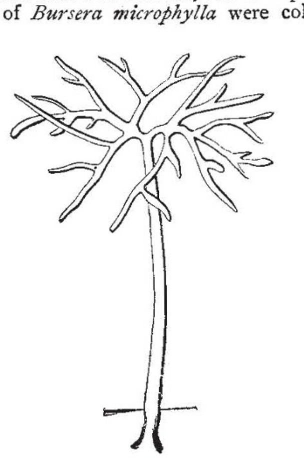
soft. The colour of moistened specimens is of a sombre green, inclining to olive. The trichomes, immersed in a homogenous colourless jelly, spread themselves around a central space; they increase towards the periphery, and become lost in the interior. These trichomes give origin to branches, either scattered or unilateral, which elevate themselves to the one height and to heterocysts either sessile on the side of the articulations, or borne on a pedicel of one to three cells; intercalary heterocysts were not observed. The heterocysts were oblong in form, easily to be distinguished from the ordinary articulations by their size, and above all, by the nature of their contents, which is more homogeneous; when old, they assume a yellowish tint; the chloro-iodide of zinc solution colours them purple. When an articulation forms a heterocyst or a branch, it first forms a lateral enlargement, which is very early isolated. This new cell may at once change into a heterocyst, and then it will be directly applied to the side of the articulation, as are the heterocysts of Capsosira and those on the large branches of Stigonema, or it may be divided once or twice before the formation of the heterocyst, which will be then pedicellated, or it may even form the cell from which a branch may arise. The branches, like the heterocysts, are not uniformly arranged along the length of the filament. At certain intervals they become closer and they become level at the same height. Some remain simple, others ramify, none terminate in a hair. No distinct trace of a sheath was observed around any of the younger portions of the trichomes, but at the base the articulations are sometimes surrounded with a somewhat thick envelope. None of the specimens (not very numerous) examined showed the least trace of spores or homogones. Two characters of this genus are particularly interesting its Rivulariaceous appearance, and its pedicellated heterocysts. This latter peculiarity, which to this time was not yet met with among the Cryptophyceæ, indicates in Mazæa a degree of specialisation of the parts of the trichome more eminent than that in any other genus of Stigonemaceæ, in fact represents the highest development in the group. Now that in this form and in *Capscsira brebissonii = Stigonema zonotrichioides*, Nordst, Stigonemaceæ have Rivularioid representatives; it may be noted that Scytonemaceæ is the only tribe in which this type is wanting. The new species is beautifully figured after drawings by Bornet (*Bull. de la Soc. Bot. de France*, tome xxviii.).

SEED LEAVES OF BURSERA.—The cotyledons of the natura family Burseraceæ are described by Bentham and Hooker ("Genera Plantarum," vol. i. p. 321) as often membranous contortuplicate, rarely solid and plano-convex, and in the genus Bursera itself they are diagnosed in addition as "interdum trifidæ, in una specie hippocrepiformes." Prof. Asa Gray, (*Proc. Amer. Acad. Arts and Sciences*, vol. xvii. p. 230) mentions that specimens of *Bursera microphylla* were collected at Cape



San Lucas, Lower California,' in fruit, and also in Sonora in flower. It appears to have all the characters of Bursera except that the ovules are solitary in the cells. Recently Messrs. Parish have collected it in Arizona, near Maricopa, in fruit, and from some of the seeds sent by them to the Botanic Gardens at Harvard University, young plants have been raised. The cotyledons are very peculiar, and are in the woodcut represented a little larger than life; they are biternately dissected into narrow linear lobes. The second pair are simpler, the secondary lobes being fewer and short, the next succeeding are pinnately parted into seven leaflets, passing toward the adult form of leaf, which is pinnate with numerous very small leaflets on an interruptedly margined rachis.

AFFINITIES OF THE BOWER BIRDS.—The very interesting group of birds known as the Bower Birds is regarded by Mr. Elliott as connected with the Birds of Paradise, and in this view Count Salvadori agrees. Mr. Sharpe in his "Catalogue of Birds" takes a different view, but in a paper on the Ornithology of New Guinea, just published (*Journal Linnean Society*, vol. xvi. p. 443, July 31, 1882), he acknowledges that he has now been convinced that the views of Elliot and Salvadori are right, and states that the following note, by Mr. Goldie, of the habits of *Diphyllodes chrysoptera*, Gould, which is a true Bird of Paradise, has in great measure been the cause of this change of view. Mr. Goldie writes: "The bird is found in very rough and thick scrubby country, at the head of gullies or on steep sidings, where he clears a space of ground, about seven feet by four, by stripping all the leaves and twigs off the bushes, leaving only the heavier branches. The ground is cleared of all leaves and is quite bare, and this seems to be his playground; in it he dances and flutters about as if at play. The natives know his call and attract him, but as soon as he perceives any one, away he flies, and can be tempted no more at that time. When not about the nest he is to be found in exceedingly high trees. His food consists of seeds." These habits are curiously like those of the Bower Birds, and show that Birds of Paradise can flirt on the earth as well as among the tree tops.

GEOGRAPHICAL NOTES

DR. MIKLUCHO-MACLAY has arrived at St. Petersburg after a sojourn of twelve years on New Guinea and neighbouring islands. It is stated that the eminent naturalist and explorer intends to remain only six weeks in Russia, when he will return to Sydney, where, as we have already intimated, he has been the means of founding a zoological station.

DR. EMIL HOLUB is arranging to set out for his new expedition to South Africa in April 1883. He proposes to spend from six to eight months in Cape Colony and in the Bechuana country respectively; after which he intends to penetrate as far north of the Zambesi as possible. Dr. Holub will devote his attention to observations and collections in zoology, botany, geology, and ethnography.

MR. H. K. BANCROFT, author of the well-known work on the Native Races of the Pacific States, is about to begin the issue of a new work in 25 large vols., giving the History of the Pacific States of North America. It is an enormous undertaking. Trübner and Co. are the publishers.

AN expedition under Lieut. Andreyew, sent out by the Russian Geographical Society, has safely reached Novaya Zemlya, where it will pass the winter. Besides Lieut. Andreyew there is a scientific staff and five sailors.

MR. STANFORD has issued the second instalment of Mr. Ravenstein's large map of Eastern Equatorial Africa. It contains sheets 12 to 18, with the exception of sheet 15. These sheets combine all the region around Lake Tanganyika, a large part of the course of the Lualuba, the Mwvtan Nzige, much of the Victoria Nyanza and the country around it, and the wide district lying between the north end of Nyassa, the south of Tanganyika, and the coast to Zanzibar. The routes of all travellers are given, the authorities for every leading feature stated, and the information laid down so detailed that the map serves all the purposes of a special treatise on African geography. The map is a credit to Mr. Ravenstein as well as to the enterprise of the Geographical Society, at whose expense it is being constructed.

THE *Deutsche Rundschau für Geographie und Statistik* has entered upon its fifth year, and appears to be a good example of a popular journal of geography. In the first number of the new volume we find an article on the Ethnography of Central Asia, by Dr. Ujfalvy; an article on Egypt, by Herr Schweiger-Lerchenfeld; an illustrated paper on Land and People in Sikkim; papers on the Transit of Venus and the Sun's Parallax, by Dr. Haletchek; on the Hydrography of Central Africa and the interesting problem of the Welle, by Dr. Chavanne; on

Baron von Richthofen (one of a series on Eminent Geographers)' besides several other papers, and notes on political geography and statistics. The *Rundschau* is edited by Prof. Umlauft, and published by Hartleben of Vienna.

THE steamer *Louise* returned to Hammerfest on October 1 from the southern part of the Sea of Kara. The Captain reports that, owing to the prevalence of a hard frost and the consequent accumulation of ice, vessels are unable to pass. The *Louise* left the Danish exploring vessels, *Varna* and *Djimpha*, on September 22, ice-bound, at a point eighty miles to the east of the island of Waigatz. All was well on board, and hopes were entertained that they would shortly be set free.

IN the October number of the *Proceedings* of the Royal Geographical Society, the leading papers are on the Cameroons District, West Africa, by Mr. George Grenfeld; and on the Coast Lands and some Rivers and Ports of Mozambique, by Mr. H. E. O'Neill, H.B.M. Consul, Mozambique. From the Notes we learn that Mr. H. Whiteley, who has devoted himself for many years to natural history pursuits in the interior of British Guiana, has just returned to England. He resided for upwards of a year among the Indians in the neighbourhood of the famous Mount Roraima, of which in its many aspects he made a numerous series of drawings. The number, we may say, contains a full report of the important paper on the Deserts of Africa and Asia, read by M. Tchihatcheff at the Southampton meeting of the British Association.

PELAGIC LIFE[1]

AS used technically by naturalists, the term "Pelagic" applied to living things denotes those animals and plants which inhabit the surface waters of the seas and oceans. Just as the land surfaces, the sea shores, and the deep ocean beds are each tenanted by assemblages of organisms specially adapted to the conditions of existence there occurring, so the surface waters of the oceans are inhabited by a characteristic fauna and flora. The special modifications in structure which the members composing this fauna and flora exhibit as adapting them to their peculiar environment are of a most interesting and remarkable character: and it is concerning the nature of the Pelagic fauna and flora, the mutual relations between the two, the strange forms which Pelagic animals assume, their curious habits of life, their zoological and geological importance, that the present lecture on Pelagic Life will consist. I have spoken of pelagic life as belonging to the surface waters of the oceans because it is in the superficial strata in which it appears to be most fully developed; but, as we shall see in the sequel, it is impossible as yet to limit definitely the range of pelagic forms in depth, and we shall even have to refer to some connections of the fauna of the deep ocean bottom with that of the surface.

Pelagic life then includes the inhabitants of the whole ocean waters, excluding those belonging to the bottom and shores; that is to say, the inhabitants of an area equal to nearly three-quarters of the surface of the globe. And it may tend to enhance our appreciation at the outset of the importance of the pelagic fauna if we reflect that in point of numbers pelagic animals probably far exceed all others existing. The extraordinary abundance of life, as seen at the surface of the ocean under certain circumstances, when the water is often discoloured for miles and its surface strata absolutely filled with small animals, has often been described by voyagers, but can never be fully realised till it is actually witnessed.

The existence of pelagic animals at all is directly dependent on that of pelagic plants. No animal life can exist without vegetable food as a basis, and the first living substance which came into existence must have been capable of constructing protein for itself from inorganic sources, and been physiologically a plant. Now, in many regions the sea-surface teems with vegetable life. In the Polar waters diatoms swarm, sometimes occurring so abundantly that they render the water thick like soup, and being washed up on the ice in the Antarctic regions, colour it brown, as Sir Joseph Hooker showed. When a fine net is towed overboard amongst them, they fill it with a jelly-like mass that, when squeezed in the hand, leaves behind their skeletons, a mass of fine silica like cotton wool. In the temperate and warmer seas, diatoms, though still present, are scarcer, and their place is taken by other simple minute algæ, mainly Oscillatoriæ. As we passed through the Arafura Sea between Australia and New Guinea in the *Challenger* Expedition, the whole sea for several days' voyage was discoloured far and wide by such algæ, and smelt like a reedy pond; and in the Atlantic we passed for days through water full of minute algæ (*Trichodemium*) gleaming in the water like particles of mica. From these fine algæ the simpler animals, on which the higher animal forms subsist, derive their food. No doubt the food-supply is largely supplemented by organic *débris* of all kinds drifted from shores, and by floating sea-weeds, certain species of which, like the gulf-weed, grow in a pelagic condition. Coccospheres and Rhabdospheres may very possibly be of vegetable nature, and contribute to the pelagic stock of food, together perhaps with some of the Cilio-flagellata, such as Ceratium,[1] which may prove also to be physiologically vegetable. However, in many parts of the ocean vegetable organisms are not markedly abundant, and it had always seemed to me that the ultimately pelagic food supply was scarcely as abundant as it should be to account for the vast extent of pelagic fauna, until the recent establishment by Dr. Karl Brandt, of the existence of the curious condition of mutual relations of certain animals and plants known as symbiosis.

It is found that amongst the tissues of certain animals there are constantly imbedded quantities of unicellular algæ. These algæ are not to be regarded as parasites, but a relation of mutual benefit exists between them and the animal with which they are associated; they are nourished by the waste products of the animal, whilst the animal thrives on the compounds elaborated by them and the oxygen they set free. Such an association of mutual benefit is termed symbiosis, and it was in the case of some of the most abundant of pelagic animals, the Radiolarians, that the true nature of the algæ in question was first discovered by Cienkowsky. I shall throw on the screen a figure of one of these Radiolarians Collozoum inerme. It consists of a rounded mass of jelly traversed by fine radiating pseudopodia with a central spherical sac or capsule, and in the interior of that a large oil globule. One function of the oil globule apparently is to float the animal at the water's surface. The animal has the power by some means of rising or sinking at will, probably by means of a modification in the size of the oil globule. Embedded in the jelly outside the capsule are seen conspicuous bright yellow cells, one of which is shown in the act of dividing. These cells contain starch, and are the unicellular algæ, which Brandt has termed Zooxanthellæ. It is obvious that a compound organism such as this is self-supporting, requiring no external source of organic food; and it would be quite possible to conceive the existence of a vast pelagic fauna having Radiolarians combined with their Zooxanthellæ only as a basis. The single organism here represented on the screen is not larger than a pin's head. In the living condition thousands of such are united, clustered together to form little bolsters of jelly about half an inch long, and on calm days on the ocean the whole surface water may be seen full of such masses for miles and miles, as far as the eye can reach, forming a vast supply of self-supporting food for other pelagic organisms. It is probable that the symbiotic condition in Radiolarians is of great importance in the general economy of pelagic life. There are other pelagic animals, for example, Ctenophora, in some of which unicellular algæ are similarly present. Symbiosis may possibly have been more common amongst pelagic faunas of earlier geological epochs, when diatoms apparently were not abundant or non-existent. The Radiolarians are characteristic members of the pelagic fauna. Most of them are provided with most beautiful siliceous skeletons, as, for example, *Rhizospæra leptomita*, now on the screen. It is, as may be seen, provided with a stock of Zooxanthella like Collozoum.

Animals are pelagic in very various degrees, and may be placed under a series of categories accordingly. There are the pelagic animals *par excellence*, those that are found at the greatest distances from shores, and which are capable of passing their whole existence there, and are floated only accidentally to land. Such are the Radiolarians, Siphonophora, very numerous Crustacea, Alciopa, Tomopteris, Heteropods, Ianthina, Pteropods, the Pelagic Cephalopods, Salpæ, and Pyrosoma, and numerous pelagic fish. These might conveniently be termed eupelagic. Then there are others, such as many Scyphomedusæ and most Ctenophora, which, though thoroughly pelagic in habit, are met with in greatest

[1] Address at the Southampton meeting of the British Association, August 28, by H. N. Moseley, F.R.S., Professor of Human and Comparative Anatomy, Oxford.

[1] Mr. John Murray has observed that species of pelagic ceratium are to be met with, often forming long chains, composed of individuals united in linear series. I observed an instance of the same fact myself. It seems to give some additional indication of the possibly vegetable nature of certain of the Cilio-flagellata.