

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.?"
Kf+C+. =Coëm. 150; Hepp, 818; Leight. 57.
43. "*Cl. sylvatica* (Hoffm.), v. *tenuis*, Flk."
Kf+C+.
44. "*Cl. sylvatica* (Hoffm.), v. *tenuis*, Flk."
Kf+C+.
45. "*Cl. sylvatica* (Hoffm.), v. *tenuis*, Flk."
Kf+C+.
46. "*Cl. sylvatica* (Hoffm.) f. *compacta*."
Kf+C+.
47. "*Cl. sylvatica* (Hoffm.), f. *ramulis extremis subfuscis, elongatis, nutantibus*."
Kf+C+.
48. "*Cl. sylvatica* (Hoffm.), f. *ramulis extremis brevibus, distantibus, laxis*."
Kf+C+.
49. "*Cl. sylvatica*, (Hoffm.) f. *erecta*."
Kf+C+.
50. "*Cl. sylvatica* (Hoffm.), v. *alpestris* (Ach.)."
Kf+C+.

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

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 Tyne-side 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" ('*Christianas Videnskabs-Selskabs Fordhandler*, 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.

	fath.		fath.
Classis RHIZOPODA.			
Rhabdammina abyssorum,		Nonionina umbilicatulæ, <i>Mont.</i>	300
<i>Sars</i> , n. g. et sp.	450	— scapha, <i>Fichtel & Moll</i> ..	300
Astrorhiza limicola, <i>Sandahl</i> ..	450	Pullenia sphaeroides, <i>D'Orb.</i> ..	450
Saccamina sphaerica, <i>Sars</i> ,		Sphaeroidina bulloides, <i>D'Orb.</i>	450
n. g. et sp.	450	Operculina ammonioides, <i>Gro-</i>	
Glandulina lævigata, <i>D'Orb.</i> ..	450	<i>novius</i>	450
Nodosaria radiculæ, <i>Linné</i> ,		Cassidulina lævigata, <i>D'Orb.</i> ..	450
<i>Parker & Jones</i>	300	Bulimina marginata, <i>D'Orb.</i> ..	450
Dentalina communis, <i>D'Orb.</i> ..	300	— aculeata, <i>D'Orbigny</i>	450
— guttiferæ, <i>D'Orbigny</i>	300	— ovata, <i>D'Orbigny</i>	300
Vaginulina linearis, <i>Montagu</i> ..	300	— pyrula, <i>D'Orbigny</i>	450
Marginulina lituus, <i>D'Orb.</i> ..	300	Virgulina Schreibersii, <i>Czjeck</i> .	300
— spinosa, <i>Sars</i> , n. sp.	300	— squamosa, <i>D'Orbigny</i> ..	300
Cristellaria crepidulæ, <i>Fichtel</i>		Textularia agglutinans, <i>D'Orb.</i>	450
& <i>Moll</i>	300	— carinata, <i>D'Orbigny</i>	300
— cultrata, <i>Montfort</i>	300	Verneuilina polystropha, <i>Reuss</i>	300
— rotulata, <i>Lamarck</i>	300	Bigennerina eruca, <i>Sars</i> , n. sp. .	300
Lagena sulcata, <i>Walker & Jacob</i>	300	Valvulina conica, <i>Parker &</i>	
— caudata, <i>D'Orbigny</i>	300	<i>Jones</i>	450
— distoma, <i>Parker & Jones</i> ..	300	— fusca (Rotalina), <i>Wil-</i>	
Polymorphina lactea, <i>Walker</i>		<i>liamson</i> ..	450
& <i>Jacob</i>	300	Trochammina irregularis, <i>Par-</i>	
— compressa, <i>D'Orbigny</i> ..	300	<i>ker & Jones</i>	450
— tubulosa, <i>D'Orbigny</i>	300	Cornuspira foliacea, <i>Philippi</i> ..	300
Uvigerina pygmæa, <i>D'Orbigny</i>	450	— marginata, <i>Sars</i> , n. sp. ..	450
— angulosa, <i>Williamson</i> ..	300	Quinqueloculina seminulum,	
Globigerina bulloides, <i>D'Orb.</i>	300	<i>Linné</i> , <i>Parker & Jones</i>	450
Truncatulina lobatula, <i>Walker</i>		— agglutinans, <i>D'Orbigny</i> ..	450
& <i>Jacob</i>	200	Spiroloculina planulata, <i>La-</i>	
— refulgens, <i>Montagu</i> , <i>Car-</i>		<i>marck</i> ..	300
<i>penter</i>	300	Triloculina oblonga, <i>Montagu</i> .	300
Anomalina coronata, <i>Parker &</i>		— cryptella, <i>D'Orbigny</i>	300
<i>Jones</i>	300	— tricarinata, <i>D'Orbigny</i> ..	300
Rotalia Soldani, <i>D'Orbigny</i> ..	300	Biloculina ringens, <i>Lamarck</i> ..	450
Pulvinulina punctulata, <i>D'Orb.</i>	300	— elongata, <i>D'Orbigny</i>	450
— <i>Karsteni</i> , <i>Reuss</i>	300	— depressa, <i>D'Orbigny</i>	300
— <i>Menardi</i> , <i>D'Orbigny</i>	300	Lituola cenomana, <i>D'Orbigny</i>	300
Discorbina obtusa, <i>D'Orbigny</i> ..	300	— canariensis, <i>D'Orbigny</i> ..	300
— rosacea, <i>D'Orbigny</i>	300	— subglobosa, <i>Sars</i> , n. sp. ..	450
Polystomella striatopunctata,		— globigeriniformis,	
<i>Fichtel & Moll</i>	300	<i>Parker & Jones</i>	450
Nonionina depressula, <i>Walker</i>		— scorpiurus, <i>Montfort</i>	450
& <i>Jacob</i>	300		

	fath.		fath.
Classis SPONGIÆ (Porifera).		Cladorhiza abyssicola, Sars,	
Cliona abyssorum, Sars, n. sp.	300	n. g. et sp.	300
Halichondria, sp.	300	Trichostemma hæmisphæri-	
Hyalonema boreale, Lovén ..	200	cum, Sars, n. g. et sp.	300
(sec. Lovén).			<hr/>
			=5.

Typus II. CŒLEENTERATA.

Classis ANTHOZOA (Polypi).		Zoanthus incrustatus (Mam-	
Paragorgia arborea (Alcyo-		millifera), Düben & Koren ..	250
nium), Linné	300	Capnea sanguinea, Forbes....	300
— grandiflora, Sars	200	Peachia Boeckii (Siphonac-	
Primnoa lepadifera (Gorgonia),		tinia), Danielssen & Koren ..	200
Linné	300	Actinopsis flava, Danielssen &	
Mopsea borealis, Sars, n. sp. ..	300	Koren	250
Funiculina finmarchica (Vir-		Tealia digitata (Actinia), O. F.	
gularia), Sars	300	Müller, Gosse	300
— Christii (Virgularia),		Actinia, sp.	300
Koren & Danielsson	200	Bolocera Tuediæ (Anthea),	
— Forbesii, Verrill (Pavona-		Johnston	300
ria quadrangularis, Forbes) ..	200		<hr/>
(sec. Koren).			=20.
Pennatula borealis, Sars	200	Classis HYDROZOA.	
Kophobelemnion stelliferum		Campanularia verticillata (Ser-	
(Pennatula), O. F. Müller ..	300	tularia), Linné, Johnston ..	300
Lophelia prolifera (Madre-		Laföcina tenuis, Sars, n. g. et	
pora), Linné	300	sp.	300
Amphelia ramea (Madrepora),			<hr/>
O. F. Müller	300		=2.
Ulocyathus arcticus, Sars	300		
Fungiacyathus fragilis, Sars,			
n. g. et sp.	300		

Typus III. ECHINODERMATA.

Classis CRINOIDA.		Ophiopholis aculeata (Asterias),	
Rhizocrinus lofotensis, Sars,		O. F. Müller	300
n. g. et sp.	300	Ophiactis clavigera, Ljung-	
Antedon Sarsii (Alecto), Dü-		man	200-300
ben & Koren	300	(sec. Ljungman).	
	<hr/>	Amphiura, n. sp. ?	300
=2.		— norvegica, Ljungman ..	450
Classis ASTERIDA.		— tenuispina, Ljungman ..	300
Astrophyton Linckii, Müller		Ophiura abyssicola, Forbes ..	300
& Troschel	250	— carnea, Sars	300
— Lamarckii, Müller &		— Sarsii, Lütken	300
Troschel	250	Ctenodiscus crispatus (Aste-	
Asteronyx Lovenii, Müller &		rias), Retzius	200
Troschel	240	Brisinga endecacnemos, Asb-	
Ophioscolex glacialis, Müller &		jörnsen	200
Troschel	300	Archaster tenuispinus (Astro-	
— purpurea, Düben & Koren	300	pecten), Düben & Koren ..	300
Ophiacantha spinulosa, Müller		— arcticus (Astropecten),	
& Troschel	300	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	450
	(sec. Danielssen).
Echinus elegans, Düben & Koren	250
	(sec. Danielssen).
Echinocyamus angulosus, Leske	300

	fath.
Echinocardium ovatum (Spatangus), Leske.....	300
	=5.

Classis HOLOTHURIDA.

Echinocucumis typica, Sars..	450
Psolus squamatus (Cuvieria), Koren	253
	(sec. Danielssen).
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 ^c Intosh ?)	300
	=8.

Typus IV. VERMES.

Classis GEPHYREA.

Chaetoderma 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.	250
	(sec. Danielssen).
	=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, Krøyer (C. Krøyerii, Sars)	250
Euchone, sp.	300
Terebella artifex, Sars	300
Pectinaria hyperborea (Cistoides), Malmgren	300
Terebellides Stroomii, Sars ..	300
Maldane biceps (Clymene), Sars.....	200
— ? pellucida, Sars, n. sp..	300

Clymene prætermisssa (Praxilla), Malmgren	300
Ereutho Smitti, Malmgren ..	300
Nerine cirrata, Sars	300
Chaetozone setosa, Malmgren .	300
Amage auricula, Malmgren ..	250
Sabellides borealis, Sars ..	300
— sexcirrata, Sars (Samytha, Malmgren)	300
— cristata, Sars (Melinna, Malmgren)	200
Eumenia ? eruceiformis, 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, Örsted ...	300
Chaetopterus norvegicus, Sars.	300
Spiochaetopterus typicus, Sars	300
Nephtys incisa, Malmgren ..	300
— longisetosa, Örsted	300
Castalia, sp.	300
Syllis, sp.	300

	fath.		fath.
Umbellisyllis fasciata, <i>Sars</i> , n. g. et sp.	300	Polynœ nodosa, <i>Sars</i> (Eunœa, <i>Malmgren</i>)	250
Lumbrinereis fragilis (Lum- bricus), <i>O. F. Müller</i>	300	— (Eunœa) abyssicola, <i>Sars</i> , n. sp.	300
Eunice norvegica (Nereis), <i>O. F. Müller</i>	300	— Sarsii (Antinoë), <i>Kin- berg</i>	300
Onuphis conchylega, <i>Sars</i>	300	Lætnonice filicornis, <i>Kin- berg</i>	300
— quadricuspis, <i>Sars</i> , n. sp.	300	Paramphionome pulchella, <i>Sars</i> , n. g. et sp.	300
Sigalion stelliferum (Nereis), <i>O. F. Müller</i> (<i>S. tetragonum</i> , <i>Ersted</i>)	300	Euphrosyne cirrata, <i>Sars</i>	300
Polynœ cirrosa (Nychia), <i>Malmgren</i> (<i>P. scabriuscula</i> , <i>Sars</i>)	300		=51.

Typus V. MOLLUSCA.

Classis POLYZOA (Bryozoa).

Crisia denticulata, <i>Lamarck</i> , <i>Smitt</i>	300
— cornuta (Sertularia), <i>Linné</i> , <i>Smitt</i>	200
Diastopora repens (Tubulipora), <i>Wood</i>	300
— hyalina (Berenicea), <i>Fleming</i>	300
— simplex, <i>Busk</i>	200–300 (sec. Smitt).
— patina (Tubulipora), <i>La- marck</i>	300
Tubulipora atlantica (Idmonea), <i>Forbes</i>	300
— serpens (Tubipora), <i>Linné</i> 200	
— (Phalangella) palmata <i>Wood</i>	200–300 (sec. Smitt).
— (Proboscina) incrassata, <i>D'Orbigny</i>	200–300 (sec. Smitt).
Pustulipora producta, <i>Sars</i> , n. sp.	300
Hornera lichenoides (Mille- pora), <i>Linné</i>	300
— violacea, <i>Sars</i>	200
Discoporella verrucaria, forma hispidia, <i>Fleming</i>	300
Defrancia lucernaria, <i>Sars</i>	200
Cellularia ternata, <i>Solander</i> , forma ternata et gracilis, <i>Smitt</i>	300
— scabra, <i>Van Beneden</i>	300
Bicellaria Alderi, <i>Busk</i> (<i>B.</i> <i>unispinosa</i> , <i>Sars</i>)	200
Bugula avicularia (Sertularia), <i>Linné</i> , forma fastigiata	300

Bugula Smitti (Kinetoskias), <i>Danielssen</i>	300
Flustra securifrons (Eschara), <i>Pallas</i> , <i>Smitt</i>	200
— abyssicola, <i>Sars</i> , n. sp. . .	300
Cellaria fistulosa, <i>Linné</i> (<i>Salic- ornaria farciminoidea</i> , <i>Just.</i>)	250
Membranipora Flemingii, <i>Busk</i> , forma trifolium	300
— pilosa (Flustra), <i>Linné</i> , forma catenularia	200–300 (sec. Smitt).
Porina (Lepralia) ciliata, <i>Pal- las</i> , forma dura	300
Anarthropora monodon (Le- pralia), <i>Busk</i>	200–300 (sec. Smitt).
— gracilis (Quadricellaria), <i>Sars</i> (<i>Onchopora borealis</i> , <i>Busk</i>)	300 (sec. Smitt, to 600).
Escharella Legentilii (Flustra), <i>Audouin</i>	200–300 (sec. Smitt).
— linearis (Lepralia), <i>Has- sall</i>	300
Mollia vulgaris (Eschara), <i>Moll.</i> , forma ansata	200–300 (sec. Smitt).
Porella lævis (Eschara), <i>Flem.</i>	200
Discopora coccinea (Cellepora), <i>Abildgaard</i> , forma ventricosa et ovalis	300
Retepora cellulosa (Millepora), <i>Linné</i> , forma <i>Beaniana</i>	300
Halilophus mirabilis, <i>Sars</i> , n. g. et sp. . .	300

	fath.		fath.
Classis TUNICATA.		Arca nodulosa, O. F. Müller..	
Ascidia obliqua, Alder	300	Yoldia pygmaea (Nucula),	250
Cynthia Lovenii, Koren & Da-		Münster	300
nielsen, MS.	300	— lucida, Lovén	300
— cinerea, Sars, n. sp.	300	— nana, Sars	300
— limacina, Forbes	220	— obtusa *, Sars, nov. sp. . .	300
		Nucula pumila, Asbjørnsen, MS.	450
	=4	— tenuis (Arca), Montagu..	300
Classis BRACHIOPODA.		Crenella decussata (Mytilus),	
Crania anomala (Patella), O.		Montagu	300
F. Müller	250	Mytilus phaseolinus (Modiola),	
Terebratula (Terebratulina)		Philippi	300
caput serpentis (Anomia),		Cardium minimum, Philippi	
Linné	300	(C. suecicum, Reeve)	300
— (Waldheimia) cranium,		Astarte sulcata (Pectunculus),	
O. F. Müller	300	Da Costa, Jeffreys	300
— (—) septata, Philippi		— —, var. scotica (Venus),	
(T. septigera, Lovén)	300	Maton & Racket	250
	=4	Kelliella abyssicola, Sars, n. g.	
Classis CONCHIFERA (Lamelli-		et sp.	450
branchiata).		Montacuta substriata (Ligula),	
Anomia ephippium, Linné, var.		Montagu	250
squamula et aculeata	300	Axinus flexuosus (Tellina),	
Pecten septemradiatus, O. F.		Montagu	450
Müller	300	— pusillus, Sars, n. sp.	450
— abyssorum, Lovén, MS. . .	300	— ferruginosus (Kellia),	
— vitreus, Chemnitz	300	Forbes	300
— mammillatus, Sars, n.		Poromya granulata, Nyst (Em-	
sp.	450	bla Korenii, Lovén)	300
— similis, Laskey	300	Scrobicularia alba (Mactra),	
Lima excavata (Ostrea), J. C.		Wood	300
Fabricius	300	— nitida (Mya), O. F. Müller	300
— elliptica, Jeffreys (L. sub-		Lyonsiella abyssicola, Sars, n.	
auriculata, Forbes & Hanley)	300	g. et sp.	450
— Sarsii (Limea), Lovén ..	300	Saxicava rugosa (Mytilus),	
Limopsis minuta (Pectunculus),		Linné, var. arctica	300
Philippi	450	Panopea plicata (Mytilus),	
Arca pectunculoides, Scacchi		Montagu (Saxicava fragilis,	
(A. raridentata, Wood), for-		Nyst)	300
ma minor	300	Necera rostrata (Mya), Spengler	300
— —, Scacchi, forma ma-		— obesa, Lovén	450
jor (Arca glacialis, Torell) . .	300	— 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. pygmaea*, 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.		fath.
Classis CEPHALOPHORA.			
Solenopus nitidulus, <i>Sars</i> , n. g.		Trochus cinereus, <i>Couthouy</i> ?,	
et sp.	300	varietas	300
Chiton Hanleyi, <i>Bean</i>	300	Adeorbis subcarinatus (<i>Helix</i>),	
Chiton cancellatus, <i>Sowerby</i>		<i>Montagu</i>	300
(<i>C. alveolus</i> , <i>Sars</i> , <i>Lovén</i>)..	300	Cyclostrema nitens (<i>Delphi-</i>	
Siphonodentalium lofotense,		nula), <i>Philippi</i>	450
<i>Sars</i>	300	Tylodina Duebenii	200
— affine, <i>Sars</i>	300	(sec. <i>Lovén</i>).	
— quinquangulare (<i>Denta-</i>		Colobocephalus costellatus, n.	
lium), <i>Forbes</i> (<i>S. penta-</i>		g. et sp.	230
gonum, <i>Sars</i>)	450	Admete viridula (<i>Tritonium</i>),	
— subfusiforme, <i>Sars</i>	450	<i>O. Fabricius</i>	300
Dentalium abyssorum, <i>Sars</i> ..	300	Cerithium metula, <i>Lovén</i> . .	300
— agile, <i>Sars</i> , n. sp.	300	Cerithiopsis costulata (<i>Turri-</i>	
Cylichna alba (<i>Bulla</i>), <i>Brown</i>	300	tella), <i>Möller</i> , <i>Jeffreys</i>	300
— umbilicata (<i>Bulla</i>), <i>Mon-</i>		Aporrhais Macandrei, <i>Jeffreys</i>	250
tagu	300	(sec. <i>Danielssen</i>).	
— conulus, <i>Forbes & Hanley</i>	300	Fusus propinquus, <i>Alder</i>	250
Utriculus expansus, <i>Jeffreys</i> ..	300	Trophon barvicensis (<i>Fusus</i>),	
Utriculopsis vitrea, <i>Sars</i> , n. g.		<i>Johnston</i>	300
et sp.	300	Aclis Walleri, <i>Jeffreys</i>	300
Philine scabra (<i>Bulla</i>), <i>O. F.</i>		Eulima distorta, <i>Deshayes</i>	300
<i>Müller</i>	300	— intermedia, <i>Cantraine</i> ,	
— granulosa, <i>Sars</i> , n. sp. . .	300	<i>Jeffreys</i>	300
— quadrata (<i>Bullæa</i>), <i>Wood</i>	300	— bilineata, <i>Alder</i>	300
Scaphander librarius, <i>Lovén</i> ..	300	— stenostoma, <i>Jeffreys</i>	300
Puncturellanoachina (<i>Patella</i>),		Odostomia acicula (<i>Melania</i>),	
<i>Linné</i>	250	<i>Philippi</i>	300
Natica affinis, <i>Gmelin</i> (<i>N.</i>		—, sp.	300
clausa, <i>Sowerby</i>)	300	— insculpta, <i>Montagu</i> ,	
— Montagu, <i>Forbes</i>	250	<i>Forbes & Hanley</i>	300
— grönlandica, <i>Beck</i>	250	Pleurotoma cancellata (<i>Fusus</i>),	
Rissoa abyssicola, <i>Forbes</i>	300	<i>Mighels & Adams</i>	300
— reticulata (<i>Turbo</i>), <i>Mon-</i>		— tenuicostata, <i>Sars</i> , n. sp.	300
tagu	300	— Mörehii (<i>Trophon</i>), <i>Malm</i>	300
— <i>Jeffreysii</i> , <i>Waller</i>	300	— violacea, <i>Migh. & Adams</i> ?	250
— soluta, <i>Philippi</i> ?, var.		— nivalis, <i>Lovén</i>	300
lævis, <i>Sars</i>	300	— carinata, <i>Philippi</i>	300
Scissurella crispata, <i>Fleming</i> ..	300	— teres, <i>Forbes</i> (<i>P. borealis</i> ,	
		<i>Philippi</i>)	250

=53

Typus VI. ARTHROPODA.

Classis ARACHNIDA.		Scalpellum vulgare, <i>Leach</i> (<i>Lep-</i>	
Nymphon longitarse, <i>Kröyer</i> ?	300	pas scalpellum, <i>O. F. Müller</i>)	300
	=1	— Stroemii, <i>Sars</i>	300
Classis CRUSTACEA.		Longipedia, sp.	250
Sylon (<i>Kröyer</i>) Hippolytes,		Harpacticus?, sp.	250
<i>Sars</i> , n. sp.	250	Cytherella abyssorum, <i>G. O.</i>	
(sec. <i>Danielssen</i>).		<i>Sars</i>	450
Verruca Stroemia (<i>Lepas</i>), <i>O.</i>		Polycope orbicularis, <i>G. O.</i>	
<i>F. Müller</i>	300	<i>Sars</i> ?	250
		Conchœcia elegans, <i>G. O. Sars</i>	300
		— borealis, <i>G. O. Sars</i>	300

	fath.		fath.
Philomedes Lilljeborgii, <i>G. O.</i>		Eurycopephalangium, <i>G. O. Sars</i>	300
<i>Sars</i>	250	— furcata, <i>G. O. Sars</i> , n. sp.	250
Asterope abyssicola, <i>G. O.</i>		Arcturus, sp.	300
<i>Sars</i> , n. sp.	250	Apsudes talpa, <i>Montagu</i> . . .	300
Cypridina norvegica, <i>Baird</i> . .	300	Tanais, sp.	300
Ilyobates prætexta, <i>G. O. Sars</i>	250	— tenuimanus, <i>Lilljeborg</i> . .	300
Cytheropteron alatum, <i>G. O.</i>		Anceus oxyureus, <i>Lilljeborg</i> . .	250
<i>Sars</i>	250	Munna limicola, <i>G. O. Sars</i> . .	250
— subcircinatum, <i>G. O. Sars</i>	250	Henopomus muticus, <i>Krøyer</i> . .	250
— hamatum, <i>G. O. Sars</i> , n.sp.	300	Æga psora (Oniscus), <i>Linné</i> . .	250
Cythereis echinata, <i>G. O. Sars</i>	300	(sec. Danielssen).	
— mucronata, <i>G. O. Sars</i> . .	300	Cyclaspis longicauda, <i>G. O.</i>	
— abyssicola, <i>G. O. Sars</i> . .	300	<i>Sars</i>	300
Argillœcia cylindrica, <i>G. O. Sars</i>	250	Platyspis typica, <i>G. O. Sars</i> ,	
Bairdia minna, <i>Baird</i>	300	n. g. et sp.	250
— angusta, <i>G. O. Sars</i> . . .	250	Campylaspis costata, <i>G. O. Sars</i>	250
Dulichia, n. sp.	250	— sulcata, <i>G. O. Sars</i> , n. sp.	250
Clydonia borealis, <i>G. O. Sars</i> ,		— undata, <i>G. O. Sars</i> . . .	300
n. sp.	300	— horrida, <i>G. O. Sars</i> , n. sp.	300
Hyperia, sp.	250	— verrucosa, <i>G. O. Sars</i> . .	300
Leucothœ articulosa, <i>Leach</i> . .	250	Eudora emarginata, <i>Krøyer</i> . .	250
Ampelisca macrocephala, <i>Lill-</i>		— hirsuta, <i>G. O. Sars</i> , n. sp.	230
<i>jeborg</i> ?	250	Leucon acutirostris, <i>G. O. Sars</i>	300
Ampelisca, sp.	250	— pallidus, <i>G. O. Sars</i> . . .	300
Krøyer, sp.	250	— nasicus, <i>Krøyer</i>	200
Ædicerus, sp.	250	Diastylis buplicata, <i>G. O. Sars</i>	300
— obtusus, <i>Bruzelius</i>	250	— longimana, <i>G. O. Sars</i> . .	250
— , sp.	250	— bispinosa, <i>Stimpson</i> . . .	250
Eusirus, sp.	250	— echinata, <i>Sp. Bate</i>	300
Stegocephalus ampulla, <i>Phipps</i> ?	250	— serrata, <i>G. O. Sars</i> . . .	300
Cerapus, sp.	250	— macrura, <i>G. O. Sars</i> , n.sp.	250
Lysianassa magellanica, <i>Lill-</i>		Boreomysis (n. g.) arctica (My-	
<i>jeborg</i> , vix <i>M.-Edwards</i>	300-400 ?	— tridens, <i>G. O. Sars</i> , n. sp.	250
Anonyx, sp.	250	Mysideis insignis (Mysis), <i>G.</i>	
Eriops elongata, <i>Bruzelius</i> . . .	250	<i>O. Sars</i>	250
Lilljeborgia, sp.	250	Hemimysis abyssicola, <i>G. O.</i>	
Gammarus ? , sp.	250	<i>Sars</i> , n. g. et sp.	250
— ? , sp.	250	Pseudomma roseum, <i>G. O. Sars</i> ,	
Paramphithœ fragilis, <i>Goës</i> . .	250	n. g. et sp.	450
— , sp.	250	— abbreviatum, <i>G. O. Sars</i> ,	
Liriope, n. sp.	250	n. sp.	250
Ischnosoma bispinosum, <i>G. O.</i>		— alline, <i>G. O. Sars</i> , n. sp.	250
<i>Sars</i>	250	Parerythropis obesa, <i>G. O. Sars</i>	250
Macrostylis spinifera, <i>G. O.</i>		Erythropis serrata (Nematopus),	
<i>Sars</i>	250	<i>G. O. Sars</i>	250
Desmosoma aculeatum, <i>G. O.</i>		— microphthalma, <i>G. O.</i>	
<i>Sars</i>	250	<i>Sars</i> , n. sp.	250
— lineare, <i>G. O. Sars</i>	250	— abyssorum, <i>G. O. Sars</i> ,	
Ilyarachna longicornis (Meso-		n. sp.	300
stenus), <i>G. O. Sars</i>	200	Thysanoessa neglecta (Thy-	
— coronata, <i>G. O. Sars</i> , n. sp.	300	sanopoda), <i>Krøyer</i> ?	250
— hirticeps, <i>G. O. Sars</i> , n. sp.	300	Thysanopoda norvegica, <i>M.</i>	
— clypeata, <i>G. O. Sars</i> , n. sp.	250	<i>Sars</i>	250
Munnopsis typica, <i>M. Sars</i> . .	300	Pasiphaë norvegica, <i>M. Sars</i> . .	300
Eurycope cornuta, <i>G. O. Sars</i>	300	Pandalus borealis, <i>Krøyer</i> . . .	300
— producta, <i>G. O. Sars</i> . . .	250		

	fath.		fath.
Hippolyte securifrons, <i>Norman</i>	250	Galathea rugosa, <i>J. C. Fa-</i>	
— polaris, <i>Sabine</i>	250	bricius	250
Cryptocheles abyssicola, <i>G. O.</i>		— tridentata, <i>Esmark</i>	300
Sars, n. g. et sp.	300		
Pontophilus norvegicus, <i>M. Sars</i>	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*.
Brosimius vulgaris, Cuvier.
Macrourus Stroemii, Reinhardt.
 — *Fabricii, Sundevall*.
Hippoglossus maximus, Minding.
Scyrnus 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 Keferstei[n] 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*, *Pennatulula borealis*; also, *Astrophyton Linckii*, *A. Lamarckii*, *Asteronyx Lovénii*, *Brisinga endecacnemus*, *Cidaris papillata*, *Molpadia borealis*; finally, *Terebratulula 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.), *Conchæcia elegans* (100–300 f.), *Conchæcia 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.), *Erythropis 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 *Pennatulula borealis*, *Funiculina finmarchica*, and *F. Christii* first appear at 200 f., and *Mopsis borealis* at 250 f. Of Echinodermata, *Echinocucumis typica* at 100 f., *Stichopus natans* 200 f. Of Polyzoa, *Flustra abyssicola* and *Habibolophus 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*, *Conchæcia 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, *Conchæcia 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 Montagu* 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 Ørsted (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." Ørsted 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.

Ørsted'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 Ørsted'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 CErsted 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 Nudi-branches, *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 CErsted 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 funmarchica*, *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 *Ulo-cyathus 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*, *Biringa*, *Archaster tenuispinus* and *A. andromeda*, *Stichopus natans*, *Conchaccia 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, *Latmonice 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 Bouguer 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 subterranean 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.