deny its existence, and the former attributes Kent’s observations to error. One constant character they do possess : they are provided with flagella at some stage of their existence, but never with cilia. Ciliated cells, in­deed, are unknown amongst the sponges, and, when pinna­cocytes exceptionally acquire vibratile filaments, as in *Oscarella* and other sponges, these are invariably flagella, never cilia. An Ascon stage having been reached at some point in the history of the sponges, the Sycon tubes and Rhagon chambers would arise from it by the active pro­liferation of choanocytes about regularly distributed centres, possibly as a result of generous feeding. Vosmaer recog­nized as the physiological cause of Sycon an extension of the choanocytal layer. Polejaeff, relying on Von Lenden­feld’s experiments, which seem to prove that it is the pinnacocytes and not the choanocytes which are concerned in the ingestion of nutriment, argues that, as in Sycon the pinnacocytal layer is increased relatively to the choano­cytal, we have in this a true explanation of the transition. The existence of *Homoderma,* Lfd., however, shows that in the first stage there was not a replacement of choano­cytes by pinnacocytes, but that this was a secondary change, following the development of radial tubes, and therefore cannot be relied upon to explain them. The radial tubes having been formed by a proliferation of choanocytal cells, the reduction of those lining the para­gastric cavity to pinnacocytes would follow in consequence of the poisonous character of the water delivered from the radial tubes to the central cavity, since this water not only parts with its dissolved oxygen to the choanocytes it first encounters, but receives from them in exchange urea, carbonic acid, and fæcal residues. The development of subdermal cavities is explicable on Von Lendenfeld’s hypothesis.

*Distribution.*

Our knowledge of this subject is at present but frag­mentary ; we await fuller information in the remaining reports on the sponges obtained by the “ Challenger.” The sponges are widely distributed through existing seas, and freshwater forms are found in the rivers and lakes of all continents except Australia, and in numerous islands, in­cluding New Zealand. Many genera and several species are cosmopolitan, and so are most orders.

As instances of the same species occurring in widely remote localities we take the following from Polejaeff :—*Sycon arcticum* is found at the Bermudas and in the Philippine Islands, as also are *Lcuconia multiformis* and *Lcucilla, uter ; Sycon raphanus* occurs at Tristan da Cunha aud the Philippines ; *Heteropegma nodus-gordii* and *Lcuconia dura* at the Bermudas and Torres Straits. We do not know, however, whether these species are isolated in their distribu­tion or connected by intermediate localities. Of the *Calcarea* about eighty-one species have been obtained from the Atlantic, twenty- two from the Pacific, and twenty-two from the Indian Ocean ; but these numbers no doubt depend largely on the extent to which the several oceans have been investigated, for the largest number of species has been found in the ocean nearest home. Schulze states that the *Hexactinellida* brought home by the “Challenger” were obtained at seventeen Atlantic stations, twenty-seven Pacific, and nineteen in the South Seas. In the last the number of species was greatest, in the Atlantic least. They flourish best on a bottom of diatomaceous mud. The *Calcarea* and *Ceratosa* are most abundant in shallow water and down to 40 fathoms, but they descend to from 400 to 450 fathoms. The *Hexactinellida* are most numerous over continental depths, *i.e*., 100 to 200 fathoms; but they extend downwards to over 2500 fathoms and upwards into shallow water (10 to 20 fathoms). The *Lithistida* are not such deep-water forms as the *Hexactinellida,* being most numerous from 10 to 150 fathoms. Only one or two species have been dredged from depths greater than 400 fathoms, and none from 1000 fathoms. The *Choristida* range from shallow water to abyssal depths. A characteristic deep-sea Choristid genus is *Thenea,* Gray (= *Wyville Thompsonia,* Wright ; *Dorvillia,* Kent). This is most frequently dredged from depths of from 1000 to 2000 fathoms ; but it extends to 2700 fathoms on the one hand and to 100 on the other.

Until about 1876 one of the chief obstacles to the inter­

pretation of fossil sponges arose from a singular mineral replacement which most of them have undergone, leading to the substitution of calcite for the silica of which their skeletons were originally composed. This change was de­monstrated by Zittel (*35*) and Sollas (*24*), and, though it was at first pronounced impossible, owing to objections founded on the chemical nature of silica, it has since be­come generally recognized. These observers also showed that the fossil sponges do not belong to extinct types, but are assignable to existing orders. Zittel in addition sub­jected large collections to a careful analysis and marshalled them into order with remarkable success. Since then several palæontologists have worked at the subject,—Pocta, Dunikowski, and Hinde (*7*), who has published a *Cata­logue—*which is much more than a catalogue—of the sponges preserved in the British Museum. The result of their labours is in general terms as follows. Fossil sponges are chiefly such as from the coarseness or consistency of their skeletons would be capable of preservation in a miner­alized state. Thus the majority are *Hexactinellida,* chiefly *Dictyonina ; Tetractinellida,* chiefly *Lithistida ;* and *Cal­carea,* chiefly *Leuconaria.* Monaxonid sponges rarely occur ; the most ancient is *Climacospongia,* Hinde, found in Sil­urian rocks. A very common Halichondroid sponge of this group *(Pharetrospongia strahani,* Soll.) occurs in the Cam­bridge greensand; it owes its preservation to the collection of its small oxeate spicules into dense fibres. The *Choristida,* though not so common as the Lithistids, are commoner than the Monaxonids, particularly in Mesozoic strata.

The distribution of fossil sponges in the stratified systems may be summarized as follows. Calcarea.—*Homocœlα,* none. *Heterocœla,* a Syconid, in the Jurassic system. Numerous *Leuconaria* from the Devonian upwards. Myxospongiæ.—None; not fitted for preservation. Hexactinellida.—*Lyssacina,* from the Lower Cambrian upwards. *Dictyonina,* commencing in the Silurian ; most numerous in the Mesozoic group ; still existing. Monaxonida.— *Monaxona,* from the Silurian upwards. *Ceratosa,* none ; few are fitted for preservation. Tetractinellida.—*Choristida,* from the Carboniferous upwards ; most numerous in the Cretaceous system. *Lithistida,* from the Silurian upwards ; most numerous in the Mesozoic group. In ancient times the Hexactinellids and Lithistids seem not to have been so comparatively uncommon in shallow water as they are at the present day. Thus, in the Lower Jurassic strata of the south-west of England we find Dictyonine Hexactinel­lids, Lithistids, and Leuconarian *Calcarea* associated together in a shelly breccia and in company with littoral shells, such as *Patella* and *Trochus.* Several Palæozoic Hexactinellids actually occur in a fine-grained sandstone. Of the Chalk, which is the great mine of fossil sponges, we must speak with caution, owing to the insufficient evidence as to the depth at which it was deposited.

As shown by *Protospongia,* the phylum of the sponges was in existence in very early Cambrian times, and probably much earlier. Before the end of the Silurian period its main branches had spread themselves out, and, developing fresh shoots since then, they have extended to the present day. Of the offshoots none of higher value than families are known to have become extinct, and of these decayed branches there are very few. The existence in modern seas of the *Asconidæ,* which must surely have branched off very near the base of the stem, is another curious instance of the per­sistence of simple types, which would thus appear not to be so vastly worse off in the struggle for existence than their more highly organized descendants.

*Bibliography.—*A fairly complete list of works on sponges published before 1SS2 will be found in Vosmaer’s article “Poriferæ,” in Bronn’s *Klassen und Ordnungen,* vol. ii. D’Arcy Thompson’s *Catalogue of Papers on Protozoa and Cœlenterata,* a still more complete list, extends to 1SS4.

The following is a list of works, including those referred to in the preceding pages :—(*1*) C. Barrois, *Embryologie d. quelques Éponges d. l. Manche,* Paris, 1876. (*3*) Bowerbank, *A Monograph of British* Spongiadæ, vols, i.-iv., 1864-82 (vol. iv. is posthumous, edited by Dr Norman). (*3*) Carter, a series of papers in the *Ann. and Mag. Nat. Hist.,* from 1847 to the present time (1887). (*4*) J. Clark, *On the* Spongiæ ciliatæ *as* Infusoria flagellata, 1865. (*5*) Grant, *Edin. Phil. Journ.,* 1825. (*6*) Haeckel, *Monographie d. Kalkschwämme,* 1871. (*7*) Hinde, *A Cata­logue of the Sponges in the British Museum,* 18S3. *(8)* Id., “On the *Beceptaculitιdæ,* in *Quart. Journ. Geol. Soc.,* xl. 795, 1884. (*9*) Keller, “Studien ii. Organisation

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