 93.

Lycodes Reinhardt.

Lycodes Reinhardt, Overs. K. D. Vidensk. Selsk. Forhandl., 1830—31, p. 74 (*vahlii*).
Lycodalepis Bleeker, Versl. K. A. W. 2e Rks., VIII, 1874, p. 369 (*mucosus*).
Lycias Jordan & Evermann, The Fishes of North and Middle America, Part III, 1898, p. 2463 (*seminudus*).

[1]) By »Polar Depths» I understand the deep waters which are bounded to the south, not by the polar circle, but by the submarine ridge between Greenland-Iceland-Færoe Isles-Shetland; because north of this ridge, polar water with a temperature under 0° C. (the »cold area») is constantly found at the bottom where this lies more than c. 300 fathoms under the surface.

Body moderately elongated (zoarciform), height over the anus ca. 7—12½ times in the total length. Teeth on the intermaxillary and mandible, vomer and palatines. Underjaw without barbules. Scales small, covering a greater or less part of the trunk and tail, sometimes wanting. Lateral line ventral or mediolateral or both mediolateral and ventral. Branchiostegal rays 6.

The characters which are of special importance for distinguishing between the numerous species of this genus have been mentioned in detail in the introduction (p. 3—7). A detailed diagnosis is given under each species and I shall here endeavour (p. 11—12) to draw up a Key for the determination of the North European and Greenland species — the many difficulties in the way of separating such nearly allied species must be the excuse for the apparent shortcomings.

Tentative key for the determination of the European and Greenland species[1]) (and varieties) of Lycodes.

I. *Vahlii-esmarkii* group: Lateral line ventral or both ventral and mediolateral. Distance between the snout and the anus 36,5—45 (47) % of the total length. D. 94—118; A. 81—102.

A. Lateral line single, ventral.

a. Rays in the pectoral fins 23. (East coast of North America; 516—1423 fathoms). *L. atlanticus* Jensen; p. 25.

b. Rays in the pectoral fins 17—21.

1. Colour (at all ages) uniform, without spots or bands. (Polar Depths from Spitzbergen to Iceland and Færoe Isles; (260?) 450—1455 fathoms). *L. frigidus* Coll.; p. 22.

2. Body with dark cross-bands, in adults ring-shaped markings or more uniform; in the anterior corner of the dorsal fin almost always one or more dark spots. (Kattegat, Skager Rak, Norway, Iceland, southerly West-Greenland; 30—300 fathoms). *L. vahlii* Reinh.; p. 13.

B. Lateral line double, ventral and mediolateral.

a. Body naked. (Polar Depths between Jan Mayen and Iceland; 1010 fathoms). *L. platyrhinus* Jensen; p. 51.

b. Body with scales.

α. Pyloric appendages absent. Rays in the pectoral fins 22—23, in the dorsal 113—118, in the anal 97—102. Hind-margin of pectoral not indented. (Finmark and towards Bear Island, Norway-Shetland Slope, Færoe Channel, east of the Færoes, Færoe-Iceland Ridge, east of Iceland, Nova Scotia; 150—300 (620) fathoms). *L. esmarkii* Coll.; p. 27.

β. Pyloric appendages present. Rays in the pectoral fins 20—22 (23), in the dorsal 100—103, in the anal 88—92. Hind-margin of pectoral indented. (Polar Depths west from Norway, north from the Færoe Isles and east from Iceland, Spitzbergen, northerly East- and West-Greenland; 150—470 fathoms). *L. eudipleurostictus* Jensen; p. 33.

[1]) A North American species, *L. atlanticus* Jensen, is included in the key because I know it at first hand. *L. microcephalus* Jensen (from the Atlantic Ocean south from Iceland, 799 fathoms; p. 53) is omitted, because the course of the lateral line in this species cannot be determined with certainty — only one small specimen being known; for the rest, it is easily distinguished from all the above species by reason of its small head, which is only 17,3 % of the total length.

γ. Pyloric appendages present. Rays in the pectoral fins 17—21, in the dorsal 94—101, in the anal 81—86.

* Belly naked on the underside.

1. Longitudinal diameter of the eye 4,5—3,1 % of the total length. (Kara Sea, Polar Depths west from Norway, north from the Færoe Isles and north from Iceland, Spitzbergen, northerly East-Greenland; 18—495 fathoms).

L. pallidus Coll.; p. 38.

2. Longitudinal diameter of the eye 5,6—4,7 % of the total length. (Polar Depths south from Jan Mayen; 371 fathoms). *L. pallidus* Coll. var. *similis* mihi; p. 39.

** Belly with scales also on the underside (either the whole or in all cases the greater portion). (Polar Depths west from Norway, north from the Færoe Isles and east from Iceland; 537—957 fathoms). *L. pallidus* Coll. var. (vel sp. n.) *squamiventer* mihi; p. 39.

II. *Reticulatus* group: Lateral line mediolateral. Distance between the snout and the anus 43—52 % of the total length. D. 90—97; A. 70—78.

a. Body naked. (Kara Sea, Ice Sea of Siberia; 15—100 fathoms). *L. agnostus* Jensen; p. 79.

b. Body more or less covered with scales.

α. Length of the pectoral fin 16,8 % of the total length, number of rays 23. (West from Spitzbergen; 459 fathoms). *L. lütkenii* Coll.; p. 59.

β. Length of the pectoral fin 14,4—13 % of the total length, number of rays 17—21.

* Colour marked by dark cross-bands. Rays in the pectoral (17) 18—19 (20). (Kara Sea, East Finmark, Spitzbergen; 5—100 fathoms). *L. rossi* Malmgr.; p. 55.

** The dark cross-bands (in older individuals) form network patterns. Rays in the pectorals 19—21.

1. Longitudinal diameter of the eye 2,7—4 % of the total length. (West Greenland; 100 fathoms).

L. reticulatus Reinh.; p. 61.

2. Longitudinal diameter of the eye 4,3—4,8 % of the total length. (Northerly East Greenland, Jan Mayen; 40—150 fathoms). *L. reticulatus* Reinh. var. *macrocephalus* mihi; p. 66.

γ. Length of the pectoral fin 11,8—9,6 % of the total length, number of rays 19—22. (Kara Sea, Polar Depths between Norway and Færoe Isles, east from Iceland and south from Jan Mayen, Spitzbergen, northerly East Greenland, West Greenland; 100—600 fathoms).

L. seminudus Reinh.; p. 71.

Lycodes vahlii Reinhardt.

Tab. I, Fig. 2 a, b, c & Tab. II, Fig. 1 a, b.

Fig. 1 & 2 in text.

1831. *Lycodes Vahlii* Reinhardt, Overs. Kgl. D. Vidensk. Selsk. Forh. 1830—31, p. 74.
1835. *L. Vahlii* Reinhardt, Overs. Kgl. D. Vidensk. Selsk. Forh. 1834—35, p. 77.
1838. *L. Vahlii* Reinhardt, Kgl. D. Vidensk. Selsk. Skr. VII, p. 153, Tab. 5.
1866. *L. gracilis* M. Sars, Forh. Vidensk. Selsk. Chria. 1866, p. 40, Pl. 1, Fig. 1—3.
1875. *L. gracilis* Collett, Norges Fiske; Tillægsh. til Forh. Vidensk. Selsk. Chria. 1874, p. 100.
1880. *L. Vahlii* Lütken, Vidensk. Medd. Naturh. Foren. Kbhvn., p. 311.
1880. *L. lugubris* Lütken, ibid. p. 315.
1891. *L. rossii* Lilljeborg (nec Malmgren), Sveriges och Norges Fiskar, III, p. 785.
1895. *L. Vahlii* Smitt, Skandinaviens Fiskar, II, p. 613 (partim).
1898. *L. gracilis* Lütken, The Danish Ingolf Expedition, II, 1, p. 22.
1899. *L. gracilis* Collett, Vidensk. Selsk. Skr. Chria. No. 6, Pl. I—III.
1901. *L. Vahlii* forma *gracilis* Smitt, Bih. K. Sv. Vet.-Akad. Handl. Bd. 27, Afd. IV, No. 4, p. 22.
1901. *L. vahlii* Jensen, Vidensk. Medd. Naturh. Foren. Kbhvn. p. 202 & p. 212.

The height over the anus amounts in general to 8—11 % of the total length. The length of the head in the males is 19,6—23,8 %, in the females 18,8—21,4 % of the total length. The tail is considerably longer than the head and trunk together, the distance from the snout to the anus being in males 37,8—42,3 %, in females 36,5—41,7 % of the total length. The young have 8—10 broad, dark cross-bands over the body; these bands in the adults either disappear entirely or dissolve into ring-shaped stripes and irregular spots; on the anterior corner of the dorsal fin is almost always a black-brown patch, behind which there often is one or two more dark spots. Scales begin to appear at a total length of ca. 60 mm.; at a length of ca. 100 mm. the tail and the trunk are completely covered by scales, as also the base of the unpaired fins. Lateral line ventral. Pyloric appendages 2. The length reaches 520 mm.

D. 95—117. A. 84—98. P. 17—20. Vert. 98—116.

Distribution. Southerly West-Greenland, Iceland, Scandinavia; 30—300 fathoms.

L. vahlii typica: maximum length 520 mm. D. 117—113; A. 98—90; P. 20—19. Vert. 116—112. Greenland.
— *lugubris*: maximum length 355 mm. D. 105—103; A. 90; P. 19—18 (17). Vert. 105. Iceland.
— *gracilis*: maximum length 196 mm.[1]) D. 97—95; A. 86—84; P. (19) 18—17. Vert. 100—98. Scandinavia.

Remarks on the Synonymy.

In 1866 a Lycodes, taken in the Christiania Fjord, was described by M. Sars under the name *L. gracilis*. It was a very young specimen, only 43 mm. long, characterised by 10 saddle shaped cross-bands on a whitish background. The species was not rediscovered until in 1888, when Conservator Storm took 4 specimens, 97—137 mm. long, in Trondhjem Fjord; a fifth, very small individual was taken in the same fjord 6 years later. Lastly, during some of the practical fisheries investigations

[1]) Cf. however Appendix, p. 21.

carried out by Dr. C. G. Joh. Petersen and Dr. Johan Hjort in 1897–98, a very large number of individuals was taken in the Kattegat, Skager Rak and Christiania Fjord. Based on this rich material, Prof. R. Collett published in 1899 a detailed description with numerous figures of the species and of its changing appearances from the young stages up to the reproductive period, the latter stage being reached in these waters at a length of 125–150 mm.; the largest specimen was 178 mm.[1] During the same period, the geographical distribution of this species became widened to embrace Iceland and West Greenland[2]; Collett had obtained from Iceland in 1891 a young specimen from B. Grondal of Reykjavik, and the Ingolf expedition took 2 specimens 143 and 244 mm. long in Davis Straits in the summer of 1895; the last specimens were determined by the present author as *L. gracilis* and were published under this name in the report on the ichthyological results of the Ingolf expedition (Lütken l. c.).

Prof. Collett in the same treatise, examined the relation of *L. gracilis* to allied species. Lack of sufficient material obliged Collett to leave unsettled whether or not *L. gracilis* is identical with *L. rossi* Malmgr. and *L. pallidus* Coll., both known from Spitzbergen. Further it is possible, he states, that *L. gracilis* may be shown to grow elsewhere to a greater size and be identical with some earlier described form, whose young stages are as yet unknown.

On the first possibility, I am unable to give Prof. Collett any support, as *L. rossi* is in all probability the young stage of another species (= *L. celatus* mihi)[3] and *L. pallidus* is a good species as I shall show later.

On the other hand, *L. gracilis* is in my opinion identical with the species long known from Greenland which Reinhardt (sen.) set up as the type of the genus, namely *L. vahlii*[4]. Our Museum possesses half a score of specimens of this Lycodes, and 7 of these were examined by Reinhardt and Lütken whilst 3 are of more recent date (1885); the value of the material is diminished by the bad preservation of the specimens on the whole, but it is quite sufficient to sustain the certainty of the contention here set forth.

Further, I am in a position to furnish proof that the *L. lugubris* from Iceland (Ofjord), described by Lütken in 1880, must also be referred to *L. vahlii*.

We see therefore the peculiar phenomenon that one and the same fish has been ascribed to 3 different species, according as it lives in the waters of Scandinavia, Iceland or Greenland. The reasons for this are twofold: partly because the separate authors have had only a limited material to decide upon; partly because the specimens fall into three groups, which severally present certain differences, and each of these groups possesses its own geographical and separate region.

As a contribution to the knowledge of the importance of geographical elements[5] for the formation of separate races the present example is not without interest, and we shall therefore look into this point a little closer later (p. 19).

I shall proceed now to treat of the separate forms, employing as titles the names they have hitherto borne.

Lycodes gracilis M. Sars.

The form from Scandinavia is so well known from Collett's latest researches (1899) that I need not dwell upon it. Collett's treatise I shall suppose as known in the following pages.

Lycodes vahlii Reinhardt.

Tab. I, Fig. 2 a, b.

At the time when I was assisting Prof. Lütken with the revision of the manuscript of "The Ichthyological Results" of the Ingolf Expedition, I saw that two small Lycodes, taken in Davis Straits out from Sukkertoppen in 88 fathoms, must be ascribed to *L. gracilis* with which I was familiar through the numerous specimens from the Skager Rak presented by Dr. C. G. Joh. Petersen to the Zoological Museum. Prof. Lütken sent these two specimens to Prof. Collett who was then busy with his monograph on *L. gracilis;* Prof. Collett acknowledged the correctness of the determination and has mentioned the discovery in his treatise.

At the same time, subjecting the other preserved material in the Museum of Lycodes from Greenland to a hasty review, it struck me that the youngest of the specimens labelled under the

[1] A somewhat larger specimen, 196 mm. long, was taken later (1900) in the Gullmar Fjord (Bohuslän); it is preserved in the Riks-Museum at Stockholm, where I have had the opportunity of seeing it.

[2] By an error in writing Collett has «East-Greenland» (l. c. p. 8).

[3] Later: A rich material recently obtained has made it clear to Prof. Collett also that *L. rossi* is an independent species.

[4] It might appear as if Prof. Smitt had already published a similar opinion, but his «*L. vahlii*» is not the same as *L. vahlii* Reinhardt. See further p. 15, note 1.

[5] By "geographical elements" I understand the sum of the natural conditions in the region.

name *L. vahlii* Reinh. were apparently not distinguishable from the Ingolf's two *L. gracilis*. At that time I had no opportunity of following up the matter; but now that I have examined it more thoroughly I find that my first impression was correct.

Proportions of the body. In order to display the proof of the correctness of this position, I give here the measurements of a number of specimens, in part the two from the Ingolf, identified by me as *L. gracilis*, in part the earlier ones ascribed by Reinhardt and Lütken to *L. vahlii*.

Measurements of *L. vahlii* Reinh. from West Greenland:

	♂	♀	♀	♀	♂	♀	♀	♀	♂	♂	♂	♀
Total length . in mm.	143	197	235	244	260	295	310	335	365	385	410	415
Length of the head . . .	28	37	45	49	52	58.5	65	66	87	90	90	80
Distance from snout to anus	54	72	88	95	99	118	127	128	152	157	160	170
Height over the anus	13,5	19,5	?	23	22	25	32	31	35	30	33	44

The length of the head is therefore in females 18,8—21 %, in males 19,6—23,8 % of the total length; in the specimens from Scandinavia the figures, expressed in % from Collett's statement of measurements, are 18,8—21,4 % and 20,4—22,7 % respectively. Further, the head and the trunk together (i. e. distance from snout to anus) is in the Greenland specimens 36,4—41,6 %, in those from Scandinavia 37,1—41,3 % of the total length. — In other words, there is as close an agreement as is possible between the Greenland *L. vahlii* and Scandinavian *L. gracilis*, with regard to the most important measurements of the body [1]).

Colour-markings. The smallest, Greenland specimen (one from the Ingolf Expedition) is a male 143 mm., figured in Tab. I, fig. 2 a. The body is adorned with broad, dark cross-bands, 2 on the trunk and 7 on the tail; on the tail posteriorly the bands extend right across and out to the borders of the unpaired fins, further forward they reach below to only a little under the median line; for the rest, each band has a light part in the centre which is not much darker than the grayish yellow ground-colour of the back and sides. In the anterior part of the dorsal fin are 3 very dark, elongated spots, the

[1]) In his work «Skandinaviens Fiskar» II, 1895, p. 615, Prof. F. A. Smitt has expressed the conjecture that *L. gracilis*, which was only known at that time (in the literature) from the original specimen of Sars, is the young stage of *L. vahlii*. — In a later note «On the Genus Lycodes» (Ann. Mag. Nat. Hist. (7) V, 1900, p. 57), written after the appearance of Collett's treatise on *L. gracilis*, the same statement is repeated, but at the same time, *L. gracilis* is given in his analytical table as a peculiar form (*borealis*) of *L. vahlii*, specially characterised by this that the length of the head is «usually» less than 22 % of the total length, whilst in *L. vahlii typica* (forma *arctica*) the length of the head exceeds 22 % of the total length; with regard to the first form it is correct that the length of the head is usually less than 22 % of the total length (see above); but it does not agree with the results of my measurements to say, that the length of the head in *L. vahlii* exceeds more than 22 % of the total length (see above) — for the simple reason that Smitt's «*L. vahlii*» is not the same as *L. vahlii* Reinhardt, as we shall soon see. — Lastly, in his latest contribution concerning the systematic relations of the genus, Smitt speaks thus: «Within the limits of the former species (i. e. *L. vahlii*) it is easy enough to distinguish a local form, *gracilis*, living in the more southerly localities on the European side of the Atlantic ..... and perhaps by this geographical selection from the true home of the genus stopped in the evolution and retaining the juvenile characters». (On the genus Lycodes. II. Bih. K. Sv. Vet.-Akad. Handl. Bd. 27, Afd. IV, No. 4, 1901, p. 20). About the same time I expressed a similar idea, as I also looked on *L. gracilis* as a local form of *L. vahlii* (but as a dwarf form indeed, not as a form which had preserved the characters of the young of *L. vahlii*; cf. Vidensk. Medd. Naturh. Foren. Kbhvn. 1901, p. 202 and the present treatise p. 19), and in a footnote (l. c. p. 203) I cited Prof. Smitt's opinion as agreeing essentially with my view; but since I have had the opportunity, thanks to Prof. Smitt, of examining his «*L. vahlii typica*», at Stockholm, I must take back my earlier half-agreement with his view; the form mentioned is not *L. vahlii* Reinhardt at all, but contains heterogeneous elements, chiefly specimens of *L. pallidus* Collett and *L. eudipleurostictus* mihi — two species which, in my opinion, show no special relationship to *L. vahlii* Reinhardt.

2nd and 3rd of which are in line each with its cross-band, whilst the 1st, in the very front corner of the fin, is in line with the posterior edge of the foremost cross-band. Specimens from the Skager Rak show the same colour-markings as the foregoing, but the comparison must be made with much smaller specimens, because the cross-bands in those from the Skager Rak have already disappeared as a rule at the same size as the above.

The next larger specimen is a female of 197 mm. long, determined as *L. vahlii* by Lütken. The colour-markings are as in the foregoing; the dark cross-bands are however somewhat fainter, but that may perhaps be due to their longer preservation in spirit.

Observation of the remaining specimens shows that the colour-markings of the young become more and more indistinct with age, especially in the males. Even in the largest female, 415 mm. long, there are still traces of the dark bands, although they are partly resolved into ring-shaped markings. The larger males, on the other hand, are darker than the females on the whole, so that the bands, partly in the form of rings, can scarcely be discerned or have entirely disappeared; at the same time, the belly is often of a sharply delimited, relatively light, sometimes even quite white colour (Tab. I, fig. 2 c). The dark spot on the anterior corner of the dorsal fin is very conspicuous both in the male (Tab. I, fig. 2 c) and female (Tab. I, fig. 2 b), sometimes also the second and third spot.

The scaly covering has already attained essentially to its fullest extent in the 143 mm. long specimen (Tab. I, fig. 2 a), as it extends forwards to the neck (on a line across the gill openings), to the bases of the pectoral fins and of the ventrals as well as out on to the unpaired fins.

The lateral line is as in *L. gracilis*»: it courses along the ventral border of the tail and rises dorsally over the anus in order to reach the upper notch of the gill-opening[1]).

The number of fin-rays differs somewhat from that in the Scandinavian specimens, which is probably in relation to the fact that the Greenland form, taken on the whole, is a stronger race; in this regard also, the Iceland specimens are transition-forms so that no specific distinctions can be grounded on these differences. This point will be further considered later (p. 19).

Since the general appearance of the body offers no mark of distinction either — that the species reaches a very much greater size at Greenland than at Iceland (cf. p. 19) denotes again only a racial difference — I look upon it as certain, that the Greenland *L. vahlii* and the Scandinavian *L. gracilis* belong to the same species.

Lycodes lugubris Lütken.

Tab. II, Fig. 1 a, b.

Before treating of this form I think it opportune to refer to some Lycodes which have recently been received at the Zoological Museum from the east coast of Iceland. They were procured by

[1]) This seems to dispute Lütken's observation: «As Hr. Collett has called to my attention, there is some reason for considering there is another lateral line, a mediolateral, in one of the present specimens (Nr. 7) ..... (Vidensk. Medd. Naturh. Foren. 1880, p. 312) and Collett's still more definite assertion: «it must however be admitted, that one of the typical specimens of *L. vahlii* exhibits traces of a mediolateral line» (The Norw. North-Atl. Exp., Fishes, p. 86). From an exact examination of the specimen concerned, I have come to the result that Collett's observation was perfectly correct; but at the same time I am nevertheless of the opinion that this specimen is not *L. vahlii* at all — in spite of the fact that it is one of Reinhardt's type-specimens — but on the contrary, is identical as species with the fishes brought home by the «Norwegian North-Atlantic Expedition» from Spitzbergen, which Collett took for young specimens of *L. esmarkii* Coll., but which I have been obliged to distinguish as a special species (see further under *L. eudipleurostictus* p. 36).

stud. mag. R. Horring during his cruise on the navy-schooner Diana. Their number is half a score, of various sizes, and they are readily recognised as being of the same species as *L. gracilis*. Measurements of some of the specimens will shew the exact agreement with those from the Skager Rak.

Measurements of Lycodes from Iceland, identified as «*L. gracilis*» M. Sars:

		♀	♂	♂	♀	♀	♀
Total length	in mm.	87	95	121	130	180	190	200	210
Length of the head	"	17	19,5	23	27	37,5	37,5	38	43
Distance from snout to anus	"	33,5	36	47	53	69	76	76	79
Height over the anus	"	8	8,5	11	12	15	17,5	19	21

The length of the head therefore, amounts to 19—20,5 % of the total length in the females, and to 20,8 % in the males; in specimens from Scandinavia these proportions, reckoned in percentages from Collett's data, are 18,8—21,4 % and 20,4—22,7 % respectively. Again, the head and the trunk together (i. e. the distance from the snout to the anus) amounts to 37,6—40,8 % of the total length in the Iceland specimens, and to 37,1—41,3 % in the Scandinavian. The narrower limits to the percentages in the Iceland specimens arise naturally from the fewer individuals on which the measurements are based. In regard to the general form of the body, course of the lateral line etc. they agree exactly with the specimens from the Skager Rak.

The colour-markings in the Iceland specimens do not differ from those of the Skager Rak specimens. The youngest individuals (ca. 90 mm. long) are provided as a rule with 8 to 9 broad, dark cross-bands, but these are already not very conspicuous; in older individuals they can just be seen or have wholly disappeared. On the dorsal fin anteriorly there are 2 (sometimes 3, sometimes only 1) black spots; this marking seems tolerably constant, even when the others disappear (Tab. II, fig. 1 a, b). The youngest individual farther, possesses a light stripe across the neck. The ground colour is brownish above, gray-yellow below.

The scales appear at the same size as in the Scandinavian specimens. A young specimen of 87 mm. shows some portions here and there where the skin is still naked, but in a slightly older specimen of 95 mm. the scales are complete.

From an examination of these specimens I have arrived at the same conclusion as Collett from his investigation of his specimen from Iceland, viz. that a *Lycodes* identical as species with *L. gracilis* occurs at this island.

Accepting this as a fact, we may now enquire more closely into the single *Lycodes* formerly known from the coast of Iceland, namely *L. lugubris* Lütk.

Of the 5 specimens, 4 males and 1 female, which in 1880 formed the basis for the establishment of this species by Lütken, only three, 2 males and 1 female now remain; a mounted skeleton in the Museum labelled «*L. lugubris*» is certainly identical with the fourth specimen but the fifth is no longer in the Museum.

Lütken has remarked that his Iceland Lycodes stood near to *L. vahlii* in respect to body form, scale-covering and course of the lateral line.

As a determining character, he first names the colour which, in the Iceland specimens is »of a perfectly uniform grayish or gray-brownish, without bands, network or the like, either on the back or fins; the only marking apparent to the eye is that the under part of the belly and head are somewhat lighter, though to a varying degree in the different individuals, and a whiter part especially is present at the corners of the mouth, embracing generally the limbs of the underjaw and the overlip and with a tolerably sharp boundary where it meets the darker head above». It may be remarked meantime that *L. vahlii* — according to Lütken's own perfectly correct statement — has only dark bands in the young, and that the bands »in the old (at least in the males) seem to dissolve entirely into an uniform dark colour». Since he pointed out the probable difference in the colouring, Lütken has obviously compared the Iceland specimens with young *L. vahlii;* if the comparison however had been made with older *L. vahlii* — which would have been better, since *L. lugubris* Lütken consisted only of developed specimens — the result would have been quite different, namely that there was the most perfect agreement between them; even the white part along the limbs of the underjaw and the overlip are found in individual larger males of *L. vahlii.* An important patch of colour, which Lütken either overlooked or attached no weight to, has also to be mentioned: in the anterior corner of the dorsal fin the characteristic dark spot of *L. vahlii-gracilis*, so often referred to above, is clearly seen in two specimens, less clearly in the third, of *L. lugubris.*

Again, according to Lütken, the Iceland form differs from the Greenland in having fewer rays in the pectorals, namely 17—18 against 19—20 in *L. vahlii.* The break is rather small by itself to make one think this »a good specific character to distinguish it from *L. vahlii*». It is due to chance also that all Lütken's specimens showed the low number. One specimen sent from Arnarfjord in the North-West Land in 1894, and ascribed by Lütken himself to *L. lugubris*, possesses 19 rays in the pectorals; I find the same number in a specimen which came from the same fjord as those of Lütken, namely Ofjord, and would be ascribed to *L. lugubris* Lütk. — Since the numbers of the rays in the pectorals thus overlap in the two forms, this loses essential importance as a specific determining character.

A further specific character is found by Lütken in this, that whilst the row of palatal teeth is as a rule longer than that on the intermaxillary in *L. vahlii*, very rarely if ever, shorter than on the latter, in *L. lugubris* it is always somewhat shorter than that on the intermaxillary. To obtain this result Lütken must certainly have had before him male individuals of *L. lugubris*, and of *L. vahlii* females more particularly; because in the single ♀ *L. lugubris*, in the collection of the Museum, the row of teeth on the palatal is of the same length (a little longer indeed on the one side) as that on the intermaxillary; and contrariwise, I find that the row on the palatals is distinctly shorter than that on the intermaxillary in all older males of *L. vahlii.* This, which Lütken had taken for a specific distinction, is thus reduced to a sexual character, which appears equally in the one form as in the other.

I think I have thus sufficiently explained the untenableness of Lütken's expressed reasons for considering *L. lugubris* distinct from *L. vahlii.* There remains only to show from measurements of *L. lugubris*, that it and *L. vahlii-gracilis* are in perfect agreement.

Measurements of *L. lugubris* Lütk.:

		♂	♀	♂	♂	♂
Total length	in mm.	300	312	320	330	355
Length of the head	—	70	59	74	75	80
Distance from snout to anus	—	127	130	128	135	147
Height over the anus	—	27	34	27	29,5	33

The length of the head is thus 18,9 % in the females, 22,5—23,3 % in the males, of the total length; the distance between the snout and the anus is 40—42,3 % of the total length. These numbers thus agree very closely with those of adult *L. vahlii*.

Remarks on the variation of the species.

From the examination just completed it will be evident that *L. vahlii-lugubris-gracilis* cannot be regarded as separate species. At the same time, it must be put forward that the members of this chain represent 3 races, each possessing its own geographical and separate region, namely Greenland *(L. vahlii typica)*, Iceland *(L. vahlii lugubris)*, and Scandinavia *(L. vahlii gracilis)*.

First of all, there is a remarkable variation in regard to size. The species reaches its maximum size at Greenland to over $^1/_2$ m. (ca. 52 cm.) long; at Iceland the maximum is 35,5 cm., and from Scandinavia no greater specimen than 19,6 cm.[1]) is known. Since these measurements are based on a large number of specimens they can scarcely be regarded as resting on chance, but one may believe that the species decreases in size as it approaches the more easterly (and southerly) regions.

Parallel with this decrease in size there is a diminution in the number of fin-rays and vertebræ, as will be seen in the following tabular review.

	Greenland *L. vahlii typica*	Iceland *L. vahlii lugubris*	Scandinavia *L. vahlii gracilis*
Maximum length in mm.	520	355	196
Number of rays in pectoral fin	20— 19	19 —18 (17)	(19) 18—17
— — dorsal	117—113	105—103	97—95[2])
— — anal	98— 90	90	86—84
Number of vertebræ	116—112	105	100 - 98

It seems therefore as if the species taken as a whole, reaches its greatest development at Greenland; at Iceland there is already a recognisable decline, and at Scandinavia we meet with the species in its most reduced condition[3]).

Differences between the sexes.

Prof. Collett has observed on specimens from Scandinavia that it is easy as a rule to distinguish males from females by their relatively longer head. The same is the case in Greenland and

[1]) Cf. Appendix however, p. 21.
[2]) Collett gives the number as ca. 120, but this must be due to an error in counting.
[3]) Cf. Appendix however, p. 21.

Iceland specimens, cf. p. 15 and p. 17 (see also Tab. I, fig. 2 b [♀] and fig. 2 c [♂]; Tab. II, fig. 1 a [♂] and fig. 1 b [♀]). On account of the greater length of the head (which shows almost to an equal degree on the pre- and post-orbital portion) the profile in the males varies also with age; the upper margin is straightened out and forms from the eye forward a faint, sloping line (see Tab. I, fig. 2 c and Tab. II, fig. 1 a); it is characteristic of the females (and the young individuals) that the upper margin from the eye forward declines somewhat sharply towards the snout (see Tab. I, fig. 2 b and Tab. II, fig. 1 b, also fig. 2 a, Tab. I of a young individual). Farther, the head of the males is broader over the cheeks than that of the females (cf. text fig. 1, ♂ and fig. 2, ♀), which has already been remarked by Collett in *L. gracilis*». Here may be added also that in the older males, the row of teeth on the intermaxillary becomes

Fig. 1. *L. vahlii* ♂.

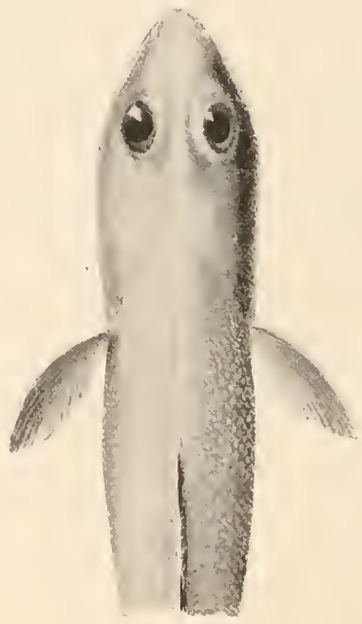


Fig. 2. *L. vahlii* ♀.

longer than that on the palatals, whilst in the females the row on the intermaxillary is only of the same length or even shorter than that on the palatals.

Concerning the colour, Collett states that old males seem as a rule to be more uniform than the females usually are at the same stage. The same holds also, but in greater degree, for the specimens from Greenland.

Reproduction.

According to Collett, *L. vahlii* (*L. gracilis*») spawns in the Skager Rak from July to October; the greatest number of eggs he found in a female was 30—48 and their maximum size was reckoned to 4 mm. in diameter. In a female 210 mm. long, taken on July 8th, 1899 at Seydisfjord on the east coast of Iceland, I find on the contrary not less than 93 eggs, whose size is 4,5 mm. in diameter (in addition, this female contained some individual eggs, obviously late in development, and numerous small eggs reserved for the next spawning period). The Greenland specimens do not throw much light on the breeding conditions, partly on account of the bad state of preservation, partly because data with regard to the catch are

wanting. In a 247 mm. long female, taken on July 11th 1895 off Holstensborg, the eggs measured scarcely 1 mm. in diameter, so that it was hardly ready for spawning in that year. A female 310 mm. long, taken at Sukkertoppen August 5th 1885, seems to have spawned as the ovaries are collapsed and contain very small eggs only.

In a male of 180 mm., taken at Iceland on April 30th, the testes are very small (9,5 mm.) and little developed. In a male 300 mm. long, likewise from Iceland, the testes measured ca. 30 mm. (the free folds being ca. 7 mm.) and are much swollen. In larger males from Greenland the testes reach a length of ca. 45 mm. (folds ca. 20 mm.).

Distribution.

In Scandinavia the species has been taken in Trondhjem fjord[1]), in the Christiania fjord, also in the Skager Rak and in the eastern Kattegat as far as the deep channel E. from Læso, at 30—300 fathoms depth (cf. Collett l. c. 1899 and C. G. Joh. Petersen[2])). At Iceland: on the east coast stud. mag. Horring has taken 7 specimens at Reydarfjord, 44 fathoms, one in outer Reydarfjord, 60—80 fathoms, one in Nordfjord's Flóin, 35—55 fathoms and one in Seydisfjord, 30—60 fathoms; from the North Land the Museum has obtained 5 specimens during the seventies from Ofjord; I have also had a further specimen from the same fjord but of later origin[3]); in the North-West Land, Capt. Bast obtained a specimen in Arnarfjord in 1894, and lastly a specimen[3]) has been taken at »North-west Iceland», ca. 80 fathoms. At Greenland: the species has been taken at the following places all lying along the south-westerly stretch of coast: Nanortalik (ca. 60° N.L.), Fiskenæs, Godthaab, Sukkertoppen and Ingolf's St. 31 (66° 35′ N.L.), 88 fathoms; the distribution therefore extends over ca. 6½ degrees of latitude.

Appendix.

During my participation in the cruise of the Norwegian fisheries steamer, »Michael Sars» in the summer of 1902, a specimen of *Lycodes vahlii gracilis* was taken in the English trawl at a depth of 190 fathoms; the place (St. 47) lay off the south-west of Norway (60° 57′ N.L. 3° 42′ E.L.).

Lastly, through the kindness of Prof. Collett, I have had the opportunity to examine a specimen which was taken (by the »Michael Sars», 14.5.01) much further to the north of Norway than the species was hitherto known, namely at Baadsfjord (East Finmark). This specimen is conspicuous by its considerable size, 268 mm. Amongst the hundreds of specimens which have previously been reported from Scandinavia, none — as already mentioned — exceeded 196 mm. in length, but they came from much more southerly regions (especially the Skager Rak). In the fjords of East Finmark, where the conditions are half arctic, the species can thus attain almost as great a size as at Iceland; in the number of fin-rays also this specimen approaches to the variety *lugubris*, as the pectoral fins have 19 rays, the dorsal fin 101, and the anal 89.

[1]) Cf. Appendix this page.

[2]) Beretning IX fra den biologiske Station, p. 17—32; Fiskeri-Beretning for Finansaaret 1898—99 (Kjobenhavn, 1900).

[3]) This belongs to the Natural History Society at Reykjavik and was kindly lent me by my friend, Adjunkt B. Sæmundsson.

Lycodes frigidus Collett.

Tab. V, Fig. 1 a, b.

1878. *Lycodes vahlii* Collett, Fiske indsamlede under den norske Nordhavs-Expeditions 2 forste Togter; Forh. Vidensk. Selsk. Chria. 1878, No. 4, p. 11 (partim).

1878. *L. frigidus* Collett, Fiske fra Nordhavs-Expeditionens sidste Togt; Forh. Vidensk. Selsk. Chria. 1878, No. 14, p. 45.

1880. *L. frigidus* Collett, The Norwegian North-Atlantic Expedition, Fishes, p. 96, Pl. III, Fig. 23—24.

1887. *L. reticulatus* Günther (nec Reinhardt), The Voyage of H. M. S. Challenger, XXII, Report on the Deep-Sea Fishes, p. 77, Pl. XIII.

1887. *L. frigidus* Günther, ibid. p. 79.

1891. *L. frigidus* Lilljeborg, Sveriges och Norges Fiskar, II, p. 19.

1895. *L. frigidus* Smitt, Skandinaviens Fiskar, II, p. 610, Fig. 146.

1898. *L. frigidus* Lütken, The Danish Ingolf-Expedition, II, 1, p. 20 (partim).

1899. *L. frigidus* Lönnberg, Bihang K. Sv. Vetensk.-Akad. Handl. Bd. 24, Afd. IV, No. 9, p. 24.

1901. *L. reticulatus* forma *frigida* Smitt, Bih. K. Sv. Vetensk.-Akad. Handl. Bd. 27, Afd. IV, No. 4, p. 29 (partim), No. 10, 11 & 12.

1901. *L. frigidus* Jensen, Vidensk. Medd. Naturh. Foren. Kbhvn., p. 213.

The height over the anus amounts to 9,5—14,2 % of the total length (in the young, 8—9,6 %). The length of the head in the males is 23,6—27,6 %, in the females 22,4—25,2 % of the total length. The tail is somewhat longer than the head and trunk together, as the distance between the snout and the anus is in the males 43,7—47 %, in the females 38,2—45,6 % of the total length. The colour is uniformly reddish gray or brown gray (in living specimens, yellow brown to chocolate colour), without bands or spots; the gill-covers and fins are dark brown toward the margins. The scales are unusually small, covering the whole of the body as far as the head, and the base of the fins also in the fully grown; in the younger, the middle part of the belly, the fins and along their bases are most often naked. Lateral line ventral[1]). Pyloric appendages 2[2]). The size reaches to ca. 560 mm.

D. 99—104. A. 85—90. P. 19—21. Vert. 103—107 (21—22 + 81—85).

Distribution. Polar depths from Spitzbergen down to Iceland and the Færoes, (260?) 450—1455 fathoms.

Prof. Collett has given detailed information with regard to the numerous specimens taken on the Norw. North-Atlantic Expedition, representing the species from the younger stages up to 510 mm.; a new and searching description is therefore unnecessary. I shall simply content myself with making some comments, in part supplementary, in part for correction.

I give below the measurements of 17 specimens from the Ingolf Expedition; the sex is stated where it could be determined with certainty, which is already possible at a length of ca. 100 mm.

[1]) In well-preserved specimens a series of dorsal pores remote from one another, can also be seen.

[2]) I do not agree here with Collett, who states that the pyloric appendages are wanting.

						♂	♀	♂	♀	♂	♀	♀	♂	♀	♀	♂	♂	♂
Total length	in mm.	49,5	56,5	76	83,5	104,5	136	173	204	215	226	290	327	345	402	406	428	515
Length of the head	—	11,75	13,5	17,5	20,5	24,5	30,5	44	50	51	57	72	82	82	96	112	101	136
Distance from snout to anus	—	19,5	22,5	29,5	36	42,5	52	78	90	94	103	130	146	160	180	189	190	242
Height over the anus	—	4	4,5	6,5	8	9,5	13	20	24	25	26	35	45	44	56	50	51	73

The length of the head therefore, amounts to 23,6—27,6 % of the total length in the males, 22,4—25,2 % in the females (23—24,6 % in the young); the distance from the snout to the anus is 43,7—47 % of the total length in the males, 38,2—45,6 % in the females (38,8—43,1 % in the young); the height over the anus 9,5—14,2 % (8—9,6 % in the young) of the same dimension.

Collett (Norw. North-Atlantic Expedition, Fishes, p. 100) states that the scales begin to develop in the young when they are about 50 mm. long, as in one specimen (from St. 124) of 62 mm. total length, the scales had begun to appear on the anterior part of the body. This statement does not agree with my experience. Thus 10 specimens (Ingolf Expedition), whose lengths lay between 49,5 and 105 mm. are quite devoid of scales. The smallest specimen on which scales can be observed, is 101 mm. long; in it scales appear about the median line of the side, on the posterior half of the trunk, and on the anterior two-thirds of the tail. This seems therefore to point to the conclusion, that the scaly covering begins to form at the earliest at a total length of ca. 100 mm., also that Collett's specimen, which was already furnished with scales at 62 mm., hardly belonged to the present species. For the rest, there is some variation in the place of appearance and distribution of the scaly covering. Four specimens, whose lengths are 108,5, 118, 120 and 138 mm. have it relatively less developed than the one just mentioned of 101 mm., as only on a small part over the anus, round the median line, do the scales make their appearance. Five individuals of 120, 125, 137, 148 and 162 mm. are quite different from these, as no scales appear on the trunk, but they are present on the other hand on the middle third of the tail. Consequently, the scales may first appear either on the middle of the body, or on the middle of the tail. At a total length of ca. 170 mm., the scaly covering extends in general from a little behind the gill-covers to the neighbourhood of the end of the tail, also below on to the underside of the belly, but the anterior part of the back (with a small strip under the front part of the dorsal fin) together with the fins are bare. At a total length of ca. 180 mm., the scales also appear on the part in front of the dorsal fin, and at ca. 200 mm. they show on the base of the dorsal fin. In the adults, the scales extend over the body right to the head as also out on the unpaired fins, but in two of the largest specimens I cannot detect scales on the front part of the back (in front of the dorsal fin), nor partly either on a strip under the front part of the dorsal fin.

Although *L. frigidus* is a well characterised species, and from its small scales and uniformly coloured body at all ages is the most readily recognised of all the Lycodes here dealt with, yet a doubt has been expressed lately from two sides as to whether it is a good species.

F. A. Smitt thus states in his great work on the fishes of Scandinavia, that the possibility is not excluded that under Collett's *L. frigidus* is concealed a number of sterile perhaps hybrid individuals; the species, to which he refers, being *L. vahlii* and *L. reticulatus*. And from a note[1]) which

[1]) Smitt: On the Genus *Lycodes*. Ann. Mag. Nat. History (7), 5, 1900, p. 56.

has but recently appeared, it is evident that Prof. Smitt has not changed his standpoint in this regard. — If one but reflects that *L. frigidus* is exceedingly common in nature — both the North-Atlantic and Ingolf Expedition have taken it more frequently and in much greater numbers than any other *Lycodes* — and that it has quite a different area of distribution from *L. vahlii* or *L. reticulatus*, which are both (as shown in the present work) restricted to relatively small depths, whilst *L. frigidus* is confined to the deeper and deepest part of the «cold area», this supposition of Prof. Smitt that *L. frigidus* is a number of sterile and hybrid (?) individuals of the two named species, strikes one at once as unnatural. I can also assert that the specimens in my hands give no indications whatsoever of being sterile; both the male and female sexual organs are well-developed, though not fully ripe, since the specimens have obviously not been taken during the spawning-period. In the largest male from the Ingolf Expedition the testes are 65 mm. long and 10 mm. broad, without free folds and of equal length (Collett mentions that in a 510 mm. long male the left testis was rudimentary); the eggs in the largest female are 1,5 mm. in diameter in the sack-shaped, ca. 55 mm. long, ovary[1]).

Again, Dr. E. Lönnberg (l. c.) is inclined to regard *L. frigidus* and *L. pallidus* as colour-varieties of one and the same species[2]). If this author had had specimens of *L. pallidus* for comparison, he would certainly not have adopted this view. *L. frigidus* is distinguished in a moment, so to speak, from *L. pallidus* — and indeed from all other scaled (European and Greenland) Lycodes species — by its extremely small scales. So small are the scales in *L. frigidus* that there are ca. 48 scales in a vertical line from the anus to the base of the dorsal fin in a specimen of 226 mm., whilst in a specimen of *L. pallidus* (var. *squamiventer)*, 230 mm. long, there are only 27 scales on the same line.

In his latest treatise on the genus *Lycodes*, F. A. Smitt (l. c. 1901) has so far changed his view that he now brings under *L. reticulatus* a singular «forma *frigida*»; during my visit to the Stockholm Riks-Museum I discovered that under this denomination were placed: 1 specimen of *L. perspicillum* Kroyer (= *L. reticulatus* Reinh. juv.?) (No. 1), 8 specimens of *L. pallidus* Coll. (No. 2—9) and 3 specimens of the veritable *L. frigidus* Coll. (No. 10—12).

Distribution.

The Ingolf Expedition has taken *L. frigidus* at the following stations which all lie north, north-east and east of Iceland and south of Jan Mayen[3]):

St. 124	495 fathoms		— 0°6 C.	5 specimens	
- 125	729	—	— 0°8 -	1	—
- 120	885	—	— 1°0 -	6	—
- 110	781	—	— 0°8 -	2	—
- 102	750	—	— 0°9 -	6	—
- 104	957	—	— 1°1 -	7	—

[1]) After this was written, I have observed a female *L. frigidus* with fully ripe eggs. The specimen was ca. 500 mm. long, with an enormous ovary, 84 mm. long, 47 mm. broad, which contained 500 eggs, almost ready to be spawned, of a diameter of 7 mm. It was taken on the 29th of August 1902, north from the Færoes (63° 13′ N.L., 6° 32′ W.L., depth 975 fathoms, temperature of the bottom — 0,51° C.) by the fisheries steamer «Michael Sars».

[2]) Lütken has also suggested that *L. pallidus* was a «subspecies or form» of *L. frigidus*. Vidensk. Medd. Naturhist. Foren. Kbhvn., 1880, p. 317.

[3]) 2 other specimens were brought home in addition to these 63, but the number of the station was lost later.

St. 111	860	fathoms	— 0°9 C.	6	specimens
- 119	1010	—	— 1°0 -	10	—
- 112	1267	—	— 1°1 -	6	—
- 118	1060	—	— 1°0 -	8	—
- 117	1003	—	— 1°0 -	5	—
- 113	1309	—	— 1°0 -	1	—

The English expeditions of the Knight Errant and Triton (1880 and 1882) caught a large number of specimens in the cold portion of the Færoe Channel at 540—640 fathoms, bottom-temperature 29°2 and 30° F.; the largest of these specimens was a male which measured ca. 558 mm. (22 inches)[1]). The Norw. North-Atlantic Expedition took 15 specimens, 37—510 mm. long, off the west of Norway, west from Bear Island and west from Spitzbergen; the depths were (260) 457—1333 fathoms, bottom-temperature (— 1 1) — 0°7 to — 1°6 C.[2]). Again, the Nathorst Expedition of 1898 took 1 specimen off West Spitzbergen where the depth was 2750 meters and the bottom-temperature — 1°4 C. Further, the Kolthoff Expedition of 1900 caught 3 specimens between Jan Mayen and Greenland (72° 42′ N.L. 14° 49′ W.L.) at 2000 meters. Lastly, the Michael Sars in 1902 caught 17 specimens (290—530 mm. long) north from the Færoes (63° 13′ N.L. 6° 32′ W.L.), where the depth was 975 fathoms, also 2 specimens (366—430 mm. long) in the cold area off western Norway (63° 7′ N.L. 1° 38′ E.L.), where the depth was 650—720 fathoms.

L. frigidus is so generally distributed over the deeper and deepest parts of the Polar Depths, from Spitzbergen down to Iceland and the Færoes, that it may be reckoned amongst the most characteristic inhabitants of this deep-sea basin.

I feel very dubious, therefore, on finding that the American authors have identified a Lycodes occurring generally in the western part of the true Atlantic Ocean, with *L. frigidus* Coll. from the ice-cold Polar Depths. I believe, indeed, I am in a position to say there must be some error in this determination. Although it is beyond the scope of the present work to enter upon the American forms, I shall yet make an exception in this case since it presents a very important question in biological regard, namely, whether a species of fish can be common to the warm ground in the depths of the Atlantic and to the ice-cold depths of the Northern Ocean.

Lycodes atlanticus Jensen.

1895. *Lycodes frigidus* Goode & Bean (nec Collett), Oceanic Ichthyology, p. 305; Mem. of the Museum of Comp. Zool. at Harvard College, vol. XXII.

1898. *L. frigidus* Jordan & Evermann (nec Collett), Fishes of North America, III, p. 2465.

1901. *L. atlanticus* Jensen, Vidensk. Medd. Naturh. Foren. Kbhvn., p. 207.

[1]) Günther (l. c.) has referred this to *L. reticulatus* Reinh., but both F. A. Smitt and Lütken have remarked upon its resemblance to *L. frigidus* Collett. It agrees perfectly in fact with the large male of *L. frigidus* from the Ingolf Expedition, as appears both from Günther's description and figure; only, Günther gives his specimen a mediolateral lateral line, which must rest on some error.

[2]) It is possible that the specimen from the relatively small depth (260 fathoms) with high bottom-temperature (+ 1°1 C.) arises from an error in determination; Prof. Collett has kindly informed me that it was given away to some Museum so that the determination cannot now be controlled; concerning a second specimen from 350 fathoms (N. North-Atlantic Exped. St. 124) which Collett has mentioned, I have already remarked that the early appearance of the scaly covering indicates that it is no *L. frigidus* (cf. p. 23).

The length of the head amounts to 22,6 % of the total length, the distance between the snout and the anus 37,6 %, the height over the anus 11,4 %. Colour uniformly brown, without bands or spots. The scales, which are of the usual size, extend forward to the head as well as out on to the unpaired fins and base of the pectorals. Lateral line ventral. P. 23.

Distribution: Atlantic Ocean off the east coast of North America, 516—1423 fathoms.

In the work mentioned above, Goode & Bean have identified a Lycodes taken in large numbers in the waters of the Atlantic Ocean off the east coast of North America (35° 12′ 10″—41° 53′ N.L. 65° 35′ - 74° 34′ 45″ W.L.), at 516—1423 fathoms depth, with *L. frigidus* Collett from the ice-cold depths of the Northern Ocean.

Unfortunately, the authors have contented themselves with copying Collett's diagnosis, and impart no information whatsoever on their material apart from a recital of the separate localities. And if one consults the most recent and principal work on the North American fishes by Jordan & Evermann, one also finds nothing concerning the American form, as these authors have contented themselves with studying a type-specimen from the Northern Ocean sent by Prof. Collett.

Thanks to the generosity of the Smithsonian Institution our Zoological Museum has meantime come into the possession of a specimen of the American *L. frigidus*.

On comparing this individual with specimens from the Polar Depths I find that they belong to two distinct species. In the uniform brown colouration, the ventral lateral line and other, though more general, features the two forms present a certain resemblance to one another, but on closer examination they are seen to be quite different in important characters.

Measurements of the American specimen are as follows:

Total length	338 mm.
Length of the head	76,5 —
Distance from snout to anus	127 —
Height over the anus	38,5 —

Put into percentages, the length of the head is therefore 22,6 %, the distance between the snout and the anus 37,6 %, the height over the anus 11,4 % of the total length. The sex cannot be determined as the internal organs of the fish have been destroyed.

Comparing this individual now with specimens from the Polar Depths, of the same length and of both sexes, we find a very distinct difference with regard to the most important measurements.

	L. frigidus Coll.		«*L. frigidus*» G. & B.
	♂	♀	
Total length in mm.	327	345	338
Length of the head in % of the total length	25,1	23,8	22,6
Distance from snout to anus — —	44,6	43,4	37,6

The tail in the American form has therefore a much greater proportion of the length in relation to the rest of the body; in agreement with this its head is relatively somewhat smaller.

Other differences are also present, which just as distinctly declare against the two forms being identical. The American specimen, for example, has much larger scales so that the number in the vertical line from the anus to the base of the dorsal fin amounts to 34; whereas, on the same line in a specimen of *L. frigidus* from the Polar Depths there are ca. 55 scales, although its total length is the same. Lastly, the American form has 23 rays in the pectoral fins whilst the number in the species from the Polar Depths is at most 21.

I can come to no other conclusion therefore, than that we have to deal with two species well separated in important structural features. The American form must consequently be renamed, and conveniently *L. atlanticus*[1]), which characterises it zoo-geographically in contrast to the *L. frigidus* of the ice-cold Polar Depths.

For the rest, it must be left to the American ichthyologists to give us further enlightenment upon this species since they have of it a large material at their disposal.

Lycodes esmarkii Collett.

Tab. III, Fig. 2 a, b, c.

1869. *Lycodes Vahli* Esmark, Bidrag til Finmarkens Fiskefauna; Forh. v. Skand. Naturf. 10. Mode i Chria. 1868, p. 524.

1875. *L. esmarkii* Collett, Norges Fiske; Tillægsh. til Vidensk. Selsk. Forhandl. Chria. 1874, p. 95.

1879. *L. vahlii* Collett, Meddelelser om Norges Fiske i Aarene 1875—78; Forhandl. Vidensk. Selsk. Chria. 1879, No. 1, p. 62 (partim).

1880. *L. esmarkii* Collett, The Norw. North-Atlantic Expedition, Fishes, p. 84 (partim), Pl. III, Fig. 22.

1884. *L. esmarkii* Collett, Meddelelser om Norges Fiske i Aarene 1879—83; Nyt Magaz. f. Naturvidensk. 29 B., p. 73 (partim).

1891. *L. esmarkii* Lilljeborg, Sveriges och Norges Fiskar, II, p. 6 (partim).

1895. *L. Vahlii* Smitt, Skandinaviens Fiskar, II, p. 613 (partim), Fig. 149.

1899. *L. vahlii* Lönnberg, Bihang K. Sv. Vetensk.-Akad. Handl. Bd. 24, Afd. IV, No. 9, p. 23.

1901. *L. esmarkii* Jensen, Vidensk. Medd. Naturh. Foren. Kbhvn., p. 213.

Height over the anus amounts to 8,9—14,4 % of the total length. Length of the head in adult males is 21—24 %, in adult females and young individuals 19,2—21,9 % of the total length. The tail is distinctly longer than the head and trunk together, as the distance between the snout and the anus amounts to 37,5—42,9 % of the total length. The posterior margin of the pectorals rounded without indentation. Colour brown, with a light stripe over the neck (or a light spot on each

[1]) I ought however to explain, that the new species has points of connection with the *Lycodes terræ-novæ* from the banks of Newfoundland, 155 m., founded by R. Collett in 1896 (Résultats Camp. Scient. Albert I, Fasc. X, p. 54). But in two specimens of similar size (370 & 310 mm.) to the above named *L. atlanticus*, the length of the head is 18,9—18,4 %, the distance from snout to anus 35,1—35,5 %, of the total length. In addition, there is a characteristic difference in regard to the teeth-equipment of the palatines: in *L. terræ-novæ* there are only 3—5 teeth on the palatines, and the whole row is scarcely half so long as that on the intermaxillaries; whereas, in *L. atlanticus* there are 10 teeth on the palatines, and the whole row is more than double that on the intermaxillaries.

side of the neck) and 5—9 whitish yellow cross-lines on the body, which are Λ-formed in the young, but in the medium-sized specimens enclose dark spots or stripes and finally form festoon-shaped markings. The scales cover the whole of the body as far as the neck and base of the ventral fins and extend far out on to the unpaired fins. The lateral line is double, mediolateral and ventral, but often indistinct, especially the mediolateral. Pyloric appendages are wanting. The length reaches to 705 mm.

D. 113—118. A. 97—102. P. 22—23. Vert. 115—118 (23 + 92—95)[1].

Distribution. Finmark, 150—200 fathoms; between Norway and Bear Island, 200 fathoms; Norway-Shetland Slope, 275 fathoms; Færoe Channel, 620 fathoms; east from the Færoes, 228 fathoms; between the Færoes and Iceland, 250 fathoms; east from Iceland, 300 fathoms; Nova Scotia.

Remarks on the Synonymy.

L. esmarkii was founded in 1874 by Collett for a Lycodes occurring in the fjords of Finmark, which was however already mentioned by Esmark in 1868 and referred by him to *L. vahlii* Reinh.; Collett also, at a certain period (1878—79), was inclined to place these two species together, but finally raised *L. esmarkii* to an independent position. Through Collett's exertions a by no means small material was gradually acquired; in 1883 the number amounted to 22. All these specimens were remarkable for their large size, lying between 575 and 705 mm. Prof. Collett kindly permitted me to examine the smallest specimen which up to the present has come from Finmark; it measured about 443 mm. Further I have had 3 larger specimens under examination which our Zoological Museum owes to the generosity of Collett.

Meantime, the Norwegian North-Atlantic Expedition during 1877—78 found 4 Lycodes, 81—295 mm. long, on the banks off the Lofotens and on the north-west coast of Spitzbergen, concerning which Collett holds it for extremely probable that they are the hitherto wanting young stages of *L. esmarkii;* the three largest of these are figured in the work on the fishes of the expedition (Pl. II, fig. 19, 20, 21) and for comparison an adult *L. esmarkii* from Finmark is also given (Pl. III, fig. 22). The differences which appear between them, especially in the colour-markings, could be ascribed according to Collett, to the great difference in age and size.

In 1896, the Ingolf Expedition obtained a 260 mm. long Lycodes north-west from the Færoes which in colour-marking recalls greatly the largest from the Norwegian North-Atlantic Expedition, and for other reasons also must be considered identical with the presumed young stages of *L. esmarkii* Coll. On opening this specimen I found the gut provided with two pyloric appendages, small yet quite distinct, whilst *L. esmarkii* of Collett displays no trace of these[2]. An investigation, undertaken thereafter on a specimen from the Norwegian North-Atlantic Expedition, showed that this likewise possessed pyloric appendages. It was therefore clear that the supposed young of *L. esmarkii* could not be stages in the development of this fish, but must belong to a separate species. A detailed comparison further strengthened the independence of the two forms, so that I was obliged to set up a new species for the specimens obtained away from Finmark, which I have called *L. eudipleurostictus;* an explanation of this point will be given later (p. 34—37).

Whilst I have been obliged to remove from *L. esmarkii* a form that had previously been considered its young stages, I have at the same time had the satisfaction of being able to show a true early stage of *L. esmarkii*. This I found in a small Lycodes, which the Swedish Nathorst Expedition of 1898 obtained between Norway and Bear Island, and which has already been described as to its most important characters by Dr. E. Lönnberg (l. c.). This author ascribed it to *L. vahlii*, as he like Prof. Smitt declares himself unable to distinguish between *L. esmarkii* and *L. vahlii*, a position I cannot agree with (cf. p. 31—32).

On a young specimen of *Lycodes esmarkii*.

Tab. III, fig. 2 a.

A comparison between the specimen just referred to (from the sea between Norway and Bear Island) and *L. esmarkii* from Finmark will show how it may rightly be considered as a very young specimen of *L. esmarkii*.

[1] Collett found Vert. 23 + 95 in one specimen, in another I counted 23 + 92, Lilljeborg (l. c. p. 16) also 23 + 92 in a third.

[2] After this was written, I have been able through Dr. E. Lönnberg's kindness, to examine a well-preserved specimen in the Museum at Upsala of the Finmark *L. esmarkii* and could convince myself that the pyloric appendages were completely wanting.

Its dimensions are as follows:

Total length	192	mm.
Length of the head	39	—
Distance between snout and anus	73	—
Height over the anus	17	—

The length of the head is thus 20,3 % of the total length and falls therefore within the limits of variation occurring in the adult specimens from Finmark; thus, the measurements given by Prof. Collett, reckoned in percentages, show the length of the head as 19,2–24 % of the total length (in 10 males 22,2—24 %, in 12 females 19,2—21,9 %). Again, the head and trunk together (or distance between snout and anus) is 38 % of the total length, which figure is very close to that of the adult individuals, where (in 4 specimens) it is 38,3—42,9 %[1]).

It is the colouration however which makes one think at once of *L. esmarkii*. The ground-colour is dusky brown above, yellowish white below; the scales are whitish and show as light points against the dark background. On the brown ground-colour the body is marked by 7 whitish yellow bands which are distributed wide apart with exception of the last. The foremost of these bands extends from the gill-cover over the edge on to the middle line of the neck; the band on the one side does not reach so high up and does not therefore meet with that on the other side. The second band lies almost over the end of the pectorals; it begins at the upper margin of the dorsal fin and divides like a horse-shoe a little below the line of the back. The third band, which lies somewhat behind the anus, is similarly branched but more angularly; the fourth and fifth bands have also more or less the distinct form of a ⅄. The sixth band as also the seventh, which lies near to the sixth, just at the end of the tail, extends across the tail and out to the borders of the fins in the form of forward projecting arches. — If one compares this with Collett's figure of an adult *L. esmarkii* (l. c. Pl. III, fig. 22) one sees that the colouration of the latter is only a further development of that in the present young specimen, as the bands by much branching have assumed the form of festoons.

The pectoral fins have 22 rays, which number agrees with that of the adults from Finmark; in five of these I have counted 22—23 rays, the above mentioned specimen of 443 mm. has 23 rays[2]). The lower rays are gradually shortened so that the posterior margin of the fin is evenly rounded as in the adults. The dorsal fin has 117 rays, the anal 102, which numbers also fall within the variations found in the adult specimens from Finmark, viz. 113—118 rays for the dorsal, 97—102 for the anal, according to Collett.

The scaly covering extends forward to the light band on the neck, to the base of the pectorals and ventrals, also some way on to the unpaired fins, especially the dorsal fin, but the foremost part of the anal fin on the other hand is naked. The scales have therefore almost reached their complete distribution.

[1]) As it might be of interest to have the measurements of the specimen ca. 443 mm. mentioned above, the smallest hitherto obtained from Finmark, I give them here: distance between snout and anus 175 mm. (39,5 % of the total length), length of the head 90 mm. (20,3 % of the total length), height over the anus 54,5 mm. (12,3 % of the total length). The specimen is badly preserved and the colour has almost entirely disappeared, the internal organs have been removed so that the sex cannot be determined.

[2]) When Collett gives 20—23 rays, it must be remembered, that the lower number has arisen through including under *L. esmarkii* the specimens with smaller number of fin-rays (= *L. eudipleurostictus*) from the Norwegian North-Atlantic Expedition.

The lateral line begins above the upper notch of the gill opening; its pores to the number of some twenty can be followed as far as the middle of the posteriorly extended pectoral; from this point one can observe by good light a very weak light line bending down towards the anus and further along the lower border of the tail; this fine line represents the ventral lateral line, but pores can only be seen here and there singly and indistinct. I believe I have seen weak traces of a mediolateral lateral line in the form of a few widely separated pores. The lateral line in this young specimen is thus in the same stage of development as in the adult *L. esmarkii;* in these the lower (ventral) branch can as a rule be followed; so far as concerns the upper (mediolateral) branch, Collett declares that it is always indistinct[1]), and this I can confirm as only in one of the three adult specimens at my disposal have I found it possible to trace some single oblong pores.

Lastly, it may be added that this young specimen shows not the slightest trace of pyloric appendages, which are also wanting in the adult *L. esmarkii*, as already mentioned (p. 28).

All the characteristics displayed above lead to the conclusion that this small specimen from the open sea off Finmark is a young stage of *L. esmarkii* from the coasts of Finmark.

Appendix.

After the foregoing had been written I have had the further opportunity of examining 6 specimens of *L. esmarkii* obtained during my participation in the 1902 summer-cruise of the Michael Sars to the seas of Shetland, the Færoes and Iceland. The distribution of this species — hitherto considered somewhat local — has thus become considerably extended. Some remarks on these specimens may fittingly find a place here.

The smallest of the specimens was taken in the Færoe Channel. The total length is 188 mm., 4 mm. smaller therefore than the one referred to (p. 28—30) from the seas between Norway and Bear Island. For the rest, they agree very closely, chiefly in regard to the most important proportions, as will be seen:

		L. esmarkii juv. from	
		Mich. Sars 1902	Nathorst-Exped. 1898
Total length in mm.		188	192
Length of the head	in % of the total length	20,7	20,3
Distance between snout and anus	— —	38,3	38
Height over the anus	— —	9,6	8,9

In the new specimen there are also 7 light bands. The foremost of these (neck-band) is broken off at the middle of the back, so that it appears as a light spot on and over the edge of the gill-cover, round the origin of the lateral line. The remaining bands have quite the same situation as in the foregoing specimen; the second to the sixth have the distinct form of a ⅄, only the seventh, at the end of the tail, is unbranched. The scaly covering and the mediolateral lateral line are in essential agreement; the ventral line however is distinct, not only from the neck down to the anus,

[1]) Nyt Magaz. f. Naturvidensk. 29 Bd., 1884, p. 77. Nevertheless, the figure in the work on the fishes of the Norw. North-Atlantic Expedition (Pl. III, fig. 22) shows a clearly marked mediolateral lateral line.

but also for a considerable distance along the underside of the tail. The pectoral fin has 23 rays and is not indented at its posterior margin. Pyloric appendages are wanting.

The others are medium-sized or larger specimens, the most important measurements of which are the following:

	L. esmarkii from Mich. Sars 1902				
	♂	♂	♂	♂	♂
Total length . . in mm.	371	374	383	521	552
Length of the head . .	78,5	78,5	86	121	120
Distance between the snout and the anus —	139	142	150	208	215
Height over the anus	41	44	42	72	66

The length of the head is therefore 21—23,2 %, the distance from the snout to the anus 37,5—39,9 %, the height over the anus 10—13,8 % of the total length.

The colouration of the three medium-sized individuals (371—383 mm.) can be derived from that of the young individual referred to above. In the light vertical bands, whose number is 6—9, spots or stripes of the dark ground-colour have appeared, both on the dorsal fins and lower down (Tab. III, fig. 2 b). The light neck-band is fully developed in one of these specimens and extends from gill-cover to gill-cover, enclosing a dark stripe; in the second specimen the neck-band is restricted to one, yet of good size, light spot on each side of the neck, enclosing a dark spot; in the third there is only an ill-defined lighter part on the upper edge of the gill-cover. In the large specimens the light bands are still further resolved into festoon-shaped markings (Tab. III, fig. 2 c).

The pectoral fins have 23 rays in four specimens, 22 in the fifth; in none of them is there any indentation of the posterior edge of the fin. In two of the specimens the dorsal fin has 115 rays, the anal 97.

The scaly covering has attained its full distribution, forwards as far as the neck and base of the ventral fins, also on the unpaired fins to near their margin.

After what has been said above, the lateral line presents the somewhat unusual, as it seems, peculiarity that the mediolateral line is rather distinct in several of the specimens.

The gut is lacking in pyloric appendages; in several specimens it was quite full of skeletal remains of echinoderms (ophiuroids).

Relation of *L. esmarkii* to *L. vahlii*.

After Prof. Collett had in his later treatises withdrawn his earlier expressed opinion that *L. esmarkii* was the same species as the Greenland *L. vahlii* Reinh., Prof. F. A. Smitt and Dr. Einar Lönnberg again took up the matter and declared themselves unable to separate the two forms from one another. This is not remarkable in itself, since neither of these authors have had specimens of *L. vahlii* at their disposal; their acquaintance with this fish was restricted to what they could read of it in Lütken and Collett. And their doubts concerning the independence of the two forms, might be justified even more as some of the distinctions put forward by Collett are not constant.

There is not the difference with regard to the length of the head, which Collett has mentioned, namely that the head in *L. esmarkii* is on the whole somewhat longer than in *L. vahlii*. Lönnberg

considers that his specimen (which I have examined in detail p. 28—30) «fills up the gap between the two forms» in this regard. Lönnberg might even have concluded this from the large series of measurements of *L. esmarkii*, which Collett published in 1884. Putting these into percentages, they show that the length of the head in *L. esmarkii* varies from 19,2—24 % of the total length; as the relation in *L. vahlii* according to numerous measurements by myself, is 18,8—23,8 %, no specific difference consequently can be founded on this. Nor does the second important proportion give any basis for a distinction; the distance between the snout and the anus for example is in *L. esmarkii* 38—42,9 %, in *L. vahlii* 36,5—42,3 %[1]).

When Collett further asserts that the shortness of the row of teeth on the palatal bones distinguishes *L. esmarkii* from *L. vahlii*, where this row is as a rule longer than that on the intermaxillary, seldom if ever shorter, he has allowed himself to be misled by Lütken's erroneous observations; as we have seen (p. 18 & p. 20) the palatal row of teeth in the adult males of *L. vahlii* is always shorter than that on the intermaxillary. This character on whose uncertainty Prof. Smitt has already remarked, must therefore also fall to the ground.

Lastly, Lönnberg remarks that little reliance can be placed on the character, that *L. vahlii* has only one, *L. esmarkii* two lateral lines, since Collett has seen traces of a mediolateral lateral line in one of the type-specimens of *L. vahlii*, and conversely the mediolateral line in *L. esmarkii* is often defaced. This must however be corrected, as *L. vahlii* never occurs with a mediolateral lateral line; this specimen, on which Collett has based his statement and which is in reality one of Reinhardt's type-specimens, is in no way *L. vahlii* but belongs to the following species which is provided with two lateral lines (see more in detail p. 36).

If now, one wishes to settle the independence of *L. esmarkii* — just as it has been done above, by consideration of the identical and exclusion of the unrelated elements — as against *L. vahlii*, one must first and foremost lay stress on the following characters: (1) want of pyloric appendages; (2) the larger number of rays in the pectorals; (3) the characteristic colouration; (4) the double (ventral and mediolateral) lateral line.

They differ from one another also in biological relations; *L. esmarkii* lives on the whole at greater depths than *L. vahlii*, and feeds chiefly on echinoderms whilst *L. vahlii* feeds on crustacea and Mollusca.

Distribution.

According to Collett, *L. esmarkii* must be considered a stationary and scarcely a rare fish on the coasts of Finmark; almost all the specimens examined hitherto have been caught in the Varanger Fjord on lines, and at the depth of 150—200 fathoms. Between Norway and Bear Island (73° 3′ N.L. 18° 30′ E.L.), where the depth was 410 m. and bottom-temperature + 2° C. the Nathorst Expedition caught the young specimen (192 mm.) referred to in detail above (p. 28) on the 4th of September 1898.

It was taken by the Norwegian Fisheries steamer Michael Sars in the summer of 1902 at the following places: Slope between Norway and Shetland (62° 30′ N.L. 1° 56′ E.L.), depth

[1]) The apparently smaller variation in *L. esmarkii* arises from the fact that the numbers are based on measurements of only 5 specimens and of these but one only was a young individual. (Appendix: in one of the specimens obtained later [«Michael Sars» 1902] the distance between the snout and the anus amounts to only 37,5 % of the total length).

275 fathoms, bottom-temperature + 4°88 C., 2 specimens (371—374 mm); Channel between Shetland and the Færoes (60° 19′ N.L. 5° 39′ W.L.), depth 620 fathoms, bottom-temperature — 0°15 C., 1 young specimen (188 mm.)[1]); east from the Færoes (62° 26′ N.L. 4° 49′ W.L.), depth 228 fathoms, 1 specimen (552 mm.)[2]); between the Færoes and Iceland (62° 59′ N.L. 10° 37′ W.L.), depth 251 fathoms, bottom-temperature — 3° 24 C., 1 specimen (521 mm.); east from Iceland (64° 58′ N.L. 11° 12′ W.L.), depth 300 fathoms, bottom-temperature — 0°38 C., 1 specimen (383 mm.).

Judging from these captures, *L. esmarkii*, which was hitherto considered as a species occurring locally at Finmark, has probably a continuous distribution over the deeper parts of the coastal plateau of the Northern Ocean and its shelving sides (slopes), from Bear Island and Finmark down to Stat, thence towards Shetland and the east banks of the Færoes, north of the Færoes and along the broad ridge from the Færoe Isles to the Iceland plateau. Exceptionally, it may venture over the sloping banks of the ocean down into the polar depths.

Again, it occurs on the east coast of North America, as Collett has identified 4 fully grown specimens from off the coast of Nova Scotia[3]).

Lycodes eudipleurostictus Jensen.

Tab. III, Fig. 1 a, b.

1878. *Lycodes vahlii* Collett, Fiske indsamlede under den norske Nordhavs-Expeditions 2 forste Togter, 1876 og 1877; Forh. Vidensk. Selsk. Chria. 1878, No. 4, p. 11 (partim).

1878. *L. vahlii* Collett, Fiske fra Nordhavs-Expeditionens sidste Togt, Sommeren 1878; Forh. Vidensk. Selsk. Chria. 1878, No. 14, p. 54 (partim).

1879. *L. vahlii* Collett, Meddelelser om Norges Fiske i Aarene 1875—78; Forh. Vidensk. Selsk. Chria. 1879, No. 1, p. 62 (partim).

1880. *L. esmarkii* Collett, The Norw. North-Atlantic Expedition, Fishes, p. 84 (partim), Pl. II, Fig. 19—21.

1891. *L. esmarkii* Lilljeborg, Sveriges och Norges Fiskar, II, p. 6 (partim).

1895. *L. vahlii* Smitt, Skandinaviens Fiskar, II, p. 613 (partim).

1898. *L. Esmarkii* Lütken, The Danish Ingolf Expedition, II, 1, p. 21.

1901. *L. esmarki* Knipowitsch, Ann. Musée zool. l'Acad. Imp. St. Pétersbourg, T. VI, p. 21.

1901. *L. Vahlii* forma *pallida* Smitt, Bih. K. Sv. Vet.-Akad. Handl. Bd. 27, Afd. IV, No. 4, p. 24 (partim), No. 13.

1901. *L. Vahlii typica* Smitt, ibid. p. 26 (partim), No. 40, 41 & 42.

1901. *L. eudipleurostictus* Jensen, Vidensk. Medd. Naturh. Foren. Kbhvn. p. 206.

The height over the anus amounts to 8,1—13,6 %, the length of the head to 19,8—24,3 % of the total length. The tail is distinctly longer than the head and trunk together, as the distance between the snout and the anus is 36,7—41,4 % of the total length. The posterior margin of the pectoral is indented. Colouration

[1]) Günther (Chall. Exped. Deep-Sea Fishes, 1887, p. 77) also refers 2 specimens from the Færoe Channel, 608 fathoms, to this species, but they perhaps belong to *L. eudipleurostictus* mihi which has been confused with *L. esmarkii*.

[2]) This specimen was taken on a line, the other specimens in the English trawl.

[3]) Goode and Bean refer also to this species a number of specimens, taken at 39° 43′—42° 43′ N.L. and 62° 20′—71° 42′ W.L., 224—420 fathoms (Oceanic Ichthyology, 1895, p. 303), but one cannot tell if the determination is correct.

brown with a light spot on each side of the neck (sometimes a light stripe across over the neck), and with 5—8 as a rule narrow whitish yellow cross-bands over the trunk and tail (sometimes partly assuming a ring-form). The scales cover the whole of the body to in front of the dorsal fin and to the ventrals, and extend out on to the unpaired fins. The lateral line is double, divided just behind the root of the pectoral into a mediolateral and a ventral branch, both distinct. Pyloric appendages 2. Size reaches to 325 mm.

D. 100—103. A. 88—92. P. 20—22 (23). Vert. 106 (20 + 86).

Distribution. Northerly West- and East-Greenland, ca. 150—400 fathoms; Spitzbergen, 260—460 fathoms; west from Lofotens in Norway, 350 fathoms; off Norway-Shetland Slope, 360—420 fathoms; north from the Færoes, 470 fathoms; east from Iceland, 300—340 fathoms.

I have been obliged to found this new species for the 4 specimens brought home by the Norwegian North-Atlantic Expedition from Spitzbergen and from the seas off Lofoten, which Prof. Collett after some reflection, considered were young specimens of *L. esmarkii* of Finmark, also for a similar specimen (260 mm. long) taken by the Ingolf Expedition north-west from the Færoes (figured in fig. 1 a of Tab. III). In addition, there is a further specimen from Umanak in West Greenland, referred formerly by Reinhardt sen. to the *L. vahlii* founded by him. Lastly, I have been able to examine 4 specimens in the Stockholm Riks-Museum, taken in Franz Joseph's Fjord (northerly East Greenland) by the Nathorst and Kolthoff Expeditions, and considered by Prof. F. A. Smitt as «forms of *L. vahlii*[1]).

As I shall now proceed to confirm the necessity of the resolved upon separation from *L. esmarkii*, I may first of all set down the proportions of the 9 specimens.[2])

	Franz Josephs Fjord	Off Lofoten	Spitzbergen	Franz Josephs Fjord ♀	Franz Josephs Fjord ♂	N.W. f. Færoes ♀	Spitzbergen ♂	Spitzbergen ♀	Franz Josephs Fjord ♂
Total length in mm.	68	81	114	165	227	260	265	295	320
Length of the head —	16,5	18,5	25	39	54	57	60	65	75
Distance from snout to anus —	27	31,5	45	66	94	102	105	116 3)	126
Height over the anus —	5,5	7	12	17	26	31,5	32	40	35

The form of the body is on the whole not unlike that of *L. esmarkii*, and the most important proportions are somewhat similar; thus, the length of the head amounts to 21,9—24,3 %, the distance between the snout and the anus to 38,9—41,4 % of the total length.

The fins on the other hand show in several ways, tolerably great differences from those of the foregoing species. Whilst the pectorals in *L. esmarkii* have 22—23 rays, the number in the present species is mostly 21, more rarely 22, only in a single specimen and in one of its pectoral fins is the

[1]) My original diagnosis (l. c.) has been changed somewhat out of regard for these 4 specimens (likewise also for the still later obtained 17 specimens of the «Michael Sars» Expeditions of 1900 and 1902 [cf. p. 36]).

[2]) The West Greenland specimen is in a tolerably bad condition and will therefore be described by itself (p. 36).

[3]) Collett has 160, which must be a misprint.

number 23. Again, the pectoral fins in *L. eudipleurostictus* are remarkable in that the lower rays are somewhat prolonged and project distinctly forward beyond the middle rays; the posterior border of the fin thus displays a distinct indentation. Collett even has remarked upon this peculiarity in his young specimens of *L. esmarkii*, but he imagines that the fin changes during development — a condition, Collett admits however, he has never seen, nor anything similar, in other species. We have just seen (p. 29 and p. 31) that the real young stage of *L. esmarkii* shows no such incision of the pectoral — so that this may be considered as one of the characteristic features of *L. eudipleurostictus*[1]).

Again, the vertical fins have distinctly fewer fin-rays. In the *L. esmarkii* from Finmark, according to Collett, the dorsal fin has 113—118 rays, the anal 97—102; in the specimens from the Norw. North-Atlantic Expedition on the other hand, the dorsal fin has only 102—103 rays (from the Ingolf Expedition, 100), and anal fin 88—92 rays (from the Ingolf Expedition, 90). Collett explains the larger number of fin-rays in the large specimens from Finmark by assuming that vertebræ might continue to be laid down along with the rays belonging to them during the whole development, but I hardly think that Prof. Collett retains this opinion.

Scales. Concerning the two largest specimens (265 and 295 mm.) from the Norw. North-Atlantic Expedition, Collett has declared that the scaly covering extends forward in front of the beginning of the dorsal fin, and on the belly to the ventrals; the dorsal and anal fins are likewise covered with scales nearly to their margins. The 260 mm. long specimen from the Ingolf Expedition is quite similar. In the two young specimens from the Norwegian North-Atlantic Expedition the scaled integument is for the most part fully developed on the body; in the largest individual (114 mm. total length) both the fins and the skin along their base are still naked; in the smallest (81 mm. total length) the scales on the tail are just beginning to develop. With regard to the three larger specimens (165—320 mm) in the Stockholm Museum, I have noted that the scales reach forward to the head and out on to the unpaired fins; the 68 mm. long individual was still naked on the posterior half of the tail, whereas the remaining part of the tail as well as the trunk to a little behind the base of the pectoral shows indications of scales.

The lateral line in *L. eudipleurostictus* is very distinctly double (I have founded the name of the species on this characteristic). It arises singly at the upper end of the gill-openings, forms a slight arch over the free edge of the gill-cover, then divides a little posterior to this into two branches, the upper of which, the mediolateral, is the most distinct and courses along the middle line of the whole body right to the caudal fin; the lower branch, the ventral, courses slantwise downwards towards the anal fin, then runs along the edge of this fin towards the caudal fin. Such is the case in the medium-sized and largest specimens. In the 81 mm. long specimen both lines are still indistinct, but they are already apparent in the one 114 mm. long. — In *L. esmarkii* the mediolateral line is often more or less indistinct.

The colouration of *L. eudipleurostictus* is rather different from that of the foregoing species and can hardly be thought to give rise to that in *L. esmarkii*, as Collett believed. The ground-

[1]) Smitt (l. c. 1901) states that the pectoral is incised in more of the Nathorst-Kolthoff Expeditions' Lycodes than the four I have here referred to *L. eudipleurostictus*, but after a personal inspection of the specimens in question I have not been able to confirm this statement. In *L. frigidus* on the other hand, the posterior margin of the pectoral is often weakly incised.

colour is brown, more or less dark, with narrow whitish yellow cross-bands whose number varies from 5—8. Further, as sign of a neck-band, there is a more or less distinct whitish yellow spot immediately over the upper end of the gill-opening, sometimes lower down on the edge of the gill-cover; concerning one of the specimens from East Greenland I have indeed noted: the neck light across over. What especially distinguishes *L. eudipleurostictus* from the foregoing species in the colouration, is that the vertical bands show no signs of resolving themselves into the characteristic festooned markings of the adult *L. esmarkii*.

When we add to this that the gut immediately behind the stomach is provided with 2 small appendages, whilst the *L. esmarkii* of Finmark is wanting in any trace of such, we have the most important differences between the present and foregoing species.

The Greenland specimen yet remains to be briefly mentioned. It was sent from Umanak in 1834 and mentioned by Reinhardt sen. amongst the 7 Lycodes which served for the preparation of his detailed treatise on *L. vahlii*[1]); its preservation however was not good, and R. when preparing his description, seems to have made no further use of it, otherwise its distinctness from *L. vahlii* might have been apparent to him. Nor did Lütken find anything remarkable in it. Prof. Collett however, on a visit to our Museum, discovered that this specimen showed signs of a mediolateral in addition to the ventral lateral line usual to *L. vahlii*[2]). This fact was for me still more striking: the two lateral lines are especially distinct, just as distinct as in the other specimens of *L. eudipleurostictus* at my disposal. Further, the number of rays in the pectorals agrees with this species and amounts to 21, a number that is never reached in *L. vahlii*. Where the colour is preserved, it is in agreement with the present species. Its length is ca. 275 mm.

I do not hesitate therefore to separate this specimen from *L. vahlii* and place it with *L. eudipleurostictus*.

Appendix.

After completing my MSS. on *L. eudipleurostictus* I have had the opportunity of studying a series of specimens, caught during my participation in the 1902 summer cruise of the Norwegian steamer Michael Sars . These specimens should be briefly described here as they lead to a few changes in the diagnosis.

The most important measurements of these 16 specimens, likewise of a 17th taken during the 1900 cruise of the Michael Sars , are as follows:

		♂	♂	♀	♂	♂	♂	♂	♂	♀	♂	♀	♂	♀	♂	♂
Total length	in mm.	75	152	203	205	206	209	223	232	253	277	285	293	302	307	315	323	325
Length of the head	—	16	34	43	44	46,5	45	50,5	52	56	59,5	62	69	64,5	65	62,5	72,5	73
Distance from snout to anus	—	28	57,5	74,5	82	82	82,5	87	86	100	104	113	119	123	119	127	124	121
Height over the anus	—	6,25	17	24	21	22,5	24	24	26	29	35,5	31,5	39	37	37	40,5	40,5	41

Put into percentages of the total length therefore, the length of the head in the males is 21,2—23,6 %, in the females and young specimens 19,8—22,6 %; distance between the snout and the anus 36,7—40,7 %; the height over the anus 8,9—13,3 %.

[1]) K. D. Vidensk. Selsk. Skr. VII, 1838, p. 165.

[2]) The Norwegian North-Atlantic Expedition, Fishes, 1880, p. 86.

The number of rays in the pectoral fin varies from 20—22; there are 20 rays in 6 specimens, 21 in 8, 22 in 2; in all, the posterior edge of the fin is distinctly indented. In one of the largest specimens I have counted 103 rays in the dorsal fin, 88 rays in the anal and 106 vertebræ in all (20 in the trunk, 86 in the tail); the number of the vertebræ is thus less than in *L. esmarkii* (23 + 92—95) and has to be reckoned amongst the distinguishing characters from that species.

In the smallest specimen (total length, 75 mm.) figured in fig. 1 b on Tab. III, the hindmost portion of the tail is naked, whereas scales have begun to appear on the anterior part of the tail as well as on the trunk. In all the remaining specimens the scaly covering extends from the end of the tail to the head. The scales extend more or less out on to the unpaired fins, least on the anterior part of the dorsal and anal.

The lateral line is distinct (except in the young specimen), both the mediolateral and the ventral branch.

The colour is dark brown, with 5—7 whitish yellow, as a rule very narrow cross-bands; sometimes indeed single light bands show transition stages to a ring-form, or (only in a single individual) they may be relatively broad, and the dark ground-colour between them appears light in the middle, so that we obtain a colouration recalling somewhat that in *L. rossi;* there is one specimen also where one or other of the vertical stripes shows signs of bifurcation below. The upper part of gill-covers have a light border; sometimes the light colour extends a little also on to the neck above, over the gill-openings.

All the specimens have two small appendages behind the pylorus.

Two of the females have large eggs in the ovary. In the one, 315 mm. long, caught on the 19th of July, the diameter of the eggs is 4—4,5 mm., and their number ca. 250 (apart from many very small eggs in the ovary); in the other, 302 mm. long, taken on the 25th of August, the diameter of the eggs is 5 mm.

If we now, with this extended knowledge of *L. eudipleurostictus*, wish to sum up the characters in which this species differs from *L. esmarkii*, these would be chiefly:

(1) the indentation in the posterior margin of the pectoral fin,

(2) the smaller number of rays in the dorsal and anal fins,

(3) the smaller number of vertebræ,

(4) presence of two small pyloric appendages,

and in the second place:

the always distinct, double lateral line,

the (as a rule) simple banded markings.

In biological regards also the two forms are markedly different: *L. eudipleurostictus* is pre-eminently a cold water, *L. esmarkii* on the other hand mainly a warm water form; *L. esmarkii* lives almost exclusively on echinoderms (especially ophiuroids), *L. eudipleurostictus* on worms and crustacea. Nor does *L. eudipleurostictus* become nearly so large as *L. esmarkii*.

Distribution.

In Europe, *L. eudipleurostictus* has been caught at several places in the «cold area», and extends from thence over to the east coast of Greenland and probably north of that land, as well as a stretch along the west coast, as a specimen has been taken there at Umanak (70° 40′ N.L.). At East Greenland it has been taken in Franz Josephs Fjord, e. g. 2 specimens at 760 meters by the Nathorst Expedition of 1899, and 2 specimens at 200—300 meters by the Kolthoff Expedition of 1900. At Spitzbergen, the Norwegian North-Atlantic Expedition took 3 specimens at depths of 459 and 260 fathoms, bottom-temperature — 1° C. and + 1°1 C.[1]); a Russian Expedition in 1899, one specimen, where the depth was 497 meters and bottom-temperature — 0°9 C.[2]). The Norwegian North-Atlantic Expedition took one specimen off Helgeland in Norway where the depth was 350 fathoms, and bottom-temperature — 0°9 C. Again, the Ingolf Expedition caught a specimen N.W. from the Færoes (St. 138) where the depth was 471 fathoms and bottom-temperature — 0°6 C. Lastly, the steamer Michael Sars obtained it at the following places in 1902: off the Norway-Shetland Slope (62° 43′ N.L. 1° 26′ E.L.), depth 420 fathoms, bottom-temperature under 0° C. (2 specimens) and (62° 40′ N.L. 1° 56′ E.L.), depth 360 fathoms, bottom-temperature — 0°3 C. (2 specimens); east from Iceland (64° 58′ N.L. 11° 12′ W.L.), depth 300 fathoms, bottom-temperature — 0°38 C. (12 specimens); and in 1900: east from Iceland, depth 340 fathoms, bottom-temperature — 0°69 C. (1 specimen).

Lycodes pallidus Collett.

Tab. IV, Fig. 1 a, b, c, d, e.

1878. *Lycodes pallidus* Collett, Fiske fra Nordhavs-Expeditionens sidste Togt, Sommeren 1878; Forh. Vidensk. Selsk. Chria. 1878, Nr. 14, p. 70.

1880. *L. pallidus* Collett, The Norwegian North-Atlantic Expedition, Fishes, p. 110, Pl. III, Fig. 26—27.

1886. *L. pallidus* Lütken, Dijmphna-Togtets zoologisk-botaniske Udbytte, p. 134, Tab. XVII, Fig. 1—3.

1898. *L. pallidus* Lütken, The Danish Ingolf-Expedition, II, 1, p. 22 (partim).

1901. *L. pallidus* Knipowitsch, Zool. Ergebn. d. Russ. Exped. nach Spitzbergen, Fische; Ann. Musée Zool. de l'Acad. Imp. d. Sci., St. Pétersbourg, T. VI, 1901, p. 23.

1901. *L. vahlii* forma *pallida* Smitt, Bihang. K. Sv. Vet.-Akad. Handl. Bd. 27, Afd. IV, No. 4, p. 24 (partim), No. 12 & 14—26.

1901. *L. vahlii* forma *typica* Smitt, ibid. p. 26 (partim), No. 30—39.

1901. *L. reticulatus* forma *frigida* Smitt, ibid. p. 29 (partim), No. 2—9.

In proportions of the total length the height over the anus is 8[3])—10,6 %, the length of the head 20,7—25,3 % (in females 20,9—23,8 %, in males 22—25,3 %), the distance between the snout and the anus 38—44,7 %, the longitudinal diameter of the eye 3,1—4,5 %. The young and smaller individuals are coloured on the back and

[1]) The station lies however just on the boundaries of the «cold area».

[2]) From the report, which Prof. N. Knipowitsch has given (l. c.) of this but 87,5 mm. long specimen, it is clearly seen that it belongs to the same species as Collett's «*L. esmarkii* juv.», or — in other words — that it is a *L. eudipleurostictus*.

[3]) In weakly young specimens sometimes sinking to 7,3 %.

sides with dark cross-bands which become indistinct in the older; they remain longest as dark patches on the dorsal fin but may also disappear from there, so that the colour in the end becomes uniformly brownish, as a rule however, darkened on the belly and posterior border of the gill-covers; the anal fin dark posteriorly (or with several dark patches); sometimes a light spot over the gill-cover or a light stripe across the neck. In older specimens the scales extend from the end of the tail almost to the root of the pectorals, but the anterior part of the back and a large portion of the belly are naked; as a rule there are no scales on the unpaired fins. The lateral line double, ventral and mediolateral, but in general only distinct in its course down towards the anus. Pyloric appendages 2. The size reaches 207 mm.

D. 97—101. A. 84—86. P. (17) 18—20(21).

Distribution. Kara Sea, 46—106 fathoms; Spitzbergen, 60—459 fathoms; north-eastern Greenland, (61/2) 18—400 fathoms; north from Iceland, 293—495 fathoms; north from the Færoes, 471 fathoms; off the Shetland-Norway Slope, 420 fathoms.

var. **similis** m.

Tab. V, Fig. 2 a, b, c, d & Tab. VI, Fig. 3 a, b, c, d.

1898. *Lycodes pallidus* Lütken, The Danish Ingolf-Expedition, II, 1, p. 22 (partim).

1898. *L. Lütkenii* Lütken, ibid. p. 21 (partim).

1901. *L. similis* Jensen, Vidensk. Medd. Naturh. Foren. Kbhvn., p. 205.

In proportions of the total length the height over the anus is 10—12,4 %, the length of the head 23—25,9 % (in females 23—24 %, in males 24,8—25,9 %), distance between the snout and the anus 41,4—44 %, longitudinal diameter of the eye 4,7—5,6 %. The colour is yellowish or brownish, in some individuals with indistinct dark cross-bands, in others distinct cross-bands, dark-brown with lighter colour in the middle, and with a light stripe across the neck. In the adults the scales cover the tail and the trunk as far as the neighbourhood of the base of the pectorals, but the anterior part of the back, a stripe under the foremost part of the dorsal fin and the greatest portion of the belly (in front of the anus) are naked; no scales on the unpaired fins. The lateral line is double, ventral and mediolateral, but usually only distinct in its course down towards the anus. Pyloric appendages 2. The size reaches to 175 mm.

D. 94—96. A. 81—82. P. 19—20(21).

Distribution. South from Jan Mayen, 371 fathoms.

var. **squamiventer** m.

Tab. IV, Fig. 2 a, b.

1898. *L. pallidus* Lütken, The Danish Ingolf-Expedition, II, 1, p. 22 (partim).

In proportions of the total length, the height over the anus is 9,4—10,8 %, the length of the head 19,6—22,4 %, the distance between the snout and the anus 37,9—

41,1 %, the longitudinal diameter of the eye 3—4,4 %. The colour is uniform, brown or grayish, without bands or spots[1]); the belly and posterior border of the gill-cover darkish. The scales are small, relatively smaller than in the two foregoing forms and have a somewhat wider distribution, as they extend from the end of the tail not only to near the base of the pectorals, but also to the neck (sometimes however, a bare strip occurs in the middle line of the back in front of the dorsal fin), as well as on the underside of the belly, which is scaled a considerable portion in front of the anus, often just to the tip or even to the root of the ventral fins; in medium-sized and adult individuals the scales spread out also on to the unpaired fins. The lateral line is double, ventral and mediolateral, most distinct in its course down towards the anus. Pyloric appendages 2. The size reaches to 260 mm.

D. 96—97. A. 81—82. P. 18—20.

Distribution. East from Iceland, 537—957 fathoms; north from the Færoes, 679 fathoms; off the Shetland-Norway Slope, 650 fathoms.

Remarks on the Synonymy.

L. pallidus was formed by R. Collett for two small Lycodes, taken by the Norwegian North-Atlantic Expedition in 1878, north-west from Spitzbergen at 260—459 fathoms depth. In 1881—82 the species was again taken in the Kara Sea by the Dijmphna Expedition, according to Lütken, who described 11 specimens from there and figured some of them. Later, the same author mentions a number of specimens, taken by the Ingolf Expedition of 1896 at 8 stations in the cold water between the Færoes, Iceland and Jan Mayen. Lastly, N. Knipowitsch has recently described a specimen, taken by a Russian expedition to Spitzbergen.

The species seems thus to have gradually gained recognition. In his latest treatise (on *L. gracilis*) Prof. Collett has meanwhile come to doubt how far *L. pallidus* (and its probable young stage *L. rossi*) is a good species, or if it possibly is synonymous with *L. gracilis* M. Sars.

The results my investigations have led to, are as follows: *L. pallidus* Collett is an independent species, which does not show any near relation to *L. rossi* or to *L. gracilis* (= *L. vahlii*). *L. pallidus* Lütken from the Kara Sea is identical with Collett's species, and the same holds for *L. pallidus* Knipowitsch. *L. pallidus* Lütken from the Ingolf Expedition belongs likewise to the same species, but in certain regards displays a tolerably great amount of variation, and for some of the specimens I have been led to form two separate varieties: *similis* (cf. p. 46) and *squamiventer* (p. 48).

After these preliminary remarks had been written down, I have had the opportunity to examine an additional and considerable number of specimens, especially from the Polar Depths and from the north-eastern Greenland; regard has also been taken for these in my diagnosis, and they are deserving of special mention.

Lycodes pallidus from the Ingolf Expedition.

Tab. IV, fig. 1 a, b, c, d, e.

There are 11 specimens in all from the seas north of the Færoes (St. 138) and Iceland (St. 124, 126); the depths varied from 293—495 fathoms.

I give below the most important measurements of these specimens:

		St. 126	St. 126	St. 126	St. 138	St. 124	St. 124	St. 138	St. 138	St. 124	St. 138 ♂	St. 124 ♀
Total length	in mm.	53	53,5	85	104	115	130	133	135	140	158	183
Length of the head	—	12,5	13	19	23	26	29	32	30	32	40	41
Distance from snout to anus	—	21,5	22	35	41	45	53	54	56	58	66	75
Height over the anus	—	4,5	4,5	8	9,5	10,5	13	14	13	13	16	17,5

[1]) Quite young individuals are certainly not known, but such is the condition in all the specimens to hand whose total length is down to 117,5 mm.

The body is thus moderately elongated (zoarciform), as the height over the anus amounts to 9,1—10,5 % of the total length. From the neck to the anus it is almost of even height, thereafter the height gradually lessens towards the pointed end of the tail. The tail is compressed, likewise the trunk, as the thickness here is still somewhat less than the height; the greatest thickness lies forward on the cheeks and is somewhat greater than the height over the anus. The head and trunk together are a good deal shorter than the tail, as the distance between the snout and the anus amounts to 39,1—41,2 % of the total length.

The length of the head is 22,1—25,3 % of the total length. It is tolerably elongated, as the height over the neck is contained twice or somewhat more in the length; it is also compressed downwards, flatly arched above, curved outwards at the sides and tolerably flat below. Seen from the side, the over margin forms a slight curve to the fore end of the snout, whose smooth point extends more or less forward in front of the intermaxillary; this again is in front of the mandible, so that the mouth lies on the under surface of the head. The eyes are tolerably small, their longitudinal diameter (in individuals over 100 mm. length) amounting to 4—4,4 % of the total length. Seen from the side, the upper border of the eye curves up over the margin of the brow; seen from above, there is a space between the two eyes which is almost equal to the vertical diameter of the eye; they are for the rest, oval, longer than high. On the cranium, the breadth of the forehead between the eyes amounts to only ca. $^1/_{20}$ of the length of the head. The snout is tolerably long, its length reckoned to the anterior border of the eye, being ca. 7—8,5 % of the total length; the males seem to have the longest snout; in the 158 mm. long male the length of the snout is 8,5 % of the total length, in the 183 mm. long female only 6,8 %. The shallow pits along the borders of the jaws are specially distinct in well-preserved specimens. The nostrils are in the form of tubes as usual. The teeth are short, conical, truncated, but tolerably strong, inserted on the intermaxillary (double row in front, single behind), on the palatals, vomer and mandible (in several rows in front).

The dorsal fin, whose distance from the snout is 29,5—31 % of the total length, contains ca. 97—100 rays[1]), the anal ca. 84[2]); in both cases half the caudal fin is as usual included. The pectorals have (18) 19—20 (21) rays[3]). The ventral fins are relatively smaller than in other species.

The scales are laid down early. In the two smallest specimens (total length 53—53,5 mm.) the scales are already in process of development on the foremost part of the body (see Tab. IV, fig. 1 a), and in the 85 mm. long specimen (Tab. IV, fig. 1 b) they cover the anterior part of the tail, also the trunk as far as the beginning of the dorsal fin, though the anterior portion of the back and the whole of the belly are naked. The 104 mm. long specimen (Tab. IV, fig. 1 c) is already almost entirely covered with scales, from near the tip of the tail forward as far as the dorsal fin extends; the anterior part of the back is however naked, as also a small portion under the base of the foremost part of the dorsal fin and the belly, or speaking more accurately, that part of the trunk which lies under the branch of the lateral line descending towards the anus. In the 115 mm. long specimen, there is a slightly larger naked part posteriorly on the tail, but the scaly covering has the same distribution

1) According to Collett 98—101.
2) — - — 84—86.
3) — - — 18—19.

in front, likewise in the 130 mm. long specimen, though here the end of the tail is scaled. In the 133 mm. long specimen, there are one to two rows of scales under the descending part of the lateral line, and the scales extend a little further forward towards the head; the neck (in front of the dorsal fin) is still however naked. The scales have a similar distribution in the specimens of 135, 140 and 158 mm. length, but there are respectively 3 to 4, 2 to 3, and 2 to 3 rows of scales under the branch of the lateral line descending towards the anus; the largest of the specimens (Tab. IV, fig. 1 d) has still a naked strip under the foremost part of the root of the dorsal fin. Lastly, in the specimen of 183 mm. (Tab. IV, fig. 1 e) the scaly covering extends from the tip of the tail to tolerably near the base of the pectorals, and there are ca. 6 rows of scales under the descending portion of the lateral line, but the belly itself is still naked, as also the back in front of the dorsal fin; in one respect this specimen differs from all the foregoing, namely, that the scales extend out on to the base of the dorsal and anal fins.

The lateral line begins over the upper end of the gill-opening, forms a slight arch over the edge of the gill-cover and bends thereafter down towards the anus; from there it can be followed — though often with difficulty and only under the lens — a shorter or longer distance along the tail, in the neighbourhood of the edge of the body. Most often there are also more or less distinct traces of a mediolateral lateral line, especially on the tail. The descending part of the lateral line is developed early and is seen already on the 53 mm. long young.

Colour. The two smallest (53—53,5 mm.) show 9 dark cross-bands, which are very sharply marked on the dorsal fin, but lower down on the body become quite feeble; between these darker cross-bands the yellowish ground-colour of the body shows itself as light cross stripes; the anal fin is dark-coloured posteriorly, almost black (Tab. IV, fig. 1 a). During development the dark cross-bands become more and more indistinct; they persist longest on the dorsal fin as dark patches, especially on the hindmost part. There is also some individual variation. In one specimen of 85 mm. (Tab. IV, fig. 1 b) the bands are already tolerably faint on the dorsal fin and hardly to be distinguished on the body; in one 104 mm. long (Tab. IV, fig. 1 c) on the other hand, they are still rather distinct right across. The following remarks on the remaining specimens will be sufficient: total length 115 mm.: 10 distinct dark markings on the dorsal fin, faint shadows on the body under them, anal fin dark posteriorly; total length 130 mm.: traces of dark markings on the dorsal fin posteriorly, anal fin dark posteriorly; total length 133 mm.: 9 dark markings on the dorsal fin, two such on the posterior part of the anal fin; total length 135 mm.: faint traces of dark markings on the dorsal, under them indistinct shadows on the body, anal fin darkened posteriorly; total length 140 mm.: two very faint shadings posteriorly on the dorsal fin, anal a little darkened quite at the posterior end; total length 158 mm.: 12 indistinct dark markings on the dorsal fin, here and there traces also of faint shadows under them on the body (Tab. IV, fig. 1 d). Finally, the 183 mm. specimen is uniformly coloured, brown, with the scales showing somewhat lighter than the ground-colour (Tab. IV, fig. 1 e). The belly in consequence of the dark peritoneum, has commonly a more or less darkened appearance; also, the posterior margin of the gill-covers and the skin over the branchiostegal rays, sometimes also the pectoral fins, are darkened.

Sexual organs. Only in one of the individuals to hand are the eggs so large that they can be recognised with the naked eye, namely in the one of 183 mm.; the sack-formed ovary is 14 mm. long and contains a somewhat small number of eggs, whose diameter does not exceed 1,5 mm.; the date of capture was the 28th of July.

Lycodes pallidus from the Kara Sea.

From the Kara Sea 11 specimens, 85—160 mm. long, have been obtained and are mentioned by Lütken (l. c.). Calculated from my measurements, the height over the anus is 8,4—8,7 %, the length of the head 22,6—24,6 %, the distance between the snout and the anus 41,4—43,1 %, the longitudinal diameter of the eye 3,3—4,1 % of the total length. Compared with the specimens from the Ingolf Expedition, *L. pallidus* from the Kara Sea has therefore a somewhat more slender body and the tail is relatively a little shorter. The pectoral fins have throughout fewer rays, their number being 18 or 19, seldom 17. The head, anterior part of the back and the belly are always naked. The smaller specimens have distinct dark cross-bands on the body and unpaired fins, in the older these become less clear on the body, and the largest (160 mm.) is almost without markings. Lütken mentions only one lateral line, viz. the ventral, but faint traces of a mediolateral branch can be detected in several specimens.

Lycodes pallidus from Spitzbergen.

The two type-specimens of the species, 93 and 164 mm. long, were taken at Spitzbergen at 260 and 459 fathoms. In these, the length of the head is 22,6 %, the distance between the snout and the anus 39—39,8 %, the height over the anus 8,5—9,1 %, the longitudinal diameter of the eye 4,3 % of the total length. The pectorals contain 18—19 rays. Scales cover the body as far as the region of the pectoral fins, but the head, neck, middle of the belly and the fins are naked; in the smallest specimen the scales extend farthest forward, namely, immediately to the base of the pectorals, and only a small strip along the middle of the belly is naked; in the largest individual on the other hand, a larger part of the belly is naked (cf. Pl. III, fig. 26 and 27 in Collett, l. c. 1880). The colour is gray-brown, with 5—7 dark markings on the dorsal fin and an almost indistinguishable shading on the body under each of them; a dark patch likewise on the anal fin towards the end. Of the lateral line Collett has only seen the ventral branch. — For the rest, see the detailed and careful description of Collett.

Again, N. Knipowitsch (l. c.) has described a specimen, 188,5 mm. long, taken in Stor Fjord at 60 fathoms depth. In it, the length of the head is 25,2 %, the distance between the snout and the anus 42,4 %, the height over the anus 9 %, the longitudinal diameter of the eye 3,5 % of the total length. The pectorals contain 18 rays. The scaly covering extends to a little in front of the commencement of the dorsal fin, the belly is naked. The colour is brown-gray, with indistinct traces of darker cross-bands. The ventral lateral line is distinct, traces of a mediolateral branch are also to be seen.

Of specimens from Spitzbergen I have myself made occasional notes concerning three; one (*L. reticulatus* forma *frigida* No. 7 apud Smitt l. c.) was taken by the Kolthoff Expedition of

1900 in the mouth of the Ise Fjord at a depth of 350 meters, the other two by the »Michael Sars» in 1901 in the Ise Fjord at a depth of 260 meters. The most important measurements of these individuals are as follows:

		♀	♂
Total length in mm.		117	147	207
Length of the head	in % of the total length	21,8	23,1	24,9
Distance between the snout and anus	— —	41	42,2	44,7
Height over the anus	— —	10,2	8,5	9,9
Longitudinal diameter of the eye	— —	3,6	4,1	3,1

The largest of the individuals is remarkable for its great breadth of head just behind the eyes; it is a male and the same characteristic has already been noted for this sex in another species (*L. vahlii*, cf. p. 20 with fig. 1 & 2); further, the snout in this individual extends unusually far forward in front of the underjaw. The pectorals contain 18, 18 and 19 rays. The distance of the dorsal fin from the snout is 28,2—31,2 % of the total length. On the side of the body the scales extend forward to a little behind the root of the pectorals, but both the anterior portion of the back and the belly on the other hand are free from scales, even in the largest of the specimens. The 207 mm. long specimen is wanting in cross-bands, uniformly grayish brown, lighter underneath especially on the underside of the head forward; the anal fin darkish, the front part lighter and with a light border. The colour in the 147 mm. long specimen is very dark, rusty brown, with extremely faint indications of cross-bands; the belly and fins are of a dark mouse-gray, the anal darker posteriorly, the underside of the head lighter in parts. In the one 117 mm. long, the colour is likewise very dark except on the foremost part of the underside of the head, with very indistinct bands, which are however, very apparent on the dorsal fin, especially towards the margin, to the number of 7 with a dark spot on the point of the tail; the anal fin blackish, especially posteriorly, forward lighter on the lower margin. The ventral lateral line is distinct, also the mediolateral in parts, yet only in the smallest individual.

Lycodes pallidus from East-Greenland.

In the Stockholm's Riks-Museum I have seen not less than 53 specimens, taken at the northerly East-Greenland by the Nathorst-Kolthoff Expeditions of 1899 and 1900. A large number of these specimens have been described by F. A. Smitt (l. c.) under the names: *L. vahlii* forma *pallida*, *L. vahlii* f. *typica* and *L. reticulatus* f. *frigida*.

Most of the specimens are under 100 mm. in length, only 18 are above that from 105—178 mm. In 33 of these (55,5—178 mm.) the length of the head is 20,7—25,3 %, the distance between the snout and the anus 38—44,4 %, the height over the anus 8—10,3 %[1]), the longitudinal diameter of the eye (in individuals of 125 mm. and over) 3,4—4,5 % of the total length. The pectoral fins contain 18—19, more rarely 20 rays. A young specimen of 55,5 mm. is still naked, but scales have begun to appear in another of 65 mm. In specimens of total length 70—125 mm., the scaly covering extends forward

[1]) In one case 11,1 %, in young specimens sometimes as low as 7,3 %.

to near the root of the pectorals, but a portion of the end of the tail is still more or less free from scales; at a total length of 137 mm. and over, the tail is completely covered with scales, so that these extend from the tip of the tail almost to the root of the pectorals, but the head, belly and fins continue to be naked even in the largest specimens. On the trunk and tail, there are 7—11 dark cross-bands (frequently also a dark spot at the end of the tail), which may become indistinct in the older (seldom in the relatively small individuals), especially on the foremost part of the body; they remain as a rule, however, on the dorsal fin; the anal fin is usually light in front, posteriorly on the other hand, it is more or less blackish (from the fusing together, entirely or in part, of the most posterior cross-bands) not rarely with a narrow, light strip along the lower margin; more rarely the anal fin is uniformly dark the whole way. Sometimes a light spot is present over the edges of the gill-cover or a light stripe across the neck. The ventral lateral line is distinct, especially on the part descending towards the anus; a distinct mediolateral lateral line is seldom seen; sometimes there is a short series of pores forwards under the dorsal fin[1]).

Lycodes pallidus from the cruise of the «Michael Sars» 1902.

Six specimens of a Lycodes, which I think *L. pallidus*, were taken off the Shetland-Norway Slope› at ca. 420 fathoms depth.

The most important measurements are as follows:

						♂	♂
Total length in mm.			98	121	122	142	181	186
Length of the head	in % of the total length		22,8	23,1	23	23,2	24	22,6
Distance between snout and anus	—	—	40,8	40,9	39,8	42,3	42	41
Height over the anus	—	—	8,9	10,2	9,4	10,6	9,1	8,7

In addition, the longitudinal diameter of the eye is 4,1—3,8 %, the length of the snout (to the eye) 7,6—8,5 %, the distance of the dorsal fin from the snout 28,7—30,4 % of the total length. The pectoral fins contain 19—20 rays. The scaly covering is almost equally developed in all specimens and extends towards the root of the pectoral fins; the anterior part of the back and the fins are naked, likewise almost all that part of the belly which lies under the branch of the lateral line descending towards the anus. The ground-colour is brownish, but darkened on the belly by the peritoneum shining through; on the body itself no cross-bands appear; in the three smallest specimens on the other hand, rather distinct black markings appear on the dorsal fin, especially on the most posterior part, and weak traces of these can be detected also in the three larger individuals; the anal fin is grayish in front, dark posteriorly. The ventral lateral line is distinct, frequently even a good bit beyond the anus; a mediolateral lateral line is rather apparent in a single individual (that of 142 mm.), in others only scattered elements of it are to be seen.

[1]) I have also observed such dorsal pores sometimes, in *L. pallidus* from other regions.

Lycodes pallidus from Jan Mayen.

(var. *similis* m.).

Tab. V, fig. 2 a, b, c, d & Tab. VI, fig. 3 a, b, c, d.

I consider as belonging to a distinct variety, 15 specimens which the Ingolf Expedition obtained in the neighbourhood of Jan Mayen (St. 116), at 371 fathoms depth. Lütken (l. c.) had referred 10 of them to *L. pallidus* Coll., to which they indeed are closely related, the remaining 5 to *L. lütkenii* Coll. to which they have a certain resemblance in colour-marking but no close relation otherwise. In my preliminary report (l. c.) I have formed these Lycodes from Jan Mayen into a separate species *(L. similis)*, pointing out at the same time their near relationship to *L. pallidus;* with my present increased knowledge of *L. pallidus* I consider it best to regard them as a local variety of this species.

The most important measurements of these specimens are as follows:

								♂	♀	♀		♀	♂	♀	♀	♂
Total length ..... in mm.	49	73	74	106	109	118	125	125	130	132	134	143	145	170	175
Length of the head ..... —	12	18,5	18	25,5	26	28	31	30	30	31,5	31	37	35	40	44
Distance between snout and anus .. —	21	30,5	31	46	48	51	53	55	55	57	56	62	60	73	75
Height over the anus ..... —	5	7,5	7,5	11,5	11,5	12,5	14	14	14	13	15,5	16	17	21	19

The body as to form has a great similarity to that in the typical *L. pallidus*, but it is throughout somewhat higher, and is thus less elongated; the height over the anus amounts to 10—12,4 % of the total length. The tail again is throughout somewhat shorter, the distance between the snout and the anus being 41,4—44 % of the body's whole length.

The head is of similar length as in the typical *L. pallidus* and amounts to 23—25,9 % of the total length. It appears however less lengthy, as the height over the neck is greater and as a rule is contained not quite twice in the length; it is consequently less depressed, and its lateral aspects approach more to the vertical. Seen from the side, its upper border from the neck to the posterior margin of the pupil is almost horizontal, and then inclines sharply almost in a straight line down to the snout. The eyes are relatively a little larger than in the typical form, their longitudinal diameter (in specimens of 118 mm. and over) being 4,7—5,6 % of the total length; their upper margin projects outwards over the level of the forehead; seen from above, there is a tolerably small space between the two eyes; on the cranium the breadth of the forehead is $^1/_{20}$ of the length of the head. The snout is not depressed, as in the true *L. pallidus*, but somewhat high; on the whole its head is higher than in the previous form whether the snout or the neck is considered. The length of the postorbital part of the head is somewhat the same in both forms; consequently, on account of the greater dimensions of the eye, the snout is relatively a little shorter in the variety *similis* and amounts to only 6,2—7,5 % of the total length against 6,8—8,5 % (or more) in the typical *L. pallidus*. The cup-shaped depressions along the margins of the jaws, and the nostrils are as in the typical form, nor do the teeth show any differences.

The dorsal fin begins about the same place as in typical specimens, namely at a distance from the snout which is 29—32,2 % of the total length; it has ca. 94—96 rays, the anal fin ca. 81—82 rays; as usual, half the tail fin is reckoned in both. The pectoral contains 19—20, seldom 21 rays. The ventral fins are just as small as in typical *L. pallidus*.

Scales. The smallest specimen (49 mm.) is naked (Tab. VI, fig. 3 a). In the 73—74 mm. long specimens the scaly covering extends from the beginning of the dorsal fin some distance on to the tail, but the anterior part of the back and the belly are naked (Tab. V, fig. 2 a). In the 106 and 109 mm. long specimens the end of the tail is further naked (Tab. V, fig. 2 b). It is only late that this portion begins to be covered with scales, viz. at a total length of 118—130 mm. In the larger specimens the scales extend from the tip of the tail forward to a line from the anterior end of the dorsal fin, yet the anterior part of the back and a strip just forward under the base of the dorsal fin as well as the greatest part of the trunk under the branch of the lateral line descending towards the anus, are free from scales (some specimens may have 2—3 rows of scales at the most, on the belly under the lateral line); scales on the unpaired fins cannot be discovered. The scales are relatively large as in the typical form and are fairly close together.

The lateral line is double. The ventral branch is distinct on the stretch from the edge of the gill-covers down to the anus, also for a shorter or longer distance along the underside of the tail; the mediolateral line is more or less apparent, sometimes specially distinct with a considerable number of pores and short lines. Some pores are sometimes seen forward under the dorsal fin.

Colour. The variety *similis* occurs in two different colour-forms, namely in one with indistinct cross-bands (Tab. V, fig. 2 a, b, c, d), another with these distinct (Tab. VI, fig. 3 a, b, c, d). Under the first come 10 specimens. The two young specimens of 73—74 mm. (Tab. V, fig. 2 a) have 4 dark bands over the first two-thirds of the dorsal fins, almost black and most distinct towards the edge of the fin; under each of these patches there is a more or less distinct, brownish cross-band on the body. The anal fin is black posteriorly, to a more or less extent, on the margin or even to the base. The peritoneum shines through giving the belly a blue-black appearance, and the posterior margin of the gill-cover as well as the skin over the branchiostegal rays is dark. Otherwise the ground-colour is yellowish brown. Two specimens which follow these in size and measure 106—109 mm., are similarly coloured; the dark markings of the fins appear mainly, however, as stripes on the margins, and the anal fin is not very dark posteriorly (Tab. V, fig. 2 b). Six other specimens at 125 (Tab. V, fig. 2 c), 130, 132, 134, 143 and 175 mm. (Tab. V, fig. 2 d), display similar colouration or have the dark markings almost entirely obliterated, so that the body seems almost uniformly brownish, with light scale-points and dark belly and gill-cover. The other colour variety is shown by 5 specimens. The first is the 49 mm. long young specimen (Tab. VI, fig. 3 a): it has a very broad cross-band on the trunk and 4 over the tail, decreasing in size posteriorly; the bands are brown, but there is a lighter part in the centre of those in front; a light band extends across the neck from gill-cover to gill-cover; the anal fin is shaded with black posteriorly. 4 specimens of 118, 125, 145 and 170 mm. have preserved this colouration in the main (Tab. VI, fig. 3 b, c, d): all show a light band across the neck as well as the dark brown cross-bands on the trunk and tail, all, or in every case the most anterior of them, with a light

centre[1]); on the anal fin the dark bands may be scattered or fused together to form a lengthy patch on the fin posteriorly. In this group of specimens also, the scales appear as lighter points, and the belly and gill-covers are dark. — This remarkable variation in colour-marking is not a sex-difference as both males and females occur in both colour-forms.

The sexual organs are little developed in the specimens to hand. In the largest male (175 mm. long) the testes are 10 mm. long, 4,5 mm. broad, without developed free folds. In the largest female (170 mm.) taken on the 23rd of July, the ovary is ca. 10 mm. long, and contains a tolerably small number of eggs of 1,5 mm. in diameter.

It is especially the less elongated body-form, the somewhat shorter tail and the relatively large eyes, which justifies the variety *similis*.

Lycodes pallidus
var. *squamiventer* m.

Tab. IV, fig. 2 a, b.

The 12 specimens, now to be mentioned in more detail, were taken partly by the Ingolf Expedition of 1896 in the waters east from Iceland (St. 105, 104, 101) and north from the Færoe Isles (St. 141), partly by the «Michael Sars» Expedition of 1902 off the Shetland-Norway «Slope»; the depths were 537—957 fathoms.

The most important proportions of these 12 specimens are as follows:

		«M. Sars» ♂	«M. Sars» ♀	«Ingolf» St. 104 ♀	«Ingolf» St. 104 ♀	M. Sars ♂	«Ingolf» St. 105 ♂	M. Sars ♂	«Ingolf» St. 101 ♂	«Ingolf» St. 141 ♂	«Ingolf» St. 101 ♂	M. Sars ♂	M. Sars ♀
Total length	in mm.	117,5	128	143	147	155	170	179	180	230	245	248	260
Length of the head	—	24,5	27	32	31	34	36	37,75	37	50	55	51	51,5
Distance between snout and anus	—	47	50,5	55	60	63,75	68	68	70	90	97	94	104,5
Height over the anus	—	11	12,25	14	14	14,75	16	17,5	17	22	25	25	28

The form of the body is similar to that in the typical *L. pallidus;* the anus has almost the same position, namely in its distance from the snout which is here 37,9—41,1 % of the total length, and the height over the anus is 9,4—10,8 % of the same length.

The head is relatively shorter than in both preceding forms, as its length is only 19,6—22,4 % of the total length, somewhat depressed, especially in adult specimens. The eyes have a similar length as in the typical *L. pallidus*, their longitudinal diameter being 3—4,4 % of the total length. The snout, whose length is 7—8,7 % of the total length, is relatively somewhat higher in the young specimens than in the old, where it is depressed. The tube-shaped nostrils are well-developed; the teeth-characters as usual.

[1]) The colouration of these specimens has a delusive resemblance to that in *L. lütkenii*, which must be the reason why Lütken in the earlier report on the Fishes of the Ingolf Expedition referred them to that species.

The dorsal fin, whose distance from the snout is 27—29 % of the total length, contains 96—97 rays, the anal fin 81—82 (half the caudal fin is reckoned with each). The pectorals have 18—20 rays. The ventrals are on the whole, somewhat longer and more developed than in the other forms of *L. pallidus*.

Scales. We do not know the youngest stages, but the smallest of the present specimens is already remarkable for the strong development of scales, though it is only 117,5 mm. long; the scaly covering extends forward to the neck and almost to the base of the pectorals, as well as forward on the belly to a line drawn almost between the anterior third of the pectorals. The 128 mm. long specimen has scales on the whole of the belly, to the base of the ventrals, and scales have begun to appear on the base of the unpaired fins; the scaly covering has thus almost reached its fullest development in this small specimen, as much as it does in the *Lycodes* genus, as it is essentially only the head which remains naked. The three largest specimens (245, 248 and 260 mm.) have only advanced further in that the scales have spread out more on to the unpaired fins. The remaining specimens, whose lengths lie between 143 and 230 mm., display a little variation, as the scaly covering in some of them has almost the same distribution as in the largest individuals, whereas in others the scales on the belly only reach forward to a line between the anterior third of the pectorals or to the tip of the ventrals when stretched out backwards, and there may also be a naked strip in the middle line of the back in front of the dorsal fin; in all, the scales extend out more or less on to the unpaired fins. — Whilst, in the two previous forms of *L. pallidus*, the scales did not extend below on to the belly itself, the underpart of the belly is always scaled in the present form, either to the base of the ventrals or at least to a short distance from it, and on the whole also, the scales extend further forward on the back as well as, except in the smallest specimens, out on to the base of the unpaired fins. The scales themselves are small, on the whole less than in the other forms of *L. pallidus*; they are sometimes so close together that they partly give one the impression of being imbricate.

The lateral line has its origin over the upper edge of the gill-cover, bends down towards the anus and can be followed a shorter or longer distance along the lower edge of the tail, sometimes even to the tip of the tail. In addition to this ventral lateral line, more or less distinct traces of a mediolateral branch are to be seen, sometimes as only single pores, sometimes more numerous pores, partly also as a thin line.

The colour is uniform, without bands or spots, dark-brown or lighter, yellowish brown or gray-brown, in all the specimens at hand; the scales stand out lighter than the ground-colour; the belly and posterior margin of the gill-cover are darker.

Sexual organs. The testes are very broad relative to the length and with very small free folds; in one specimen 245 mm. long, the testis measures 16 mm. in length by 7 mm. in breadth, the free fold is only 3 mm. long. The largest individual (260 mm.) is a female taken on the 28th of June; the ovary is 22 mm. in length and contains eggs with a diameter of 3,5 mm. The next largest female is 147 mm. long; the ovary is only 8 mm. long and contains extremely small eggs.

In certain respects therefore, the present form is somewhat distant from *L. pallidus*: the head is relatively a little shorter; the scales are less and have a wider distribution, both on the belly, back

and unpaired fins; the colour is uniform and shows no indication of bands or spots (though it must be remembered, however, that the young are unknown).

For the rest, it has a very great resemblance to *L. pallidus*, and I think it most prudent meantime to consider it a variety of this species. In time it may possibly be raised to a separate species, and its name *squamiventer* could then be retained as the specific name.

As the facts are at present, I regard it as a deep water form of *L. pallidus*. It lives at depths of 537—957 fathoms, whilst the true *L. pallidus* in my opinion is not known to go to greater depths than 495 fathoms. It seems to me worthy of remark in this regard, that one of the specimens of *L. pallidus* from the deepest place (the 183 mm. long specimen described before and represented in fig. 1 e on Tab. IV) forms in part a transition stage to the variety *squamiventer*, being scaled on the uppermost part of the belly (6 rows of scales beneath the descending branch of the lateral line) and contrary to the usual, has scales on the base of the unpaired fins.

Distribution.

The typical *L. pallidus* is found in the Kara Sea, at Spitzbergen, at north-eastern Greenland, and north from Iceland, north from the Færoes and N.N.E. from Shetland.

In the Kara Sea the Dijmphna Expedition took 11 specimens at a depth of 46—106 fathoms.

At Spitzbergen the Norw. North-Atlantic Expedition took 2 specimens where the depths were 260—459 fathoms, and the bottom-temperature + 1°1 and — 1° C.; a Russian Expedition 1 specimen in Stor Fjord at a depth of 60 fathoms, and bottom-temperature of — 2° C.; the Kolthoff Expedition of 1900 1 specimen at the mouth of Ise Fjord, where the depth was 185 fathoms, and the »Michael Sars» 1901 2 specimens at Ise Fjord at a depth of 140 fathoms.

At north-eastern Greenland no fewer than 53 specimens have been taken. The Nathorst Expedition of 1899 took it in Franz Josephs Fjord, at 400 fathoms (4 specimens) and at 73° 20′ N.L. 21° 20′ W.L. where the depth was 37 fathoms (1 specimen). The Kolthoff Expedition of 1900 obtained it at the following places: Franz Josephs Fjord, head of Myskoxe Bay, 53 fathoms (2 specimens); Franz Josephs Fjord, outer part of Myskoxe Bay, 106 fathoms (1 specimen); mouth of Franz Josephs Fjord, 106—212 fathoms (4 specimens); off Franz Josephs Fjord, between Bontekoe Island and Mackenzie Bay, 132 fathoms (2 specimens); Mackenzie Bay, $6^1/_2$—18 fathoms (35 specimens, 1 of 178 mm., 1 of 125 mm., the rest between 40—110 mm.); off Mackenzie Bay, 53 fathoms (3 specimens); S.E. from Walrus Island (74° 30′ N.L. 18° 40′ W.L.), 42—53 fathoms (1 specimen).

The Ingolf Expedition of 1896 took 7 specimens north of Iceland at St. 124 and 126, where the depths were 293—495 fathoms, and bottom-temperature — 0°5 and — 0°6 C.

The same Expedition of 1896 took 4 specimens north from the Færoes at St. 138, at a depth of 471 fathoms, and bottom-temperature — 0°6 C.

Off the Shetland-Norway Slope (62° 43′ N.L. 1° 26′ E.L.) the »Michael Sars» in 1902 took 6 specimens, where the depth was ca. 420 fathoms and bottom-temperature under 0° C.

The variety *similis* was taken by the Ingolf Expedition of 1896 (15 specimens) south from Jan Mayen (St. 116) where the depth was 371 fathoms and bottom-temperature — 0°4 C.

The variety *squamiventer* was taken by the Ingolf Expedition of 1896 east from Iceland (St. 105, 104, 101), where the depths were 537–957 fathoms and the bottom-temperature —0°7 to —1 1 C. (5 specimens); north from the Færoe Isles (St. 141) at 679 fathoms and bottom-temperature —0°6C. (1 specimen); and by the Michael Sars in 1902 off the Shetland-Norway Slope (63° 7′ N.L. 1° 38′ E.L.), where the depth was 650 fathoms and bottom-temperature under 0° C. (6 specimens).

L. pallidus lives in polar waters; in southern latitudes therefore, it is first met with at great depths (300 fathoms and deeper) but in high arctic seas it comes up quite to the sublittoral zone.

Lycodes platyrhinus Jensen.

Tab. VI, fig. 2. Figs. 3—5 in text.

1898. *Lycodes frigidus* Lütken, The Danish Ingolf Expedition, II, 1, p. 20 (partim).

1901. *L. platyrhinus* Jensen, Vidensk. Medd. Naturh. Foren. Kbhvn. p. 208.

Body zoarciform, yet relatively more elongated than in most other species of the genus Lycodes, the height over the anus being only 8,2 % of the total length; the length of the head is 19,9 % of the same length, the distance between the snout and the anus 37 %. The colour is uniformly of a ruddy brown-gray. Scales are wanting. Lateral line double, ventral and mediolateral, most distinct in its course towards the anus. The size (of the single specimen) 148,5 mm.

D. 99. A. 82. P. 15.

Distribution. Between Jan Mayen and Iceland, 1010 fathoms.

Only one specimen of this species, which was placed by Lütken with *L. frigidus*, is at hand for investigation; it is a male.

The most important proportions are the following:

Total length	148,5 mm.
Length of the head	29,5 —
Distance between snout and anus	55 —
Height over the anus	12,25 —

The form of the body is more slender than in most other species of the genus *Lycodes*, the height over the anus being only 8,2 % of the total length. On the trunk the height is almost uniform and the tail tapers very gradually down to the tip. The trunk is somewhat compressed, its thickness being 1½ times in the height, and the tail becomes gradually more and more compressed. The anus lies a little behind the termination of the anterior third of the body, the distance between the snout and the anus being 37 % of the total length.

The head is broad, flat in front and tolerably short, its length being 19,9 % of the total length. The height over the crown is somewhat greater than the breadth at the same place, but further forward the head becomes very low without at the same time losing in breadth; the end of the snout is blunt, but low, seen from above it is broadly rounded off. The eyes are small, so that their longitudinal diameter is scarcely 1/9th of the total length of the head; they are placed high up, on the very margin of the forehead, but at a fairly clear distance from one another amounting to quite one

and a half times the diameter of the eye. The length of the snout to the eye, is not quite $3^1/_2$ times in the whole length of the head. The lower jaw extends almost as far forward as the upper, whose posterior angle lies under the anterior third of the eye. The lips are tolerably fleshy. The teeth are small and pointed, placed as usual on the intermaxillary, palatal, vomer and mandible. The grooves for the pores of the lateral line are in parts considerable and very deep, surrounded by soft, projecting borders; from the snout to under the eye there is a row of 7 distinct pits, and another row of pits, likewise 7 in number, from the tip of the mandible to the lower posterior corner of the

3 4 5

Fig. 3—5. Head of *Lycodes platyrhinus*, seen from above, the side and from underneath. × 1.

preoperculum. The tube-shaped nostrils are situated a little above the interspace between the two foremost grooves of the upper jaw.

The dorsal fin begins almost over the posterior third of the pectoral when extended backwards, at a distance from the snout equal to 26,3 % of the total length. Both this fin and the anal fin are covered by a thick skin, so that it is difficult to count the rays; I have reckoned the number to be 99 in the dorsal fin, 82 in the anal, half of the tail fin being as usual reckoned in each. The pectoral, which contains 15 rays, is of an oblique quadrangular form; its length is 11,3 % of the total length. The ventral fins are short (almost of the same length as the space between the eyes) and placed very close to one another.

Of scales no trace can be observed; whether this naked condition is a constant feature or only due to the small size of the specimen, can naturally not be decided with certainty, but the scaly covering is generally far advanced in development at a length of ca. 150 mm. in the Lycodes which are on the whole provided with scales, so that the first alternative is the most probable.

The ventral branch of the lateral line is only distinct in its course down towards the anus. It begins on the neck, forms a small arch over the free flap of the gill-cover and inclines thereafter down towards the anus, but becomes already indistinct over the anus. Along the median line of the side a tolerably distinct line with not a few pores is to be seen under the lens; the pores are somewhat far apart in front but closer together posteriorly.

The colour is uniformly a ruddy brown-gray, the fins and underside of the head lighter, dirty gray; the dark peritoneum shows through the belly.

Distribution. A single specimen (♂) was taken by the Ingolf Expedition in 1896 between Jan Mayen and Iceland (St. 119), where the depth was 1010 fathoms and bottom-temperature — 1°0 C.

Relation of the species to *Lycodes frigidus* Coll.

L. platyrhinus was placed with *L. frigidus* Coll. by Lütken, and it certainly presents some resemblance with this species in appearance, namely, in its uniform, ruddy brown-gray colour; but a more thorough comparison will at once show important differences of which the following may be emphasized.

L. frigidus has a less elongated body-form, the height over the anus, in a specimen of similar length, being 10 % or somewhat more of the total length; the tail especially is quite different in appearance when seen from the side, as it becomes pointed posteriorly somewhat quickly in *L. frigidus*. Again, the head is larger in *L. frigidus*, its length being 22 % or more of the total length. *L. frigidus* has more rays in the pectoral fins, namely 19—21. Lastly, the scaly covering in *L. frigidus* is far advanced at the total length of the present species, and its lateral line is single (ventral).

Lycodes microcephalus Jensen.

Tab. I, fig. 1. Fig. 6—8 in text.

1901. *Lycodes microcephalus* Jensen, Vidensk. Medd. Naturh. Foren. Kbhvn., p. 206.

The height over the anus is 8 % of the total length. The head is small, its length being only 17,3 % of the total length. The tail is much longer than the head and trunk together, the distance from the snout to the anus being 38,3 % of the total length. The colour is a uniform yellowish white, without bands or spots, blue-black on the belly. Lateral line mediolateral(?), only apparent on the trunk. The scales extend to the point of the pectoral fin, but naked spots occur here and there, especially on the tail posteriorly; incipient scale-formation on the unpaired fins. Size 81 mm.

D. 92. A. 76. P. 15.

Distribution. Northern Atlantic Ocean S.W. from Iceland, 799 fathoms.

Only one specimen is present for examination. Its most important proportions are the following:

Total length	81 mm.
Length of the head	14 —
Distance between the snout and the anus	31 —
Height over the anus	6,5 —

The form of the body is somewhat elongated; the greatest height lies over the belly a little in front of the anus and goes 10 times in the length. The trunk itself is almost of even height, but lessens at the anus, its height here going $12^1/_2$ times in the total length; the tail tapers slowly and fairly evenly towards the point. The greatest thickness lies across the cheeks and is but little less than the greatest height of the body; the trunk is a little smaller, and the tail becomes more and more compressed towards the tip. The anus lies a long distance in front of the middle of the length of the body, its distance from the snout being 38,3 % of the total length.

The head is less than in some of the Lycodes species here treated of, its length being only 17,3 % of the total length. For the rest it has a thick and plump appearance; seen from the side, the upper and lower edges converge slightly forwards, and the end is blunt; seen from above it narrows a little towards the broad rounded end of the snout. The eyes are placed so high up that their upper margin projects a little in front of the forehead; their longitudinal diameter is $5^1/_2$ times in the length of the head; seen from above, the distance between the eyes is equal to the diameter of the eye. The length of the snout to the eye, is about $3^4/_5$ times in the length of the head. The lower jaw extends almost as far forward as the upper, whose posterior angle lies under the anterior third of the eye. The lips are thick. The tubular nostrils are well-developed. Of large, cup-shaped pits there is a no small number: 1 behind the eye, towards the upper side, 5 under and in front of the eye, 1 behind and 1 in front of the nostril, 8 on the preoperculum and mandible, lastly 1 on the neck

6 7 8

Fig. 6—8. Head of *Lycodes microcephalus*, seen from above, the side and from underneath. × 2.

a little in front of the origin of the lateral line. Further, there is a number of fine lateral line pores on the top of the head, the operculum and preoperculum.

The dorsal fin begins relatively far forward, namely, at a distance from the snout which is equal to 21,6 % of the total length; it contains ca. 92 rays, the anal fin ca. 76 rays (half the tail fin being reckoned with each). The ventral fins are relatively long (3,5 mm.), but very thin. The pectorals are 8,5 mm. long and contain 15 rays, the lowermost of which extend at their points beyond the covering skin.

The scales already show a tolerably wide distribution, namely, forward to the tip of the pectoral fin when laid backwards. They are not yet very close together, here and there also are some naked spots, especially on the hindmost portion of the tail, and in front the scaly covering projects forwards in the shape of a wedge leaving the belly and back bare. Further, the scales show signs of going to spread out on to the unpaired fins.

The lateral line seems to be mediolateral. It begins over the upper notch of the gill-cover, forms a slight arch over the flap of the latter, and can then be followed along the median line of the trunk as far as the vertical line through the anus; the pores are tolerably distant from one another and only number 21 on the whole distance mentioned. Possibly there is likewise a ventral branch, as on the one side there seem to be 2—3 pores on the belly in front of the anus.

The colour is a uniform brownish yellow without any signs of stripes. The belly shows blue-black owing to the peritoneum shining through. In the journal of the Expedition it is written

concerning the fresh fish: almost without colour, a little bluish gray in tone; the top of the head slightly reddish; the side of the trunk and belly (over the peritoneum) dark blue.

An unpaired sexual organ is present. No pyloric appendages to be seen.

Distribution. The single specimen taken in 1896 by the Ingolf Expedition[1]) was obtained S.W. from Iceland, were the depth was 799 fathoms and the bottom-temperature 4°5 C. (St. 78).

This new species does not seem to stand anyway near any of the other Lycodes; *L. atlanticus* mihi, to which one might be inclined to relegate it as the young, has a relatively greater head and more numerous rays in the pectorals (23).

Lycodes rossi Malmgren.

Tab. VII, Fig. 1 a, b, c, d, e, f, g.

1828.(?)*Blennius polaris* Ross (vix Sabine) in Parry, Narrative of an attempt to reach the North Pole, p. 200.
1864. *Lycodes rossi* Malmgren, Om Spetsbergens Fiskfauna; Öfvers. Kgl. Sv. Vet. Akad. Förhandl., p. 516.
1880. *L. rossi* Collett, The Norwegian North-Atlantic Expedition, Fishes, p. 106.
1886. *L. reticulatus* Rhdt.(?) jun., Lütken, Kara-Havets Fiske; Dijmphna-Togtets zoologisk-botaniske Udbytte, p. 136, Tab. XVII, Fig. 4—5.
1886. *L. Lütkenii* Lütken, ibid. p. 128 (partim), Tab. XVI, Fig. 1 (nec Fig. 2—6).
1895. *L. reticulatus* Smitt, Skandinaviens Fiskar, II, p. 612 (partim), Fig. 148.
1899. *L. rossi* Collett, Vidensk. Selsk. Skr. Chria., No. 6, p. 8 (cum fig.).
1901. *L. reticulatus* Reinh.(?), Knipowitsch, Ann. Musée Zool. l'Acad. Imp. St. Pétersbourg, T. VI, p. 25.
1901. *L. reticulatus* forma *reticulata* Smitt, Bih. K. Sv. Vet.-Akad. Handl. Bd. 27, Afd. IV, No. 4, p. 33 (partim), No. 23 & 27.
1901. *L. reticulatus* forma *seminuda* Smitt, ibid. p. 32 (partim), No. 16.
1901. *L. celatus* Jensen, Vidensk. Medd. Naturhist. Foren. Kbhvn., p. 208.
1901. *L. rossii* Jensen, ibid. p. 213 (partim).

Of the total length the height over the anus is (8,5) 9,4—11,7 %, the length of the head 22,4—25,3 %, the longitudinal diameter of the eye 3,6—4 %, the distance between the snout and the anus 43,1—49,3 %, the length of the pectorals 13,1—13,6 %. The young have dark cross-bands on a light ground, the bands relatively light in the centre, but with a very dark margin (on the dorsal fin, blackish); a light band across the neck. In larger individuals the dark (6—10) cross-bands on the side of the body are partly confluent below, so that the light interspaces partly show as saddle-shaped markings from the free edge of the dorsal fin down towards the lateral line; the light neck-band frequently divides up into several spots. The scaly covering in the older individuals reaches forward to a point, which lies almost under the beginning of the dorsal fin, and is wedge-shaped in front so that the

[1]) The specimen was overlooked and not included in The Ichthyological Results.

anterior part of the back and belly are free of scales, likewise the head and fins. The lateral line is mediolateral. Pyloric appendages 2. Size 223 mm.

D. 91—96. A. 71—76. P. (17) 18—19 (20).

Distribution. Spitzbergen, 5—75 fathoms; Kara Sea, 46—100 fathoms; Porsanger Fjord (East Finmark), 30—50 fathoms.

Remarks on the Synonymy.

In 1828, Ross referred a fish taken by the Parry North Pole Expedition north of Spitzbergen at a depth of 80 fathoms, to the *Blennius polaris* described by Sabine from arctic America, though Ross at the same time noted some differences between them. From the description, it is quite clear that Ross' specimen was a species of the genus *Lycodes*.

In 1861, a Swedish Expedition to Spitzbergen obtained two small Lycodes, which Malmgren took — and probably rightly — to be identical as species with Ross' specimen. But M. rejected the reference of this Lycodes to Sabine's *Blennius polaris*, and after likewise rejecting the possibility of its identity with either of the *L. perspicillum* and *L. nebulosus* from Greenland established by Kroyer, gave it the name *L. rossi*, the diagnosis of which is based on a single 32 mm. long specimen (the second specimen seems to have been lost).

The next reference to *L. rossi* is by Collett in 1880. After examining Malmgren's type-specimen Collett came to the conclusion that *L. rossi* was really the same as *L. perspicillum* Kr., and again that *L. gracilis* M. Sars, which was only known from a young specimen from Christiania Fjord, was identical with *L. rossi*. Further, Collett explains: it is probable that all these are only young stages either of *L. reticulatus* alone, or also of a second nearly related species, perhaps *L. lütkenii* (l. c. p. 105).

In his great work on Scandinavian Fishes Prof. F. A. Smitt likewise expresses the opinion that *L. rossi* is the young of *L. reticulatus* Reinh., but with this he unites not only *L. perspicillum* Kr., but also *L. seminudus* Reinh. and *L. lütkenii* Coll. of the European-Greenland forms.

In his monograph on *L. gracilis* (1899) Collett again takes up the question of the position of *L. rossi*. He declares that in certain features *L. rossi* differs from *L. gracilis*, but he is still inclined to consider them identical; on the other hand, he now considers the transference of *L. perspicillum* to this species as problematical, and there is no further talk of bringing *L. gracilis-rossi* under *L. reticulatus*.

In my preliminary report on the Lycodes of the Ingolf Expedition I was of the opinion that I had again found *L. rossi* in two small specimens from the seas south of Jan Mayen, and that these united *L. rossi* with *L. lütkenii* Coll. In this however, I made an error. Later, in the material of the Kolthoff Expedition, I have seen so many specimens identical with the form from Jan Mayen, that with this increased knowledge, I must refer them to *L. seminudus* (cf. this species). And after I had the opportunity, through the favour of Prof. F. A. Smitt, of examining Malmgren's type-specimen of *L. rossi*, I think it certain that this form is a very young stage of the species *L. celatus* mihi.

This specific name I had employed for three small Lycodes from the Kara Sea; they were considered by Lütken, though with some doubt, as the young of *L. reticulatus* Reinh. I could not agree with this author on this point and formed the species *L. celatus*. To this I further referred two small Lycodes taken by Russian Expeditions in the Stor Fjord at Spitzbergen. Prof. N. Knipowitsch had identified these specimens as Lütken's *L. reticulatus* jun.? and with right, as I could judge from a direct comparison which Prof. K. kindly enabled me to make; through some differences in the most important proportions however, I felt obliged to distinguish it as a distinct variety: *spitsbergensis*.

But, as said, after I had seen the type-specimen of *L. rossi* Malmgr., I came to the conclusion that my *L. celatus* must be somewhat larger specimens of the same species.

Later, I got to know *L. rossi* closer through a whole series of specimens, old and young, which Dr. Johan Hjort had taken in 1901 in the Ise Fjord at Spitzbergen. And for use in this treatise, Prof. R. Collett has lent me a series of specimens, which kindness I appreciate the more as Prof. Collett had intended to work them out. With the help of this excellent material, I discovered that the largest of the specimens, which Lütken in his report on the fishes of the Kara Sea had referred to *L. lütkenii* Coll., belonged to *L. rossi*[1]). Lastly, I became convinced that two Lycodes must also be referred to *L. rossi*, which were taken at Spitzbergen (Ise Fjord and W. from Cape Mitra) by the Kolthoff Expedition of 1900 and ascribed to *L. reticulatus* by Prof. Smitt (l. c.).

Description.

Altogether I have had 19 specimens for investigation; they are enumerated below with the most important proportions:

[1]) The remaining (27) specimens, on the other hand, form a new species belonging to the scaleless Lycodes, which I have named *Lycodes agnostus* (cf. p. 79—80).

		Spitzbergen, 1861 *L. rossi* Malmgr. sp. orig.	Spitzbergen, 1901	Spitzbergen, 1901	Kara Sea	Spitzbergen, 1900	Spitzbergen, 1900	Spitzbergen, 1899	Spitzbergen, 1901	Spitzbergen, 1901	Spitzbergen, 1901	Spitzbergen, 1901	Kara Sea	Kara Sea	Spitzbergen, 1901	Spitzbergen, 1901	Spitzbergen, 1900 ♀	Spitzbergen, 1901 ♂	Spitzbergen, 1901 ♀	Kara Sea ♀
Total length	in mm.	32	54,5	60,5	65	68,2	75,5	75,8	85	86	88,5	92,5	94	105	114	118	163	191	205	223
Length of the head	—	7,5	12,5	14	15,5	17,25	18,25	18,5	20,2	21,2	21	22,5	22	23,5	28	28,5	40	47,5	50	55
Distance from snout to anus	—	14,5	24,2	27,5	28	32	34	34,5	37	39	39,5	42	42	47	53	53,5	78	92	101	110
Height over the anus	—	3	5,2	6	6,5	7	8	7,75	9	9	9	9,5	8	10	12	11,25	16,5	21	24	24,5

The form is moderately elongated, the height over the anus being $8^1/_2$—$10^1/_2$ times (in young individuals sometimes almost 12) in the total length. As in other Lycodes species the head is somewhat depressed, whilst the somewhat compressed trunk passes evenly into the strongly compressed tail. The head is a little broader than the trunk; its greatest thickness lies over the cheeks and is ca. $1^1/_{10}$—$1^2/_9$ greater than the greatest height of the trunk. In adult specimens the anus lies almost at the middle of the body, as its distance from the snout is 47,8—49,3 % of the total length; younger specimens (under 120 mm.) have relatively longer tails, the distance of the anus from the snout in them being 43,1—47 % of the total length.

The head is relatively small, its length being only 22,4—25,3 % of the total length. The eyes are situated high up, so that their upper margins project forward over the forehead, and the space between them is somewhat hollow; their longitudinal diameter (in specimens of 118—223 mm.) is 6—6,9 times in the length of the head or 4—3,6 % of the total length; they are thus relatively small. The length of the snout, reckoned to the eye, is 2,9—3,7 times in the length of the head or 7,6—8,6 % of the total length. The upper-jaw extends to the vertical line through the middle of the eye; the end of the snout projects a certain distance in front of the underjaw. The lips are thick; the underlip has a dependant fold on each side, and the fold of skin along the underjaw's lower edge is overlapping on the chin. The tube-shaped nostrils are well-developed. Along the upper and under-jaws are shallow pits for the lateral line. The strong teeth are placed in a single row on the intermaxillaries (10—15), on the palatals (9—14) and on the mandible (10—15); on the foremost part of the jaws (especially on the under-jaw) they form however a double row; further, there is a small group (4—5) on the portion of the vomer lying between the anterior ends of the palatals.

The dorsal fin begins at a distance from the snout equal to 30—31,7 % of the total length; it contains 91—96 rays, the anal 71—76. The ventral fins are small (of a length almost equal to the breadth of the forehead between the eyes). The length of the pectorals is 13,1—13,6 % of the total length, i. e. almost equal to the distance between the posterior margin of the eye and the edge of the gill-cover; they contain most frequently 18—19, more rarely 17 or 20 rays, of which the lower ones project at their points beyond the covering skin.

The scales in the larger specimens (163—223 mm., Tab. VII, fig. 1 f & g) cover the sides of the tail almost completely, but on its foremost part are already somewhat distant from the dorsal fin and continue forward from thence on the side of the trunk as a broad wedge, ending a little behind,

or at a point opposite to, the beginning of the dorsal fin; the head, anterior part of the back, the belly and fins are thus quite free of scales. The two smallest specimens (32 and 54,5 mm., Tab. VII, fig. 1 a & b) are naked, but scales have already begun to show on the 60,5 mm. specimen, on the foremost part of the tail and on the trunk to the point of the closed pectoral fin, mainly above the median line of the side. In the 65 mm. long specimen, only some few scales can be observed on the boundary between the trunk and the tail, up towards the back, but in three young specimens of 68,2, 75 and 75,8 mm. (Tab. VII, fig. 1 c & d) a distinct strip of scales is seen on the side of the body, in front to the middle of the pectoral when laid backwards and posteriorly an almost equal distance behind the anus. In the 85 mm. long specimen, the scaly covering is relatively very early developed, as it has here essentially the same distribution as in the adults, only the end of the tail is naked (which may also occur in part in much larger specimens); the individuals of 114 and 118 mm. are in a similar condition, but one of 105 mm. is much less advanced: in this the scales are only on the foremost three fifths of the tail and on the trunk to a little distance behind the tip of the pectoral, and for the most part they only extend from the back more or less to near the middle line of the side; only on a small portion do they reach below this. These examples should sufficiently illustrate the variations in the distribution of the scales in young and medium-sized specimens.

The lateral line is single, mediolateral, arises at the upper end of the gill-opening, forms a slight arch on the shoulder and courses along the dorsal aspect of the trunk but more in the median line on the tail. Over the first obliquely descending part of this lateral line there is a horizontal row of 4 to 5 pores, placed somewhat remote from one another, and there is a similar row between the posterior part of the head and the front end of the dorsal fin.

Colour. I shall begin with a description of the smallest specimen but 32 mm. long (type-specimen of *L. rossi* Malmgr.). As fig. 1 a of Tab. VII in natural size shows, this has 8 broad, dark bands on the body, and also a dark spot at the end of the caudal fin. The first of these bands reaches from behind the head to the front end of the dorsal fin, the second band lies under and a little beyond the posterior portion of the pectoral, the third has its anterior border lying over the anus, the most posterior (eighth) covers the end of the tail. All the bands reach down over the linear depression along the middle of the side of the body; the fifth extends to near the anal fin, the sixth, seventh and eighth extend on to this fin. Above, they all extend on to the dorsal fin. The ground-colour is yellow white (that is, on the specimen now much bleached; Malmgren wrote: dilute fulvo flavus), and the bands which are saddle-shaped, have a small, dark margin with lighter centre. The first band is separated from the dark posterior margin of the head by a light stripe across the neck. There is a dark streak on each side of the head, from the snout on to the gill cover[1]). — The next smallest specimen (54,5 mm.), represented in fig. 1 b of Tab. VII, is very similar to the foregoing in colour-markings, but the bands are broader and their number is only 7. Then comes the 60,5 mm. specimen whose colouration agrees completely with that of the type-specimen. The 65 mm. specimen from the Kara Sea displays a certain difference as a small, dark-brown spot appears in the lighter centre of the

[1]) The figure in F. A. Smitt (l. c. 1895) show a light spot behind the eye, towards the upper side, but I think the artist has depicted the brain showing through the skull; Malmgren says expressly (concerning the specimens at hand, two this time): »in the Spitzbergen specimens the light spots on the dark crown characteristic for the last-named (i. e. *L. perspicillum* Kr.) are moreover wanting».

bands (see fig. 5, Tab. XVII of Lütken l. c. 1886); this specimen has 9 dark cross-bands (besides the dark spot on the point of the tail), but it does not stand alone, as in my fig. 1 e, Tab. VII a specimen with 10 cross-bands will be seen, whilst on the other hand, the number of bands in a specimen 114 mm. long is reduced to 6. — In specimens not quite young the sharp boundary between the dark cross-bands on the side of the body gradually disappear, dark colour-material being here deposited; the light interspaces between the bands then assume the form of saddle-shaped markings, which extend from the free edge of the dorsal fin down towards the lateral line, but they may be traced especially on the posterior part of the tail right across the body (cf. the two largest figures on Tab. VII). — The light dark-margined band, which extends across the neck and down on to the free fold of the gill-cover, is frequently divided in part or entirely, into three light spots by a dark longitudinal streak on each side, sometimes even into four spots by another dark streak on the middle line of the neck; rarely it is represented only by a light spot on and over the gill-cover.

In all the 3 females the eggs are small, at the most with a diameter of 1,5 mm. (in the 205 mm. female, taken the 26th of July 1901).

Distribution. *L. rossi* is a high arctic fish, hitherto only found in the Kara Sea, in Porsanger Fjord and at Spitzbergen.

At Spitzbergen, it has been taken at several places. First by a Swedish expedition of 1861 in Treurenberg Bay, at 5 fathoms depth, and at Fosters Islands in Hinlopen Straits, in each case a quite small specimen; next, by the Russian expeditions of 1899 and 1900 in the Stor Fjord, where the depth was 39—75 fathoms and bottom-temperature — 0,7 to — 1,6° C., a small specimen at each place. The Kolthoff Expedition of 1900 took one specimen 163 mm. long in Ise Fjord (Coal Bay) at 100 meters depth, and another of 87 mm., W. from C. Mitra (79° 10′ N. L. 11° E. L.) at 100 meters. Lastly, Dr. Johan Hjort in 1901 took a number of specimens (54,5—205 mm. long) in Green Harbour (an arm of Ise Fjord), where the depth was 75 fathoms.

In the Kara Sea the Dijmphna Expedition of 1882—83 obtained four specimens (65—223 mm. long) at 46—100 fathoms depth.

Finally, Dr. Hjort during the 1900 cruise of the »Michael Sars», obtained it in one of the fjords of East Finmark, namely in the innermost part of the Porsanger Fjord (the so-called Ostpol) where the depth was 30—50 fathoms and the bottom-temperature — 1,2° C.

Relation to allied Species.

L. rossi stands very close to the Greenland *L. reticulatus* Reinh.; it has however a more slender form, and on the whole fewer rays in the pectoral fin (|17| 18—19 |20| against |19| 20 |21|), and its colouration does not change over with age into the network-formation (reticulate). Concerning its relation to *L. reticulatus* var. *macrocephalus* see p. 70.

L. lütkenii Coll. is also a closely allied form (cf. p. 61).

Lycodes lütkenii Collett.

1878. *Lycodes reticulatus* Collett (nec Reinhardt), Fiske fra Nordhavs-Expeditionens sidste Togt; Forh. Vidensk. Selsk. Chria. 1878, No. 14, p. 59.

1880. *L. lütkenii* Collett, The Norwegian North-Atlantic Expedition, Fishes, p. 103, Pl. III, Fig. 25.

In relation to the total length, the length of the head is 25,7 %, the distance between the snout and the anus 47,3 %, the height over the anus 12,7 %, the longitudinal diameter of the eye 3,3 %, the length of the pectoral 16,8 %. The colour is gray-brown with 7 broad, dark cross-bands; a light band across the neck. The scales extend to a point under the anterior end of the dorsal fin. The lateral line is mediolateral. Pyloric appendages 2. The size (of the single specimen, a female), 370 mm.

D. 94. A. 76. P. 23.

Distribution. W. from North Spitzbergen, 459 fathoms.

Remarks on the Synonymy.

L. lütkenii was established in 1880 by R. Collett for a species, a single specimen of which, 370 mm. long, was taken by the North-Atlantic Expedition W. from North Spitzbergen, where the depth was 459 fathoms and the bottom-temperature — 1° C.; it was previously described by the same author in 1878 under the name *L. reticulatus* Reinhardt, an error that Collett himself corrected in the interval after he had examined the real *L. reticulatus* in the Zoological Museum of Copenhagen.

Later, *L. lütkenii* was reported, on the authority of Lütken, to have been again found in numbers both by the Dijmphna and Ingolf Expeditions. In 1886 he referred no less than 28 specimens from the Kara Sea to *L. lütkenii;* I have come to the conclusion however, that the largest of these specimens must be referred to *L. rossi* Malmgr., and that the others constitute a new species, belonging to the scaleless Lycodes: *Lycodes agnostus* (cf. p. 79). In 1898 further, Lütken mentioned quite briefly that the Ingolf had taken 6 *L. lütkenii* S. from Jan Mayen. Five of these however, are a colour-variety of *Lycodes pallidus* Coll. var. *similis* mihi (cf. p. 46). The sixth specimen was rightly determined according to my earlier opinion, as expressed in my preliminary report on the Lycodes of the Ingolf Expedition (l. c.), but after examining a whole series of similar specimens in the Stockholm Riks-Museum, brought from East Greenland by the Nathorst-Kolthoff Expeditions, I have come to a different conclusion, namely: that we have here a form which cannot be separated from *L. seminudus* Reinhardt, and must be considered as a colour-variety of this species (see further p. 72).

On *Lycodes lütkenii* Coll. (nec Lütken).

This form has been described in detail and well illustrated by Collett in his work on the fishes of the North-Atlantic Expedition. After I had learnt, through the kindness of Prof. Collett, to know it for myself, I became quite at one with him in believing it to be a distinct species from *L. reticulatus* Reinh. as C. has well shown (l. c. p. 104). In certain respects, *L. lütkenii* is nearly related to *L. seminudus*, as we now know it with the banded colour-markings, and I shall therefore briefly discuss the mutual relations of these forms.

If the single female specimen of *L. lütkenii* is compared with a specimen of *L. seminudus* of the same sex and similar size, they agree essentially in the most important proportions of the body; yet *L. lütkenii* is a less slender form, as will be seen:

	L. seminudus ♀	*L. lütkenii* ♀
Total length in mm.	335	370
Length of the head in % of total length	25,1	25,7
Distance from snout to anus — —	46,9	47,3
Height over the anus — —	10,2	12,7

The head is of similar form as in *L. seminudus*, but seems to be less broad-snouted. The eyes seem relatively a little smaller, their longitudinal diameter being 3,3 % of the total length (against 3,7 % in the above specimen of *L. seminudus*), and the flap of the gill-cover is not bent upwards. The number of teeth is somewhat less than in *L. seminudus;* on the intermaxillary I have counted 15 in series, 15 on the palatines, 5 on the vomer, and on the mandible 15 in series (cf. p. 78).

The dorsal fin begins at a distance from the snout, which is equal to 30 % of the total length. The number of rays in the unpaired fins falls within that in *L. seminudus*. The pectorals, on the other hand, show a very important difference, being of a much greater size, their length being 16,8 % of the total length; in none of the 18 specimens of *L. seminudus* does the length of the pectorals exceed 11,8 % of the total length.

The scales extend further forward than in the most scaled specimen of *L. seminudus*, namely to a point under the anterior end of the dorsal fin, but at the same time both the belly and anterior portion of the back are naked.

The colouration agrees on the whole with that in the banded forms of *L. seminudus;* that the dark bands are rather indistinct (except on the dorsal fin) comes probably from the advanced size of the specimen.

The differences mentioned, especially the less slender form of the body, and the large pectorals, seem to me so important, that *L. lütkenii* Coll. ought to be held distinct from *L. seminudus* Reinh.

(Later. *L. lütkenii* presents even greater resemblance to *L. rossi* Malmgr., whose appearance in the adult condition is now known. Of important differences I can only mention, that in *L. rossi* the pectoral fins are shorter (their length being 13,1—13,6 % of the total length) and contain fewer rays, namely 17—20. All the same, I think it best to keep these forms separate so long as transitional forms are not found).

Lycodes reticulatus Reinhardt.

Tab. II, Fig. 2. Fig. 9—10 in text.

1835. *Lycodes reticulatus* Reinhardt, Overs. Kgl. D. Vidensk. Selsk. Forh. 1834—35, p. 77.
1838. *L. reticulatus* Reinhardt, Kgl. D. Vidensk. Selsk. Skr. VII, p. 167, Tab. 6.
1880. *L. reticulatus* Lütken, Vidensk. Medd. Naturh. Foren. Kbhvn., p. 318 (partim).
1895. *L. reticulatus* Smitt, Skandinaviens Fiskar II, p. 611 (partim).
1897. *L. reticulatus* Vanhöffen, Grönland-Expedition der Gesellschaft für Erdkunde zu Berlin, II, 1, p. 101.

The height over the anus amounts to 11,3—14,2 % of the total length. The length of the head in males is 25,1—26,5 %, in females 22,4—24,4 % and the longitudinal diameter of the eye 4—2,7 % of the total length. The distance between the snout and the anus in males is 46,7—49,7 % of the total length, in females 46,2—47,4 %. The length of the pectoral is 13—14,2 % of the total length. Young specimens have 7—9 dark cross-bands on the trunk and tail, which (all or essentially only the foremost) form network markings in the older; a light band across over the neck

and dark lines of network on the sides of the head. The scaly covering reaches to a point under or a little in front of the anterior end of the dorsal fin, but the belly and the anterior part of the back as well as the fins are naked. The lateral line is mediolateral. Pyloric appendages 2. Size up to 380 mm.

D. 92—93. A. 75. P. 19—21. Vert. 93 (21—22 + 72—71).

Distribution. West Greenland, ca. 100 fathoms.

Remarks on the Synonymy.

Of the 10 specimens referred by Lütken (l. c.) to *L. reticulatus* Reinh., I think we must reject the following: Nr. 18 must be brought under *L. seminudus* Reinh.; Nr. 24 and Nr. 25, now prepared skeletons, I am unable to determine with perfect certainty, but in all probability they likewise belong to *L. seminudus* Reinh. Further reasons for this separation will be found under *L. seminudus* (cf. p. 71 and p. 75).

Lastly, it cannot be considered absolutely certain, that Nr. 23, type-specimen to *L. perspicillum* Kroyer, is the young form of the present species; it is better therefore, to discuss it separately with some young specimens of similar appearance which have appeared later (cf. p. 64—66).

Description.

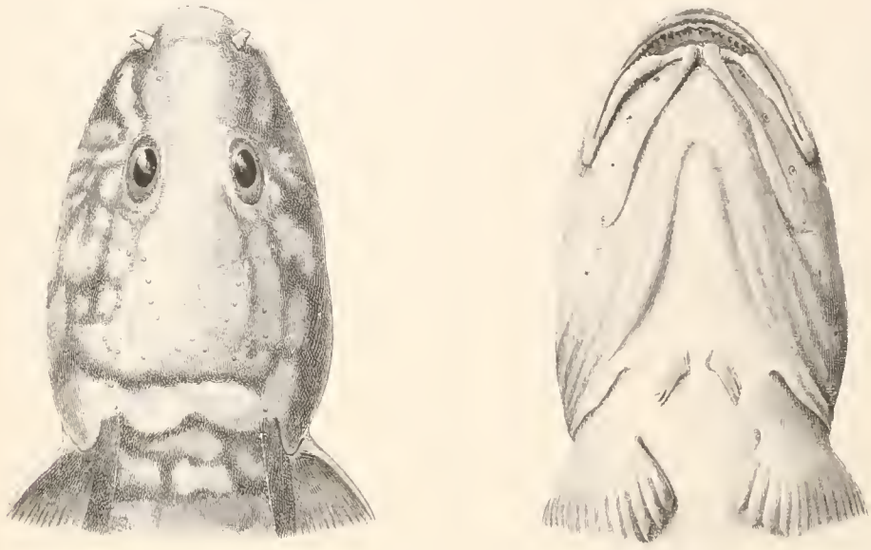
After separating out the foreign elements as mentioned above, our knowledge of *L. reticulatus* rests upon 6 specimens preserved in the Museum here. Their proportions are given below along with those of a seventh (255 mm. long) which was taken later by Dr. E. Vanhöffen and preserved in the Berlin Museum, from which I have had it for inspection.

		♀	♂	♀	♀	♂	♂	♂
Total length	in mm.	225	255	270	286	345	370	380
Length of the head	—	55	64	62	64	90	98	97
Distance from snout to anus	—	106	119	128	132	161	184	184
Height over the anus	—	25,5	32	37	33	49	47	?

The form is therefore somewhat elongated, the height over the anus going 7—8,8 times in the total length. The greatest breadth lies as usual forward on the cheeks, and is ca. $1^1/_3$ times greater than the height at the same place; the trunk is somewhat compressed, the height half way along being $1^1/_2$ times greater than its thickness, and the tail posteriorly becomes gradually more and more compressed. The tail has a slight advantage in length over the rest of the body, the distance between the snout and anus being in males 46,7—49,7 % of the total length, in females 46,2—47,4 %.

The length of the head amounts in the males to 25,1—26,5 %, in the females to 22,4—24,4 % of the total length. Seen from the side the upper and lower margins each form a slightly bent line, seen from above (fig. 9 in text) the outline approaches an oval form. The head above is somewhat arched, and rounded towards the sides, which again are convex; the under surface is also slightly arched. The eyes are rather small and as usual relatively the smallest in full-grown specimens, so that their longitudinal diameter is 6—10 times in the length of the head or 4—2,7 % of the total length; the distance between the two eyes is almost equal to the longitudinal diameter of the eye. The length of the snout to the eye is 7,8—9 % of the total length. The upper jaw reaches to the

perpendicular line through the centre or the posterior third of the eye, and extends anteriorly a little in front of the lower jaw. The lips are particularly fleshy; the underlip has an overhanging fold on each side, and the fold of skin along the underjaw's lower margin droops like a flap on the chin (see fig. 10 in text). The teeth are curved, conical or almost cylindrical; on the intermaxillary in front there is a double row, and on the underjaw 3 rows in front, but otherwise they are in a single



9 10

Fig. 9 10. Head of *Lycodes reticulatus,* seen from above and below. × 1.
From a 255 mm. long specimen (♂) from the innermost parts of Umanak Fjord (West Greenland), 190 m. Drygalski Expedition (Dr. E. Vanhöffen), 27. 3. 1893.

row; I have counted 9—14 teeth in a row on the intermaxillary, on the palatines 9—13, on the vomer 2—5 and on the underjaw 8—15 in a row.

The dorsal fin begins at a distance from the snout which is equal to 30—31,8 % of the total length; it contains 92—93 rays, the anal fin 75 rays. The ventral fins are small, almost of the same length as the diameter of the pupil. The length of the pectorals amounts to 13—14,2 % of the total length; they contain (19) 20 (21) rays.

The scales in all the present specimens (225—380 mm. long) reach to a point which lies under or a little in front of the anterior end of the dorsal fin, yet a part under the dorsal fin anteriorly and the belly to the anus (likewise a little behind this) are naked. In the smallest specimen the scaly covering ceases at some distance (23 mm.) from the end of the tail, but in the others it extends very close or even to the root of the tail. The fins are free of scales.

The lateral line begins on the back of the head over the gill-cover, curves down with a slight arch towards the median line, along which it then continues to the point of the tail. A few pores are to be seen forward on the trunk above this mediolateral lateral line.

The colouration is somewhat speckled (Tab. II, fig. 2 and fig. 9 in text). I cannot give a better notion of it than by citing Lütken's description, which says concerning the males: The colour-markings are as a rule in the form of a network on the trunk and tail, i. e. composed of an

irregular network of brown bands and lines of various breadth, which separate spots more or less large of a lighter ground-colour; but it is clear as a rule — and noticeable in all cases, if one seeks for it, in younger specimens — that the foundation for this network lies or has been in a system of 7—9 dark and especially dark-margined cross-bands, which extend from the trunk and tail out on to the dorsal fin where they are usually very distinct; between these bands, which extend down almost to the median line, are light parts or spots (often with a darker spot again in the light). Especially constant is such a dark margined light spot or cross-band across over the neck from the one gill-opening to the other, and also some light dark-bordered spots or sinuous markings posterior to and over the eyes, as well as on the sides of the head under the eyes as far the nostrils . And of the females it is said at the same place: «The two larger specimens have plainly the reticulate markings characteristic of the species in general; these extend out on to the dorsal fin and the posterior part of the anal fin as more or less distinct bands, and on the head like the markings already described above for the males; the smallest has also these on the whole, specific and very characteristic markings on the head, but on the trunk and tail on the other hand there are only 8 dark-margined cross-bands on the back and dorsal fin .

Distribution.

L. reticulatus is distributed along the southern parts of West Greenland. During the last century 7 specimens are known to have been taken there, at Julianehaab, Fiskenæs, Godthaab and Umanak. Only of one of these specimens is there the further information (by Dr. Vanhöffen) that it was taken in the innermost parts of Umanak Fjord (Karajak Fjord) in a trap at 190 metres depth.

According to Goode & Bean[1]) the species has been taken at several places on the east coast of the United States at 17—140 fathoms depth, but one cannot tell with certainty if these authors have had the true *L. reticulatus* before them; their figures (Pl. 78, fig. 273 and Pl. 81, fig. 281 a b) indicate so however.

Relation to allied forms.

L. reticulatus stands very close to the form from East Greenland I have called *L. reticulatus* var. *macrocephalus*; on p. 70 I give the reasons for holding them partly separate for the time.

Concerning the relation of this species to *L. seminudus* see p. 78 and to *L. rossi* p. 59.

Young forms of *L. reticulatus* (*L. perspicillum* Kroyer , Tab. II, fig. 3).

The specimens certainly *L. reticulatus* sent here from Greenland are medium-sized to large (225—380 mm.). Concerning the appearance of the young we have only conjectures, Prof. Collett in 1878 expressing the supposition that the small Lycodes described long ago by Kroyer under the name *L. perspicillum* was the young of *L. reticulatus*[2]). With this view Lütken agreed. In my preliminary report on the European-Greenland Lycodes I differed from this opinion and made *L. perspicillum* a distinct species without giving particular reasons for this step however; certain know-

[1]) Goode & Bean: Oceanic Ichthyology, p. 305; Mem. of the Museum af Comp. Zoology at Harvard College, vol. XXII, 1896.
[2]) Vidensk. Selsk. Forh. Chria. 1878, No. 14, p. 61.

ledge gained in the interval has brought me however to the position that Collett was probably right, and in that case the synonymy-list for *L. reticulatus* must be augmented by the following names:

1844. *Lycodes perspicillum* Kroyer, Overs. Kgl. D. Vidensk. Selsk. Forh. p. 140.
(1845). *L. perspicillum* Kroyer, in Gaimard: Voyages en Scandinavie, en Laponie etc., Zoologie, Poissons, Pl. 7.
1862. *L. perspicillum* Kroyer, Naturhist. Tidsskr. 3. R., 1. B., p. 289.
1880. *L. perspicillum* Lütken, Vidensk. Medd. Naturh. Foren. Kbhvn. p. 321.
1898. *L. perspicillum* Lütken, The Danish Ingolf Expedition, II, 1, p. 22, Tab. IV, Fig. 5.
1899. *L. Lütkenii* Holmquist (nec Collett), Ann. Mag. Nat. History (7), vol. 3, p. 221 (partim).
1901. *L. reticulatus* forma *frigida* Smitt, Bih. K. Sv. Vet.-Akad. Handl. Bd. 27, Afd. IV, No. 4, p. 29 (partim), No. 1.
1901. *L. perspicillum* Jensen, Vidensk. Medd. Naturh. Foren. Kbhvn., p. 213.

This form is known by 3 specimens from West Greenland. One of these is the 65 mm. long specimen[1]) described in detail by Kroyer and figured in Gaimard's Voyages (Pl. 7, fig. A[2]). A second specimen, 43 mm. long, was taken by the Ingolf Expedition of 1895 off Sukkertoppen (63° 24′ N.L.) at 68 fathoms depth; the figure cited, painted from the living fish, gives an idea of its appearance. Lastly, Dr. A. Ohlin who was with the Peary Auxiliary Expedition as Zoologist, also obtained a 43 mm. long specimen in Murchison Sound (between 77—78° N.L.) at 45 fathoms depth; it is the one of the two specimens which Holmquist (l. c.) has determined as *L. lütkenii* Coll.; F. A. Smitt has later referred it to *L. reticulatus* forma *frigida*; of the incorrectness of both determinations I have been able to convince myself by an examination of the specimen itself, which is preserved in the Riks-Museum at Stockholm.

The most important proportions of these 3 specimens[3]) are as follows:

Total length . . . . . in mm.	43	43	65
Length of the head	10	10	15
Distance from snout to anus . .	18,75	18,75	28
Height over the anus	4,25	4,5	6,5

The length of the head is therefore 23,1—23,3 %, the distance between the snout and the anus 43—43,6 %, the height over the anus 10—10,5 % of the total length. It is clear therefore, that these young forms are relatively long-tailed in comparison with the adult *L. reticulatus*, but this is no absolute objection to their being referred to the named species, because in other Lycodes I have observed an approximately similar disagreement between the young and adult individuals (cf. e. g. *L. rossi*, p. 57).

[1]) Kroyer mentions and figures (Pl. 7, fig. B) still another specimen, ca. 40 mm. long, but that has been disposed of long since.

[2]) The figure is not entirely successful, showing amongst other things not the slightest trace of scales.

[3]) Lütken mentions and figures still a fourth »*L. perspicillum?*», 69 mm. long, in »Dijmphna-Togtets zoologisk-botaniske Udbytte», 1886, p. 137—138, Tab. 17, fig. 6. This specimen was from Greenland (Disko Bay); it must have been lost as I cannot find it in our collection. Concerning the other »*L. perspicillum?*» from Kara Sea mentioned at the same place, see *L. rossi* Malmgr. (p. 56).

The colouration (cf. Tab. II, fig. 3, representing Kroyer's type-specimen) consists of 9—11 dark saddle-shaped cross-bands on the trunk and tail, the most posterior on the outermost point of the tail; each of these bands is bordered by a very dark, sharply outlined margin; the most anterior band is separated from the dark upper surface of the head by a light cross-stripe (neck-band); the head is encircled by a dark-brown O-shaped stripe, extending from the snout to the front margin of the eye, from the posterior margin of the eye to the gill-cover's edge and from there on to the neck in front of the light neck-band; further an oval spot, light-coloured but surrounded by a brown ring is observed behind the eye towards the upper edge of the head. — This regular banded marking seemed to me previously to tell against these individuals being considered the young of the network-marked *L. reticulatus;* but after I had seen in a series of specimens of the nearly allied *L. reticulatus* var. *macrocephalus*, just such a similar change in colouration, occuring with age (cf. p. 68—69 and Tab. VIII), I think it very probable that *L. perspicillum* can change in a similar manner to *L. reticulatus.*

The scales in the largest specimen show on the middle third of the body, namely on the portion from a point under the anterior end of the dorsal fin, to the middle of the tail; in the smallest specimen of *L. reticulatus* the scales also cease at some distance from the end of the tail.

Taking all in all, it seems to me extremely probable, that *L. perspicillum* Kroyer is the young stage of *L. reticulatus* Reinhardt, as Collett was the first to remark. Complete certainty, of course, will not be arrived at until the transition stages are found.

I may just add, that according to Goode & Bean (Oceanic Ichthyology, 1895, p. 307), the Albatross has taken specimens of *L. perspicillum* Kr. off the east coast of North America (45° 24½′ —47° 29′ N.L.), at 59—86 fathoms depth; the figures given (Pl. 80, fig. 278 & 278 a) suggest that these author's *L. perspicillum*, which they consider a separate species, is identical with Kroyer's; it agrees well therefore, that there should be a form on the east coast of North America which is probably the same as *L. reticulatus* Reinhardt (cf. p. 64).

var. **macrocephalus** m.

Tab. VIII, Fig. 1 a, b, c, d, e, f.

1886. *Lycodes reticulatus* Steindachner, Die Österr. Polarst. Jan Mayen (Internat. Polarforsch. 1882—83), 3. Bd., p. 107.

1901. *L. reticulatus* forma *reticulata* Smitt, Bih. K. Sv. Vet.-Akad. Handl. Bd. 27, Afd. IV, No. 4, p. 33 (partim), No. 26 & 28—36, Fig. 4—5.

1901. *L. reticulatus* forma *seminuda* Smitt, ibid. p. 31 (partim), No. 13.

In proportions of the total length, the height over the anus is 10—12,2 %, the length of the head in males 26,2—28,6 %, in females and young 25—26,6 %, the longitudinal diameter of the eye 4,3—4,8 %, the distance between the snout and the anus 46,2—50,6 %, the length of the pectorals 13—14,4 %. The young have 7—9 dark and dark-bordered cross-bands on a light ground, and in addition a dark spot on the end of the caudal fin; a light band across over the neck, and often a dark longitudinal streak on the sides of the head. In older specimens a more or less distinct

network-marking is developed from the dark borders of the bands, especially on the front portion of the body. The scaly covering in older individuals extends from a little behind the root of the pectorals to the end of the tail or ceases somewhat in front of this, but the belly and the anterior part of the back are naked; there are no scales on the fins. The lateral line is mediolateral. Pyloric appendages 2. Size 245 mm.

D. 91—96. A. 72—78. P. (19) 20—21.

Distribution. Northern East Greenland, ca. 50—150 fathoms; Jan Mayen, ca. 40—100 fathoms.

Of this form, which I have thought it best to consider as a variety of the foregoing species, there is a number (14) of specimens, presenting a special interest as they show transition stages in markings from the young with sharply marked black cross-bands to a network formation in the adults (cf. Tab. VIII), reminding one quite of that in *L. reticulatus*. For this reason Prof. Smitt (l. c.) has referred (the most of) these specimens to the West-Greenland species; I cannot but think however that the differences are important, and I must for the time being hold them in part distinct. Eleven specimens were taken at northern East Greenland by Swedish expeditions; two were taken at Jan Mayen in 1900 by the steamer Michael Sars and kindly handed over to me for examination by Prof. Collett; one was likewise taken at Jan Mayen by Dr. Fischer and has been placed at my disposal by Prof. F. Steindachner.

Description.

The most important proportions of all 14 specimens are as follows:

		East-Greenland 1900	Jan Mayen 1900	East-Greenland 1900	Jan Mayen 1883	East-Greenland 1900	East-Greenland 1899	East-Greenland 1900		Jan Mayen 1900	East-Greenland 1900				
							♀	♂	♂		♀		♂	♂	♂
Total length	in mm.	61	83	86	87	88	113	115	116	119	120	133	156	195	245
Length of the head	—	16	20,75	22,2	22,75	22,5	28,2	29,2	30,5	30	30,5	34	42	53	70
Distance from snout to anus	—	29	39,5	41,5	41,25	42	53	52,5	54,5	58	56,5	61,5	76	94	124
Height over the anus	—	6	9	9	9,5	8,8	11,5	12	12,5	14	13	14	16	20	30

The form is moderately elongated, the height over the anus going 8—10 times in the total length. The greatest thickness lies forward on the cheeks and is ca. $1^1/_3$ times greater than the height at the same place; the trunk is already somewhat compressed, as its thickness a little in front of the end of the pectoral goes about 1,4 times in the height, and the tail becomes gradually more and more compressed. The anus lies almost at the middle of the body, its distance from the snout being 46,2—50,6 % of the total length.

The length of the head is 26,2—28,6 % of the total length in males, 25—26,2 % in young females and small specimens. Seen from the side, its upper and lower margins each form a slightly curved line, seen from above the outline is somewhat oval. The top of the head is slightly arched. The eyes are placed high up, so that their upper margins project forward over the forehead; their

longitudinal diameter is contained 5,4—6,7 times in the length of the head, or is 4,3—4,8 % of the total length; the distance between the two eyes is a little smaller than the longitudinal diameter of the eye. The length of the snout, measured to the eye, is contained 2,7—3,3 times in the length of the head or is 8—9,8 % of the total length. The upper jaw reaches to the vertical line through the middle or anterior third of the eye, and anteriorly extends a little way in front of the under jaw. The lips are thick; the underlip has a dependant fold on each side, and the fold of skin along the lower margin of the lower jaw is spread out like a flap on the chin. The nasal tubes are well-developed. Along the upper and lower jaws there are shallow pits for the lateral line. The teeth are short but strong; I have counted 8—11 teeth in a row on the intermaxillary, 8—10 on the palatine, 1—5 on the vomer, 9—14 in a row on the mandible; forward on the intermaxillary and mandible there is further a posterior row of teeth.

The dorsal fin begins at a distance from the snout which is equal to 29,2—32,3 % of the total length; it contains 91—96 rays, the anal fin 72—78 rays. The ventral fins are short (almost of the same length as the longitudinal diameter of the eye). The length of the pectoral is almost equal to the distance from the snout to the posterior margin of the eye and amounts to 13—14,4 % of the total length; they contain 20—21 rays (only in one specimen — that of 113 mm. — have I found 19 rays).

Scales. The smallest of the present specimens, which is 61 mm. long, lacks any trace of scales. In the 83 mm. specimen (Tab. VIII, fig. 1 c) scales have begun to appear as a small strip round the lateral line, forward to the middle of the posteriorly extended pectoral and posteriorly almost the same distance behind the anus. The further development of the scaly covering consists essentially in the appearance of scales on the posterior part of the tail also, and at the same time the rows are increased in a vertical direction. Some variation exists however. Thus, the scaly covering in a 133 mm. long specimen (Tab. VIII, fig. 1 d) does not have any greater extension relatively than in that of 83 mm., whilst in another only 116 mm. long, it approaches distinctly nearer to the root of the tail. In some of the largest specimens the scales extend from a little behind the base of the pectoral to, or nearly to, the beginning of the caudal fin, but they are less close together at the root of the tail fin, and the belly as also a stretch on the back anteriorly are naked; in other specimens just as large the end of the tail is however still naked, and that holds also for a narrow stretch along the base of the dorsal and anal fins (Tab. VIII, fig. 1 e & f). No scales are to be seen on the unpaired fins.

The lateral line begins over the operculum, forms a slight arch on the shoulder and from there courses along the median line of the body. A shorter or longer series of pores, with wide interspaces and without the character of a true lateral line, is often to be seen on the anterior portion of the back above this mediolateral lateral line.

Colour. The young have 7—9 dark cross-bands on a light ground, and in addition a dark spot on the end of the tail; the bands again are bordered by a more or less marked edge of darker, almost blackish colour; the hindmost 2—5 bands extend out on to the anal fin as darkish streaks in line with those on the dorsal fin where the bands end; further forward the bands extend more or less down below the median line of the side. Across over the neck and on to the operculum extends a light band which is most frequently divided in part or entirely into three light spots by a dark streak on each side, which crosses from the dark edge bordering the neck-band in front and behind.

On the side of the head, from the snout to under the eye and out on to the gill-cover, a dark streak often runs. — The central part of the cross-bands becomes lighter and lighter with age, or several light spots appear in each band, retaining the dark border, so that a reticulate marking is formed, as is seen in fig. 1 e, Tab. VIII. The distinct network-marking does not occur equally early or strong in all specimens. The largest of those present (245 mm. long) is essentially at the same stage as that of 195 mm. represented in fig. 1 f, whereas the specimen only 156 mm. long represented in fig. 1 e, Tab. VIII, presents a very distinct reticulate marking. Of the specimens from Jan Mayen a somewhat distinct reticulate marking is already seen in that of 119 mm. (Tab. VIII, fig. 1 b), and even in the specimen 87 mm. long such a marking has already begun to form in the foremost band; in the specimen 83 mm. long (Tab. VIII, fig. 1 c) an oval spot, light and surrounded by a dark ring, is present behind the eye towards the upper side.

Concerning the reproduction, but little can be elucidated, as none of the females are more than 120 mm. long. In a female of this size, taken on the 7th of July 1900 at East Greenland (72° 25′ N.L.), the eggs measure scarcely 0,5 mm. in diameter. In the largest of the males (245 mm. long) the testes are well-developed, 16,5 mm. long.

Distribution. *L. reticulatus* var. *macrocephalus* is a high-arctic fish, only known from northern East Greenland and Jan Mayen.

At East Greenland 11 specimens, whose size lay between 61 and 245 mm., were taken between 72° 25′ and 74° 35′ N.L. The several localities are distributed as follows:

72° 25′ N.B. 17° 56′ W.L.	300 metres	6 specimens	Kolthoff Expedition	1900.
73° 32′ — 24° 38′ —	100—110 -	1 —	Nathorst —	1899.
73° 55′ — 19° 20′ —	150 -	3 —	Kolthoff —	1900.
74° 35′ — 18° 15′ —	150 -	1 —	— —	—

At Jan Mayen the Austrian Polar station in 1882—83 took a small specimen (87 mm.) at a depth of 100 fathoms, and the Michael Sars 2 specimens (83—119 mm.) at a depth of 60—75 m. on the 8th of August 1900.

Appendix.

Two small Lycodes, taken during the cruise of the Fylla in 1886 by the botanist Th. Holm at northern West Greenland, namely in Baffins Bay, at 92 fathoms, may perhaps be referred to *L. reticulatus* Reinh. var. *macrocephalus*. These specimens measure:

Total length	in mm.	45,5	47,5
Length of the head	»	11,5	12
Distance from snout to anus	»	21	22
Height over the anus	»	5,25	5,5

The height over the anus is therefore 11,3—11,6 %, the length of the head 25,3 %, the distance between the snout and the anus 46,2—46,3 % of the total length. In respect to the most important proportions they thus stand very close to the above-described young *L. reticulatus* var. *macrocephalus*, but the tail is relatively a little longer and the height over the anus a little greater. The colour-

tion is also very similar: 7 saddle-shaped bands, bordered by a dark margin, break the light ground-colour; between the foremost band and the dark-coloured neck there is a light cross-stripe. In addition, a brown stripe is present on the head, extending from the snout under the eye on to the gill-covers; further, there is a light oval spot but surrounded by a dark margin, behind the eye towards the upper side. The pectorals count 20—21 rays; in one specimen there are 92 rays in the dorsal fin, 73 rays in the anal.

One of these specimens is represented in fig. 1 a on Tab. VIII.

Comparison with *Lycodes reticulatus*.

The present form displays no slight resemblance to *L. reticulatus* Reinh. from West Greenland, mainly in respect to colouration, as both in the older stages have the dark cross-bands transformed to a more or less distinct network-formation; further, they have a mediolateral lateral line; nor do the numbers of rays in the fins present any differentiating character. On the other hand, it seems as if the variety *macrocephalus* was a form with relatively large head and large eye, which will appear from the following comparison between two male specimens of almost equal size:

	L. reticulatus forma *typica* ♂	*L. reticulatus* var. *macrocephalus* ♂
Total length . . . . . in mm.	255	245
Length of the head . . . . . in % of total length	25,1	28,6
Longitudinal diameter of the eye — —	3,5	4,3

Further comparison between almost equally large adult specimens is unfortunately not possible for the time being, as *L. reticulatus* is not present in smaller nor var. *macrocephalus* in larger male specimens than those given, and there is also a great gap in size between the females at hand. I must provisionally suggest that the differences noted cannot be overlooked without further investigation and that two varieties are to be reckoned with.

If we bring «*L. perspicillum*» Kr., the supposed young of *L. reticulatus*, into the comparison, we see that the young of the latter have likewise a smaller head as well as a relatively longer tail:

	L. reticulatus juv.? (*L. perspicillum* Kr.)			*L. reticulatus* var. *macrocephalus*				
Total length . . . . . in mm.	43	43	65	61	83	86	87	88
Length of the head . . . . . in % of total length	23,3	23,3	23,1	26,2	25	25,8	26,1	25,6
Distance from snout to anus . . . . . — —	43,6	43	43,1	47,5	47,6	48,3	47,4	47,7

L. rossi Malmgr. (from Spitzbergen and the Kara Sea) is also near to the present form, but it has a smaller head (length, 22,4—25,3 % of the total length) and relatively small eyes (longitudinal diameter, 3,6—4 % of the total length). In addition, *L. rossi* has on the average fewer rays in the pectorals, namely (17) 18—19 (20), and the marking does not change over into the reticulate.

Lycodes seminudus Reinhardt.

Tab. IX, Fig. 1 a, b, c, d, e & Tab. X, Fig. 1 a, b. Fig. 11—14 in text.

1838. *Lycodes seminudus* Reinhardt, Kgl. D. Vidensk. Selsk. Skr. VII, p. 223.

1878. *L. seminudus* Collett, Fiske fra Nordhavs-Expeditionens sidste Togt, Sommeren 1878; Forh. Vidensk. Selsk. Chria. 1878, No. 14, p. 67.

1880. *L. seminudus* Lütken, Vidensk. Medd. Naturh. Foren. Kbhvn., p. 325.

1880. *L. reticulatus* Lütken, ibid. p. 318 (partim).

1880. *L. seminudus* Collett, The Norwegian North-Atlantic Expedition, Fishes, p. 113, Pl. IV, Fig. 28.

1895. *L. reticulatus* Smitt, Skandinaviens Fiskar, II, p. 611 (partim).

1897. *L. seminudus* Vanhöffen, Grönland-Expedition der Gesellschaft für Erdkunde zu Berlin, II, 1, p. 100.

1898. *L. Lütkenii* Lütken, The Danish Ingolf-Expedition, II, 1, p. 22 (partim).

1901. *L. reticulatus* forma *seminuda* Smitt, Bih. K. Sv. Vet.-Akad. Handl. Bd. 27, Afd. IV, No. 4, p. 31 (partim), No. 14–15, 17—18 & 20—22.

The height over the anus is 9—10,6 % of the total length. The length of the head in males is 27—30 %, in females 25—28 % of the total length. The longitudinal diameter of the eye is 5,3—3 % of the total length. The distance between the snout and the anus is 44,6—50,6 % of the total length. The length of the pectoral is 9,6—11,8 % of the total length. The colour is a uniform gray-brown, or there are indistinct dark cross-bands on the trunk and tail, or distinct dark cross-bands (7—9) and as a rule a light neck-band. The scales as a rule reach forward only to a point a little behind, over or a little in front of the anus (seldom to the tip of the flattened-out pectoral). Lateral line mediolateral. Pyloric appendages 2. The size ca. 500 mm.

D. 91—97. A. 73—78. P. (19)20—22.

Distribution. West Greenland, ca. 100 fathoms; East-Greenland, ca. 100—400 fathoms; Jan Mayen, 370 fathoms; off the Norway-Shetland Slope, 600 fathoms; Spitzbergen, 260 fathoms; Kara Sea, 92 fathoms.

Remarks on the Synonymy.

The species *L. seminudus* was formed in 1838 by Prof. Reinhardt sen. for a Lycodes almost 1½ feet long, taken at Umanak in West Greenland. From *L. reticulatus* Reinh. to which it stood near in several ways, it was distinguished at the first glance in that the body was uniformly coloured and naked from the snout to the vertical line through the anterior end of the anal fin; in his detailed description however, R. laid less weight on these characters, rightly paying attention especially to other more important structural features (number of the teeth, shortness of the pectorals etc.).

The same specimen was dealt with by Lütken in his treatise of 1880. L. came to the conclusion, after some acquaintance with larger males of *L. reticulatus* had been gained in the interval, that there was nothing else on which a specific difference between *L. reticulatus* and *L. seminudus* could be based, than the distinctly less extension of the scaly covering in the latter. This impression in my opinion was due to an erroneous division of the material which Lütken had. So far as I can see, namely, Nr. 18 (l. c. p. 332) of the specimens referred by Lütken to *L. reticulatus* belongs to the present species; this individual, whose length is 365 mm., possesses certainly a weakly banded marking and a somewhat widely distributed scaly covering, but in more important characters it seems to agree with *L. seminudus*. In all probability also, the specimens Nr. 24 and Nr. 25 (l. c p. 332) referred by Lütken to *L. reticulatus* belong to *L. seminudus;* perfect certainty, however, cannot be attained as they are now unfortunately prepared skeletons[1]).

[1]) Lütken says of these specimens, that the colouration was not at all and the scaly covering only partly recognisable. The moderate condition of these individuals has naturally brought it about that a failure in determination could more easily take place.

In later years 2 further specimens of *L. seminudus* have been taken at West Greenland. One of these, a uniformly coloured female of 335 mm., was taken 1893 by Dr. E. Vanhöffen in Umanak Fjord; it was kindly handed over to me for investigation by the Berlin Museum. The other was sent to our Zoological Museum in 1901 by P. Müller of Jakobshavn, governor of the colony; it is only 180 mm. long and of special interest, as in agreement with the above mentioned specimen it shows a not very distinct, yet clearly recognisable, banded marking.

Apart from West Greenland *L. seminudus* was again found at Spitzbergen by the Norwegian North-Atlantic Expedition, as a single, uniformly coloured specimen only 128 mm. long; Prof. Collett has kindly handed it to me for study and I can confirm the correctness of his determination.

In addition to the uniformly coloured or weakly banded form, *L. seminudus* may however also appear with very distinct cross-bands and with a light band across over the neck. In the Riks-Museum of Stockholm I have had the opportunity, through the kindness of Prof. Smitt, to see no less than 7 specimens (129—280 mm. long) from East Greenland (Nathorst and Kolthoff Expeditions of 1899 and 1900) of a form, which only differs from the typical *L. seminudus* by the pronounced, livelier marking. In his treatise of 1901 F. A. Smitt had rightly referred these specimens to Reinhardt's *L. seminudus*, but in this species he sees only a form of *L. reticulatus*, an opinion I cannot agree with.

A similar specimen (180 mm. long) had also been taken by the Ingolf Expedition south from Jan Mayen. In my preliminary notice on the Lycodes of this expedition (l. c. p. 213), I have referred it to *L. lütkenii* Coll., which again I identified with *L. rossi* Malmgr. from Spitzbergen, as a small specimen (67 mm. long) from the Ingolf Expedition seemed to me a transition-form between *L. rossi* and the larger specimen from the same expedition referred to *L. lütkenii*. This position I have meanwhile been obliged to give up. *L. rossi* Malmgr. is without doubt the young stage of *L. celatus* established by myself (cf. further p. 56). And since both the specimen of the Ingolf Expedition (that of 180 mm.) and the above-mentioned 7 specimens of the Nathorst-Kolthoff Expeditions seem constantly to have very short pectorals, whereas *L. lütkenii* Coll. is characterized specially by large pectoral fins, I consider it best to keep the last named separate from *L. seminudus*. And the small specimen referred to (from the Ingolf Expedition), which I had erroneously taken for a connecting-link with *L. rossi*, becomes the young form of *L. seminudus* (cf. further p. 76—77).

Description.

Proportions of the uniformly coloured or indistinctly banded form:

		♀[1]	♀	♀	♂	♂
Total length	in mm.	128	180	335	365	445
Length of the head	—	32	46	84	100	127
Distance from snout to anus	—	57	82,5	157	184	225
Height over the anus	—	12,5	18,75	34	38,5	50

Proportions of the distinctly banded form:

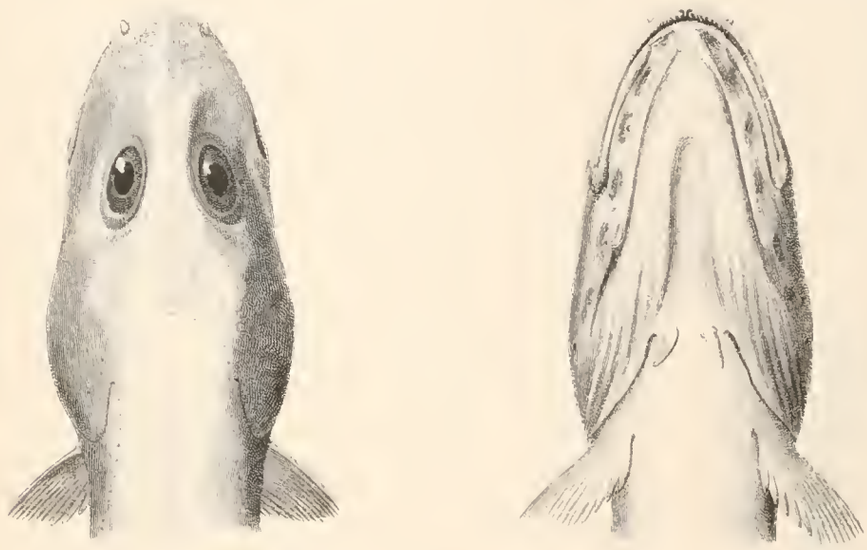
		♂	♂	♀[2]	♂	♀	♀	♂	♂
Total length	in mm.	129	161	180	180	197	218	250	280
Length of the head	—	36	43,5	48,5	49	52,5	61	67,5	77
Distance from snout to anus	—	61,5	77	88	83	94	106	116	130
Height over the anus	—	12	16	19	16	18	22	25,5	28

The form is elongated, the height over the anus going ca. $9^1/_2$—11 times in the total length. The greatest thickness lies forward on the cheeks and is equal to or somewhat greater than the height at the same place; the trunk is tolerably compressed, its height midway being $1^1/_2$ greater than the thickness, and the tail becomes more and more slender posteriorly. The anus in the males lies at, or a little in front of, the middle of the body, its distance from the snout being 46,1—50,6 % of the total length; in females its distance from the snout is 44,6—48,3 % of the total length.

[1]) The specimen is from Spitzbergen (North-Atlantic Expedition), the others from West Greenland.

[2]) This specimen is from Jan Mayen (Ingolf Expedition), the others from East Greenland (Nathorst and Kolthoff Expeditions).

The length of the head in males is 27—28,5 %, in females 25—28 % of the total length. Seen from the side, the upper margin is almost horizontal at the neck, and from there slopes gradually, evenly and almost in a straight line down towards the snout, which is low; the under margin rises up slightly only in front; seen from above, the head decreases but little in breadth towards the anterior end of the snout, which is broadly rounded off so that the outline of the head forms an elongated oval. The crown is flat, the cheeks almost perpendicular or only slightly convex; taken with the depressed and broad, somewhat flat snout, this gives the head a characteristic appearance, reminding one somewhat of a pike. The eyes are situated high up, so that their upper border juts forward over the forehead; the size decreases a good deal relatively with age, their longitudinal diameter going 4,8—9,4 times in the length of the head, i. e. 5,3—3 % of the total length; the distance



11 12

Fig. 11 12. The head of *Lycodes seminudus*, seen from above and underneath. × 3/4.

From a 335 mm. long specimen (♀) from the innermost parts of the Umanak Fjord (West Greenland), 200 m. Drygalski-Expedition (Dr. E. Vanhöffen), 17.3.1893.

between the two eyes is almost equal to 2/3 rds of the longitudinal diameter of the eye (in old specimens quite equal to this). The length of the snout to the eye, is 3,5—2,9 times in the length of the head or 7,5—10 % of the total length. The upper jaw reaches to a perpendicular line through the centre or anterior third of the eye, and anteriorly it extends a little in front of the lower jaw. The lips are rather fleshy along the upper jaw and on the sides of the lower, but somewhat thin in front on the latter; the fold of skin along the under margin of the latter is relatively little developed the whole way (see fig. 12 in text). The free flap of the gill-cover is relatively long and bent up at the corner. There is a number of shallow grooves for the lateral line along the upper and under jaws. The teeth are truncate and conical or almost cylindrical, in a double row on the intermaxillary anteriorly, in three rows (2 in young specimens) on the mandible anteriorly, but otherwise form a single row; in larger specimens I have counted 17—24 teeth in a row on the intermaxillary, 16—24 on the palatines, 3—6 on the vomer and 17—26 in a row on the mandible.

The dorsal fin begins at a distance from the snout equal to 29,6—33,7 % of the total length; it contains 91—97 rays, the anal fin 73—78 rays. The ventral fins are small (almost of the same length as or even shorter than the longitudinal diameter of the pupil). The pectorals are relatively broad but short, their length being 9,6—11 % of the total length or always less than the distance between the snout and the posterior margin of the eye; they contain (19) 20—22 rays, of which the lower project at their points from the connecting skin.

The scales extend from the end of the tail more or less far forward on the sides of the body; the covering tends to a point in front like a wedge, leaving the side of the back and belly naked for some distance; there are no scales on the fins, or in any case only on the posterior half of the dorsal fin, along the base. In the uniformly coloured or weakly banded form, the scaly covering is subject to great variation in regard to distribution in part independently of the age of the individuals, it seems. In the type-specimen, which is 445 mm. long, the scaly covering extends forward scarcely to a point which lies directly over the origin of the anal fin. In the second largest (365 mm.) on the other hand, the scales reach to a point at the tip of the flattened pectoral and have thus attained the greatest extension known as yet for the species. In the 335 mm. specimen (Tab. X, fig. 1 b) and that of 180 mm. (Tab. X, fig. 1 a) the scaly covering extends forward a little in front of the anus, in Collett's specimen from Spitzbergen (128 mm. long) just a trifle in front of the anus. The specimens present of the distinctly banded variety have a much more regular distribution of the scales (Tab. IX, fig. 1 b, c, d, e). In 3 specimens of 280, 218 and 180 mm. the scaly covering extends forward like a wedge to a point, which lies directly over the anus, whilst in 5 specimens of 250, 197, 180, 161 and 129 mm. it stops at a short distance behind the anus.

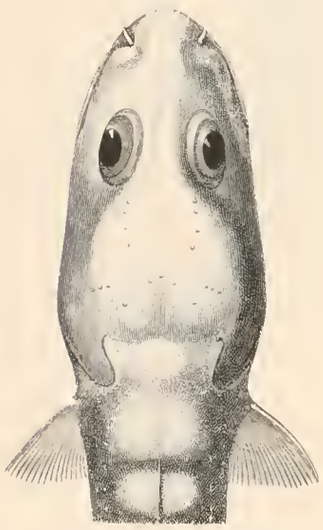


Fig. 13. The head of *Lycodes seminudus*, of the variety with distinct cross-bands. × 3/4. From a 280 mm. long specimen (♂) from northern East Greenland (Franz Joseph's Fjord) 760 m. Nathorst Exped., 14.8.1899.

The lateral line begins over the gill-cover, forms an arch over the shoulder and courses from there along the middle of the body. On the foremost part of the trunk in well-preserved specimens, a shorter or longer series of pores is present above the lateral line, with wide interspaces and without forming any true lateral line.

Colour. The present species occurs in two colour-varieties, it seems, namely, one uniformly coloured or with slightly marked cross-bands, the other with distinct cross-bands. — Those entirely uniform of a gray-brown are: Reinhardt's type-specimen (445 mm. ♂) from Umanak; Vanhöffen's specimen (335 mm. ♀) from Umanak Fjord (Tab. X, fig. 1 b)[1]; Collett's specimen (128 mm. ♀) from Spitzbergen. A weak banded marking is seen in: the specimen (365 mm. ♂) from Godthaab, referred to *L. reticulatus* by Lütken, also the specimen (180 mm. ♀) recently sent from Jakobshavn. In the first of these, there are above the median line 7 dark bands, 2 on the trunk and 5 on the tail, which again are somewhat lighter in the centre; in the small specimen, a similar number of somewhat more apparent bands are seen (Tab. X, fig. 1 a). —

[1]) By very favourable light, exceedingly weak traces of a faded, banded marking may perhaps be detected in this specimen.

The specimens from East Greenland and Jan Mayen all show a livelier colouration, as is seen in Fig. 1 b, c, d, e of Tab. IX and Fig. 13 & 14 in the text. They have distinctly 2 dark bands on the trunk and 5—7 on the tail; in addition, the end of the tail (fin) is dark-coloured; the dark bands are especially distinct on the dorsal fin and the upper part of the body, lower down they may disappear in the general darkish ground-colour, but they are often also, especially on the tail posteriorly, separated by light interspaces right across, the light may even separate the bands forward on the body and constitute an important part of the colouration. The dark bands are light in the centre, often so light that the margins show as a distinct, dark-brown frame, or that an originally single band dissolves into two; sometimes the light in the band is partly limited to a rounded-off spot (see Fig. 1 e of Tab. IX). Right across the neck, from gill-cover to gill-cover stretches a light, dark-bordered stripe, which sometimes however can be limited to a rounded-off light spot on the centre of the neck or very rarely may disappear almost entirely.

As already mentioned, I am much inclined to refer Nr. 24 and Nr. 25 among Lütken's *L. reticulatus* (l. c. p. 332) to *L. seminudus*. Full certainty cannot be attained as the specimens are now skeletons, but the considerable length of the head (28,5—29,5 % of the total length), the rich provision of teeth (on the intermaxillary 17—18 teeth in a row, 5—7 on the vomer and 20 in a row on the mandible), as also the shortness of the pectorals (10 % of the total length) seem to point certainly in this direction. The number of the vertebræ is 95—96 (23—24 + 72).

[Later addition. During my participation in the summer cruise of the Michael Sars in 1902, a specimen of *L. seminudus* was taken on the 26th of June at 62° 58′ N.L. 1° 56′ E.L., and at c. 600 fathoms; the place lies in the cold area off western Norway.

It is a ♂ with all the known characters of the species; its most important proportions are as follows:

Total length	268	mm.
Length of the head	73	—
Distance from snout to anus	128	—
Height over the anus	28	—

In proportions of the total length, the length of the head is therefore 27,2 %, the distance between the snout and the anus 47,8 %, the height over the anus 10,4 %; of the same length the distance between the snout and the anterior end of the dorsal fin is 32,1 %, the length of the pectoral 10,6 %; the latter fin contains 21 - 22 rays.

The scaly covering reaches from the end of the tail forward to a point, which lies an eye's length behind the point of the pectoral, being wedge-shaped in front; the scales extend out on to the basis of the posterior part of the dorsal fin. The body is without markings.

Further, our Museum has recently received through Mr. H. Kraul, director of the Upernivik colony in West Greenland, 4 very large *L. seminudus* (400—497 mm. long), all males, which are remarkable for their relatively large head (its length being 27,6—30 % of the total length). The pectorals, which count (19) 20 rays, amount in length to 11,1—11,8 % of the total length. The scaly wedge in one specimen extends forward slightly in front of the vertical line through the anterior end of the

anal fin, in the three others it ceases a little behind this point. The colouration has almost vanished, yet traces of dark cross-bands and light interspaces may be detected, especially on the dorsal fin.]

On an early and a young stage of *Lycodes seminudus*.

Amongst the material brought home by the Ingolf Expedition is a small, 67 mm. long Lycodes which I take to be an early stage of *L. seminudus;* it remained undetermined and is not mentioned in the report on the ichthyological results of the expedition.

This specimen was taken at St. 116 (south from Jan Mayen, 371 fathoms), at the same place therefore, where the 180 mm. long specimen of *L. seminudus*, mentioned previously, was taken — a circumstance that might at once make one think of the possible specific identity of these specimens.

The proportions of this little specimen are as follows:

Total length	67 mm.
Length of the head	18 —
Distance from snout to anus	31 —
Height over the anus	6 —

Putting these figures into percentage, one finds that the length of the head is 26,9 %, the distance between the snout and the anus 46,3 %, the height over the anus 9 % of the total length.

As is shown in Fig. 1 a of Tab. IX, which represents this young specimen natural size, it has 8 broad, dark bands over the body. The first band extends from the back of the head to the beginning of the dorsal fin, the second lies over the tip of the pectoral, the anterior margin of the third lies over the anus, the eighth (last) band covers the end of the tail. All the bands reach from the outer border of the dorsal fin across the back and traverse the linear depression running along the middle of the body; the fifth reaches to near the anal fin, the sixth to the basis of this fin, the seventh and the eighth extend a little on to it. The ground-colour of the body is yellowish white, except on the belly, which is coloured blue-black on account of the peritoneum shining through; the cross-bands have chestnut-brown borders and a somewhat lighter centre. Lastly, one can discern an indication of a neck-band, namely a light spot in the centre line of the neck, beyond the upper notch of the gill-openings. Scales are wanting and a lateral line is not yet apparent. The dorsal fin contains 95 rays, the anal 77, and the pectoral 22.

If we now compare this young individual with the specimen of *L. seminudus*, 180 mm. long, from the same Ingolf station, we find such a great agreement between them that their specific identity cannot be doubted. Figure 14 below shows this larger specimen, natural size.

The length of the head is 27 %, the distance between the snout and the anus 49 % of the total length (180 mm.). The head has thus relatively the same length as in the younger specimen, whereas the tail has less preponderance in length over the rest of the body. It must be added that it is a female with very small eggs in the ovary.

On the trunk are again the two broad bands, although at the first glance they are not recognised as corresponding to the dark bands of the younger specimen; the central part namely has become very light and takes up also such a large part of the band that only its borders stand out

as dark cross-stripes. The tail has only 5 dark bands. None of the bands show, as in the younger stage, any sharp boundaries below, as the ground colour has here become dark, but they stand out clearly against the yellow-white colour of the back and dorsal fin. The neck-band is more strongly developed than in the younger individual and extends from gill-cover to gill-cover as a narrow, light band.

The number of rays in the fins is in tolerably close agreement with that in the younger specimen, namely 94 in the dorsal fin, 75 in the anal and 21 in the pectoral.

Fig. 14. *Lycodes seminudus* Reinh. (♀). × 1. S. from Jan Mayen, 371 fathoms. Ingolf Expedition 1896.

Lastly, amongst the specimens from the Kara Sea labelled by Lütken *L. pallidus*, I have found a young Lycodes which undoubtedly belongs to the species *L. seminudus;* this specimen is not named with the other *L. pallidus* in Lütken's report on the fishes of the Dijmphna Expedition, so that L. has probably regarded the determination as less certain.

Its proportions are as follows:

Total length	87 mm.
Length of the head	22,5 —
Distance from snout to anus	40 —
Height over the anus	8 —

The length of the head is thus 25,9 %, the distance between the snout and the anus 46 %, the height over the anus 9,2 % of the total length, which numbers fall within those found in *L. seminudus*. Just as certain a mark of recognition lies in the small pectorals whose length is only 10,3 % of the total length; they contain 19 rays.

Although the specimen is somewhat bleached, one can readily see that the colouration in the main has been the same as in the smaller specimen just described, namely 8 broad, dark and dark-bordered cross-bands, 2 on the body and 6 on the tail, in addition a dark spot at the end of the caudal fin; on the neck one can detect signs of a light cross-band. Scales have begun to appear on the tail, at some distance behind the anus.

It was taken by the Dijmphna Expedition in the Kara Sea at 92 fathoms depth.

Distribution.

A specimen was taken at West Greenland at each of the following localities: Godthaab, Jakobshavn, Karajak Fjord (in the innermost part of Umanak Fjord, 200 meters depth) and Umanak, also 4 specimens at Upernivik. At East Greenland the Nathorst Expedition of 1899 took a specimen as far up as 74° 52′ N.L. 17° 16′ W.L. (S. from Shannon Island), 350 meters, and 2 specimens in

Franz Joseph's Fjord, 760 meters, whilst the Kolthoff Expedition of 1900 took 4 specimens at various places in Franz Joseph's Fjord, 200—300 meters. The specimen of the North-Atlantic Expedition was taken on the north coast of Spitzbergen, where the depth was 260 fathoms and bottom-temperature of + 1,1° C. The Dijmphna Expedition took the above-mentioned, but 87 mm. long, specimen in the Kara Sea at 92 fathoms depth. The 2 specimens of the Ingolf Expedition were caught south from Jan Mayen, where the depth was 371 fathoms and the bottom-temperature — 0°4 C. Lastly, the Michael Sars in 1902 took a specimen in the cold area off the west coast of Norway, at 62° 58′ N.L. 1° 56′ E.L., 600 fathoms.

Comparison between *Lycodes seminudus* and *L. reticulatus*.

As it has often been doubted that these names represent two different species, it may be of use to go over the most important differences between them, so far as they are limited in this treatise.

The form of the body is more slender in *L. seminudus* than in *L. reticulatus*, so that the height over the anus is 9—10,6 % of the total length in the former against 11,3—14,2 % in the latter.

The head is relatively larger in *L. seminudus* than in *L. reticulatus;* in the first-named namely, the length in the males is 27—30 %, in the females 25—28 % of the total length, whereas in the latter the numbers are respectively 25,1—26,5 % and 22,4—24,4 %. The form also is somewhat different: seen from the side, the head in *L. seminudus* is more pointed forward, which arises from the snout being much compressed in this species by comparison with *L. reticulatus;* the flat crown and the almost vertical cheeks in *L. seminudus* are also in contrast to the convex cheeks and the somewhat arched crown of *L. reticulatus*. Next, *L. seminudus* has larger eyes, their longitudinal diameter being 5,3—3 % of the total length, whilst the same proportion sinks with age from 4—2,7 % of the total length in *L. reticulatus*. The lips in *L. seminudus* are less fleshy than in *L. reticulatus*. and the double fold of skin hanging down from the chin in the latter (see fig. 10 in text) is very little developed in *L. seminudus* (see fig. 12 in text). Further, the bones of the mouth in *L. seminudus* have a greater equipment of teeth than those of *L. reticulatus;* thus in *L. reticulatus*, I have counted 9—14 teeth in a row on the intermaxillary, 8—15 in a row on the mandible, 9—13 on the palatine; in *L. seminudus* on the other hand, 17—24 teeth in a row on the intermaxillary, 17—26 on the mandible, 16—24 on the palatine. Lastly may be mentioned, that the free flap of the gill-cover is relatively long in *L. seminudus*, and that in this species the distance between the gill-openings across the belly is much less than in *L. reticulatus* (cf. fig. 12 with fig. 10 in text).

A very evident difference is shown in the size of the pectorals, as their length in *L. reticulatus* is 13—14,2 % of the total length, but only 9,6—11,8 % in *L. seminudus*.

The scaly covering has on the whole a greater extension in *L. reticulatus* than in *L. seminudus*, so far as we yet know. In all the specimens of *L. reticulatus* to hand, whose lengths lie between 225—380 mm., not only the tail, but also most of the trunk is covered with scales, as these reach forward to a point which lies under, or indeed somewhat in front of, the anterior end of the dorsal fin. In a single specimen of *L. seminudus*, that of 365 mm. namely, the scaly covering extends forward to a point at the end of the flattened-out pectoral fin, and in all the remaining (17) specimens

whose lengths are from 129—497 mm., it does not once extend so far, but ceases a little in front of the anus, over the anus or a little behind this.

Lastly, as regards colouration, none of the present specimens of *L. seminudus*, not even the distinctly banded, show signs of assuming the network markings so characteristic of *L. reticulatus*.

Taking all together, the differentiating characters seem to me so important, that the reference of these two forms to one species would be quite unnatural.

If we take *L. reticulatus* var. *macrocephalus* into the comparison, the boundaries between the two species are certainly reduced, so far as the relative sizes of the head and eyes are concerned, but the other distinguishing characters (length of the pectorals, distribution of the scales etc.) still hold good.

Lycodes agnostus Jensen.

Tab. VI, Fig. 1 a, b.

1886. *Lycodes Lütkenii* Lütken, Kara-Havets Fiske; Dijmphna-Togtets zoologisk-botaniske Udbytte, p. 128 (partim), Tab. XVI, Fig. 2—6.

1895. *L. reticulatus* Smitt, Skandinaviens Fiskar, II, p. 611 (partim), Fig. 147.

1901. *L. reticulatus* forma *seminuda* Smitt, Bih. K. Sv. Vet.-Akad. Handl. Bd. 27, Afd. IV, No. 4, p. 32 (partim), No. 19.

1901. *L. agnostus* Jensen, Vidensk. Medd. Naturh. Foren. Kbhvn., p. 209.

In proportions of the total length, the height over the anus is 9,3—12 %, the length of the head 22—24,8 %, the distance from the snout to the anus 46—52 %, the longitudinal diameter of the eye in larger individuals 3,4—2,7 %, the length of the pectorals 10—12,5 %. 9 12 cross-bands, dark with lighter central part; a light stripe across the neck above. Scales wanting. Lateral line mediolateral[1]). Pyloric appendages 2. Size 233 mm.

D. 90—93. A. 70—75. P. 16—17.

Distribution. Kara Sea, 46—100 fathoms; Arctic Sea of Siberia (Chatanga Bay), 15 fathoms.

In the report on the fishes of the Kara Sea, Lütken referred 28 specimens of a Lycodes to the *L. lütkenii* described by Collett from the deep water at Spitzbergen. From an examination of these specimens however, I discovered that Lütken had mixed two species together under his «*L. lütkenii*», as I shall now explain.

The largest specimen, which is 223 mm. long[2]), has scales on the tail and a great part of the trunk, whereas the remaining 27 specimens are completely wanting in scales, although amongst them there are specimens up to 186 mm. in length. This alone at the beginning would counsel great caution in bringing these individuals together under one species; certainly one may find in the present treatise many examples to show that variation may occur within one and the same species of the genus

[1]) In well-preserved specimens further, a whole series of dorsal pores can be seen.

[2]) Lütken gives the length to 225 mm.

Lycodes with respect to the development of the scaly covering, but such a sudden jump as Lütken here makes possible, would be quite singular.

Again, the 27 specimens in comparison with the 28th belong to a relatively small-eyed form, the longitudinal diameter of the eye (in specimens of over 100 mm.'s length) amounting to only 3,4—2,7 % of the total length; in the two largest specimens (185—186 mm.) the horizontal diameter of the eye is thus 3—2,7 % of the total length, but in the 223 mm. long specimen 3,6 % of the total length, although in consequence of its greater size it should have had relatively still smaller eyes than the two named, if we had to do with the same species.

Further, the number of rays in the pectorals shows a very considerable difference: the 27 specimens have only 16—17 rays, whereas the 28th has 19. Lütken indeed, has remarked this difference, but he endeavoured to explain it away by supposing that the number undergoes some increase with age.

Although the colouration may seem quite similar on a cursory view, when rightly seen there is the difference that the 27 specimens have more numerous dark cross-bands, namely 9—12 (cf. Lütken l. c. Tab. XVI, fig. 2—6), whilst the 28th has only 8 (ibid. fig. 1).

From all these important differences I drew the conclusion that the 223 mm. long specimen must be specifically distinct from the others, and I was successful later in identifying it with *L. rossi* Malmgr. (cf. p. 56).

The remaining 27 specimens seemed to me to belong to a form which retained its naked condition throughout its whole life; in my preliminary report (l. c.) I gave it the name *Lycodes agnostus*.

Later I gained a welcome confirmation that I had judged rightly, as I found a specimen in the Stockholm Riks-Museum, which in all respects agreed with the form from the Kara Sea, also in that it was perfectly naked even though its total length was still greater than that of the specimens in my hands. F. A. Smitt in his great work on the Scandinavian Fishes gives a figure of it (fig. 147) under the name *L. reticulatus*, *Turnerii*, and in his later treatise On the genus *Lycodes* (l. c. 1901) he has mentioned it under the name *L. reticulatus* forma *seminuda*. Its most important proportions are as follows:

Total length	233	mm.
Length of the head	56,5	—
Distance from snout to anus	117	—
Height over the anus	22,5	—

In proportions of the total length, the length of the head is thus 24,3 %, the distance between the snout and the anus 50,2 %, and the height over the anus 9,7 %. The eyes are small, their longitudinal diameter being only 2.7 % of the total length. The body, as already mentioned, is quite free of scales. The lateral line is mediolateral. The colouration has now disappeared so that I cannot decide if the figure in Smitt has struck the right proportion between the light and dark bands. The pectorals contain 16 rays, the dorsal fin ca. 90 and the anal ca. 70 rays.

The specimen, which is a male with well-developed testes (33 mm. long), was taken on the 24th of August 1878 by the Vega Expedition on the east side of the Taimur peninsula, namely in

the mouth of Chatanga Bay (75° N.L. 113° 30' E.L.), where the depth was 15 fathoms and the bottom-temperature −0,8° C.

The specimens of the Dijmphna Expedition were taken in the Kara Sea at a depth of 46—100 fathoms. I give below the proportions of 11 specimens chosen according to size:

								♀		♂	♀	♀
Total length	in mm.	66	70	94	105	116	135	138	147	155	185	186
Length of the head	—	16	16,5	23	26	28	33	34	35	37	45	41
Distance from snout to anus	—	31	32	44	52	58	68	67	70	77	97	90
Height over the anus	—	6,5	6,5	9	10	11	13,5	14	15	15	22	16

In the 185 mm. long female the eggs are of a considerable size, namely 4,5 mm. in diameter; the date of the catch is not forthcoming.

Comparison with allied forms.

A scaleless Lycodes has not been known hitherto from the European-Greenland coasts. From Arctic North America however, 2 species were known, which are described as perfectly naked, and set up by Bleeker therefore as a separate genus: *Lycodalepis*, namely *L. turnerii* Bean (Alaska, Bering Straits) and *L. mucosus* Richardson (Northumberland Sound, Cumberland Gulf). The scaleless Lycodes from the Kara Sea presents great similarity to *L. turnerii* amongst these, the latter's proportions according to Bean[1]) being as follows:

Total length			330 mm.
Length of the head	in %	of the total length	23
Longitudinal diameter of the eye	—	—	2,5
Distance of the anal fin from the snout	—	—	51

But *L. turnerii* has 18 rays in the pectorals, 85 in the dorsal fin, and 67 in the anal; and these data can scarcely be regarded as resting on wrong counting, since Scofield[2]) in a second specimen has found: P. 18, D. 86, A. 67. Nor does the colouration agree, so far as I can discern from the figure which Jordan & Evermann[3]) have given of Bean's type-specimen.

Until further information is forthcoming, I must therefore consider the scaleless Lycodes from the Kara Sea and Chatanga Bay a separate species. The European Lycodes-fauna is thus enriched by an interesting form which has hitherto been misunderstood. I cannot find however, any sufficient ground for adopting the genus-name *Lycodalepis* proposed by Bleeker, since we know forms which, in their weak development of the scaly covering (e. g. *L. seminudus*), present transitions between entirely naked and perfectly scaled species; and other characters do not exist which might be the basis for a generic separation of the naked species, so far as I can see (cf. for the rest p. 5, with remarks on the likewise scaleless *L. platyrhinus* mihi).

[1]) Proc. U. S. Nat. Mus. 1878, p. 463.

[2]) List of fishes obtained in the waters of Arctic Alaska. The Fur Seals and Fur-Seal Islands of the North Pacific Ocean, Part III, 1899, p. 505.

[3]) Fishes of North and Middle America, IV, Pl. 350, Fig. 858. Bull. U. S. Nat. Mus. 1900.

Lycenchelys Gill.

Lycenchelys Gill, Proc. Acad. Nat. Sci. Philad., 1884, p. 180 (*muræna*).

The body is very elongated (anguilliform), the height over the anus going ca. 16—24 times in the total length. Teeth on the intermaxillary and mandible, vomer and palatines. Lower jaw without barbules. Scales small. Lateral line ventral or mediolateral, or both ventral and mediolateral. Branchiostegal rays 6.

From the waters of North America 3 species of this genus have been described, namely: *Lycenchelys verrillii* Goode & Bean, off the east coast of the United States (34° 39′ 40″—42° 33′ N.L. 68° 22′—75° 14′ 40″ W.L.), 75—603 fathoms; *Lycenchelys paxillus* Goode & Bean, off the east coast of the United States (35° 45′ 30″—42° 48′ N.L. 63° 07′—74° 48′ W.L.), 263—904 fathoms; *Lycenchelys porifer* Gilbert, off Lower California, 857 fathoms[1]).

From the European and Greenland waters are at present known 4 species, distinguished from one another in the following manner:

I. 7 pits for the lateral line along the upper jaw and under the eye.
   A. Distance of the dorsal fin from the snout is less than 20 % of the total length.
      a. Length of the head is less than 14 % of the total length. Colour uniform. (The cold area off west Norway, east Iceland, and in the Færoe Channel; 340—620 fathoms). *L. muræna* Coll.; p. 82.
      b. Length of the head is more than 14 % of the total length. Dark spotted colouration. (Northern East Greenland; ca. 160 fathoms). *L. kolthoffi* Jensen; p. 88.
   B. Distance of the dorsal fin from the snout is 21 % or more of the total length. (Skager Rak, south and west Norway; 70—300 fathoms). *L. sarsii* Coll.; p. 86.

II. 8 (larger) pits for the lateral line along the upper jaw and under the eye. (Davis Straits; 393 fathoms). *L. ingolfianus* Jensen; p. 90.

Lycenchelys muræna Collett.

Fig. 15—19 in text.

1878. *Lycodes muræna* Collett, Fiske fra den Norske Nordhavs-Exped. 1876—77; Forh. Vidensk. Selsk. Chria. 1878, No. 4, p. 15.

1878. *L. muræna* Collett, Fiske fra Nordhavs-Expeditionen 1878; Forh. Vidensk. Selsk. Chria. 1878, No. 14, p. 74 (partim).

1880. *L. muræna* Collett, The Norwegian North-Atlantic Expedition, Fishes, p. 116 (partim), Pl. IV, Fig. 30 (nec Fig. 29 & 31).

1891. *L. muræna* Lilljeborg, Sveriges och Norges Fiskar, II, p. 25 (partim).

1895. *L. muræna* Smitt, Skandinaviens Fiskar, II, p. 616 (partim) (non Fig. 152).

1901. *Lycenchelys muræna* Jensen, Vidensk. Medd. Naturh. Foren. Kbhvn., p. 214.

[1]) Concerning these species, see Goode & Bean: Oceanic Ichthyology, 1895, p. 309—312; also Jordan & Evermann: The Fishes of North and Middle America, Part III, 1898, p. 2470.

The height over the anus is 4,1—5 % of the total length. The head, whose length is 12,9—13,3 % of the total length, is not particularly broad, the trunk is somewhat compressed; the tail becomes much compressed and loses gradually in height towards the end. The lower jaw extends almost to the end of the upper. 7 pits for the lateral line along the upper jaw and under the eye. The distance between the snout and the anus is 27,6—30,4 % of the total length. The distance of the dorsal fin from the snout is 17,6—18,2 % of the total length. The colour uniform yellow-brown. The scales are distributed over the tail and trunk, whilst the head and fins are naked. Lateral line double, divided into a ventral and mediolateral branch, the latter however frequently indistinct. Pyloric appendages not developed. Size 181 mm.

D. 118—126. A. 100—104[1]). P. 13—15.

Distribution. The cold area off west Norway, east from Iceland, and in the Fœroe Channel; 340—620 fathoms.

Remarks on the Synonymy.

Lycodes muræna was established by Collett for a 140 mm. long specimen of an elongated Lycodes, which the North-Atlantic Expedition of 1877 took in the ice-cold waters off Helgeland in Norway, at 350 fathoms depth. In 1878, off Bear Island and Spitzbergen, in ice-cold water and from depths of 459—658 fathoms, the North-Atlantic Expedition got 3 other specimens (112—198 mm.) likewise of a very elongated Lycode, which Collett referred to the same species, as he considered certain differences as less essential and a sign of the variability of the species. From a study of the figures 29, 30 and 31 of the chief publication of the North-Atlantic Expedition's Fishes I got however the impression that — if the figures were correct — they could not belong to one and the same species: figs. 29 and 31 must represent another species than fig. 30, which formed the type-specimen from the 1877 cruise of the North-Atlantic Expedition.

After I had had the opportunity, through the kindness of Prof. Collett, to examine 2 of the specimens of the North-Atlantic Expedition, namely the type-specimen from 1877 and one of the specimens (not figured) from 1878, my presupposition became a certainty: the specimens from the 1878 cruise of the North-Atlantic Expedition ought to form a species by themselves, belonging to the genus *Lycodonus* Goode & Bean (cf. p. 95) and this I proposed to name *L. flagellicauda*. To this form further are to be referred, the specimens obtained by the English expeditions of the «Knight Errant» and «Triton» in the Færoe Channel, and which Günther referred to *Lycodes muræna* Coll. (the figures in Chall. Report leave no doubt about the matter), and also the specimens from the Ingolf Expedition referred to *L. muræna* Coll., which were taken north of the Iceland-Færoe ridge[2]). Of the true «*Lycodes muræna*», which ought to be referred to the genus *Lycenchelys* Gill, only the type-specimen was known until a short time ago, but during the revision of my manuscript I have further been able to study 2 specimens, taken by the «Michael Sars», the one (145 mm. long) in 1900 E. from Iceland, the other (181 mm. long) in 1902 in the Færoe Channel.

A detailed comparison will vindicate the necessity of the intended separation.

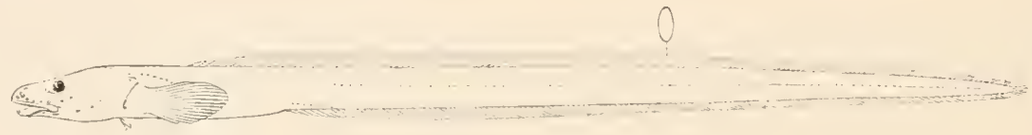
Comparison between *Lycenchelys muræna* Coll. and *Lycodonus flagellicauda* m.

The form of the body is throughout more elongated in *L. flagellicauda;* in *L. muræna* namely, the height over the anus is 4,1—5 % of the total length, in specimens of *L. flagellicauda* of similar size 3,4—4,4 %. In other regards also the form is essentially different. *L. muræna* is a compressed form: the trunk is already (if not distended by sexual products) somewhat thinner than high, and the tail quickly becomes strongly compressed; close behind the anus, the thickness is to the height

[1]) According to Collett D. 118, A. 100; according to my observations in another specimen D. 126, A. 104.

[2]) But not the large specimen from Davis Straits, because it forms a distinct species both from *L. muræna* and from *L. flagellicauda: Lycenchelys ingolfianus* (see p. 90). Nor the young specimen from the Atlantic S. from Iceland; though it stands very close to *L. flagellicauda*, it represents in my opinion quite a separate species: *Lycodonus ophidium* (cf. p. 97).

in the relation of about 1 : 2 (sometimes 2 : 3), and thereafter the tail becomes narrower towards the root of the caudal fin. *L. flagellicauda* on the other hand has a much broader body: the trunk is round; at the beginning of the anal fin the body is almost as thick as high, and the tail has almost the same thickness relatively in the greatest part of its length, only near the end does it become compressed. Seen from above, *L. muræna* (fig. 16) with its compressed tail looks therefore rather different by the side of the round-tailed *L. flagellicauda* (fig. 30). The difference is most apparent indeed, if the animals are viewed from the side: in *L. muræna* (fig. 15) the tail displays a gradual decrease in height, whereas in *L. flagellicauda* (fig. 29) the tail becomes directly remarkably low, as the lower edge immediately behind the anus rises upwards with a rapid slope; by its specially slender, whip-like tail, *L. flagellicauda* stands on the whole quite isolated amongst the



15

16

Fig. 15—16. *Lycenchelys muræna*, seen from the side and from above. × 1.
The scales are omitted. The oval ring over the upper figure shows the form of a cross-section at the place indicated. — The figures are drawn from Collett's type-specimen of *Lycodes muræna* from the Norwegian North-Atlantic Expedition of 1877.

Lycodes known to me. — The distance between the snout and the anus in *L. muræna* is 27,6—30,4 % of the total length, in specimens of *L. flagellicauda* (of similar size) 24,2—28 %, i. e. on the whole is greater in *L. muræna*.

17

18

19

Fig. 17—19. Head of *Lycenchelys muræna*, seen from above, the side and below. × 2 1.
Drawn from Collett's type-specimen from the Norwegian North-Atlantic Expedition of 1877.

The head has about the same relative length in the two species; in the specimens at hand of *L. muræna* the length of the head namely is 12,9—13,3 % of the total length, in adult specimens of

L. flagellicauda 12,7—14,2 %. But for the rest, there are apparent differences. The head in *L. flagellicauda* (fig. 31) is much broader than in *L. muræna* (fig. 17). In *L. muræna* the underjaw, seen from below, forms a tolerably steep arch, and its end reaches almost as far forward as the upper jaw (fig. 19); in *L. flagellicauda* on the other hand, the under jaw forms a flat arch, and its anterior end lies a good way behind the point of the upper jaw (fig. 33), so that the mouth always stands open . As a result of the breadth of the head, the eyes in *L. flagellicauda* are more upturned than in *L. muræna*, in which they look more out to the side. Teeth are found in both species on the jaws, palatines and vomer, but they are relatively long in *L. muræna*. The number of branchiostegal rays is 6 in *L. muræna*, only 5 in *L. flagellicauda*. The lateral line's deep, cup-shaped grooves along the upper and lower jaws, reminding one of the suckers of the octopus, adorn the head of *L. flagellicauda* in a characteristic manner; also, the number in the row on the upper jaw is a little different, being 8 in *L. flagellicauda* against 7 in *L. muræna* (cf. fig. 32 and 18).

The dorsal fin begins, as Collett has also remarked, a little further forward relatively in *L. muræna*, as its distance from the snout in this species is 17,6—18,2 % of the total length, whilst its distance in 12 specimens of *L. flagellicauda* amounts to 18,8—20,6 %. As I could not count the rays in the dorsal and anal fins of *L. muræna* with certainty, I am unable to say if any distinguishing character can be obtained therefrom; according to Collett the numbers (*L. muræna* sens. strict.: D. 118, A. 100[1]); *L. flagellicauda:* D. 101—108, A. 97—103) would indicate not. On the other hand, *L. muræna* has certainly a fewer number of rays throughout in the pectorals, viz. 13—15; in 12 specimens of *L. flagellicauda* I have counted 15—17 rays, and Collett gives for his two large specimens likewise 15—17 rays, only a quite small specimen appears to have 13—14.

The scales are evidently laid down earlier in *L. muræna* than in *L. flagellicauda*. The smallest specimen present, 140 mm. long, of *L. muræna* s. str. is already covered with scales on the tail and the trunk, and the larger specimens (145 and 181 mm. long) are similarly covered; only the middle of the belly (in front of the anus) is naked. *L. flagellicauda* shows some irregularity with regard to the time of appearance of the scales. Of the specimens from the Ingolf Expedition, the largest, whose total length is 204 mm., shows but quite solitary scales on the posterior portion of the tail. The next largest, 200 mm. long, is much more richly provided with scales; it has the posterior portion of the tail densely covered, but further forward on the tail the scales are more spread out and none are to be seen on the trunk. In a 183 mm. long specimen, the scaly covering has a similar distribution as in the foregoing, but the scales are on the whole less close. Lastly, two specimens of respectively 184 and 170 mm. are perfectly naked. These specimens all come from one and the same place (Ingolf St. 104). The remaining specimens (110—188 mm. long) are either quite naked or show only weak traces of scales. Of Collett's two large specimens, the one (217 mm. long) was at the same stage as the Ingolf's 204 mm. specimen, whereas the second, 198 mm. long, is much more richly covered with scales than any other specimen of this species as yet known, not only the tail but also the trunk itself being provided with scales[2]). — Altogether, one may say, that the scales are laid down earlier in

[1]) In a specimen obtained later (from the »Michael Sars») I have found: D. 126, A. 104.

[2]) In one of 3 specimens I have seen later (»Michael Sars» 1902), the scales also extended relatively far forward, namely to the vertical line through the anterior end of the dorsal fin, though they were much scattered; the length of this specimen was 203 mm.

L. muræna sens. str., and have a greater distribution in relation to the total length of the fish, than in *L. flagellicauda.*

The lateral line is double in both species, mediolateral and ventral; the mediolateral branch may sometimes be particularly distinct in *L. muræna* (see fig. 15), but in *L. flagellicauda* it is always very indistinct, as even in the most favourable cases only single pores can be seen[1]). For the rest, the ventral branch in both species may be rather difficult to follow, or not at all traced, beyond the anus.

The colour in both species is uniform, without bands or spots. *L. muræna* is brownish above, below the median line yellowish; the anal fin and pectorals are grayish-white, the dorsal fin dark-gray; on the belly, the black peritoneum shines through; the scales stand out lighter than the ground-colour of the body. *L. flagellicauda* tends most often to be more gray-brown.

In conclusion I may give the most important proportions of the three *L. muræna* present:

		♀		♀
Total length	in mm.	140	145	181
Length of the head	—	18	19,25	24
Distance from snout to anus	—	39	40	55
Height over the anus	—	5,75	7	9
Distance of dorsal fin from snout	—	25	25,5	33

Distribution. With the limitation here given to *Lycenchelys muræna* Coll., the species is only known from 3 specimens. The first of these (140 mm. long) was taken by the Norwegian North-Atlantic Expedition in June 1877 off Helgeland in Norway, 325 kilom. W.S.W. from Bodo (66° 41′ N.L. 6° 59′ E.L.), where the depth was 350 fathoms and temperature of the bottom — 0°9 C. The second specimen (145 mm. long) was caught in July 1900 by the steamer Michael Sars E. from Iceland (64° 53′ N.L. 10° W.L.) where the depth was 340 fathoms and bottom-temperature — 0°69 C. Lastly, the third specimen (181 mm. long) was taken in 1902, likewise by the »Michael Sars», in the Færoe Channel (60° 19′ N.L. 5° 39′ W.L.), where the depth was 620 fathoms and bottom-temperature under 0° C.

Lycenchelys sarsii Collett.

Fig. 20—22 in text.

1871. *Lycodes sarsii* Collett, Forh. Vidensk. Selsk. Chria., p. 62, c. tab.

1874. *L. sarsii* Collett, Norges Fiske; Tillægsh. til Forh. Vidensk. Selsk. Chria. 1874, p. 102.

1884. *L. sarsii* Collett, Meddelelser om Norges Fiske i Aarene 1879—83; Nyt Magaz. f. Naturvidensk. 29 Bd., p. 78, Pl. I, Fig. 3—4.

1891. *L. sarsii* Lilljeborg, Sveriges och Norges Fiskar, II, p. 23.

1895. *L. sarsii* Smitt, Skandinaviens Fiskar, II, p. 616, Fig. 151.

1898. *L. sarsii* Collett, Vidensk. Selsk. Skr. Chria. No. 1, Pl. I—II.

1901. *Lycenchelys sarsii* Jensen, Vidensk. Medd. Naturh. Foren. Kbhvn., p. 214.

[1]) Such is the case at any rate in my present specimens. Fig. 31 in the Fishes of the North-Atlantic Expedition shows however, a whole row of pores along the linear median furrow of the side; such a condition I have not seen.

The height over the anus (in medium-sized and adult individuals) is 5,2—5,9 % of the total length. The head is tolerably broad, the trunk a little compressed, the tail gradually becoming more strongly compressed and losing slowly in height. The length of the head in males is 14,1—15 %, in females 13,7—14,2 %[1]) of the total length. The lower jaw reaches almost to the end of the upper. 7 pits for the lateral line along the upper jaw and under the eye. The distance between the snout and the anus is in males 27,2—28,6 %, in females 26,2—27,7 % of the total length[2]). The distance of the dorsal fin from the snout is 21—24,7 % of the total length. Small specimens uniformly gray-brown along the back, yellow-white on the underside, somewhat larger specimens similar but with irregular, brown to black cross-markings and shades over the back and tail, and with a dark stripe between the eye and the snout; older individuals uniformly yellowish brown with indistinct shadings down the sides. The scales in developed specimens reach to the head and partly out on to the unpaired fins. The lateral line ventral, indistinct. Pyloric appendages rudimentary. The size up to 184 mm.

D. ca. 123. A. ca. 117. P. 15—16.

Distribution. Western and southern Norway; Skager Rak; 70—300 fathoms[3]).

20 21 22

Fig. 20—22. Head of *Lycenchelys sarsii*, seen from above, the side and below.

Prof. Collett has recently (1898) given so detailed and careful information concerning this species, a relatively considerable number of specimens of which has been brought to light by the practical fisheries investigations of Dr. Petersen and Dr. Hjort, that there is no need to treat of it anew. As supplementary information I shall only state the proportions of the 8 specimens from the Skager Rak at my disposal, mentioning the sex; it will thus appear that the differences in proportions are not great in adult individuals (cf. Diagnosis).

[1]) In small specimens (44—62 mm. long) 14,9—17,5 %, according to Collett.

[2]) » 29,8—32,8 %, »

[3]) Concerning the separate localities where the species was taken, cf. Collett l. c. 1898 and C. G. Joh. Petersen, Beretning IX fra den biologiske Station, p. 17, 21 & 22 (Fiskeri-Beretning for Finansaaret 1898—99, Kjobenhavn 1900). — How far the form from »North Atlantic, in 180 fathoms», which Günther formerly referred to *Anguilla kieneri*, and Day corrected to *Lycodes kieneri* and Günther finally to *L. sarsii* (cf. Voy. Challenger, Rep. Deep-Sea Fishes, XXII, 1887, p. 80), is really a *L. sarsii*, I shall leave unanswered as I have not seen the specimen; if the accompanying figure in Chall. Rep. (Fig. 3) purports to be more than a sketch, it would indicate indeed that the form was not identical with *L. sarsii*.

		♀	♂	♀	♀	♂	♂	♂
Total length	in mm.	89	128	140	146	151	152	169	184
Length of the head	—	12,5	18	21	20	21,5	21,5	24	27,5
Distance from snout to anus	—	24,5	35,5	40	39,5	39,5	42	46	51
Height over the anus	—	5	7	8	7,5	7,5	9	9,5	10

Lycenchelys muræna Coll. is the European Lycode with which the present species might most easily be confused. The following distinguishing characters however, are sufficient to separate them:

L. muræna is a more elongated species than *L. sarsii*, the height over the anus being only 4,1—5 % of the total length.

In *L. muræna* the dorsal fin begins further forward than in *L. sarsii*, its distance from the snout being only 17,6—18,2 % of the total length.

L. muræna has fewer rays in the pectorals, namely 13—15.

Lycodonus flagellicauda Jensen is likewise a more elongated species, the height over the anus being only 3,4—4,4 % of the total length, and is immediately distinguished from the present by its particularly slender, whip-like tail.

Lycenchelys kolthoffi n. sp.

Tab. X, Fig. 2. Fig. 23—25 in text.

1901. *Lycodes Verrillii* Smitt (nec Goode & Bean), Bih. K. Sv. Vet.-Akad. Handl. Bd. 27, Afd. IV, No. 4, p. 22, Fig. 1—3.

The height over the anus amounts to 4,9—5,2 % of the total length. The head, whose length is 14,3—14,8 % of the total length, is tolerably broad and flat, the

23 24 25

Fig. 23—25. Head of *Lycenchelys kolthoffi*, seen from above, the side and below. × 2.

trunk is approximately cylindrical; the tail is of a low, very elongated form, not much compressed, except near the end. The anterior point of the lower jaw lies a good bit behind the end of the upper jaw. 7 pits for the lateral line along the upper jaw and under the eye. The distance between the snout and the anus is

27,8—28,4 % of the total length. The distance of the dorsal fin from the snout is 18,6—18,9 % of the total length. The colour yellow-white, with many brown spots, which on the tail posteriorly, adorn both the unpaired fins and the body between them, but on the foremost part of the tail and on the trunk are mainly on the dorsal fin, the back and the upper part of the side; a dark-brown spot above at the shoulder, and a dark arched band across over the pectoral, on the skin between the rays; top of the head brown, the sides and under surface whitish; a dark band from the snout to the eye, a dark spot behind the eye and one on the gill-cover. The scales extend from the end of the tail to, or a little beyond, the anterior end of the dorsal fin, but the belly and the under part of the trunk (in front of the anus) are naked; no scales on the fins. The lateral line double, rather distinct from the flap of the gill-cover down towards the anus (the ventral branch); in addition, isolated pores are present along the median line (the mediolateral branch). Pyloric appendages not developed. The size (of the two males to hand) ca. 130 mm.

D. ca. 124. A. ca. 110. P. 14—15.

Distribution. Northern East-Greenland, ca. 160 fathoms.

Of this new species the Kolthoff Expedition took 2 specimens (♂♂) off the east coast of northern Greenland (72° 25′ N.L. 17° 56′ W.L.) on the 30th of July 1900; the depth was 300 meters, and the bottom stony and sandy.

The most important proportions of these specimens are as follows:

		♂	♂
Total length	in mm.	128,5	131,5
Length of the head	—	19	18,75
Distance from snout to anus	—	36,5	36,5
Height over the anus	—	6,75	6,5
Distance from snout to dorsal fin	—	24,25	24,5
Length of the pectoral	—	14,5	13,5
Length of the snout	—	6,3	6,4
Longitudinal diameter of the eye	—	3,25	3,25

The North American *Lycodes Verrillii* Goode & Bean (Oceanic Ichthyology, 1895, p. 309, Fig. 277), with which F. A. Smitt (l. c.) had identified the present form, is quite a different species, as will appear from the following measurements of 2 specimens, presented to the Copenhagen Zoological Museum from the Smithsonian Institution.

L. verrillii Goode & Bean:

		♂	♀
Total length	in mm.	135	138
Length of the head	—	26	22
Distance from snout to anus	—	45	44
Height over the anus	—	7,25	8,5
Distance from snout to dorsal fin	—	35	32
Length of the pectoral	—	12	10,5
Longitudinal diameter of the eye	—	5	5,5

Compared with *L. verrillii* Goode & Bean, therefore, we have in *L. kolthoffi:*

The body is more slender, the height over the anus being 4,9—5,2 % of the total length (against 5,5—6,2 % in *L. verrillii*).

The anus lies further forward, its distance from the snout being 27,8—28,4 % of the total length (against 31,9—33,3 % in *L. verrillii*).

The head is relatively shorter, its length being 14,3—14,8 % of the total length (against 19,3 [in ♀ 16] % in *L. verrillii*).

The dorsal fin begins relatively further forward, its distance from the snout being 18,6—18,9 % of the total length (against 23,2—25,9 % in *L. verrillii*).

The pectorals are larger, their length being 10,3—11,3 % of the total length (against 8,3—8,9 % in *L. verrillii*).

The eyes are relatively smaller, their longitudinal diameter being 2,5 % of the total length (against 3,7—4 % in *L. verrillii*).

In addition, the dark colouration is marbled in *L. kolthoffi*, but in regular cross-bands in *L. verrillii.*

L. kolthoffi stands much nearer to *L. sarsii* Coll., from which however it can be easily distinguished in that the eyes are relatively a little smaller, that the pectorals are larger, and that the dorsal fin begins further forward; thus in a 140 mm. long *L. sarsii* ♂, the longitudinal diameter of the eye is 2,9 %, the length of the pectoral 7,9 %, the distance of the dorsal fin from the snout 22,2 % of the total length. In addition, the colouration is quite different; the present species is strongly spotted, whilst adult *L. sarsii* are more uniform, with only indistinct shadings down on the sides.

Lycenchelys ingolfianus Jensen.

Tab. X, Fig. 3. Fig. 26—28 in text.

1898. *Lycodes muræna* Lütken, The Danish Ingolf-Expedition, II, 1, p. 20 (partim).

1901. *Lycenchelys ingolfianus* Jensen, Vidensk. Medd. Naturh. Foren., p. 210.

The height over the anus is 5,1 % of the total length. The head tolerably broad, the body almost round, the tail gradually compressed and losing very slowly in height. The length of the head is 12,4 % of the total length. The anterior end of

the lower jaw lies a good bit behind the point of the upper. 8 large pores for the lateral line along the upper jaw and under the eye. The distance between the snout and the anus amounts to 27,6 % of the total length. The distance of the dorsal fin from the snout is 20 % of the total length. The colour uniformly yellow-brown. Scales cover the tail and the trunk as also the unpaired fins towards their margin. Lateral line double, divided into a ventral and a mediolateral branch. Pyloric appendages very small. The size (of the only known specimen) 275 mm.

D. 128. A. 116. P. 17.

Distribution. Davis Straits, 393 fathoms.

The single specimen to hand of this new species, which Lütken had referred to *L. muræna* Coll., though with some hesitation, is a female with small eggs in the ovary; the most important proportions are as follows:

Total length	275	mm.
Length of the head	34	—
Distance from snout to anus	76	—
Height over the anus	14	—
Distance of dorsal fin from snout	55	—

The form of the body is more elongated than in most of the species of the genus, the height over the anus being 5,1 % of the total length. The greatest height of the body lies over the anus; from this the height remains almost unaltered towards the head, and posteriorly decreases very slowly and evenly towards the tail. The trunk itself approximates to the cylindrical, its thickness being only $1^1/_5$—$1^1/_4$ times in the height, but the tail becomes gradually more strongly compressed. The anus lies far forward, its distance from the snout being 27,6 % of the total length.

26 27 28

Fig. 26–28. Head of *Lycenchelys ingolfianus*, seen from above, the side and below. × 1.

The head is relatively short, its length being 12,4 % of the total length. It is tolerably broad, especially on the cheeks, where the breadth indeed is a little greater than the height. Seen from the side, the height remains the same from the neck to near the eye, where the orbit shows a little convexity; from the anterior margin of the eye the snout descends somewhat sharply, yet so that the slope forms a weak arch, and at the same time the lower surface rises up. Seen from above, it is a little bent out over the cheeks, and the point of the snout is broadly rounded off. The upper

surface is flat on the crown, slightly arched on the snout but has a depression between the eyes. The eyes are large, their longitudinal diameter being $^1/_4$ of the length of the head; seen from the side, the upper margin projects forward over the forehead; seen from above, there is an eye's diameter between the two eyes; they are almost circular. The length of the snout to the eye is ca. $3^1/_3$ times in the whole head. The lower jaw is much shorter than the upper and reaches only to the vertical line through the tube-shaped nostrils. The upper lip is swollen, the lower lip tolerably thin it the middle, but thick at the sides and provided as usual with a dependant fold. The teeth are small, truncate and conical. On the intermaxillary there are two rows, the first of which is much the longest and consists of 15 teeth on each side, decreasing in size towards the angle of the mouth; the second row has 5 teeth. On each palatal bone there is a tolerably short row of teeth; the vomer is also sparingly provided with teeth. The lower jaw has several irregular rows of teeth in the centre, a single row towards the sides.

The dorsal fin begins almost over the point of the flattened-out pectoral, at a distance from the snout equal to 20 % of the total length. It contains, so far as I have been able to count, 128 rays, the anal 116 rays; in both numbers half the tail fin is as usual reckoned. The pectorals, which contain 17 rays, are of a broad oval form; their length is 7,4 % of the total length or equal to the distance from the end of the opercular flap to the middle of the lens of the eye. The ventral fins are small (about $^2/_3$rds the diameter of the eye) and thin.

The head and the paired fins are naked; the rest of the body is covered with small scales which on the unpaired fins reach to near the margins.

The lateral line is double, divided into a mediolateral and a ventral branch, but for the greatest part of its course it is only discernible under a lens. It begins on the neck, a little above and in front of the posterior corner of the gill-cover, and inclines obliquely therefrom towards the belly, which it reaches at a distance of about $^1/_3$rd of the length of the trunk from the base of the pectoral; this descending portion of the lateral line is relatively distinct with pores close together. From there it continues almost on the boundary between the side and the belly and can be followed a good distance on the tail as an extremely fine light strip with very small, but rather closely-placed pores. The mediolateral branch can be followed right out to the base of the caudal fin; its pores are less close to one another than in the ventral branch, so that there are 2—3 scales between two successive pores against 1—2 scales in the latter.

On the head, the lateral line opens into a number of distinct pores. From the snout to under the eye there is a row of 8 large pores, from the tip of the lower jaw to the preoperculum's lower and posterior corner there is another row of 7 similar pores. Between the posterior margin of the eye and the neck is a row of 8 fine pores, whose 5th pair is connected by a cross line of 2 pores. Between the eye and the upper posterior corner of the preoperculum there are 3 pores and on the preoperculum itself another 3 pores.

The colour is a uniform yellow-brown on the back, yellowish or grayish on the belly; of markings only a dark border is seen along the free edge of the gill-cover, and the tube-shaped nostrils are coloured black. The scales appear as light points.

Distribution. A single specimen (♀) was taken by the Ingolf Expedition of 1895 (St. 27) in Davis Straits off the coast between the colonies Godthaab and Sukkertoppen (64° 54′ N.L. 55° 10′ W.L.), where the depth was 393 fathoms and bottom-temperature + 3°8 C.

Relation to allied species. Of these, *L. murænа* Coll. is the one which is most remote from the present species. *L. murænа* is namely a still more elongated form, the height over the anus being 4,1—5 % of the total length, and it has a more compressed tail; further, its underjaw reaches almost to the tip of the upper, its dorsal fin begins further forward (the distance from the snout is = 17,6—18,2 % of the total length), and it has fewer rays in the pectorals, namely 13—15.

L. sarsii Coll. is distinctly nearer to the present species, but its head is somewhat longer (the length in the two females at my disposal being 13,7—14,2 % of the total length), and flatter, and the lower jaw reaches almost as far forward as the upper (see Fig. 21 & 22 in text). In addition, it has fewer rays in the pectorals, namely 15 16.

On the other hand, there might be some doubt, whether the present species is not identical with the *L. paxillus* Goode & Bean[1]) taken on the east coast of North America in deep water (263—904 fathoms). As I am not myself acquainted with *L. paxillus*, I shall only indicate that this species appears to be less elongated, the height going 16 times in the total length (whereas in *L. ingolfianus* it is almost 20 times); further, *L. paxillus* seems to have only 16 rays in the pectorals, 118 in the dorsal and 110 in the anal fin; lastly, the ateral line is given as being single (mediolateral).

Lycodonus Goode & Bean.

Lycodonus Goode & Bean, Bull. Mus. Comp. Zool., X, No. 5, 1883, p. 208 *(mirabilis)*.

The body very elongated (anguilliform), the height over the anus going ca. 21—30 times in the length. Teeth on the intermaxillary, mandible, vomer and palatines. Lower jaw without barbules. Scales small. Lateral line mediolateral or both mediolateral and ventral. Along the bases of the dorsal and anal fins a row of small bony plates (lateral out-growths of the upper ends of the interspinous rays), on which the rays are superimposed. Branchiostegal rays 5.

This genus, which in relation to the other anguilliform *Lycodinæ* is specially characterized by the structure of the interspinous bones and by only having 5 branchiostegal rays, consists now of 3 species from deep water: *Lycodonus mirabilis* Goode & Bean, off the east coast of the United States (35° 45′ 23″—41° 53′ N.L. 65° 21′ 50″—74° 34′ 45″ W.L.), 721—1309 fathoms; *L. ophidium* Jensen, North Atlantic Ocean S. from Iceland, 1089 fathoms; *L. flagellicauda* Jensen, the polar depths from Spitzbergen down towards Iceland and the Færoes, 459—1003 fathoms.

The American species lacks fin-rays on the anterior (9—11) plates on the back, whereas all the plates bear fin-rays in the European species. The two last species can be distinguished from one another by the following characters:

[1]) *Lycodes paxillus* Goode & Bean, Proc. U. S. Nat. Mus. 1879, p. 44. *L. paxilloides* Goode & Bean, Bull. Mus. Comp. Zool., X, 1883, p. 207. *Lycenchelys paxillus* Goode & Bean, Oceanic Ichthyology, 1895, p. 311, Fig. 279 & 282; Jordan & Evermann, Fishes of North America, III, 1898, p. 2471.

a. The distance between the snout and the anus is 24,1—28 % of the total length, the distance of the dorsal fin from the snout, 18,2—20,6 %. *L. flagellicauda* Jensen; p. 94.

b. The distance between the snout and the anus is 21,6 % of the total length, the distance of the dorsal fin from the snout 15,3 %. *L. ophidium* Jensen; p. 97.

Lycodonus flagellicauda Jensen.

Fig. 29—33 in text.

1878. *Lycodes muræna* Collett, Fiske fra Nordhavs-Expeditionen 1878; Forh. Vidensk. Selsk. Chria., 1878, No. 14, p. 74 (partim).

1880. *L. muræna* Collett, The Norwegian North-Atlantic Expedition, Fishes, p. 116 (partim), Pl. IV, Fig. 29 & 31.

1887. *L. muræna* Günther, The Voyage of H. M. S. Challenger, vol. XXII, Report on the Deep-Sea Fishes, p. 79, Pl. XII, Fig. A.

1891. *L. muræna* Lilljeborg, Sveriges och Norges Fiskar, II, p. 25 (partim).

1895. *L. muræna* Smitt, Skandinaviens Fiskar, II, p. 616 (partim), Fig. 152.

1898. *L. muræna* Lütken, The Danish Ingolf-Expedition, II, 1, p. 20 (partim).

1901. *Lycenchelys flagellicauda* Jensen, Vidensk. Medd. Naturh. Foren. Kbhvn., p. 210.

The height over the anus is 3,4—4,4 % of the total length. The head, whose length is 12,7—14,5 %[1] of the total length, is broad and flat, the trunk round; the tail becomes very low immediately behind the anus and is of a round whip-shaped form, only becoming compressed near the end. The front of the lower jaw lies a good bit behind the tip of the upper. 8 pits for the lateral line along the upper jaw and under the eye. The distance between the snout and the anus is 24,1—28 % of the total length[2]. The distance between the snout and the dorsal fin is 18,2—20,6 % of the total length. The colour uniformly gray-brown. The scales may extend to the head, when the total length of the fish is ca. 200 mm., but usually they are much less advanced at this (or a still greater) total length. The lateral line double, divided into a ventral and a mediolateral branch, but of the latter only isolated pores are usually to be seen along the median line of the side[3]. Pyloric appendages not developed. The size up to 217 mm.

D. 101—109[4]. A. 97—103[4]. P. (13—14) 15—17.

Distribution. The polar depths from Spitzbergen down towards Iceland and the Færoes, 459—1003 fathoms.

[1] In 4 males 13,3—14,2 %, in 8 females 12,7—13,8 %, in 2 young specimens 14,1—14,5 %.

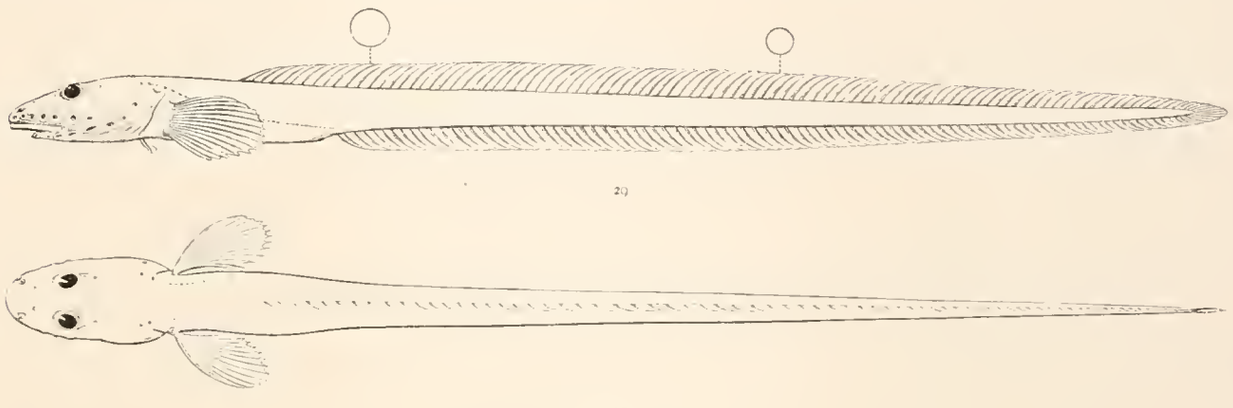
[2] In 4 males 25—26,8 %, in 8 females 24,4—28 %, in 2 young specimens 24,1—25,4 %.

[3] Figure 31 in Collett (N. North-Atlantic Exped., Fishes) shows a whole row of pores along the middle of the side, but I have not seen anything similar.

[4] According to Collett: D. 101—108; A. 97—103. In two specimens I have found: D. 108—109; A. 98—102.

Under *Lycenchelys muræna* (p. 83—86) I have described this form in detail and indicated its independence from *L. muræna*.

In my preliminary notice on the *Lycodinæ* of the Ingolf Expedition (l. c.) the present form is given as a *Lycenchelys*, with the addition however that it would seem most natural to remove it and



29

30

Fig. 29—30. *Lycodonus flagellicauda*, seen from the side and above. × 1.
Scales are omitted, likewise the small bony plates along the bases of the unpaired fins. The two rings over the upper figure represent the form of a cross-section at the place indicated.

31 32 33

Fig. 31—33. Head of *Lycodonus flagellicauda*, seen from above, the side and below. × 5/3.

make it into a separate genus. On further research I find this supposition strengthened: *Lycenchelys» flagellicauda* (and the following species, *L. ophidium*) are of one genus with *Lycodonus* Goode & Bean.

The genus *Lycodonus* was founded in 1883 by the American ichthyologists Goode & Bean (Bull. Mus. Comp. Zool. X, No. 5, p. 208) with a single species: *L. mirabilis*. In 1895, when this fish was again mentioned by the same authors in their work Oceanic Ichthyology (p. 312), a considerable number of specimens had been taken off the coast of New England, in deep water (721—1309 fathoms). Our Museum possesses two specimens presented by the Smithsonian Institution, so that I can judge of it from personal observation.

The two most important peculiarities, which in my opinion, specially characterise the genus *Lycodonus*, are shared in common by this species and *L. flagellicauda* (and the succeeding *L. ophidium*): first and foremost, the number of the branchiostegal rays, which is only 5 on each side (in *Lycenchelys*

on the other hand, 6); and next, a peculiarity in the structure of the dorsal and anal fin: along the bases of these fins there is a row of small bony shields, on which the fin-rays are superimposed, one on each plate; these bony plates are especially apparent in *L. mirabilis*, in lesser degree in *L. flagellicauda*, because it is quite a small fish, but one can observe them easily under a lens, especially if the skin is allowed to dry a little; Goode & Bean designate these plates as ectodermal scutes or plates , but on dissection they prove to be lateral outgrowths of the outer ends of the interspinous rays (or perhaps more correctly of the small bones fused with the outer part of the interspinous rays).

For the rest, the genera *Lycenchelys* and *Lycodonus* agree so far as I can see. Goode & Bean certainly mentioned another peculiarity in the latter, namely: caudal distinct not fully connect with dorsal and anal , but in the two specimens of *L. mirabilis* at my disposal the unpaired fins join into one, just as in *L. flagellicauda.*

Concerning *Lycodonus mirabilis*, Goode & Bean remark: The first 10 or 11 scutes do not support rays, but whether rays were originally present or not cannot be ascertained . In the two specimens at my disposal fin-rays are wanting on the first 9—11 plates, and there is no sign that the rays have been torn off, so that it must be a normal condition. In *L. flagellicauda* (and *L. ophidium*) on the other hand, all the plates bear fin-rays. This difference seems to me indeed of subordinate importance, in any case not so important, that it should prevent the three species being placed within the same genus.

For the sake of completeness, I add here the most important proportions of 14 *Lycodonus flagellicauda* which I have investigated (those of 185, 197 and 203 mm. are from the 1902 cruise of the Michael Sars , the others from the Ingolf Expedition of 1896).

				♂	♀	♀	♀	♀	♂	♀	♀	♀	♂	♂	♀
Total length .	in mm.	110	114	141	162	170	181	183	184	185	188	197	200	203	204
Length of the head ...	—	15,5	16,5	20	20,5	22	24,25	23,5	24,5	25,5	25	27	26,5	28	28
Distance from snout to anus	—	26,5	29	35,5	39,5	43	46,5	45	46,5	50,5	48,25	55	50	54,5	54
Height over the anus	—	3,75	4	5,5	5,5	6,5	6,75	6,75	6,5	7	8	7,5	8,25	7,75	9
Distance of dorsal fin from the snout ..	—	20	22	28,5	31	35	36,5	34,5	35,5	36	38	39,5	40	40,25	41

Distribution.

The Norwegian North-Atlantic Expedition took 2 specimens W. from Spitzbergen, where the depth was 459 fathoms and bottom-temperature — 1° C., and a small individual W. from Bear Island, where the depth was 658 fathoms and bottom-temperature — 1°2 C. The English Expeditions of 1880 and 1882 with the «Knight Errant» and «Triton» obtained many specimens in the Færoe Channel, where the depths were 540 and 608 fathoms, bottom-temperature 29°2—30° F.; in the same channel (at 60° 19′ N.L. 5° 39′ W.L.) the «Michael Sars» in the summer of 1902 took 3 specimens where the depth was 620 fathoms and bottom-temp. under 0° C. Further, the Ingolf Expedition took it in 1896 at the following places:

St. 117.	South from Jan Mayen...	1003 fathoms	—	1° C.	1	specimen
- 125.	North from Iceland	729	—	— 0°8 -	1	—
- 102.	East from Iceland.....	750	—	— 0°9 -	1	—
- 104.	»	957	—	— 1°1 -	5	—
- 105.	.....	762	—	— 0°8 -	2	—
- 139.	North from Færoes	702	—	— 0°6 -	1	—

Lycodonus flagellicauda is thus widely distributed over the deeper parts of the «cold area», from Spitzbergen down to Iceland and the Færoe Channel.

Lycodonus ophidium Jensen.

1898. *Lycodes muræna* Lütken, The Danish Ingolf-Expedition, II, 1, p. 20 (partim).

1901. *Lycenchelys ophidium* Jensen, Vidensk. Medd Naturh. Foren. Kbhvn., p. 212.

The single specimen present, a young individual of 118 mm., stands very near to *Lycodonus flagellicauda*, but in proportion to the total length, the length of the head is 12 %, the distance between the snout and the anus 21,6 % and the distance of the dorsal fin from the snout 15,3 %. P. 15.

Distribution. North Atlantic Ocean S. from Iceland, 1089 fathoms.

As there is but a single and young specimen to hand, only the above preliminary characterisation of the species can be given.

This specimen has in the main the same characteristic appearance as the young *L. flagellicauda* and is hardly to be distinguished from these on superficial observation. But the measurements show that the head is shorter, that the anus lies further forward and that the dorsal fin begins nearer the head. These features will appear on comparison with three *L. flagellicauda* of similar length:

	Lycodonus flagellicauda			*L. ophidium*
	Totall. 110 mm.	Totall.[1] 112 mm.	Totall. 114 mm.	Totall. 118 mm.
In percentage of the total length:				
Length of the head	14,1 %	14,3 %	14,5 %	12 %
Distance from snout to anus	24,1 %	26,8 %	25,4 %	21,6 %
Distance of dorsal fin from the snout	18,2 %	19,6 %	19,3 %	15,3 %

The specimen was taken by the Ingolf Expedition of 1896 in the North Atlantic S. from Iceland (St. 65), where the depth was 1089 fathoms and bottom-temperature + 3° C. In Lütkens report on the ichthyological results of the expedition it is referred to *L. muræna* Coll.

[1] From Collett's measurements of a specimen from the North-Atlantic Expedition; the two other specimens are from the Ingolf Expedition.

APPENDIX.

On some new discoveries of Lycodes.

Dr. phil. Joh. Schmidt, who conducted the zoological investigations of the Danish steamer Thor at Iceland during 1903, has had the goodness to show me the Lycodes taken during this cruise. Of special interest were the following:

Lycodes vahlii Reinh. This species occurs, in addition to what has been stated previously (p. 21) at west, north and east Iceland, also at south Iceland, as the Thor» took 3 young specimens at 63° 15′ N.L. 20° 4′ W.L., at a depth of 326—216 m.

Lycodes frigidus Coll. 1 specimen was taken in the polar depths off north-east Iceland (66° 19′ N.L. 10° 45′ W.L.) where the depth was 1440 m., bottom-temp. — 0°92 C.

Lycodes pallidus Coll. 1 specimen was taken in the polar depths off north-east Iceland (66° 2′ N.L. 11° 5′ W.L.), where the depth was 1040—900 m., bottom-temp. — 0°58 C.

Lycodes seminudus Reinh. 3 specimens (2 ♂♂, 31—36 cm. long, 1 ♀, 33 cm. long, all uniformly coloured) were taken in the polar depths off north-east Iceland (66° 2′ N.L. 11° 5′ W.L.) where the depth was 1040—900 m., bottom-temp. — 0°58 C.

Literature published (or coming into the hands of the author) after the end of the year 1902.

Römer und Schaudinn: Fauna Arctica. II, 1, 1901. Die Fische von E. Ehrenbaum.

In this general treatise (p. 123) Prof. Ehrenbaum mentions that Römer and Schaudinn in 1898 took a small Lycodes (67 mm. long) N.W. from Ross Island at a depth of 85 m.; this specimen E. refers to *L. reticulatus* Reinhardt (in the synonymy-list including with others, *L. rossi* Malmgr.); further, that the Olga-Expedition took 2 specimens of *Lycodes* (180 and 250 mm. long) at the entrance to Green Harbour in 145—180 m. depth, both of which had to be referred to the *reticulatus*-group.

All these 3 specimens belong without doubt to *Lycodes rossi* Malmgren.

R. Collett: Om tre for Norges Fauna nye Fiske. Arch. f. Math. og Naturvidensk. B. XXV. Nr. 2. 1903.

On p. 14—26, Collett discusses the *Lycodes rossi* Malmgr. taken by the Michael Sars» in Porsanger Fjord and at Spitzbergen, and mentions also a specimen from the bank south from Bear Island, depth 130 m., bottom-temp. + 0°5 C.[1]). Concerning the delimiting of the species Prof. C. has a similar opinion to my own, being however inclined to consider *L. lütkenii* Coll. as the fully grown stage of *L. rossii*; I have set forth my own views, on this point on p. 61.

[1]) When Collett (p. 26) also gives *L. rossi* as from East Greenland, that is incorrect, but the fault lies entirely with myself, as I at a certain time considered the East Greenland Lycode, which I have named *L. reticulatus* Reinh. var. *macrocephalus* in the present work, to be identical with *L. rossi* and had informed Prof. C. of this.

N. Knipowitsch: Zool. Ergebn. d. Russ. Exped. nach Spitzbergen. Fische. Nachtrag. Ann. Musée Zool. de l'Acad. Imp. d. Sci. St.-Pétersbourg, T. VIII, 1903.

In this treatise Prof. Knipowitsch corrects the *Lycodes esmarki* Coll. and *L. reticulatus* Reinh. (?) previously described by him from Spitzbergen to: *L. eudipleurostictus* Jensen and *L. rossi* Malmgr. A new discovery is further mentioned (1901): *Lycodes pallidus* Coll., a 70,8 mm. long specimen taken in Stor Fjord, depth 102½ m., bottom-temp. — 1°8 C.; *L. rossi* Malmgr., a 42 mm. long specimen taken in Stor Fjord, Genevra Bay, depth 42 m., bottom-temperature + 2°3 C.

R. Collett: Meddelelser om Norges Fiske i Aarene 1884—1901. II. Chria. Vidensk.-Selsk. Forhandl. 1903, No. 9.

On p. 3—18, Prof. Collett discusses in detail the 4 Lycodes occurring in Norway: *Lycodes vahlii* Reinh., *gracilis* M. Sars, *L. rossi* Malmgr., *L. esmarkii* Coll. and *Lycenchelys* (»*Lycodes*«) *sarsii* Coll.

With regard to *Lycodes vahlii* Reinh., *gracilis* M. Sars, Prof. Collett agrees with the view set forth by me that *L. gracilis* M. Sars is a form of *L. vahlii* Reinh. It is common at relatively shallow depths along the whole coast-line of the land, and penetrates far into the large fjords, such as Trondhjem and Christiania Fjords . . . «it is taken tolerably frequently by the fishermen during the fishing for the so called deep-water prawn *(Pandalus borealis)*, which has been carried on within recent years in various fjords and bays on the south coast. This fishing takes place in the mouths of the Christiania Fjord at about 30 to 60 fathoms as a rule». From Finmark, in addition to the specimen from Baads Fjord mentioned in the present work (p. 21), C. mentions 3 others, 179—220 mm. long, taken by the »Michael Sars» during 1901 in Varanger Fjord at ca. 100 fathoms depth.

Lycodes esmarkii Coll. Since 1884 Prof. C. has again been able to examine a considerable number (almost 50) of adult individuals (the largest 745 mm. long), all taken on lines at the same localities in Finmark as before: Ox Fjord, Vardo and Varanger Fjord.

Lycenchelys sarsii Coll. Since C.'s latest report on this species (1898) only two new specimens have been found, from Trondhjem Fjord, 150 fathoms and from Nordfold in Salten, 280 fathoms. »The 19 certain specimens hitherto known were taken within the waters lying between the Skager Rak and the Polar Circle».

Ad. S. Jensen: The Fishes of East-Greenland. Meddelelser om Gronland, vol. XXIX, 1904.

Contains a report on the Lycodes taken by Swedish expeditions at northern East-Greenland: *Lycodes pallidus* Coll. (p. 256), *L. eudipleurostictus* Jensen (p. 257), *L. reticulatus* Reinh. var n. *macrocephalus* (p. 258; Pl. XIII, fig. 2 a & b), *L. seminudus* Reinh. (p. 260) and *Lycenchelys kolthoffi* n. sp. (p. 261; Pl. XIII, fig. 1).

Tab. I.

Tab. I.

Fig. 1. *Lycodes microcephalus* Jensen; p. 53.

The only specimen, 81 mm. long; nat. size.

S.W. from Iceland, 799 fathoms. Ingolf Expedition, 1896.

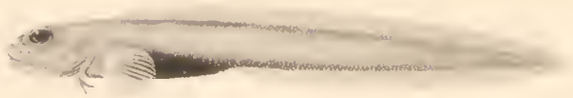
Fig. 2. *Lycodes vahlii* Reinh., *typica;* p. 14.

2 a. A young specimen, 143 mm. long, with distinct banded markings, mentioned p. 15; nat. size.
Southerly West-Greenland, 88 fathoms. Ingolf Expedition, 1895.

2 b. An adult female, 310 mm. long, still with traces of the dark bands; reduced to $^3/_4$ nat. size.
Southerly West-Greenland (Sukkertoppen). Copenhagen Museum.

2 c. An adult male, 410 mm. long, where the banded markings have almost disappeared; reduced to ca. $^5/_8$ nat. size.
Southerly West-Greenland (Sukkertoppen). Copenhagen Museum.

1



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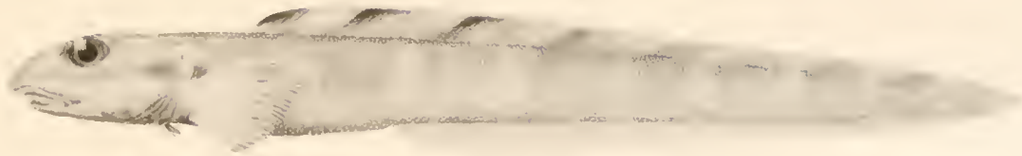

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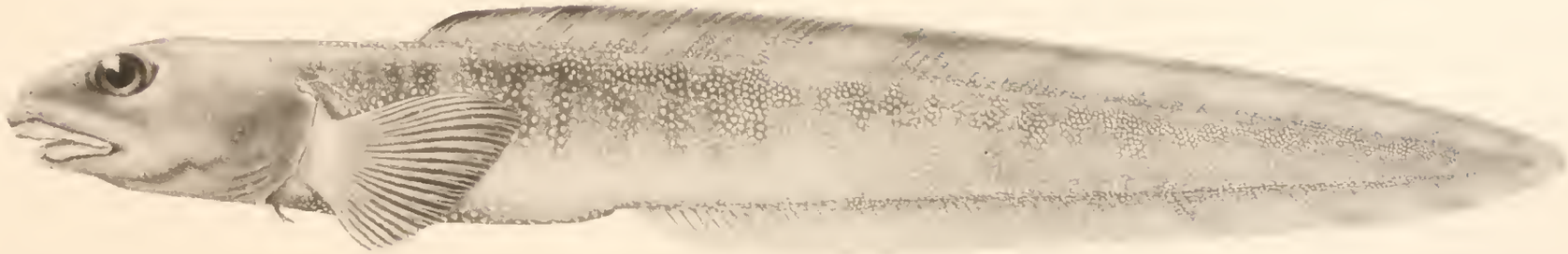

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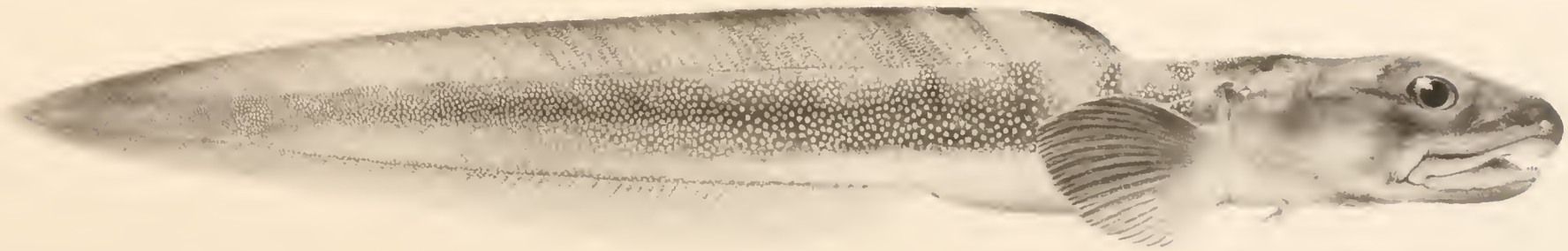


Th. Bloch del.

Pacht & Croge phototyp.

Tab. II.

Tab. II.

Fig. 1. *Lycodes vahlii* Reinh., *lugubris* Lütk.; p. 16.

1 a. An adult male specimen, 300 mm. long, where the dark bands have disappeared; with characteristic dark spot in the anterior corner of the dorsal fin; reduced to $^{11}/_{15}$ nat. size. North-west Iceland (Arnar Fjord). Copenhagen Museum.

1 b. An adult female, 210 mm. long, similar to the foregoing specimen; nat. size. East Iceland (Seydis Fjord). Copenhagen Museum.

Fig. 2. *Lycodes reticulatus* Reinh.; p. 61.

An adult male, 255 mm. long; a little reduced.

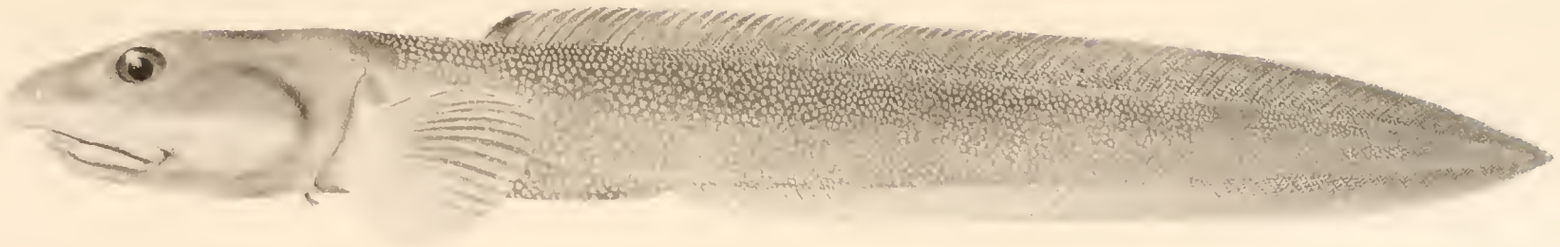
West Greenland (Umanak Fjord). Drygalski Expedition, 1893.

Fig. 3. *Lycodes reticulatus* Reinh. (?), juv.; p. 64.

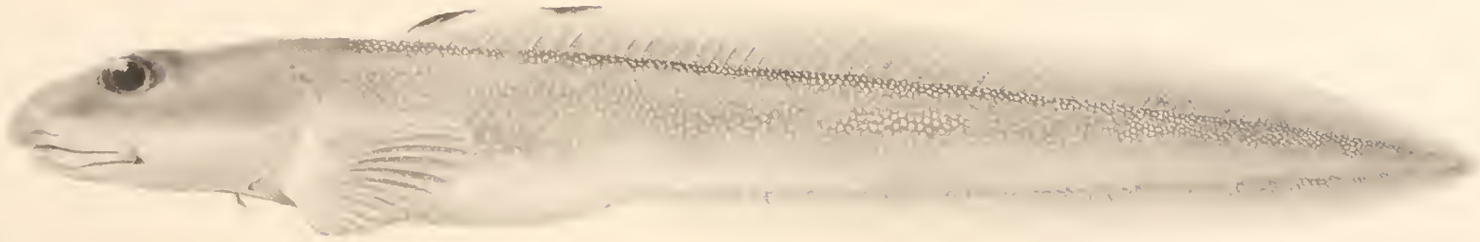
Type-specimen of »*Lycodes perspicillum*» Kroyer; nat. size.

West Greenland. Copenhagen Museum.

1 a



1 b



3

2

Th. Bloch del.

Pacht & Crone phototyp.

Tab. III.

Tab. III.

Fig. 1. *Lycodes eudipleurostictus* Jensen; p. 33.

1 a. An adult female, 260 mm. long; a little reduced.

N.W. from the Færoes, 471 fathoms. Ingolf Expedition, 1896.

1 b. A young specimen, 75 mm. long; nat. size.

Off the Norway-Shetland «Slope», 360 fathoms. «Michael Sars», 1902.

Fig. 2. *Lycodes esmarkii* Coll.; p. 27.

2 a. A young specimen, 192 mm. long, with Λ-shaped, light bands (cf. p. 28); almost nat. size.

Between Norway and Bear Island, 410 metres. Nathorst Expedition, 1898.

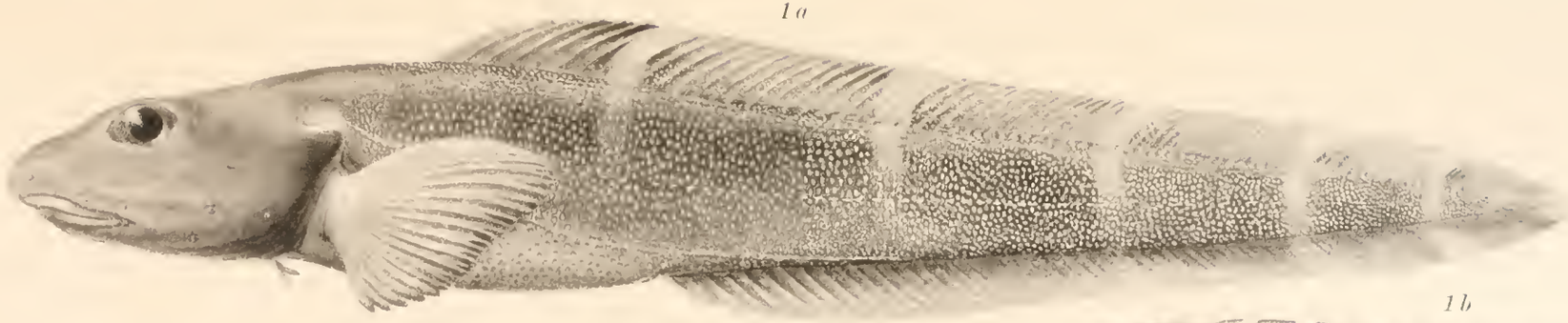
2 b. A somewhat larger specimen, 371 mm. long, with dark stripes and spots in the light bands (cf. p. 31); reduced to $^3/_5$ nat. size.

Norway-Shetland «Slope», 275 fathoms. «Michael Sars», 1902.

2 c. An adult (♂) specimen, 552 mm. long, colouration in the final stage, the light bands being dissolved into festoon-shaped markings; reduced to $^5/_{11}$ nat. size.

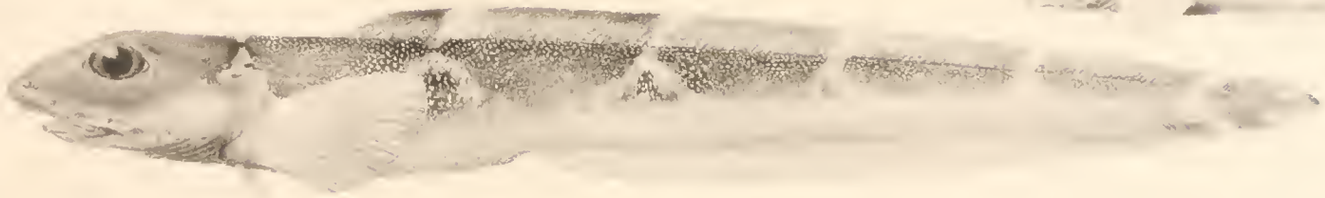
E. from the Færoes, 228 fathoms. «Michael Sars», 1902.

1 a



1 b

2 a



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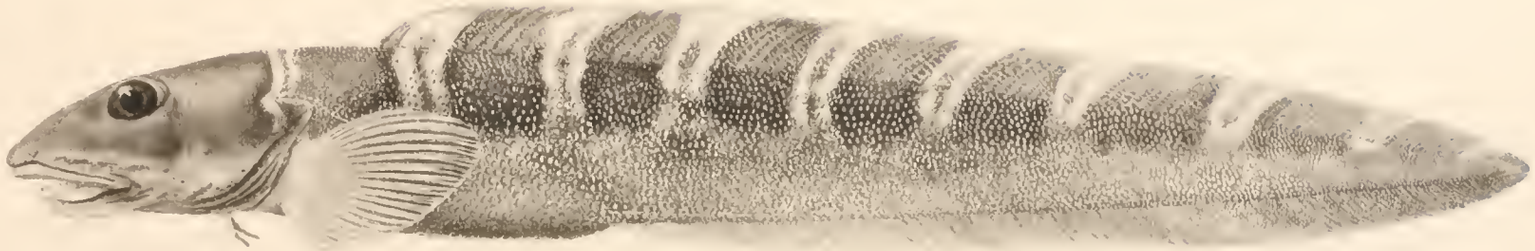

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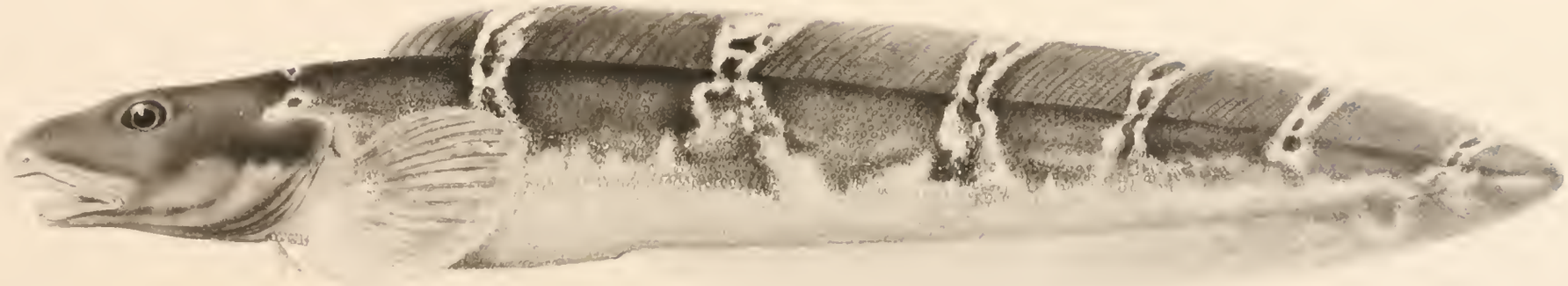


Th. Bloch del.

Pacht & Crone phototyp.

Tab. IV.

Tab. IV.

Fig. 1. *Lycodes pallidus* Coll., *typica;* p. 38 & 40.

1 a, b, c, d og e. A series of specimens showing the varying colouration from the young's distinct banded markings to the adult's uniform colour; nat. size.

N. from the Færoes and N. from Iceland, 293—495 fathoms. Ingolf Expedition, 1896.

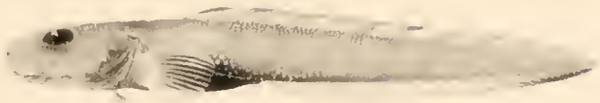
Fig. 2 a, b. *Lycodes pallidus* Coll., var. *squamiventer* m.; p. 39 & 48.

The scales are seen to be more widely distributed, both on the belly and back, than in the typical form; nat. size.

E. from Iceland and N. from Færoes, 679—957 fathoms. Ingolf Expedition, 1896.

1 a

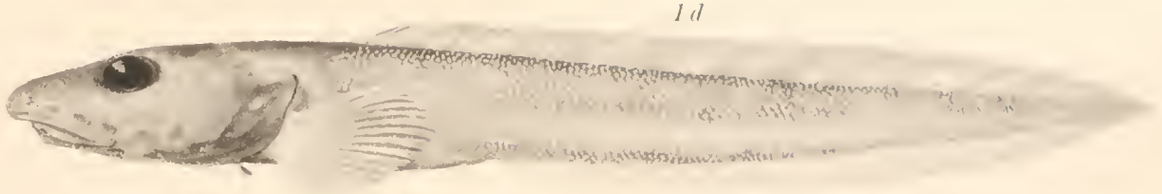
1 b



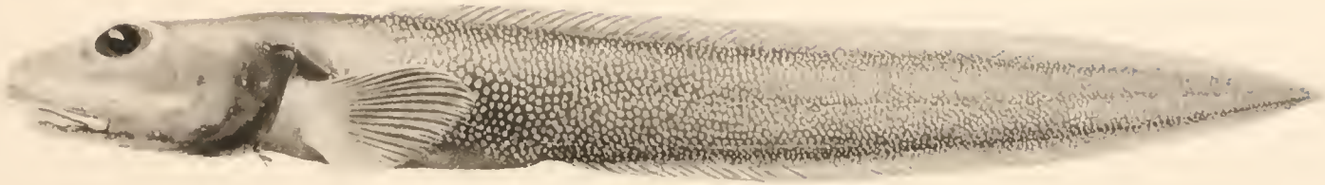
1 c

2 a

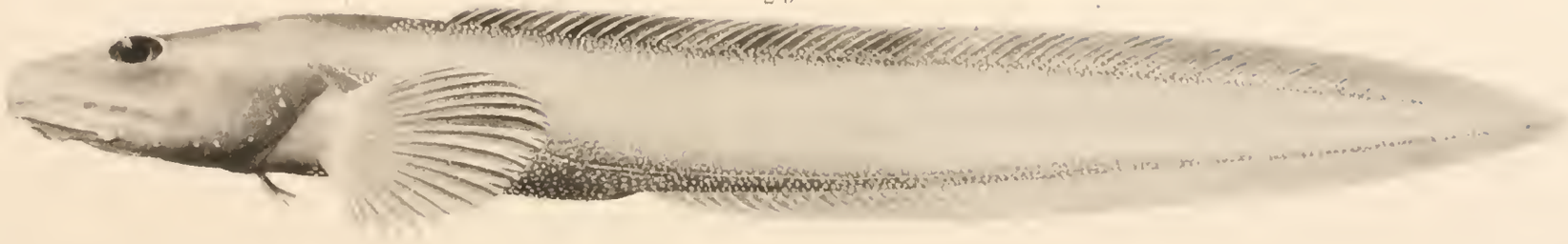
1 d



1 e



2 b



Th. Bloch del.

Pacht & Crone phototyp.

Tab. V.

Tab. V.

Fig. 1. *Lycodes frigidus* Coll.; p. 22.

1 a. A medium-sized specimen, 232 mm. long; nat. size.

S. from Jan Mayen, 1003 fathoms. Ingolf Expedition, 1896.

1 b. A very young specimen, 50,5 mm. long; nat. size.

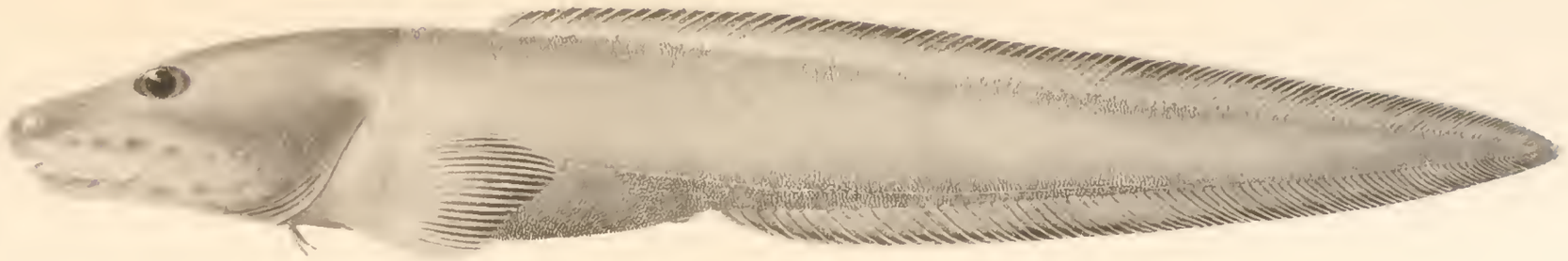
N.E. from Iceland, 860 fathoms. Ingolf Expedition, 1896.

Fig. 2. *Lycodes pallidus* Coll., var. *similis* m.; p. 39 & 46.

2 a, b, c and d. A series of specimens in which the dark bands become indistinct with age; nat. size.

S. from Jan Mayen, 371 fathoms. Ingolf Expedition, 1896.

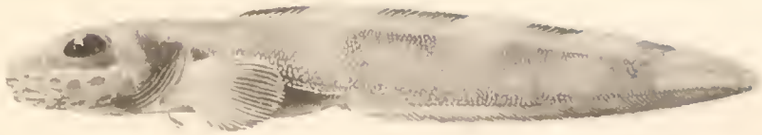
1 a



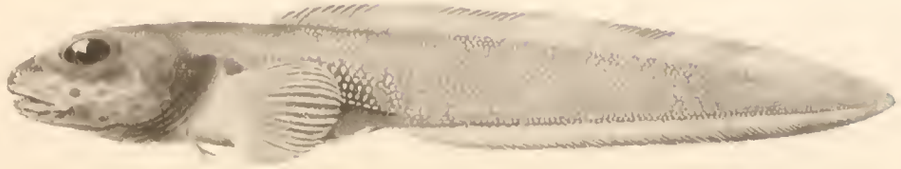
1 b

2 a

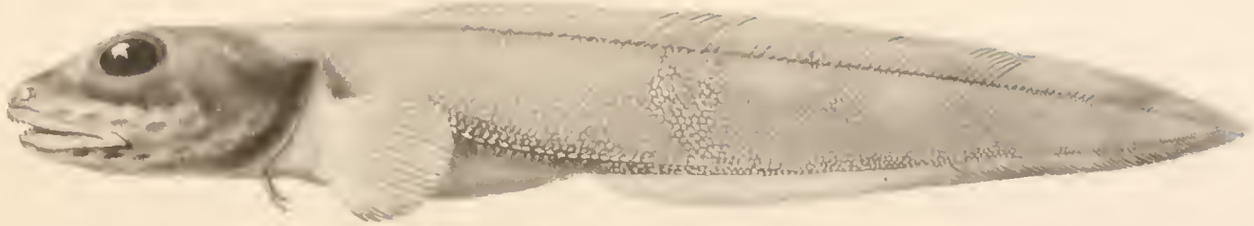
2 b



2 c



2 d



Th. Bloch del.

Pacht & Crone phototyp.

Tab. VI.

Tab. VI.

Fig. 1. *Lycodes agnostus* Jensen; p. 79.

1 a. A medium-sized specimen, 147 mm. long; nat. size.

The Kara Sea, 46—100 fathoms. Dijmphna Expedition, 1882—83.

1 b. A young specimen, 62 mm. long; nat. size.

The Kara Sea, 46—100 fathoms. Dijmphna Expedition, 1882—83.

Fig. 2. *Lycodes platyrhinus* Jensen; p. 51.

The only specimen, 148,5 mm. long; nat. size.

Between Jan Mayen and Iceland, 1010 fathoms. Ingolf Expedition, 1896.

Fig. 3. *Lycodes pallidus* Coll., var. *similis* m.; p. 39 & 46.

3 a, b, c and d. A series of specimens in which the dark bands remain distinct; nat. size.

S. from Jan Mayen, 371 fathoms. Ingolf Expedition, 1896.

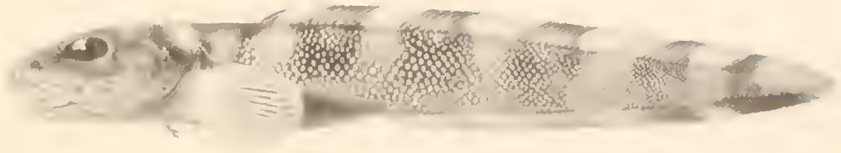
1 a

1 b

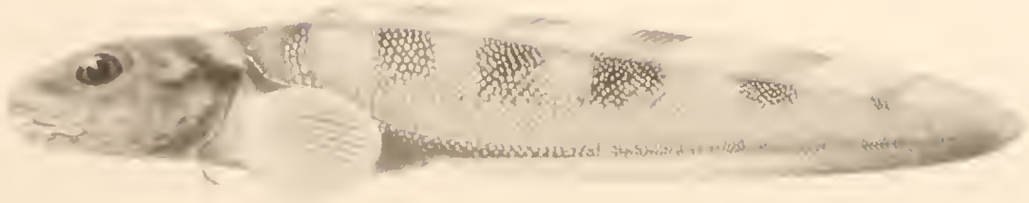
2

3 a

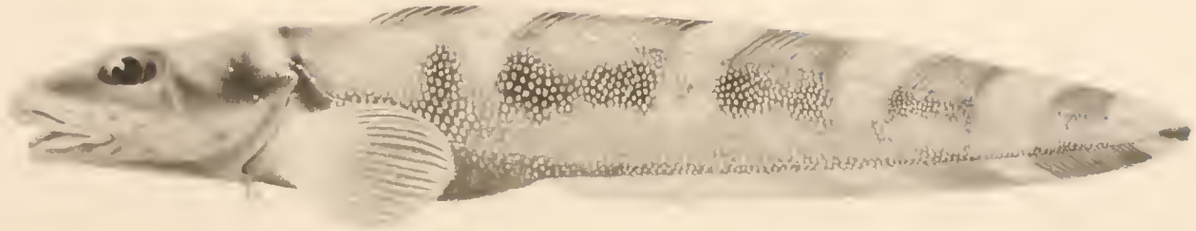
3 b



3 c



3 d



ZOOLOGISK MUSEUM

Tab. VII.

Tab. VII.

Lycodes rossi Malmgr.; p. 55.

1 a. Type-specimen of *L. rossi* Malmgr.
Spitzbergen, Treurenberg Bay, 5 fathoms. Stockholm Museum.

1 b. Specimen, 54,5 mm. long.
Spitzbergen, Green Harbour, 75 fathoms. Michael Sars, 1901.

1 c. Specimen, 68,2 mm. long.
Spitzbergen, Stor Fjord, 39 fathoms. St. Petersburg Museum.

1 d. Specimen, 75,8 mm. long.
Spitzbergen, Stor Fjord, 75 fathoms. St. Petersburg Museum.

1 e. Specimen, 118 mm. long.
Spitzbergen, Green Harbour, 75 fathoms. Michael Sars, 1901.

1 f. Specimen, 163 mm. long (♀).
Spitzbergen, Ise Fjord, 100 metres. Kolthoff Expedition, 1900.

1 g. Specimen, 205 mm. long (♀).
Spitzbergen, Green Harbour, 75 fathoms. «Michael Sars», 1901.

All natural size.

1 a

1 b

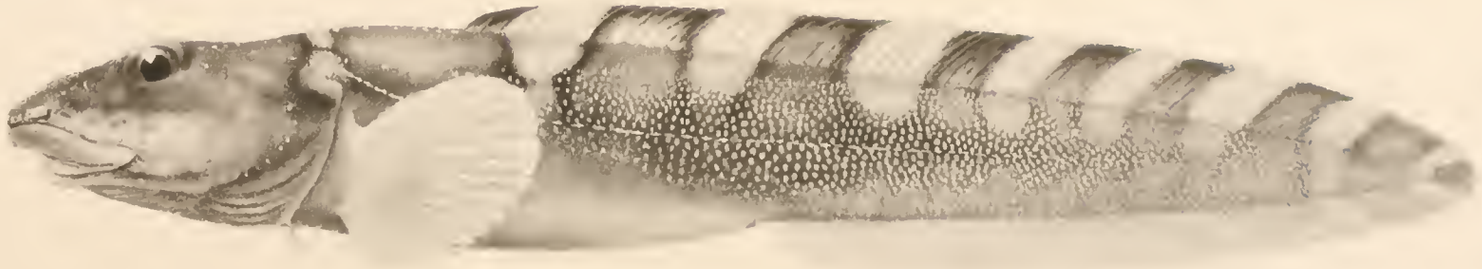
1 c

1 d

1 e

1 f

1 g



Tab. VIII.

Tab. VIII.

Lycodes reticulatus Reinh. var. *macrocephalus* m.; p. 66.

1 a. A specimen, 45,5 mm. long, doubtfully of the present species (cf. p. 69).
Baffins Bay, 92 fathoms. Copenhagen Museum.

1 b & c. Two specimens, 119 and 83 mm. long; in the largest the bands have already begun to assume the net-form.
Jan Mayen, 60—75 metres. «Michael Sars», 1900.

1 d, e and f. Three specimens, 133, 156 and 195 mm. long; the intermediate shows very distinct reticulate markings, which is far from being the case in the larger last specimen.
Northern East-Greenland (1 d from 74° 35′ N.L. 18° 15′ W.L., 150 metres; 1 e and f from 72° 25′ N.L. 17° 56′ W.L., 300 metres). Kolthoff Expedition, 1900.

All natural size.

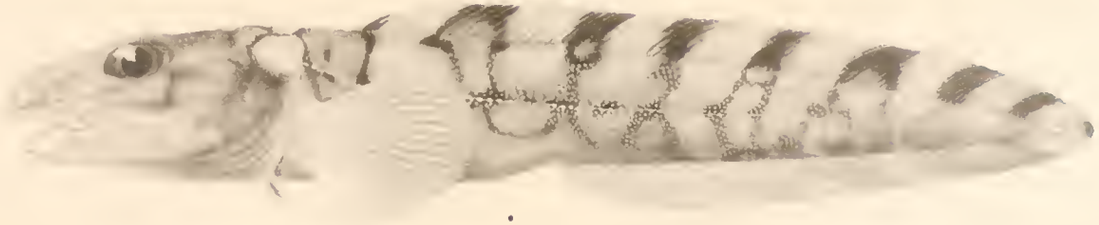
1 a

1 b

1 c

1 d

1 e



1 f

Th. Bloch del.

Pacht & Crone phototyp.

Tab. IX.

Tab. IX.

Lycodes seminudus Reinh.; p. 71.

1 a. A very young specimen, 67 mm. long, still naked, with distinct dark bands; cf. p. 76. S. from Jan Mayen, 371 fathoms. Ingolf Expedition, 1896.

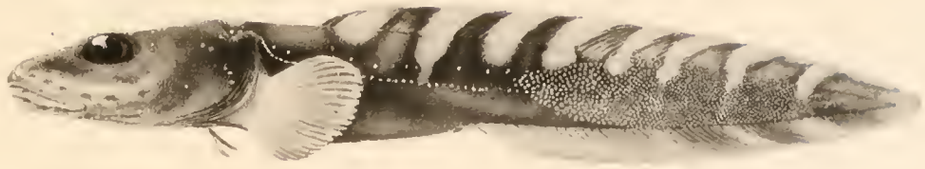
1 b, c, d and e. Four specimens, 129 (♂), 161 (♂), 218 (♀) and 280 (♂) mm. long, belonging to the variety with a distinct banded marking (cf. p. 74—75).

Northern East-Greenland (1 b and d from the mouth of Franz Joseph Fjord, 200—300 metres; 1 c from outer part of Myskoxe Bay, 200 metres; 1 e from Franz Joseph Fjord, 760 metres). Nathorst Expedition, 1899 and Kolthoff Expedition, 1900.

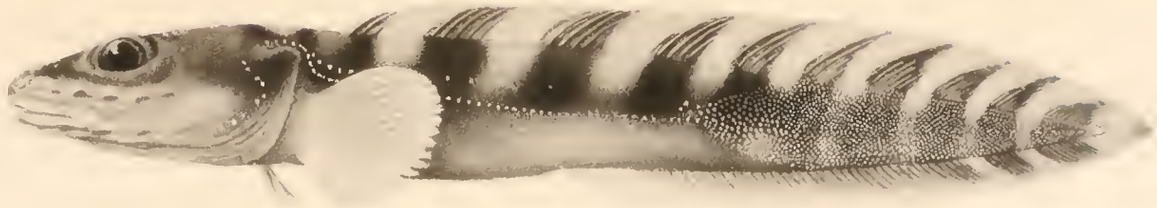
All natural size, except 1 e which is slightly reduced.

1 a

1 b



1 c



1 d

1 e

KGL. BIBLIOTEKET KØBENHAVN

Th. Bloch del.

Pacht & Crone phototyp.

Tab. X.

Tab. X.

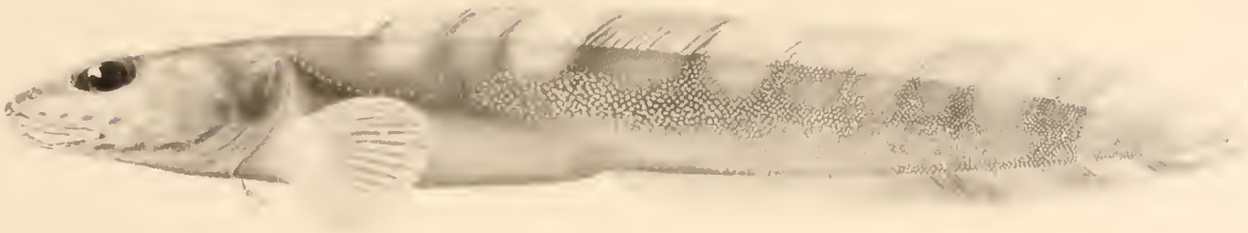
Fig. 1 a. *Lycodes seminudus* Reinh.; p. 71.
Specimen, 180 mm. long (♀), with less distinct banded marking; cf. p. 74; nat. size.
West Greenland (Jakobshavn). Copenhagen Museum.

Fig. 1 b. *Lycodes seminudus* Reinh.; p. 71.
Specimen, 335 mm. long (♀), of the uniformly coloured variety; cf. p. 74; reduced to $^3/_4$ nat. size.
West Greenland (Umanak Fjord). Drygalski Expedition, 1893.

Fig. 2. *Lycenchelys kolthoffi* Jensen; p. 88.
Specimen, 131,5 mm. long (♂); nat. size.
Northern East-Greenland (72° 25′ N.L. 17° 56′ W.L.), 300 metres. Kolthoff Expedition, 1900.

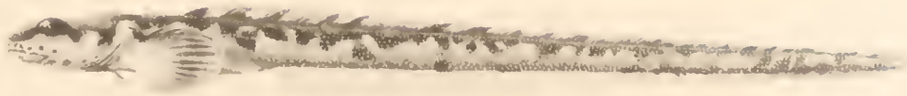
Fig. 3. *Lycenchelys ingolfianus* Jensen; p. 90.
The only specimen, 275 mm. long (♀); slightly reduced.
Davis Straits (64° 54′ N.L. 55° 10′ W.L.), 393 fathoms. Ingolf Expedition, 1895.

1 a



1 b

2



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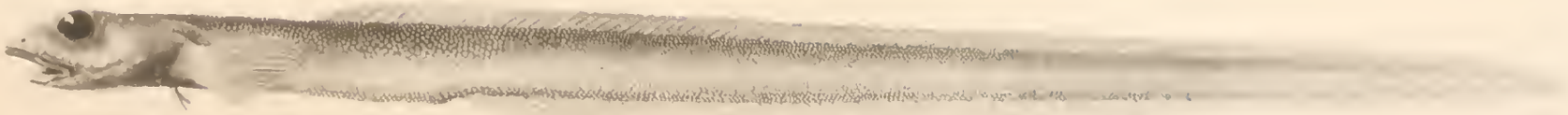

Th. Bloch del.

Pacht & Crone phototyp.

THE INGOLF-EXPEDITION

1895—1896.

THE LOCALITIES, DEPTHS, AND BOTTOMTEMPERATURES OF THE STATIONS.

Station Nr.	Lat. N.	Long. W.	Depth in Danish fathoms	Bottom-temp.	Station Nr.	Lat. N.	Long. W.	Depth in Danish fathoms	Bottom-temp.	Station Nr.	Lat. N.	Long. W.	Depth in Danish fathoms	Bottom-temp.
1	62° 30′	8° 21′	132	7°2	24	63° 06′	56° 00′	1199	2°4	45	61° 32′	9° 43′	643	4°17
2	63° 04′	9° 22′	262	5°3	25	63° 30′	54° 25′	582	3°3	46	61° 32′	11° 36′	720	2°40
3	63° 35′	10° 24′	272	0°5		63° 51′	53° 03′	136		47	61° 32′	13° 40′	950	3°23
4	64° 07′	11° 12′	237	2°5	26	63° 57′	52° 41′	34	0°6	48	61° 32′	15° 11′	1150	3°17
5	64° 40′	12° 09′	155			64° 37′	54° 24′	109		49	62° 07′	15° 07′	1120	2°91
6	63° 43′	14° 34′	90	7°0	27	64° 54′	55° 10′	393	3°8	50	62° 43′	15° 07′	1020	3°13
7	63° 13′	15° 41′	600	4°5	28	65° 14′	55° 42′	420	305	51	64° 15′	14° 22′	68	7°32
8	63° 56′	24° 40′	136	6°0	29	65° 34′	54° 31′	68	0°2	52	63° 57′	13° 32′	420	7°87
9	64° 18′	27° 00′	295	5°8	30	66° 50′	54° 28′	22	1°05	53	63° 15′	15° 07′	795	3°08
10	64° 24′	28° 50′	788	3°5	31	66° 35′	55° 54′	88	1°6	54	63° 08′	15° 40′	691	3°9
11	64° 34′	31° 12′	1300	1°6	32	66° 35′	56° 38′	318	3°9	55	63° 33′	15° 02′	316	5°9
12	64° 38′	32° 37′	1040	0°3	33	67° 57′	55° 30′	35	0°8	56	64° 00′	15° 09′	68	7°57
13	64° 47′	34° 33′	622	3°0	34	65° 17′	54° 17′	55		57	63° 37′	13° 02′	350	3°4
14	64° 45′	35° 05′	176	4°4	35	65° 16′	55° 05′	362	3°6	58	64° 25′	12° 09′	211	0°8
15	66° 18′	25° 59′	330	—0°75	36	61° 50′	56° 21′	1435	1°5	59	65° 00′	11° 16′	310	—0°1
16	65° 43′	26° 58′	250	6°1	37	60° 17′	54° 05′	1715	1°4	60	65° 09′	12° 27′	124	0°9
17	62° 49′	26° 55′	745	3°4	38	59° 12′	51° 05′	1870	1°3	61	65° 03′	13° 06′	55	0°4
18	61° 44′	30° 29′	1135	3°0	39	62° 00′	22° 38′	865	2°9	62	63° 18′	19° 12′	72	7°92
19	60° 29′	34° 14′	1566	2°4	40	62° 00′	21° 36′	845	3°3	63	62° 40′	19° 05′	800	4°0
20	58° 20′	40° 48′	1695	1°5	41	61° 39′	17° 10′	1245	2°0	64	62° 06′	19° 00′	1041	3°1
21	58° 01′	44° 45′	1330	2°4	42	61° 41′	10° 17′	625	0°4	65	61° 33′	19° 00′	1089	3°0
22	58° 10′	48° 25′	1845	1°4	43	61° 42′	10° 11′	645	0°05	66	61° 33′	20° 43′	1128	3°3
23	60° 43′	56° 00′	Only the Plankton-Net used		44	61° 42′	9° 36′	545	4°8	67	61° 30′	22° 30′	975	3°0

Station Nr.	Long. W.	Lat. N.	Depth in Danish fathoms	Bottom-temp.
68	62° 06′	22° 30′	843	3°4
69	62° 40′	22° 17′	589	3°9
70	63° 09′	22° 05′	134	7°0
71	63° 46′	22° 03′	46	
72	63° 12′	23° 04′	197	6°7
73	62° 58′	23° 28′	486	5°5
74	62° 17′	24° 36′	695	4°2
	61° 57′	25° 35′	761	
	61° 28′	25° 06′	829	
75	61° 28′	26° 25′	780	4°3
76	60° 50′	26° 50′	806	4°1
77	60° 10′	26° 59′	951	3°6
78	60° 37′	27° 52′	799	4°5
79	60° 52′	28° 58′	653	4°4
80	61° 02′	29° 32′	935	4°0
81	61° 44′	27° 00′	485	6°1
82	61° 55′	27° 28′	824	4°1
83	62° 25′	28° 30′	912	3°5
	62° 36′	26° 01′	472	
	62° 36′	25° 30′	401	
84	62° 58′	25° 24′	633	4°8
85	63° 21′	25° 21′	170	
86	65° 03′ 0	23° 47′ 0	76	
87	65° 02′ 3	23° 56′ 2	110	
88	64° 58′	24° 25′	76	6°9
89	64° 45′	27° 20′	310	8°4
90	64° 45′	29° 06′	568	4°4
91	64° 44′	31° 00′	1236	3°1
92	64° 44′	32° 52′	976	1°4
93	64° 24′	35° 14′	767	1°46
94	64° 56′	36° 19′	204	4°1
	65° 31′	30° 45′	213	
95	65° 14′	30° 39′	752	2°1
96	65° 24′	29° 00′	735	1°2
97	65° 28′	27° 39′	450	5°5
98	65° 38′	26° 27′	138	5°9
99	66° 13′	25° 53′	187	6°1
100	66° 23′	14° 02′	59	0°4
101	66° 23′	12° 05′	537	—0°7
102	66° 23′	10° 26′	750	—0°9
103	66° 23′	8° 52′	579	—0°6
104	66° 23′	7° 25′	957	—1°1
105	65° 34′	7° 31′	762	—0°8
106	65° 34′	8° 54′	447	—0°6
	65° 29′	8° 40′	466	
107	65° 33′	10° 28′	492	—0°3
108	65° 30′	12° 00′	97	1°1
109	65° 29′	13° 25′	38	1°5
110	66° 44′	11° 33′	781	—0°8
111	67° 14′	8° 48′	860	—0°9
112	67° 57′	6° 44′	1267	—1°1
113	69° 31′	7° 06′	1309	—1°0
114	70° 36′	7° 29′	773	—1°0
115	70° 50′	8° 29′	86	0°1
116	70° 05′	8° 26′	371	—0°4
117	69° 13′	8° 23′	1003	—1°0
118	68° 27′	8° 20′	1060	—1°0
119	67° 53′	10° 19′	1010	—1°0
120	67° 29′	11° 32′	885	—1°0
121	66° 59′	13° 11′	529	—0°7
122	66° 42′	14° 44′	115	1°8
123	66° 52′	15° 40′	145	2°0
124	67° 40′	15° 40′	495	—0°6
125	68° 08′	16° 02′	729	—0°8
126	67° 19′	15° 52′	293	—0°5
127	66° 33′	20° 05′	44	5°6
128	66° 50′	20° 02′	194	0°6
129	66° 35′	23° 47′	117	6°5
130	63° 00′	20° 40′	338	6°55
131	63° 00′	19° 09′	698	4°7
132	63° 00′	17° 04′	747	4°6
133	63° 14′	11° 24′	230	2°2
134	62° 34′	10° 26′	299	4°1
135	62° 48′	9° 48′	270	0°4
136	63° 01′	9° 11′	256	4°8
137	63° 14′	8° 31′	297	—0°6
138	63° 26′	7° 56′	471	—0°6
139	63° 36′	7° 30′	702	—0°6
140	63° 29′	6° 57′	780	—0°9
141	63° 22′	6° 58′	679	—0°6
142	63° 07′	7° 05′	587	—0°6
143	62° 58′	7° 09′	388	—0°4
144	62° 49′	7° 12′	276	1°6

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