38. " *Cl. bacillaris* (Ach.), f. *phyllocephala*."
K− C−.
39. " *Cl. bacillaris* (Ach.), f. *coronata* (Ach.)."
K− C−.
40. " *Cl. macilenta*, Hoffm."
K+ C+.
41. " *Cl. rangiferina* (L.), Hoffm."
K+ C−. =Coëm. 140.
42. " *Cl. sylvatica*, Hoffm., v. *tenuis*, Flk. ?"
K f+ C+. =Coëm. 150; Hepp, 818; Leight. 57.
43. " *Cl. sylvatica* (Hoffm.), v. *tenuis*, Flk."
K f+ C+.
44. " *Cl. sylvatica* (Hoffm.), v. *tenuis*, Flk."
K f+ C+.
45. " *Cl. sylvatica* (Hoffm.), v. *tenuis*, Flk."
K f.+ C+.
46. " *Cl. sylvatica* (Hoffm.) f. *compacta*."
K f+ C+.
47. " *Cl. sylvatica* (Hoffm.), f. ramulis extremis subfuscis, elongatis, nutantibus."
K f+ C+.
48. " *Cl. sylvatica* (Hoffm.), f. ramulis extremis brevibus, distantibus, laxis."
K f+ C+.
49. " *Cl. sylvatica*, (Hoffm.) f. *erecta*."
K f+ C+.
50. " *Cl. sylvatica* (Hoffm.), v. *alpestris* (Ach.)."
K f+ C+.

LIII.—*Remarks on the Distribution of Animal Life in the Depths of the Sea.* By M. Sars*.

Upon the question, so interesting and important in many respects, how far animal life extends downwards in the sea, and of what kind are the animals which occur in the great depths, the observations of the last few years have, as is well known, furnished us with some valuable information. This, however, is still extremely scanty, and embraces only a very small number of animal forms accidentally brought to light; they are, it would appear, little more than isolated glimpses of the life that stirs in the abysses of the ocean.

In order, if possible, to obtain a more comprehensive knowledge of this subject, investigations have been made near our

* Translated from the 'Videnskabs-Selskabs Forhandlinger' for 1868, pp. 246–275, by the Rev. A. Bethune, M.A., late President of the Tyneside Naturalists' Field-Club; and communicated by the Rev. A. M. Norman.

coast in the last two years, which, however, as the necessary means for reaching greater depths are still wanting, have for the present been limited to depths between 200 and 300 fathoms, only in a few cases reaching 450 fathoms.

The apparatus, such as the sounding-lead and "Bulldog's machines," which have hitherto especially been employed for the investigation of great depths in the sea, are in reality very imperfect, inasmuch as with them one can only bring up a very small portion of what there is at the sea-bottom, and only from that particular and very limited space upon which the instrument may chance to descend. The ordinary large dredge, which has done such good service in smaller depths, can hardly be used at depths above 200 fathoms, except by an extraordinary expenditure of time and money; and yet it is undoubtedly the most serviceable apparatus for the purpose, as it can be dragged over a larger portion of the sea-bottom, and by this means take up a greater number of the animals living upon it. It is of consequence therefore to improve this apparatus so as to fit it for more convenient use at great depths. Such a modified dredge, of smaller dimensions than the common, but yet sufficiently heavy to withstand the force of the often strong sea-currents, and provided with a fine net to contain animals, has been constructed by my son, G. O. Sars, and found to be very convenient in depths of 300 fathoms, and even sufficient at 450 fathoms. With this instrument nearly all the species referred to in the present paper have been obtained.

Since my former paper on this subject, "Remarks on the extent of Animal Life in the depths of the Sea" ('Christianias Videnskabs-Selskabs Fordhandlinger,' 1864), I am in a position to make a very considerable addition to what is there contained, nearly all derived from my son's unwearied researches during his journeys to the Lofodens, and some contributions kindly communicated by my friends Danielssen and Koren. The number of species from the depth mentioned is, with this addition, which amounts to nearly quadruple what was known before, increased to such a degree that it now supplies us with a tolerably clear idea of the whole fauna living there, which seems very far indeed from being yet fully known—though it is worthy of remark that it exhibits representatives of nearly all classes of marine animals, and an unexpected wealth of forms, of which not a few seem to be peculiar to these depths, while the remainder belong to levels more or less high up.

In my former paper 92 species were given as occurring on our coast at a depth of 200 or 300 fathoms. As three of these

have been found by later explorers to be mere varieties, and the nomenclature otherwise stands in need of some correction, I have thought that I ought to include all these earlier mentioned species in the following catalogue.

Catalogue of all Living Species hitherto found on the Coast of Norway at from 200 *to* 300 *fathoms, and in part also at* 450 *fathoms.*

Typus I. PROTOZOA.

Classis Rhizopoda.

	fath.
Rhabdammina abyssorum, *Sars*, n. g. et sp.	450
Astrorhiza limicola, *Sandahl*.	450
Saccammina sphærica, *Sars*, n. g. et sp.	450
Glandulina lævigata, *D'Orb.*	450
Nodosaria radicula, *Linné, Parker & Jones*	300
Dentalina communis, *D'Orb.*	300
—— guttifera, *D'Orbigny*	300
Vaginulina linearis, *Montagu*	300
Marginulina lituus, *D'Orb.*	300
—— spinosa, *Sars*, n. sp.	300
Cristellaria crepidula, *Fichtel & Moll*	300
—— cultrata, *Montfort*	300
—— rotulata, *Lamarck*	300
Lagena sulcata, *Walker & Jacob*	300
—— caudata, *D'Orbigny*	300
—— distoma, *Parker & Jones*	300
Polymorphina lactea, *Walker & Jacob*	300
—— compressa, *D'Orbigny*	300
—— tubulosa, *D'Orbigny*	300
Uvigerina pygmæa, *D'Orbigny*	450
—— angulosa, *Williamson*	300
Globigerina bulloides, *D'Orb.*	300
Truncatulina lobatula, *Walker & Jacob*	200
—— refulgens, *Montagu, Carpenter*	300
Anomalina coronata, *Parker & Jones*	300
Rotalia Soldani, *D'Orbigny*	300
Pulvinulina punctulata, *D'Orb.*	300
—— Karsteni, *Reuss*	300
—— Menardi, *D'Orbigny*	300
Discorbina obtusa, *d'Orbigny*	300
—— rosacea, *D'Orbigny*	300
Polystomella striatopunctata, *Fichtel & Moll*	300
Nonionina depressula, *Walker & Jacob*	300
Nonionina umbilicatula, *Mont.*	300
—— scapha, *Fichtel & Moll*	300
Pullenia sphæroides, *D'Orb.*	450
Sphæroidina bulloides, *D'Orb.*	450
Operculina ammonioides, *Gronovius*	450
Cassidulina lævigata, *D'Orb.*	450
Bulimina marginata, *D'Orb.*	450
—— aculeata, *D'Orbigny*	450
—— ovata, *D'Orbigny*	300
—— pyrula, *D'Orbigny*	450
Virgulina Schreibersii, *Czjeck.*	300
—— squamosa, *D'Orbigny*	300
Textularia agglutinans, *D'Orb.*	450
—— carinata, *D'Orbigny*	300
Verneuilina polystropha, *Reuss*	300
Bigenerina eruca, *Sars*, n. sp.	300
Valvulina conica, *Parker & Jones*	450
—— fusca (Rotalina), *Williamson*	450
Trochammina irregularis, *Parker & Jones*	450
Cornuspira foliacea, *Philippi*	300
—— marginata, *Sars*, n. sp.	450
Quinqueloculina seminulum, *Linné, Parker & Jones*	450
—— agglutinans, *D'Orbigny*	450
Spiroloculina planulata, *Lamarck*	300
Triloculina oblonga, *Montagu*	300
—— cryptella, *D'Orbigny*	300
—— tricarinata, *D'Orbigny*	300
Biloculina ringens, *Lamarck*	450
—— elongata, *D'Orbigny*	450
—— depressa, *D'Orbigny*	300
Lituola cenomana, *D'Orbigny*	300
—— canariensis, *D'Orbigny*	300
—— subglobosa, *Sars*, n. sp.	450
—— globerigeriniformis, *Parker & Jones*	450
—— scorpiurus, *Montfort*	450
	=68.

	fath.
Classis Spongiæ (Porifera).	
Cliona abyssorum, *Sars*, n. sp.	300
Halichondria, sp.	300
Hyalonema boreale, *Lovén* ..	200 (sec. Lovén).
Cladorhiza abyssicola, *Sars*, n. g. et sp.	300
Trichostemma hæmisphæricum, *Sars*, n. g. et sp.	300
	=5.

Typus II. CŒLENTERATA.

Classis Anthozoa (Polypi).	
Paragorgia arborea (Alcyonium), *Linné*	300
—— grandiflora, *Sars*	200
Primnoa lepadifera (Gorgonia), *Linné*	300
Mopsea borealis, *Sars*, n. sp.	300
Funiculina finmarchica (Virgularia), *Sars*	300
—— Christii (Virgularia), *Koren & Danielsson*	200
—— Forbesii, *Verrill* (Pavonaria quadrangularis, *Forbes*)	200 (sec. Koren).
Pennatula borealis, *Sars*	200
Kophobelemnon stelliferum (Pennatula), *O. F. Müller*.	300
Lophelia prolifera (Madrepora), *Linné*	300
Amphelia ramea (Madrepora), *O. F. Müller*	300
Ulocyathus arcticus, *Sars*	300
Fungiacyathus fragilis, *Sars*, n. g. et sp.	300
Zoanthus incrustatus (Mammillifera), *Düben & Koren*.	250
Capnea sanguinea, *Forbes*	300
Peachia Boeckii (Siphonactinia), *Danielssen & Koren*	200
Actinopsis flava, *Danielssen & Koren*	250
Tealia digitata (Actinia), *O. F. Müller, Gosse*	300
Actinia, sp.	300
Bolocera Tuediæ (Anthea), *Johnston*	300
	=20.
Classis Hydrozoa.	
Campanularia verticillata (Sertularia), *Linné, Johnston*	300
Lafoëina tenuis, *Sars*, n. g. et sp.	300
	=2.

Typus III. ECHINODERMATA.

Classis Crinoida.	
Rhizocrinus lofotensis, *Sars*, n. g. et sp.	300
Antedon Sarsii (Alecto), *Düben & Koren*	300
	=2.
Classis Asterida.	
Astrophyton Linckii, *Müller & Troschel*	250
—— Lamarckii, *Müller & Troschel*	250
Asteronyx Lovenii, *Müller & Troschel*	240
Ophioscolex glacialis, *Müller & Troschel*	300
—— purpurea, *Düben & Koren*	300
Ophiacantha spinulosa, *Müller & Troschel*	300
Ophiopholis aculeata (Asterias), *O. F. Müller*	300
Ophiactis clavigera, *Ljungman*	200–300 (sec. Ljungman).
Amphiura, n. sp.?	300
—— norvegica, *Ljungman*	450
—— tenuispina, *Ljungman*	300
Ophiura abyssicola, *Forbes*	300
—— carnea, *Sars*	300
—— Sarsii, *Lütken*	300
Ctenodiscus crispatus (Asterias), *Retzius*	200
Brisinga endecacnemos, *Asbjörnsen*	200
Archaster tenuispinus (Astropecten), *Düben & Koren*	300
—— arcticus (Astropecten), *Sars*	300

	fath.
Archaster andromeda (Astropecten), *Müller & Troschel*. .	250
Goniaster granularis (Asterias), *O. F. Müller*.	300
Cribrella sanguinolenta (Asterias), *O. F. Müller*	300

=21.

Classis Echinida.

Cidaris papillata, *Leske*	200
Echinus norvegicus, *Düben & Koren* . . . . . (sec. Danielssen).	450
Echinus elegans, *Düben & Koren* . . . . . (sec. Danielssen).	250
Echinocyamus angulosus, *Leske*	300

	fath.
Echinocardium ovatum (Spatangus), *Leske*.	300

=5.

Classis Holothurida.

Echinocucumis typica, *Sars*. .	450
Psolus squamatus (Cuvieria), *Koren* . . . . . (sec. Danielssen).	253
Holothuria tremula, *Gunnerus*	250
—— intestinalis, *Ascanius & Rathke*.	300
Stichopus natans, *Sars*, n. sp. .	300
Molpadia borealis, *Sars*.	200
Oligotrochus vitreus, *Sars*, n. g. et sp.	300
Synapta tenera, *Norman* (S. Buskii, *M'Intosh* ?)	300

=8.

Typus IV. VERMES.

Classis Gephyrea.

Chætoderma nitidulum, *Lovén*	300
Phascolosoma olivaceum, *Sars*, n. sp.	300
—— pusillum, *Sars*, n. sp. . .	300
—— margaritaceum (Sipunculus), *Sars*.	300
—— lævissimum, *Sars*, n. sp .	230
Sipunculus, n. sp. . . . . (sec. Danielssen).	250

=6.

Classis Annelida.

Spirorbis borealis, *Daudin*, *Mörch*	300
—— Fabricii, *Mörch*.	300
—— lucidus, *Montagu*	300
Ditrypa libera (Serpula), *Sars*	300
Placostegus tridentatus (Serpula), *J. C. Fabricius*	300
Protula borealis, *Sars*, n. sp. . .	300
Filograna implexa, *Berkeley*. .	300
Chone infundibulum, *Kröyer* (C. Kröyerii, *Sars*)	250
Euchone, sp.	300
Terebella artifex, *Sars*	300
Pectinaria hyperborea (Cistenides), *Malmgren*	300
Terebellides Stroemii, *Sars* . .	300
Maldane biceps (Clymene), *Sars*.	200
—— ? pellucida, *Sars*, n. sp. . .	300
Clymene prætermissa (Praxilla), *Malmgren*	300
Ereutho Smitti, *Malmgren* . .	300
Nerine cirrata, *Sars*	300
Chætozone setosa, *Malmgren*.	300
Amage auricula, *Malmgren* . .	250
Sabellides borealis, *Sars*	300
—— sexcirrata, *Sars* (Samytha, *Malmgren*)	300
—— cristata, *Sars* (Melinna, *Malmgren*)	200
Eumenia ? erucæformis, *Sars*, n. sp.	300
Ephesia gracilis, *H. Rathke*. .	300
Scalibregma inflatum, *H. Rathke*.	300
Chloræma pellucidum, *Sars*, n. sp.	200
Trophonia pallida, *Sars*, n. sp. (*an* T. glauca, *Malmgren* ?) .	300
—— pilosa, *Sars*, n. sp.	300
—— flabellata, *Sars*, n. sp. . .	300
Ammotrypane aulogaster, *H. Rathke*.	300
Pygophelia singularis, *Sars*, n. g. et sp.	300
Glycera capitata, *Œrsted*	300
Chætopterus norvegicus, *Sars*.	300
Spiochætopterus typicus, *Sars*	300
Nephthys incisa, *Malmgren* . .	300
—— longisetosa, *Œrsted*	300
Castalia, sp.	300
Syllis, sp.	300

	fath.
Umbellisyllis fasciata, *Sars*, n. g. et sp.	300
Lumbrinereis fragilis (Lumbricus), *O. F. Müller*	300
Eunice norvegica (Nereis), *O. F. Müller*	300
Onuphis conchylega, *Sars*	300
—— quadricuspis, *Sars*, n. sp.	300
Sigalion stelliferum (Nereis), *O. F. Müller* (S. tetragonum, *Ærsted*)	300
Polynoë cirrosa (Nychia), *Malmgren* (P. scabriuscula, *Sars*)	300
Polynoë nodosa, *Sars* (Eunoa, *Malmgren*)	250
—— (Eunoa) abyssicola, *Sars*, n. sp.	300
—— Sarsii (Antinoë), *Kinberg*	300
Lætmonice filicornis, *Kinberg*	300
Paramphinome pulchella, *Sars*, n. g. et sp.	300
Euphrosyne cirrata, *Sars*	300
	=51.

Typus V. MOLLUSCA.

Classis Polyzoa (Bryozoa).

Crisia denticulata, *Lamarck, Smitt*	300
—— cornuta (Sertularia), *Linné, Smitt*	200
Diastopora repens (Tubulipora), *Wood*	300
—— hyalina (Berenicea), *Fleming*	300
—— simplex, *Busk*	200–300 (sec. Smitt).
—— patina (Tubulipora), *Lamarck*	300
Tubulipora atlantica (Idmonea), *Forbes*	300
—— serpens (Tubipora), *Linné*	200
—— (Phalangella) palmata *Wood*	200–300 (sec. Smitt).
—— (Proboscina) incrassata, *D'Orbigny*	200–300 (sec. Smitt).
Pustulipora producta, *Sars*, n. sp.	300
Hornera lichenoides (Millepora), *Linné*	300
—— violacea, *Sars*	200
Discoporella verrucaria, forma hispida, *Fleming*	300
Defrancia lucernaria, *Sars*	200
Cellularia ternata, *Solander*, forma ternata et gracilis, *Smitt*	300
—— scabra, *Van Beneden*	300
Bicellaria Alderi, *Busk* (B. unispinosa, *Sars*)	200
Bugula avicularia (Sertularia), *Linné*, forma fastigiata	300
Bugula Smitti (Kinetoskias), *Danielssen*	300
Flustra securifrons (Eschara), *Pallas, Smitt*	200
—— abyssicola, *Sars*, n. sp.	300
Cellaria fistulosa, *Linné* (Salicornaria farciminoides, *Jnst.*)	250
Membranipora Flemingii, *Busk*, forma trifolium	300
—— pilosa (Flustra), *Linné*, forma catenularia	200–300 (sec. Smitt).
Porina (Lepralia) ciliata, *Pallas*, forma dura	300
Anarthropora monodon (Lepralia), *Busk*	200–300 (sec. Smitt).
—— gracilis (Quadricellaria), *Sars* (Onchopora borealis, *Busk*)	300 (sec. Smitt, to 600).
Escharella Legentilii (Flustra), *Audouin*	200–300 (sec. Smitt).
—— linearis (Lepralia), *Hassall*	300
Mollia vulgaris (Eschara), *Moll.*, forma ansata	200–300 (sec. Smitt).
Porella lævis (Eschara), *Flem.*	200
Discopora coccinea (Cellepora), *Abildgaard*, forma ventricosa et ovalis	300
Retepora cellulosa (Millepora), *Linné*, forma *Beaniana*	300
Halilophus mirabilis, *Sars*, n. g. et sp.	300
	=35

fath.

Classis Tunicata.

Ascidia obliqua, *Alder* 300
Cynthia Lovenii, *Koren & Danielssen*, MS. 300
—— cinerea, *Sars*, n. sp. 300
—— limacina, *Forbes* 220

=4

Classis Brachiopoda.

Crania anomala (Patella), *O. F. Müller*..... 250
Terebratula (Terebratulina) caput serpentis (Anomia), *Linné* 300
—— (Waldheimia) cranium, *O. F. Müller* 300
—— (——) septata, *Philippi* (T. septigera, *Lovén*) 300

=4

Classis Conchifera (Lamellibranchiata).

Anomia ephippium, *Linné*, var. squamula et aculeata..... 300
Pecten septemradiatus, *O. F. Müller* 300
—— abyssorum, *Lovén*, MS... 300
—— vitreus, *Chemnitz* 300
—— mammillatus, *Sars*, n. sp. 450
—— similis, *Laskey* 300
Lima excavata (Ostrea), *J. C. Fabricius*..... 300
—— elliptica, *Jeffreys* (L. subauriculata, *Forbes & Hanley*) 300
—— Sarsii (Limea), *Lovén* .. 300
Limopsis minuta (Pectunculus), *Philippi* 450
Arca pectunculoides, *Scacchi* (A. raridentata, *Wood*), forma minor..... 300
—— ——, *Scacchi*, forma major (Arca glacialis, *Torell*).. 300

fath.

Arca nodulosa, *O. F. Müller*.. 250
Yoldia pygmæa (Nucula), *Münster* 300
—— lucida, *Lovén*..... 300
—— nana, *Sars* 300
—— obtusa *, *Sars*, nov. sp... 300
Nucula pumila, *Asbjörnsen*, MS. 450
—— tenuis (Arca), *Montagu*.. 300
Crenella decussata (Mytilus), *Montagu* 300
Mytilus phaseolinus (Modiola), *Philippi* 300
Cardium minimum, *Philippi* (C. suecicum, *Reeve*) 300
Astarte sulcata (Pectunculus), *Da Costa, Jeffreys* 300
——, var. scotica (Venus), *Maton & Racket* 250
Kelliella abyssicola, *Sars*, n. g. et sp. 450
Montacuta substriata (Ligula), *Montagu* 250
Axinus flexuosus (Tellina), *Montagu* 450
—— pusillus, *Sars*, n. sp. 450
—— ferruginosus (Kellia), *Forbes* 300
Poromya granulata, *Nyst* (Embla Korenii, *Lovén*) 300
Scrobicularia alba (Mactra), *Wood* 300
—— nitida (Mya), *O. F. Müller* 300
Lyonsiella abyssicola, *Sars*, n. g. et sp. 450
Saxicava rugosa (Mytilus), *Linné*, var. arctica 300
Panopea plicata (Mytilus), *Montagu* (Saxicava fragilis, *Nyst*) 300
Neæra rostrata (Mya), *Spengler* 300
—— obesa, *Lovén* 450
—— abbreviata, *Forbes*..... 300 (sec. Koren).
—— lamellosa, *Sars*, n. sp. .. 300

=37

* *Yoldia obtusa.* This I formerly named *Y. abyssicola*; but it is very distinguishable from the form described under the same name by Torell, which is nothing more than the common northern variety (*Nucula gibbosa*, Smith) of *Y. pygmæa*, Münster. To avoid confusion, I have therefore called my new species *Y. obtusa*. It is nearest to *Leda obesa*, Stimpson, but is more than twice as large. The back of the shell is both longer and higher, and it has many hinge-teeth (dent. ant. 11–15, post. 18–27), while *Y. obtusa* has dent. ant. 10, post. 12 (Stimpson).

fath.

Classis Cephalophora.

Solenopus nitidulus, *Sars*, n. g. et sp. 300
Chiton Hanleyi, *Bean* 300
Chiton cancellatus, *Sowerby* (C. alveolus, *Sars*, *Lovén*).. 300
Siphonodentalium lofotense, *Sars* 300
—— affine, *Sars*..... 300
—— quinquangulare (Dentalium), *Forbes* (S. pentagonum, *Sars*) 450
—— subfusiforme, *Sars* 450
Dentalium abyssorum, *Sars* .. 300
—— agile, *Sars*, n. sp. 300
Cylichna alba (Bulla), *Brown* 300
—— umbilicata (Bulla), *Montagu* 300
—— conulus, *Forbes & Hanley* 300
Utriculus expansus, *Jeffreys* .. 300
Utriculopsis vitrea, *Sars*, n. g. et sp. 300
Philine scabra (Bulla), *O. F. Müller* 300
—— granulosa, *Sars*, n. sp. .. 300
—— quadrata (Bullæa), *Wood* 300
Scaphander librarius, *Lovén* .. 300
Puncturella noachina (Patella), *Linné* 250
Natica affinis, *Gmelin* (N. clausa, *Sowerby*)..... 300
—— Montagui, *Forbes* 250
—— grönlandica, *Beck*..... 250
Rissoa abyssicola, *Forbes* 300
—— reticulata (Turbo), *Montagu* 300
—— Jeffreysii, *Waller* 300
—— soluta, *Philippi* ?, var. lævis, *Sars* 300
Scissurella crispata, *Fleming*.. 300

fath.

Trochus cinereus, *Couthouy* ?, varietas 300
Adeorbis subcarinatus (Helix), *Montagu* 300
Cyclostrema nitens (Delphinula), *Philippi* 450
Tylodina Duebenii..... 200 (sec. Lovén).
Colobocephalus costellatus, n. g. et sp. 230
Admete viridula (Tritonium), *O. Fabricius* 300
Cerithium metula, *Lovén* .. . 300
Cerithiopsis costulata (Turritella), *Möller*, *Jeffreys* 300
Aporrhais Macandrei, *Jeffreys* 250 (sec. Danielssen).
Fusus propinquus, *Alder* 250
Trophon barvicensis (Fusus), *Johnston* 300
Aclis Walleri, *Jeffreys* 300
Eulima distorta, *Deshayes*.... 300
—— intermedia, *Cantraine*, *Jeffreys*..... 300
—— bilineata, *Alder* 300
—— stenostoma, *Jeffreys* 300
Odostomia acicula (Melania), *Philippi* 300
——, sp. 300
—— insculpta, *Montagu*, *Forbes & Hanley* 300
Pleurotoma cancellata (Fusus), *Mighels & Adams* 300
—— tenuicostata, *Sars*, n. sp. 300
—— Mörchii (Trophon), *Malm* 300
—— violacea, *Migh. & Adams*? 250
—— nivalis, *Lovén*..... 300
—— carinata, *Philippi* 300
—— teres, *Forbes* (P. borealis, *Philippi*) 250

=53

Typus VI. ARTHROPODA.

Classis Arachnida.

Nymphon longitarse, *Kröyer*? 300

=1

Classis Crustacea.

Sylon (*Kröyer*) Hippolytes, *Sars*, n. sp. ..... 250 (sec. Danielssen).
Verruca Stroemia (Lepas), *O. F. Müller*..... 300
Scalpellum vulgare, *Leach* (Lepas scalpellum, *O. F. Müller*) 300
—— Stroemii, *Sars* 300
Longipedia, sp. 250
Harpacticus ?, sp. 250
Cytherella abyssorum, *G. O. Sars*..... 450
Polycope orbicularis, *G. O. Sars*? 250
Conchœcia elegans, *G. O. Sars* 300
—— borealis, *G. O. Sars* 300

	fath.
Philomedes Lilljeborgii, *G. O. Sars*	250
Asterope abyssicola, *G. O. Sars*, n. sp.	250
Cypridina norvegica, *Baird*	300
Ilyobates prætexta, *G. O. Sars*	250
Cytheropteron alatum, *G. O. Sars*	250
—— subcircinatum, *G. O. Sars*	250
—— hamatum, *G. O. Sars*, n. sp.	300
Cythereis echinata, *G. O. Sars*	300
—— mucronata, *G. O. Sars*	300
—— abyssicola, *G. O. Sars*	300
Argillœcia cylindrica, *G. O. Sars*	250
Bairdia minna, *Baird*	300
—— angusta, *G. O. Sars*	250
Dulichia, n. sp.	250
Clydonia borealis, *G. O. Sars*, n. sp.	300
Hyperia, sp.	250
Leucothoë articulosa, *Leach*	250
Ampelisca macrocephala, *Lilljeborg*?	250
Ampelisca, sp.	250
Kröyera, sp.	250
Œdicerus, sp.	250
—— obtusus, *Bruzelius*	250
——, sp.	250
Eusirus, sp.	250
Stegocephalus ampulla, *Phipps*?	250
Cerapus, sp.	250
Lysianassa magellanica, *Lilljeborg*, vix *M.-Edwards* 300–400?	
Anonyx, sp.	250
Eriops elongata, *Bruzelius*	250
Lilljeborgia, sp.	250
Gammarus ?, sp.	250
——?, sp.	250
Paramphithoë fragilis, *Goës*	250
——, sp.	250
Liriope, n. sp.	250
Ischnosoma bispinosum, *G. O. Sars*	250
Macrostylis spinifera, *G. O. Sars*	250
Desmosoma aculeatum, *G. O. Sars*	250
—— lineare, *G. O. Sars*	250
Ilyarachna longicornis (Mesostenus), *G. O. Sars*	200
—— coronata, *G. O. Sars*, n. sp.	300
—— hirticeps, *G. O. Sars*, n. sp.	300
—— clypeata, *G. O. Sars*, n. sp.	250
Munnopsis typica, *M. Sars*	300
Eurycope cornuta, *G. O. Sars*	300
—— producta, *G. O. Sars*	250
Eurycope phalangium, *G. O. Sars*	300
—— furcata, *G. O. Sars*, n. sp.	250
Arcturus, sp.	300
Apseudes talpa, *Montagu*	300
Tanais, sp.	300
—— tenuimanus, *Lilljeborg*	300
Anceus oxyuræus, *Lilljeborg*	250
Munna limicola, *G. O. Sars*	250
Henopomus muticus, *Kröyer*	250
Æga psora (Oniscus), *Linné* (sec. Danielssen)	250
Cyclaspis longicauda, *G. O. Sars*	300
Platyaspis typica, *G. O. Sars*, n. g. et sp.	250
Campylaspis costata, *G. O. Sars*	250
—— sulcata, *G. O. Sars*, n. sp.	250
—— undata, *G. O. Sars*	300
—— horrida, *G. O. Sars*, n. sp.	300
—— verrucosa, *G. O. Sars*	300
Eudora emarginata, *Kröyer*	250
—— hirsuta, *G. O. Sars*, n. sp.	230
Leucon acutirostris, *G. O. Sars*	300
—— pallidus, *G. O. Sars*	300
—— nasicus, *Kröyer*	200
Diastylis biplicata, *G. O. Sars*	300
—— longimana, *G. O. Sars*	250
—— bispinosa, *Stimpson*	250
—— echinata, *Sp. Bate*	300
—— serrata, *G. O. Sars*	300
—— macrura, *G. O. Sars*, n. sp.	250
Boreomysis (n. g.) arctica (Mysis), *Kröyer*	200
—— tridens, *G. O. Sars*, n. sp.	250
Mysideis insignis (Mysis), *G. O. Sars*	250
Hemimysis abyssicola, *G. O. Sars*, n. g. et sp.	250
Pseudomma roseum, *G. O. Sars*, n. g. et sp.	450
—— abbreviatum, *G. O. Sars*, n. sp.	250
—— affine, *G. O. Sars*, n. sp.	250
Parerythrops obesa, *G. O. Sars*	250
Erythrops serrata (Nematopus), *G. O. Sars*	250
—— microphthalma, *G. O. Sars*, n. sp.	250
—— abyssorum, *G. O. Sars*, n. sp.	300
Thysanoessa neglecta (Thysanopoda), *Kröyer*?	250
Thysanopoda norvegica, *M. Sars*	250
Pasiphaë norvegica, *M. Sars*	300
Pandalus borealis, *Kröyer*	300

	fath.		fath.
Hippolyte securifrons, *Norman*	250	Galathea rugosa, *J. C. Fabricius*	250
—— polaris, *Sabine*	250	—— tridentata, *Esmark*	300
Cryptocheles abyssicola, *G. O. Sars*, n. g. et sp.	300		
Pontophilus norvegicus, *M. Sars*	450		=105

RECAPITULATION.

Protozoa	Rhizopoda	68 species.	
	Spongiæ	5	
			73
Cœlenterata	Anthozoa	20	
	Hydrozoa	2	
			22
Echinodermata	Crinoida	2	
	Asterida	21	
	Echinida	5	
	Holothurida	8	
			36
Vermes	Gephyrea	6	
	Annelida	51	
			57
Mollusca	Polyzoa	35	
	Tunicata	4	
	Brachiopoda	4	
	Conchifera	37	
	Cephalophora	53	
			133
Arthropoda	Arachnida	1	
	Crustacea	105	
			106
	Total		427

In addition to these, there are, moreover, several fishes, of whose range in the deep nothing has been known beyond what fishermen have happened to discover in the use of their deep lines, and have told. Of such fish some descend to 200–300 fathoms, and even deeper, although they often swim far higher up, so that some of them (as the Turbot, Ling, &c.) at certain seasons of the year approach nearer to the shore.

Sebastes norvegicus (Perca), *O. F. Müller*, *Cuvier*.
—— dactylopterus, *Delaroche* (S. imperialis, *Cuvier*).
Molva vulgaris, *Nilsson*.
—— abyssorum, *Nilsson*.
Brosmius vulgaris, *Cuvier*.
Macrourus Stroemii, *Reinhardt*.
—— Fabricii, *Sundevall*.
Hippoglossus maximus, *Minding*.
Scymnus borealis, *Scoresby*.

Lastly, there are some other fishes which are only extremely

rarely, and as it were accidentally, caught on our coasts, and whose yet unknown dwelling-place may probably be the greatest depths, such as *Lampris guttatus*, Brünnich, *Trachypterus arcticus*, Nilsson, *Gymnetrus Grillii*, Lindroth, &c.

There is now, therefore, quite a considerable and unexpected multitude of forms which live in what a short time ago were considered uninhabited depths; but there are certainly still many more which are as yet unknown. It seems to me, therefore, still too early to draw from the facts we have discovered more than some general results which seem as it were to present themselves to our notice or are forced upon us as scientific conclusions.

Of the great divisions of the animal kingdom we find at these depths the mollusks to be the most numerously represented (133 species); next the Arthropoda (106 species), namely the Crustacea, for of the small number of sea-spiders only one species is yet known; then Protozoa (73 species, of which, perhaps, not a few are to be regarded as only varieties of a small number of typical species); Annelids (57 species); Echinodermata (36 species); and, lastly, Cœlenterata (22 species). With regard to the last, there is the interesting and, as it seems, tolerably certain conclusion that the Hydrozoa at these depths are very few (only 2 species known); they seem to be almost exclusively confined to the upper soundings, as, indeed, the greatest number of those animals which are subject for the most part to an alternation of generations are in their last condition or generation more or less pelagic.

It is stated by many naturalists (see Keferstein on the distribution of mollusks, Bronn's 'Classen und Ordnungen des Thierreichs,' 1864, vol. iii. p. 1098) that the Conchifera in the whole sea have a wider extension in depth than the Cephalophora (*i. e.* Gasteropoda). Examination of the depths on our coast contradict this statement, since the former are represented by 37, and the latter by 53 species, thus exceeding the Conchifera by a considerable number.

One of the rather surprising results of these present researches is that many species which are known to us as inhabitants of shoal water, far from being confined to such situations, have a considerable range in depth, and extend from the shore to the greatest depths examined on our coast.

On the other hand, we find not a few species which, according to the facts now known, are confined to the great depths.

As such peculiarly deep-sea species I have, in my earlier paper, mentioned:—the great corals *Lophelia prolifera*, *Amphelia ramea*, *Ulocyathus arcticus*, *Primnoa lepadifera*, *Paragorgia arborea* and *P. grandiflora*; the great Pennatulids

Funiculina finmarchica, *F. Christii*, *Pennatula borealis*; also, *Astrophyton Linckii*, *A. Lamarckii*, *Asteronyx Lovénii*, *Brisinga endecacnemos*, *Cidaris papillata*, *Molpadia borealis*; finally, *Terebratula septata*, *Lima excavata*, *Yoldia obtusa*.

To these, after the last two years' explorations, the following are now to be added:—

Cladorhiza abyssorum (200–300 fathoms), *Trichostemma hemisphæricum* (100–300 f.), *Funiculina Forbesii* (200 f.), *Mopsea borealis**, *Fungiacyathus fragilis* (100–300 f.), *Echinocucumis typica* (100–450 f.) †, *Stichopus natans* (200–300 f.), *Flustra abyssicola* (100–300 f.), *Halilophus mirabilis* (100–300 f.), *Axinus pusillus* (200–450 f.), *Lyonsiella abyssicola* (100–450 f.), *Dentalium agile* (250–300 f.), *Phascolosoma olivaceum* (250–300 f.), *Cytheropteron hamatum* (250-300 f.), *Cythereis mucronata* (100–300 f.), *Cytherella abyssorum* (100–450 f.), *Conchœcia elegans* (100–300 f.), *Conchœcia borealis* (about 300 f. or more), *Clydonia borealis* (about 300 f., and not rare), *Campylaspis sulcata* (100–250 f.), *Campylaspis horrida* (100–300 f.), *Cyclaspis longicauda* (100–300 f.), *Ilyarachna coronata* (300 f.), *Ilyarachna hirticeps* (100–300 f.), *Hemimysis abyssicola* (250 f.), *Pseudomma roseum* (250–450 f.), *Erythrops abyssorum* (300 f.), *Cryptocheles abyssicola* (300 f.), *Pasiphaë norvegica* (100–300 f.)—altogether 46 kinds, independent of several others that cannot yet with certainty be said to be deep-sea forms.

Although, as we see by the examples adduced, there is some variation in the limits of these true deep-water species, we can yet nevertheless generally gather, from the known facts, that *the proper deep-water zone* begins somewhere about 100 fath., since the greater part of those forms which here begin to show themselves now and then, increase in number of individuals downwards to 300 fathoms, and, in some cases in which research has been carried lower down, even to 450 fathoms. How far this zone descends into the abyss, or whether there be, as is probable, still other zones differing in character from this, is a point which for the present we cannot decide.

The sea-bottom along our coast, at the greatest depth at which it has been examined, appears to vary in condition.

* Living specimens occurred at 300 fathoms, stuck together in the direction of their longitudinal axes, which, from a great number of casts at and near to the same place, were not found higher up than 250 fathoms. A single example by chance occurred in 120 fath., but it may have been carried by the force of the current.

† In my account of the Echinodermata of Norway (p. 103), *Echinocucumis typica* is said by mistake to have been found in from 40 to 100 fathoms, instead of from 100 to 200 fathoms.

Generally it seems to consist of soft materials or so-called clay, but frequently also of harder clay mixed with sand, of sand and gravel or stones of different sizes, and also of the bare rock. It is only on this last kind of bottom (big stones or the firm rock) that the great corals sit and grow, among which numerous animals live that are never found on a soft bottom.

I shall now shortly mention some of the latest opinions advanced on the extent of animal life in the depths of the sea.

Keferstein (*l. c.* p. 1095) deduces, from the soundings most recently made at great depths, the following among other conclusions:—"That the animals there found consist of few species, but of many individuals: exactly as has been observed in the arctic zone." Again (p. 1097):—"At moderate depths of about 300–500 fathoms there seem to be the fewest inhabitants." Neither of these statements agrees quite with the abundance both of species and individuals which we find, according to the observations referred to, to be living on our coast at these very depths.

Lovén (Trans. Scand. Naturalists, Stockholm, 1863, p. 384) has expressed opinions on the range of animal life in the depths of the sea, founded apparently in great measure on the soundings of the Swedish Expedition to Spitzbergen. He affirms that from 60 to 80 fathoms, down to the greatest depth at which we have hitherto known animal life to exist, the bottom of the sea is covered with a fine mud, which is commonly called clay, and there prevails, from pole to pole, in all latitudes, a fauna of the same common character, of which some species are very widely distributed.

That in all the seas of the world, from pole to pole, in all latitudes, there should exist a deep-water fauna of the same common character, seems for the moment nothing else than an hypothesis for which he who advances it is responsible; however, I will not entirely deny the possibility that at the greatest depths there may be a greater uniformity in the fauna than has hitherto been admitted. But I may remark on this subject that, with the exception of the North Sea, we know next to nothing of the fauna of the rest, especially of the equatorial seas; and therefore next to nothing is known of its "common character."

The only point Lovén advances in support of his assertion is "that in the Antarctic Sea are found forms of Mollusks and Crustacea which seem in part to agree generically, and in part to be almost (!) specifically identical with northern and arctic forms." A certain agreement in physiognomy between the faunæ of the Arctic and Antarctic Seas is readily admitted,

and has been long ago observed to exist. The cause has been sought in the similar conditions of life in either case, although it must be admitted that little can be said on this subject till the facts are more clearly known. There are, likely enough, also in both faunæ not a few identical genera; but I have seen no satisfactory evidence of any full identity of species. Lovén expresses himself on the subject with some hesitation when he speaks of an *almost specific identity*, which, in fact, is no identity at all, for the very idea of identity implies *completeness*. Finally, to conclude with Lovén, to judge of all the seas in the world from the analogy of the Antarctic and Arctic Seas seems to me rather hasty. These hasty conclusions will perhaps soon disappear when the detailed evidence on which they are supposed to rest is published, which we may soon expect from the distinguished Swedish naturalists. This uniform fauna of Lovén's begins 60–80 fathoms deep. Such a boundary line between the deep-sea and surface fauna it is impossible to draw. As has been already stated, there are many of the species dwelling in our shallow water which extend down to the greatest depth reached on our coast (commonly 300 fath.). Next appear decided deep-sea species, which at least range downwards to 300 fath., in very marked depth, and not at all at at 60–80 f. Such, *e. g.*, are the great corals, *Lophelia prolifera*, *Ulocyathus arcticus*, *Primnoa lepadifera*, and *Paragorgia arborea* (100 f.); with which *Pennatula borealis*, *Funiculina finmarchica*, and *F. Christii* first appear at 200 f., and *Mopsia borealis* at 250 f. Of Echinodermata, *Echinocucumis typica* at 100 f., *Stichopus natans* 200 f. Of Polyzoa, *Flustra abyssicola* and *Halilophus mirabilis* at 100 f. Of Conchifera, *Axinus pusillus* at 200 f., *Lyonsiella* at 100 f., and *Yoldia obtusa* at 250 f. Of Cephalophora, *Dentalium agile* at 250 f. Of Crustacea, *Cytherella abyssorum*, *Cythereis mucronata*, *Conchœcia elegans*, *Cyclaspis longicauda*, and *Pasiphaë norvegica* at 100 f. On the other hand, *Cytheropteron hamatum*, *Ilyarachna coronata*, *Hemimysis abyssicola*, and *Pseudomma roseum* first show themselves at 250 f. And, lastly, *Conchœcia borealis*, *Clydonia borealis*, and *Cryptocheles abyssicola* have hitherto been found only at 300 f.

Then with respect to the deep-water fauna living on the coast of Norway, so far as we are acquainted with it, it seems, instead of agreeing perfectly with the very little of that we know from other seas, much more to show itself *to be peculiarly and characteristically northern*, as much as can be desired. To mention some of the more striking forms, where out of the North Sea have been found *Trichostemma*, *Lophelia prolifera*, *Ulocyathus*, *Fungiacyathus*, *Primnoa lepadifera*,

Paragorgia arborea, our great Pennatulids, *Rhizocrinus*, *Astrophyton Linckii* and *A. Lamarckii*, *Asteronyx*, *Ophioscolex*, *Ophiacantha spinulosa*, *Ctenodiscus*, *Brisinga*, *Echinocucumis typica**, *Oligotrochus*, *Terebratula septata* and *T. cranium*, *Lima excavata*, *Limopsis minuta*, *Lyonsiella*, &c. ?

With so rich a fauna as that with which we are in some degree acquainted on our coast to the depth of 200–300 fath., and in some cases to 450 fath., which already reckons 427 species *of nearly all the classes of marine animals*, there is plainly yet *no sign which indicates any diminution of animal life*. This, indeed, also agrees very well with the glimpse of that life which we have lately had through the soundings of Wallich and O. Torell in still greater depths, which show us that even at 1200–1400 fathoms, tolerably highly organized animals live, namely, Echinodermata, Vermes, Mollusks, and Arthropoda. In depths of 3000 fathoms, according to Wallich, no other living animals are found than Protozoa (Rhizopoda, Radiolaria, Spongiadæ). It is very probable that animal life, as depth increases little by little, decreases by degrees, till at last it disappears; but to take the last-named depth and lay it down as the line of zero, is to build too much on weak premises. It is of consequence in this dark and difficult field, more than elsewhere, to guard against rash conclusions. We have on this very subject a warning example in the case of the eminent Ed. Forbes, who having found in the Ægean Sea, at the depth of 230 fathoms, a pair of living species of Mollusks and Annelids, fell into the great mistake of thinking that animals were there on the verge of disappearance, and rather arbitrarily fixed his zero at 300 fathoms. And since Protozoa have been brought up from so considerable a depth as 3000 fathoms, to conclude that no other or more highly organized creatures live there is to conclude too hastily and too much,—especially considering, on the one hand, the limited number of soundings made at such depths, and, on the other, the imperfection of the instruments used. Most certainly many more researches must be made before we dare to hazard a decided opinion as to the point at which animal life necessarily lessens or disappears.

In conclusion, I will make a remark or two respecting *colours*, the intensity of which is commonly supposed to depend on the action of the sunlight.

Edward Forbes has remarked (Proc. Royal Soc. vol. i.) that Testacea taken on the British coast from localities under 100 fathoms, are *entirely white and colourless*, even when they

[* A new species of this genus, *E. adversaria*, has lately been found by Semper in the Philippine Islands.—A. M. N.]

were individuals of species which, in shoal water, are brightly banded or striped, that between 60 and 80 fathoms stripes and bands seldom appear on our shells, especially in the northern provinces, but that from 50 fathoms and upwards colours and patterns are well marked.

Against the general tenor of these statements of Forbes, that colours in individuals of the same species gradually disappear according to the depth, Jeffreys has rightly declared himself (British Conchology, vol. i. Introd. p. 49), and has used his experience of mollusks to illustrate his meaning, which I can also confirm by numerous examples.

Thus, to name some among many, and among other classes than mollusks, the dorsal surface of *Ophioscolex purpurea*, from 300 fathoms, is of as lively a bright red, or sometimes dark red, as are individuals from 45–50 fathoms. *Archaster tenuispinus* from 300 fathoms is as bright orange-red as from 30–50 fathoms. *Ophiura abyssicola* from 300 fathoms is of the same light grey, sometimes pale rose-colour, with reddish, chestnut, and dark-brown spots, as from 50–100 fathoms. *Onuphis quadricuspis* from 300 fathoms has as bright an opalescent gleam with two blood-red lines along the middle of its back as individuals taken from 50 fathoms. The shell of *Pecten septemradiatus* from 300 fathoms is as red and white-speckled as from 20–30 fathoms. *Astarte sulcata* from 300 fathoms has a chestnut-brown epidermis the same as if from 5–10 fathoms. *Natica Montagui* from 250 fathoms appears of a red-brown with a white band on its sutures, just as if from 15–20 fathoms. *Eulima bilineata* from 300 fathoms is found with two yellow spiral bands as bright as from 15–20 fathoms; and many more.

Sometimes, indeed, it happens that lively colours seem in some degree to fade with the depth, as e. g. *Hippolyte polaris*, which in the laminarian zone has many large blood-red and two sky-blue spots on the hinder part of each segment, at 200–250 fathoms is paler, the red disappearing, and has scarcely any sky-blue spots.

Thus Forbes's assertion is certainly not universally true. It seems to have been made under the influence of an idea, held by many naturalists, that light could not penetrate deep into the sea, and that therefore in the greater depths of the sea complete darkness reigned, in which all colours must disappear, as in those creatures (e. g. *Proteus*, *Amblyopsis*, &c.) which inhabit subterranean caves; and he was doubtless confirmed in his opinion by finding, as he occasionally did, at depths under 100 fathoms, white or colourless individuals of species elsewhere coloured. But such albino varieties occur at all depths.

There is another observation (if it be true), that in general certain colours prevail among animals at certain depths. This is what Œrsted (Meddelelser fra den naturh. Forening i Kjöbenhavn, 1849, p. 57) tried to establish. He believed himself to have discovered "a law which holds good among the animals that inhabit the sea, viz. that *they have the same colour as the light under whose action they live.*" He supports this by remarking "of the changes which light undergoes in its condition, that which falls upon the water is refracted so that the several coloured rays of which light is composed penetrate to unequal depths down into the sea. The violet and blue rays are first intercepted, next the green, and so on, the red reaching to the lowest depth." "The sea in this manner," he says, "may be regarded as divided into strata of colour, according to the condition of light at the different depths; and these strata will follow the order of the solar spectrum, *i.e.* from the top downwards, from violet to red." Œrsted has endeavoured to give his theory a practical form by defining six such strata or regions:—

1. *The violet or blue animals' region*, which occupies the surface of the open sea,—that is, the region of pelagic or oceanic animals.

2. *The earthy-coloured or spotted animals' region*, also beginning at the surface of the sea, but in the neighbourhood of coasts comprising the belt which lies between the highest and lowest tides.

3. *The green animals' region*, which runs in bights where the green algæ grow, and extends to about 10 feet below the mean surface of the sea.

4. *The yellow or brown animals' region*, from about 10 to about 50 feet below the surface.

5. *The red animals*, from 50 to about 500 feet.

6. *The white animals*, comprising all depths below the above.

Œrsted's theory seems to be based rather on speculative fancy than on scientific facts; at least, I never could find any particular agreement between these and the regions defined by him. Others have had the same difficulty; for the theory has been questioned, nay, sharply opposed, at least in respect to the first of Œrsted's regions, by Reinhardt and Steenstrup (*l. c.* p. 45), who produced many examples of pelagic animals of other colours than violet or blue. I think it superfluous to add my own experience of numberless pelagic animals in the Mediterranean completely agreeing with this; I shall only remark, in passing, that among our northern Siphonophora the red colour is predominant. It is, besides, undoubted that at the surface of the sea there is not *violet* or *blue* light, but *white*.

And so of the other regions or zones which Œrsted speaks of. My experience distinctly contradicts his theory. *I find white, yellow, green, brown, and red animals in them all*; or, in other words, there is in general no prevailing colour in any of them, nor any distinct connexion between the colours of animals and the belts which they inhabit, with the exception of what I shall now mention.

It is quite true, as Forbes and others since have remarked, that the brightest and most variegated colours, stripes, and bands, in greatest number and intensity, are oftenest found in animals near the shore, in the *laminarian zone* (which extends from low-water mark to about 10–20 fathoms, and in certain localities even to 30–40 fathoms), such as many Nudibranchs, *Patella pellucida*, *Trochus*, and many more; whereas, on the other hand, animals in the deeper belts are generally of one colour, not variegated.

Again, although, as has been said, there seems to be no universally prevailing colour for each zone of the sea, yet the researches on our coast have distinctly shown that *the greater number of animals at the greatest depths there touched* (200–300 and in some cases 450 fathoms) *either are red or white in colour*. So that it appears, regarding colours as depending in a general way on light, that of the coloured rays of which the sun's light is composed, the red, as a rule, penetrates deepest —much deeper than Œrsted supposed, since he fixes its limits at 500 feet (83 fathoms), beyond which he places his region of white animals, which, so far as researches on our coast tell us, are rarely or never found at that depth.

I have already on a former occasion (*l. c.* p. 60) stated that the creature *Lima excavata* from 300 fathoms depth is of as lively a bright red as *L. Loscombii* and *L. hians*, which both live in shallow water. As some further examples of the frequency of the red colour, the following larger forms may serve:—*Funiculina finmarchica*, *F. Christii*, *F. Forbesii*, *Pennatula borealis*, and *Goniaster granularis*, which are all of a bright-red colour; among our large corals, there are always some (sometimes, also, polypi) more or less markedly red; the colour of *Ulocyathus arcticus* from 300 fathoms is quite the same as from 100 fathoms (the highest limits of the species), the mouth and interior (primary and secondary) tentacles scarlet or brown-red approaching blood-red, and the rest a lighter red, and the folds of the mouth a dark blood-red or brown-red; further, *Fungiacyathus fragilis*, *Capnea sanguinea*, both our species of *Astrophyton*, *Asteronyx Lovenii*, both species of *Ophioscolex*, *Brisinga*, *Archaster tenuispinus* and *A. andromeda*, *Stichopus natans*, *Conchœcia borealis*, *Campylaspis undata*, *C. costata*,

and *C. horrida* are red. Many of our deep-water Mysidea, among them *Pseudomma roseum*, are strongly rose-red, with a shade of orange or violet; and many more animals. All the Rhizopoda are white. *Echinocucumis typica*, nearly all the Polyzoa, and most of the higher mollusks (of which perhaps the colour of a sufficient number has been given above).

Although the red and white colours are thus predominant at these great depths, *other colours are by no means absent.* Thus *Actinopsis flava* is entirely yellow, *Lætmonice filicornis* has there, as in shallow water, shining yellow foot-brushes. The limbs of the three species of *Cythereis* mentioned are all yellow. The sarcode of *Cristellaria rotulata* is light citron-yellow. *Phascolosoma olivaceum* is dark olive-green. *Umbellisyllis fasciata* has interrupted olive-green cross bands on the back. *Ctenodiscus crispatus* is light reddish brown. *Ophiura abyssicola* and *Ophiacantha spinulosa* are grey or chestnut-brown and spotted; *Antedon Sarsii* more or less brown, with small yellow or brown-red blisters along its tentacular grooves; and *Eurycope furcata* has a singular yellow-brown cross band. *Molpadia borealis* is dark-brown violet, *Hornera violacea* pale violet.

It has been generally supposed that light could only penetrate into the sea to a comparatively small depth, since, according to the late experiments of Bouger and Lambert on the absorption of light in water, all trace of it disappears at 120 fathoms under the surface. Late discoveries of the existence of many *coloured animals* at much greater depths (since, as I have said, colour is held to stand in close relation to light) agree very little with these experiments, which are further contradicted by another fact learnt on our coast. Not only at the depth of 300 fathoms, but even of 450 fathoms, have been found living animals (e. g. *Pasiphaë norvegica*, *Pontophilus norvegicus*, *Cryptocheles abyssicola*, and others) possessing perfectly developed organs of vision, which could be of no use (since nature does nothing in vain) if in those depths of the sea there reigned such absolute darkness as exists in those subterrancan caves whose inhabitants we find to *have no eyes.* It is much to be regretted that we have yet no certain knowledge as to how far light penetrates down into the sea, or its mode of transmission there, or other physical facts connected with it.

I add, lastly, that the many new animal forms referred to in the present paper, of which some are very remarkable, will all, as the collected materials are by degrees worked out, and as soon as possible, be described and published.