Zoology. — *"On the Occurrence of desmas or desmoids in Hymeniacidon sanguinea"*. By Prof. G. C. J. VOSMAER.

(Communicated in the meeting of January 29, 1916).

The term desma was first applied by SOLLAS (1887, p. 416) to the well-known irregular spicules of LITHISTIDS. A desma is composed of two distinct elements, the crepis and the prosthema[1]). The crepis is a spicule, tetraxon or monaxon in form, and produced in a single mother-cell. It soon undergoes an arrest of development and the axial filament is entirely shut in by spicopal. On the crepis as foundation secondary layers of silica are deposited. These layers are at first concentric with it, but subsequently grow out into irregular branches, cladi, and tubercles which are altogether independent of it (SOLLAS 1888 p. LIX). SOLLAS sometimes saw cells which resemble the ordinary scleroblasts situated in close contact with such a crepis and feels inclined to consider them as the mother-cells which secrete the epirhabd. MINCHIN, whose early death we all learned with profound regret, was more definite. He wrote (1909 p. 220) that the crepis "is produced in a single mother-cell. On the crepis secondary layers of silica are deposited by other cells". This is plain enough. However, as far as I know, nothing has been published on the subject after SOLLAS. The question is of importance and it is highly desirable that arguments should been given which either prove or disprove SOLLAS' suggestion. For the moment it is not decided. Whether formed by the scleroblast of the crepis or by other cells, the prosthema may at any rate be considered as a secondary formation of spicopal, since the axial canal of the crepis is shut and normal primary growth of the spicule therefore excluded. The crepis is usually considered as a spicule. If this is of a tetraxon nature the desma will become tetracrepid; if it is a monaxon rhabdocrepid (monocrepid). In several cases the original axial filament cannot be seen; such desmas are called acrepid.

The diagrams in fig. 1—3 explain the different parts.

As a rule the desmas are considered to be characteristic of Lithistids. But SCHMIDT found similar spicules in certain other sponges. The question is in how far these are real desmas.

OSCAR SCHMIDT described in 1862 two "new species" of *Suberites*, which he called *S. crambe* and *S. fruticosus*. I showed in 1880

[1]) πρόσθημα, what is added, any addition. I propose this term prosthema for secondary additions of spicopal in general. In desmas the prosthema can represent either the epirhabd or the epactines of SOLLAS.

1. that these sponges certainly do not belong to *Suberites* and 2. that the two "species" are identical. I believed a new genus had to

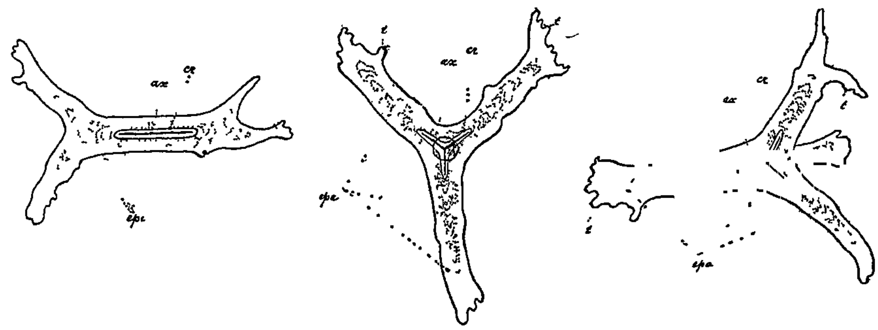

Fig. 1. Fig. 2. Fig. 3.

Fig. 1. Rhabdocrepid desma; *ax.* axial thread of the crepis, *cr.*; *epi* epirhabd. Fig. 2—3 Tetracrepid desma, *ax.* and *cr.* as in fig. 1; *epa* epactines; *t.* tubercles. The layers which form the prosthema are in all three figures represented by dotted lines

be established for which I proposed the name *Crambe*. Because of the isochelae I discovered in type-specimens both of *Suberites crambe* and *fruticosus*, I arranged the genus *Crambe* under the Desmacidinae.

Unacquainted with these statements, LENDENFELD (1894 γ) once more identified the two "species" and again coined a new generic name viz. *Tetranthella*. Obviously this name is a synonym of *Crambe* and accordingly it has to be cancelled.[1]) Whereas I considered the sponge under consideration to belong to the Desmacidonidae, LENDENFELD brought it to the Lithistida. Now it is universally admitted that these two groups stand far from each other. How then is this contradiction to be explained? The fact is that in SCHMIDT's sponge, in addition to the styli, which form the great bulk of spicules and indeed chiefly compose the skeleton, two other sorts of spicules are met with, viz. isochelae and spicules, which look like desmas. The former we know to be characteristic of Desmacidonidae, the latter of Lithistida. LENDENFELD says (1894 γ p. 50): "Microsclere habe ich nicht finden können. Wohl beobachtete ich zweimal ein Chel. Aber es scheint mehr als fraglich ob diese Chele nicht von aussen her zufallig hineingerathen sind". LENDENFELD, therefore, believes the sponge to belong to the Lithistida. My opinion was, on the contrary, that the chelae were of primary importance

1) It seems to me superfluous to enter into a discussion of the nomenclature; enough can be found in the papers by TOPSENT and THIELE. The more so, as I will demonstrate later on that both names, *Crambe* as well as *Tetranthella* should be cancelled.

and that not too much value was to be attached to the occurrence of the irregular "Kieselkorperchen" (SCHMIDT). THIELE afterwards (1899 *a*) arrived at the same conclusion. It struck him that the enigmatic corpuscles were very irregular and very variable in size. He could never trace an axial thread in the prolongations ("Fortsatze"); only in the centre he saw a "sternformige Hohlraum" in the full-sized specimens, whereas juvenile specimens resemble irregular asters as occur e.g. in *Thenea*. "Darnach ist es unmoglich, diese Kieselkorper fur 'tetracrepide Desmen' zu erklaren, vielmehr werden sie fur eigenartig entwickelte Aster, also Microsclere, gelten mussen. Damit stimmt auch ihre absolute Grosse, die bedeutend hinter derjenigen der gewöhnlichen Lithistiden-Desmen zuruckbleibt". And further on THIELE correctly remarks (l. c. p. 90). "Auch die Lage der fraglichen Kieselkorper, die man als Desmoide wird bezeichnen konnen, ist ja doch so ganz verschieden von derjenigen der Lithistiden, dass schon dieser Umstand ihre Homologie ausschliessen muss". THIELE never observed that the extremities of the desmoids possessed many tubercles by which neighbouring spicules were fixed together as LENDENFELD asserted having seen. THIELE, consequently, said: "Ich bin also der Ansicht, dass die Desmoide von *Crambe* nur die Bedeutung von accessorischen Microscleren haben, demnach fur die Stellung der Gattung von untergeordneter Bedeutung sind". Although I maintain my old opinion and so far agree with THIELE's conclusion, the following observations may be made.

THIELE uses the term "Desmoide" [1]) in order to emphasize that the spicules under consideration are different from the desmas of Lithistids. He does so, on account of the fact that the corpuscles often show more than four axes and are rather to be derived from asters. SOLLAS and later MINCHIN derive certain desmas from calthrops, which, according to SOLLAS, are also a form of asters. And on the other hand SOLLAS says (1888 p. LX—LXI): "In one group of Lithistids.... the desma does not form upon a crepis, at least not a spicular crepis; it presents a massive centrum with what appears to be a large nucleus, and which may indeed actually be the nucleus of a crepidial scleroblast, which has ceased to secrete its sclere; variable numbers of actines proceed from the centrum, usually four to twelve; when, as is usual, only four or five are present, they proceed from one face of the centrum...." It follows that there is no special reason so far for the new term desmoid. However, if the spicules are desmas, this does not involve the sponge in which they are found belonging to the Lithistida.

[1]) Cf. TOPSENT 1894 (3) p. 314.

75*

Supposing the general structure of "*Crambe*" to be entirely different from that of Lithistids, there remain evidently two other possibilities: either the desmas are formed by *Crambe* itself or they are not. In the former case the desmas would no longer be especially characteristic of Lithistids. In the latter case they are corpora aliena as occur so frequently in sponges. I hope to make it probable that this is really the case.

Among the sponges I collected in Naples, there are several specimens in which such irregular spicules occur as found in Crambe. In working out the Desmacidinae for the "Fauna and Flora of the Bay of Naples" I provided each specimen which is mentioned therein with successive numbers. In the following I will use the same numbers, so that everything can be checked and compared with the numerous illustrations, when the monograph is published.

There are in the collection from Naples two specimens, **977** and **1039**, which form thin red incrustations on barnacles. The skeleton is mainly composed of styli, with a few strongyla. From the substratum start more or less vertical bundles, generally beginning with a single stout stylus; around which slenderer styli are situated. Such a bundle may bifurcate and the two branches may bifurcate again. At any rate the bundle terminates in a flat tuft of diverging styli. The shape and size of the styli vary slightly; the maximal length of the stout styli is 435 μ in **977** and 480 μ in **1039**; the slender styli vary between 200 μ and 280 μ in **977**, between 170 μ and 300 μ in **1039**. A third specimen (**1153**) appears as a red crust on *Euspongia*. No doubt the three specimens belong to the same species. In all three we find chelae of the sort LEVINSEN (1894 p. 4) calls "anchorae"; they are tolerably frequent in **1039**, but rather scarce in the two other specimens. Externally in no way distinguishable from **977** and **1039** is specimen **1090**. It forms likewise a bright red crust on barnacles. However, here no chelae could be discovered at all; on the other hand a few acanthostyli occur. In six other specimens (**967**, **975**, **1026**, **1037**, **1040**, **1127**), in which chelae are present, though sparingly, I found likewise some few acanthostyli. Specimen **1040** is especially remarkable because distinct acanthostyli are exceedingly rare, but on many styles vestiges of spini are visible [1]). All these sponges appear as scarlet crusts and most certainly belong to the same species, as their general structure shows. If this be so, the presence or absence of acanthostyli or chelae ("ancorae") has no specific value in the present case. With rare exceptions, chelae are

[1]) The illustrations are all ready for the monograph.

not abundant; in some cases they are exceedingly scarce and only discovered after looking through many sections. What we have said about the chelae likewise holds for sigmata. If microsclera are present, generally a few acanthostyli occur; but it sometimes happens also that the latter are present, without any microscleres being found (**1090**). Taking everything together we get the impression that the sponges under consideration are descendants from forms with a full set of spicules: styli, acanthostyli, sigmata and isochelae.

If the scarlet crusts mentioned above occasionally possess such a small quantity of acanthostyli or microsclera that these are only discovered after long searching, there is a fair chance that we shall meet with specimens in which the additional spicules are entirely absent and in which the skeleton is composed of styli only. At any rate the absence of accessory spicules does not prevent us from identifying our specimens with already described sponges of which it is stated that they possess only styli; of course if they agree in other respects. I do no thesitate, therefore, to recognise a close relation between our crusts and two sponges formerly described, viz. *Spongia sanguinea* GRANT and *Hymeniacidon caruncula* Bwk. The former was subsequently likewise brought to the genus *Hymeniacidon* and TOPSENT even advocated the identity of both. He writes (1900 p. 261):.... "je crois bien que l'Éponge désignée par BOWERBANK sous le nom de *Hymeniacidon sanguinea* n'est pas différente de celle qu'il a appelée *Hymeniacidon caruncula*". Miss STEPHENS (1912 p. 37—38) I understand, arrived at the same result and I can but agree with these distinguished spongiologists.

Now there is among the Sponges from the Bay of Naples a remarkable specimen (**16**), which covers the rhizoma of *Posidonia*. In some places it is a mere thin crust, in others it is thicker and exhibits knobs and lobes and ridges. In such places it looks rather massive, but sections show that in reality the whole sponge is hardly more than a crust. Besides this specimen there are several others in my collection which possess such lobes and ridges, which are prolongations from the general encrusting base. In this connection JOHNSTON's observation on "*Halichondria sanguinea*" (= *Spongia sanguinea* Grant) is worth noticing. He says that the sponge occurs in crusts; but he adds (1842 p. 134): "*H. sanguinea* occasionally occurs in amorphous masses of considerable size and thickness with very uneven or ragged surface". Further I draw attention to KÖLLIKER's statement that some of the spicules of a sponge which he determined as *Halichondria sanguinea* possess short spines (1864 p. 56).

We see thus that there are specimens of *Hymeniacidon sanguinea* which are only thin incrustations but that others tend to grow out. Indeed I examined several such specimens and they gradually lead to really more massive ones. All these specimens doubtless belong to the same species, which I, therefore, all determined as *H. sanguinea.* Some of them show an unmistakable likeness to certain specimens of SCHMIDT's "*Acanthella*", e.g. specimens **607, 749, 1154**. Now it must be remembered that SCHMIDT (1862 p. 66), in describing his *Suberites crambe* and *S. fruticosus,* draws attention to their external resemblance to *Acanthella*. Of the former he wrote: "Diese Art würde man nach dem äusseren Habitus fur eine *Acanthella* halten, indem die Oberfläche des blattrig und lappig gefalteten Korpers mit stumpfen Dornen besetzt ist" and about *S. fruticosus* SCHMIDT says: "Auch die Gestalt dieser Art erinnert an *Acanthella obtusa*." On the other hand TOPSENT taught us (1894 ε p. XXXV and 1894 δ p. 314) that in Banyuls SCHMIDT's *Suberites fruticosus* [1]) often occurs in thin crusts. These red incrustations were already known to TOPSENT and described under the name of *Stylinos brevicuspis* (1892 α p. XX).

So far for the external appearance. If we now examine the microscopic, structure and the spicules we find the same variability as we found in the incrusting specimens.

A specimen which comes very near **16** is **749**. In both the skeleton is built up chiefly of styli of various dimensions, only in **749** we find in addition some strongyla. It is, however, evident that these strongyla are modified styli. TOPSENT found in his *Stilynos brevicuspis* that the styli were characterised by the shortness of the pointed extremities. TOPSENT proceeds (1892 α p. XX): "leur pointe (est) parfois réduite à un mucron ou même tout à fait atrophiée". This is exactly what often happens in my specimens. In some there are more, in others there are fewer strongyla, but a comparison of several specimens teaches us clearly that the presence or absence of strongyla is of no specific value. We have seen already that this is likewise the case in the incrusting specimens with regard to acanthostyli, chelae and sigmata. In the massive or pseudo-massive ones it is the same. The specimens **484** and **486** resemble each other most strikingly, but the relative number of acanthostyli and their grade of spination differ slightly. Moreover I found, after a long and careful examination, a few isochelae in **484**. Again in another specimen (**487**) which nobody could externally distinguish from **486**, there are no acanthostyli, but a few more isochelae than in **484**. Surely all these specimens are identical with specimen **16**,

[1]) TOPSENT calls it *Crambe fruticosus* and afterwards *Tetranthella fructicosa.*

		strongyla	styli	acanthostyli	sigmata	isochelae	
*Hymeniacidon sanguinea	953	+(rare)	{230—240} {...- 450}			38	red crust
" "	967	+(rare)	{200—280} {...--380}	+(rariss.)	+ (rariss.)	+ (rariss.)	" "
" "	975	250—280	{200—280} {...—480}	+(rariss.)		+(rare)	" "
* " "	977	+ (few)	{200--280} {...—435}		+ (rariss.)	+ (rariss.)	" "
* " "	1026	+ (few)	{215—300} {...—400}	+ (rare)		+ (rariss.)	" "
* " "	1037	+ (few)	{200—375} {... - 530}	+ (rare)	+	+ (rare)	" "
* " "	1039	+ (few)	{170—300} {...—480}			34	" "
" "	1040	+(rare)	{ 300 } {...—500}	+	+ (rariss.)	+ (rariss.)	" "
" "	1090	+	{ 280 } {...—480}	120 (rare)			" "
" "	1153	+ (few)	{240—400} {...—490}		+ (rariss.)	+ (rariss.)	" "
" "	16		{ 330 } {200—430}				{ " " with erect lobes
" "	192		{ + } {...—450}	+			{ red crust with small processes
" "	725	+ (few)	{...—440} {...—460}	+(rariss.)		+ (rariss.)	{ more or less massive, red
" "	749	265	{ 260 } {...—600}				massive; red
" "	1064		{260—330} {...—480}				
" "	1127	+(rare)	{220—400} {...—500}	+		38(rare)	red crust
* " "	1130		{150—375} {...—375}	70—310 (?)		+ (few)	" "
" "	1142	+ (few)	{240—350} {... 460}				" "
" "	57		...—400				massive; red
" "	388	+ (few)	+				{ " " (*A. crista-galli*)
" "	484	+ (few)	230—350	+ (rare)		+ (rariss.)	massive; red
" "	486	+ (few)	...—360	+(rariss.)			" "
" "	487		{ + } {...—460}			+	" "

		strong-yla	styli	acantho-styli	sigmata	iso-chelae	
Hymeniacidon sanguinea	510	+(rare)	...—350 ...—490				massive, red
" "	607	+(rare)	190—370	100 (rare)	+ (rariss.)		red incrustation with lobes
" "	888	280(few)	300 ...—500				massive red
" "	1044		180—375 360—600	+(rariss.)			red incrustations with lobes, in many places resembling *Hym. caruncula*
" "	1154		250—310 ...—490				
Spongia "	GRANT		+				red crust
Halichondria "	JOHNST.						crust or more massive
" "	KÖLL.		+	+(rare)			
Hymeniacidon "	BWK.		160—306				
" "	STEPH.		240—270				
Amorphina "	TOPS.		+				
Hymeniacidon caruncula	BWK.		148—270				coating, thick
" "	RDL.		230—290				
" "(type)	RDL.		190—320				
" "	STEPH.		240—270				
*Suberites crambe	O.S.	+	+				massive, "*Acanthella*"-like
* " " (co-type)	G. M. 88		270—360 ...—620			..—34	
*Crambe "	THIELE		350 550			30—44	
*Suberites fruticosus	O. S.		+				" "
* " " (type)	G.M. 104	+	240—305 ...—500	+(rare)		+(are)	
* " "(co-type)	G.M. 102	+	300 ...—500			40	
*Stylinos brevicuspis	TOPS.	+	280—330				red crust
Axinella crista-galli	MAAS	+(?)	+				thick crust, with processes
Hymeniacidon viridans	BWK.		330—400				coating
" consimilis	BWK.		433				coat., with process
" mammeata	BWK.		300 866				" " "
" medius	BWK.		220—340				massive
" agminata	RDL.		280				"

which in its turn is identical with the crusts mentioned above and which I believe are equivalent to *Spongia sanguinea* Grant, or, as its name should be now: *Hymeniacidon sanguinea.*

In the foregoing table the variability in spiculation and in size of the spicules is conspicuous. The measurements are given in microns; the sizes of the spicules in Bowerbank's specimens are calculated from his illustrations. In the specimens marked with an asterisk, desmoïds were found.

Generally two sorts of styli can be distinguished: slender and stout ones. In such cases this is indicated in the above table; the upper numbers refer to the slender ones. Often it is, however, difficult to make a distinction on account of the transitions. The absolute mininum in my specimens is 150 μ, the maximum 865 μ; on an average they vary between 210 μ and 470 μ. Of course the figures in the list do not prove much, for a much larger material is wanted in order to draw conclusions of importance. But it is sufficiently evident that the styli vary a good deal in length and that no specific distinction can be made on account of slight differences in size of the styli. If, therefore, Ridley says (1884 p. 467) that this *Hymeniacidon agminata* is near *H. caruncula,* "only the spicules are of a rather smaller average size"...., this is for me no reason for a specific distinction. Topsent has already identified *H. consimilis* and *H. viridans* with *H. caruncula.* I am of opinion that the differences between *H. mammeata* Bwk., *H. medius* Bwk. and *H. consimilis* Bwk. are not of a specific nature; the more so since Bowerbank-Norman (1882 p. 82) state that the "mammiform organs" are by no means always present.

As for Maas's *Axinella crista-galli* I suggested (1912 p. 316) that this sponge was n o t an *Axinella.* As far as can be judged from Maas's description *A. crista-galli* is nothing but a synonym of the sponges mentioned above. In external appearance it agrees with such specimens from Naples as e. g. **388**, of which I give a coloured illustration from the living animal in my monograph. Among the hundreds of sponges from Naples I examined I never saw a single *Axinella* with which it could possibly be identified; whereas the resemblance with several specimens of *Hymeniacidon sanguinea* is very striking. "Der Schwamm ist von ansehnlicher Grösse, bildet Krusten, die seitlich comprimirt und gewunden sind wie ein Hahnenkamm. Die Oberfläche ist unregelmässig wellig" (Maas, 1893 p. 338). The skeleton, according to Maas, is composed of two sorts of spicules which are said to be "stecknadelförmig", but according to the figures these spicula are styles with some strongyla. I examined a number.

of larvae and pupae of *H. sanguinea*; I perfectly agree with MAAS's statements; only in my specimens I discovered sometimes, though very scantily, isochelae. And TOPSENT (1911 *a* p. IX) says about the larvae of MAAS's sponge: "La ressemblance en est très grande avec celle que je viens de décrire . . ." (viz. *Hymeniacidon caruncula*).

Taking everything together I believe that we may draw up the following list of synonyms of *Hymeniacidon sanguinea* (Grant) Bwk.:

1826 (η). Spongia sanguinea GRANT.
1828. Halichondria sanguinea FLEMING.
1848. Halispongia sanguinea GRAY.
1857. Hymeniacidon caruncula BOWERBANK.
1862. Suberites crambe SCHMIDT.
1862. Suberites fruticosus SCHMIDT.
1866. Hymemacidon caruncula BOWERBANK.
1866. Hymeniacidon consimilis BOWERBANK.
1866. Hymeniacidon mammeata BOWERBANK.
1866. Hymeniacidon sanguinea BOWERBANK.
1866. Hymeniacidon viridans BOWERBANK.
1874. Hymeniacidon medius BOWERBANK.
1880. Crambe harpago VOSMAER.
1882. Amorphina caruncula BOWERBANK-NORMAN.
1882. Amorphina consimilis BOWERBANK-NORMAN.
1882. Amorphina sanguinea BOWERBANK-NORMAN
1882. Reniera mammeata BOWERBANK-NORMAN.
1882. Reniera caruncula BOWERBANK-NORMAN.
1882. Reniera consimilis BOWERBANK-NORMAN.
1882. Reniera sanguinea BOWERBANK-NORMAN.
1882. Reniera viridans BOWERBANK-NORMAN.
1884. Hymeniacidon agminata RIDLEY.
1888. Amorphina viridans TOPSENT.
1892 (α). Stylinos brevicuspis TOPSENT.
1893. Axinella crista-galli MAAS.
1894 (ε). Crambe fruticosus TOPSENT.
1894 (γ). Tetranthella fruticosa LENDENFELD.
1899 (α). Crambe crambe THIELE.

With this conception of *Hymeniacidon sanguinea* we may say that it is a sponge which usually appears as a scarlet[1]) crust. In

[1]) Of course the red colour is not always exactly the same; sometimes it is more blood red or coral-red, sometimes more scarlet etc. On the whole it generally comes nearest "miniatus" of SACCARDO's list.

some specimens this crust is only one or two millimeters thick and then the surface is generally smooth and even. In others it is thicker and provided with small tubercles, lobes or ridges. Such specimens form transitions to more massive ones, albeit that they often rather simulate a massive mass, in reality being but incrustations In the former case they are described under the names *Spongia* (*Hymeniacidon*) *sanguinea* and *Stylinos brevicuspis*. Specimens like *Hymeniacidon caruncula, consimilis, mammeata* etc. form transitions to such as are known as *Axinella crista-galli, Suberites* (*Crambe*) *crambe* and *fruticosus*. In the simplest condition, as thin crusts, the skeleton is formed of vertical bundles of styli, branched or not, terminating in fan-shaped tufts. These bundles are attached to the substratum by means of a thin layer of spongine, which forms conical elevations in which the bundles are firmly fixed with their basal parts. If the crust becomes thicker, localised or in general, the bundles of course grow higher; neighbouring bundles may be united by spicules, with or without the aid of spongine. This gradually leads finally to a sort of network of bundles, united by a very variable amount of spongine. Between the vertical bundles loose spicules may be found, often in a horizontal position i. e. parallel to the substratum. Moreover some acanthostyli occasionally occur; their typical situation is erect on the substratum. And finally, likewise in very variable number, sigmata and isochelae may be found.

Let us now return to the desmas.

In six of the incrusting specimens I found desmoids, viz. in **953**, **977**, **1026**, **1037**, **1039** and **1130**. However, these organisms are never found regularly dispersed through the sponge, but only in certain parts. More especially they occur at localised places of the base of the sponge, immediately against the substratum or, if they are found higher up, they are more or less in contact with the erect bundles of styli. This situation suggests that they are organisms not belonging to the sponge itself. Supposing this to be the case, where do they come from and what can possibly be their true nature? It is highly improbable that they belong to some Lithistid, simply because I found Lithistids only twice or thrice in the Bay of Naples.

It is a fact well known to everyone who has examined microscopic sections of sponges that they frequently contain foreign objects. Leaving out of consideration the numerous commensals we find in sponges, we often find spicules of other Sponges, Radiolarians, Foraminifera etc. entirely incorporated in the parenchyma. Thus I found in some sections of specimen **975** spicules which had a great likeness to the microcalthrops of *Plakina trilopha.* They are for the greater part found in groups on the same substratum as the sponge **975**. They are kept together by traces of degenerated soft tissue. Now it is certainly of importance that in several cases I found on the same stone together with the red incrustations mentioned above crusts of Plakinidae. The majority of my specimens of Plakinidae came from the same grounds as the red crusts of *H. sanguinea* viz. Posillipo, Pozzuoli and Nisida. The supposition that the irregular siliceous bodies are to be derived from spicules of Plakinidae seems to me, therefore, not over fantastic. We know by F. E. SCHULZE's researches how variable the spicules of Plakinidae are. The various shapes of the desmoids we find sometimes in *Hymeniacidon sanguinea* are all easily explained, if we admit that spicules of Plakinidae form the crepis. We might suppose that little crusts of these curious Porifera are overgrown by the stronger, expanding *Hymeniacidon* and are finally killed by it. In this way groups of spicules of some *Plakina* or other may be incorporated in the parenchyma of *Hymeniacidon*. But, these spicules are not yet desmas or desmoids.

We saw that, according to SOLLAS, MINCHIN and others, desmas are formed by secondary deposit of silica on a spiculum, which is early arrested in growth, and by which process the axial thread becomes shut off from the surrounding cytoplasm of the scleroblast. Whether the spicopal, which will form the prosthema is secreted by the mother-scleroblast of the crepis or by others, is of no consequence for our suggestion.

Is there anything to be seen in our *Hymeniacidon* which resembles the development and structure of true desmas? I believe there is, as far as can be judged from examination of objects no more in contact with their mother-cells. Every phenomenon we are able to observe in true desmas can be seen in the siliceous bodies under consideration. If we apply the heating method and subsequent mounting in glycerine, in general in observing the spicules in question in media of various refractive index, we get pictures which fully correspond to SOLLAS's statements about desmas. So far there seems to be no reason for a distinction between desma and desmoid, since it is *not* confirmed in any way that the secondary silica is deposited by other cells than the mother-scleroblast of the crepis. Consequently, if one wishes still to make a distinction, it must be for other reasons. Such a reason might be found in the fact that the desmas of Lithistids are spicules normally secreted by the Sponge itself — at least as far as we know. But the desmoids of *Hymeniacidon sanguinea*, according to my views, do *not* belong to the Sponge; the crepis at any rate is foreign and this is essential. It is unknown how the surrounding layers of the prosthema are formed; but it seems to me very probable that the mother-scleroblast of the crepis is responsible for it. Little is known about such secondary deposits; still less than about the primary spicopal, which is in contact with the axial thread and very probably stands under its influence. A slight irregularity in the axial thread is followed by the same irregularity in the spicopal. One can convince oneself easily of this fact by carefully examining microscopic preparations of spicules. Invariably some abnormalities are found. Take e.g. a preparation of styli; generally there are some which show slight thickenings in the axial thread near the base. The layers of spicopal follow the thickening most minutely. Often between the normal styli, others are found which are obviously arrested in growth so that they do not terminate in a sharp point, but are rounded off. In such cases one can repeatedly see that at that end the spicopal has formed exactly the same curved lamellae as, normaliter, at the base. Such layers are thicker, the earlier normal growth has stopped. These are pathological products. We get the impression that the silica, which is still present in the scleroblast, is used up, *also* if the axial canal is shut. But this secondary deposit is generally more irregular. We may suppose that similar processes are going on in desmoids, only on still larger scale. The reason of such abnormal development may be sought in the poor condition into which *Plakina* comes after it has been overgrown by *Hymeniacidon*. We know of several analogous cases of secondary deposit of spicopal. As far as I am aware little attention has been paid to it. Examples we have e.g. in sterrasters, spherasters, sterrospirae; but also, I believe, in the spines of acanthostyli. Sterrasters and spherasters are both polyaxon spicula; the primary spicopal is deposited on the axial threads, with some form of oxyaster as result. If then the axial canals are shut, the secretion of silica goes on for a while, with the result that the centre becomes more and more one mass of spicopal. This mode of growth is for both kinds of spicules fundamentally the same; only in sterrasters it goes farther. For these spicules at least it has been proved that the primary spicopal as well as the secondary is secreted by a single cell. Sterrospirae [1]) on the other hand are monaxon spicules. As in sterrasters secondary silica is secreted after the closing of the central canal, so it happens in sterrospirae, albeit in another way. Why the secondary spicopal in acanthostyli and spinispirae is deposited in concentric lamellae and finally as conical spines vertical on the axis, whereas

[1]) Cf. VOSMAER 1902, p. 111.

in desmas or desmoids it happens as irregular knobs and tubercles, are questions I am as little prepared to answer as why some spicules are monaxon, others tetraxon etc. I only wish to draw attention to what I believe to be analogous phenomena.

In describing the development of desmas in *Neosiphonia superstes*, Sollas says explicitly that cladi and tubercles are formed independently of the axial thread. But he continues (1888 p. 300): An axial portion, however, is still to be traced through the twigs and branches. It consists of silica of different refractive index and different solubility in the outer coatings, and runs as a wide core . . ." etc. This is, however, by no means peculiar to desmas. It has been long known that a lamellar structure is often met with in sponges. BÜTSCHLI demonstrated that different layers may show different refraction, an observation which WIJSMAN and I myself afterwards confirmed. Leaving out of discussion the explanation, it may be stated that in most spicules the different layers not only have a different refractive index but also a different solubility. I have made in this matter a number of observations, which I hope to continue.

These observations all point to the fact that we have to do with very complicated, partly optical phenomena. Roughly speaking we can say that the spicopal around the axial thread has a lower refractive index than the peripheral layer or layers [1]). Similarly is the solubility in hydrofluoric acid of the central layers is stronger than that of the pheripheral ones, in so far as the former are easier dissolved. Another difference between the layers is observed after careful heating; the well known brownish colour first appears in the inner layers and seldom occurs in the most external layer just under the spicule-sheath. All these phenomena are seen in desmoids of *H. sanguinea* just as distinctly as in simple styli of this or other Sponges.

LIST OF REFERENCES.

(chronological).

1826 (A) GRANT, in: Edinb. new Phil. Journ. II.

1842 JOHNSTON, A History of British Sponges.

1862 SCHMIDT, Die Spongien des adriatischen Meeres

1864 KÖLLIKER, Icones histolog. I.

[1]) Even very slight differences in refraction are easily seen by a bluish or pinkish colour. If spicules are observed in a medium, the index of which differs but slightly from the spicopal, a pinkish colour proves that the spicopal has a slightly lower refractive index than the medium. On the other hand the index of the spicopal is slightly higher than the medium if it appears with a bluish tinge. Spicules seldom disappear entirely in the medium, because the spicopal is almost invariably built up in layers of different refractive index.

1866–1874 BOWERBANK, A Monograph of the British Spongiadae. I—III.
1880 VOSMAER, in: Notes Leyden Museum. II.
1882 BOWERBANK—NORMAN, A Monograph of the British Spongiadae. Suppl.
1884 RIDLEY, in: Rep. Zool. Coll. "Alert".
1887 SOLLAS, Article Sponges in: Encyclop. Britann.
1888 SOLLAS, Report Tetractinellida in: Rep. Challenger. Zool. XXV.
1889 (γ) TOPSENT, in: Bull. Soc. Linn. Norm. (4) II.
1892 (α) TOPSENT, in: Arch. Zool. Expérim. (2). X. Notes et revues.
1893 MAAS, in: Zool. Jahrb Abth. Morph. VII.
1894 (γ) LENDENFELD, in: Zool. Anz. XVII.
1894 LEVINSEN, in: Vidensk. Medd. naturh. Forh. Kjöbenhavn. 1893.
1894 (β) TOPSENT, in: Rev biol. Nord France, VII.
1894 (?) TOPSENT, in: Id. VI.
1894 (ε) TOPSENT, in: Arch. Zool. Expérim, (3) I.
1899 (α) THIELE, in: Arch. Naturgesch. LXV.
1900 TOPSENT, in: Arch. Zool. Expérim (3) VIII.
1902 (β) VOSMAER, in: Versl. gew. verg. Kon. Akad. Wetensch. Afd. W. en N.
1902 (α) VOSMAER en VERNHOUT, in: Siboga Expeditie VI, a.
1905 VOSMAER en WIJSMAN, in: Versl. gew. verg. Kon. Akad. Wetensch. Amsterdam. Afd. W. en. N.
1909 MINCHIN, in: Ergebn. u. Fortschr. Zoologie. II.
1911 (α) TOPSENT, in: Arch. Zool. Expérim. (5) VII.
1912 STEPHENS, in: Proc. Irish Acad. XXXI.
1912 VOSMAER, in: Zool. Jahrb. Suppl. XV.

Leiden, Jan. 27 1916.

Mathematics. — A posthumous work of Dr. P. H. SCHOUTE. By Prof. J. CARDINAAL.

(Communicated in the meeting of January 29, 1916).

At the moment of Dr. P. H. SCHOUTE's regretted decease four sections of his great treatise "Analytical treatment of the polytopes regularly derived from the regular polytopes" had been inserted in the works of this Academy (Verhandelingen XI 3 and XI 5). The fifth section failed, which was the more to be regretted, as the author considered it a quite essential part of his researches and might well hope to complete the whole work in his lifetime.

It was to be supposed that part of this fifth section might be found amidst SCHOUTE's papers. Happily this supposition proved to be true; the fifth part was found nearly complete in manuscript. It is true, the manuscript bore the character of a first concept and had to be put in final form, but the clearness and accurateness of expression, so characteristic of the deceased, revealed themselves in this concept. The results were nearly all put down, so we can fairly admit, that it is SCHOUTE's work that is now to be published.

We wish to give some remarks relating to this publication. In