Aboralseite eine Cuticula abgeschieden worden, und hier sind auch die Zellen etwas verändert, indem am peripheren Ende derselben der körnige Dotter großentheils aufgelöst und zur Bildung gewöhnlichen Plasmas verwandt ist. Vielleicht kommt an dieser Stelle die erste Knospe zum Vorschein.

Die Gewebe der eben geborenen Larve sind noch so stark von Dotterkörnern durchsetzt, daß man wohl auf eine längere Dauer des Larvenlebens schließen darf. Da ich nur wenig Material hatte, so konnte ich die Umwandlung in den festsitzenden Stock nicht beobachten.

Ich werde die Untersuchung so bald als möglich fortsetzen und hoffe dann eine ausführliche Darstellung liefern zu können.

So viel ist sicher, daß *Paludicella* auch hinsichtlich ihrer Entwicklung in keiner näheren Beziehung zu den Phylactolaemen steht. Sie schließt sich eng an ihre marinen Verwandten an.

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3. The Term »Syzygy« in the Description of Crinoids.

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In examining the joints between the arm-ossicles of extinct crinoids, and in comparing them with those of recent crinoids, I have, in connection with the term »syzygy«, encountered serious difficulties, which it is the object of this note to expose and dispel. 1) None will gainsay that the leading writers on the Crinoidea use the term with more than one meaning, and therefore unscientifically: 2) some of us students think that the manner in which these same writers employ the term in taxonomic description tends to obscure origins and morphological affinities, and this no less seems to us an unscientific proceeding: 3) the excuse of these writers is their praiseworthy desire for brevity and ready means of comparison; but these ends can be attained just as well by another method that shall not trifle with either words or facts. I proceed to prove these statements in order.

1) The meaning of the term »Syzygy«. — The term »syzygy« was invented by Johannes Müller in these words: »Unter Syzygie verstehe ich die unbewegliche Nahtverbindung zweier Glieder« (»Über den Bau des *Pentacrinus*« Phys. Abh. Akad. d. Wiss. Berlin 1841, p. 215: 1843). In the whole paragraph it is clear that the word »Syzygie« refers to the joint or sutural union. But on the next page Müller says: »Bei *Pentacrinus caput-medusae* bilden nur das erste und zweite Glied über jedem Axillare ein Syzygium.« In this sentence the word »Syzy-

gium« obviously refers to the two ossicles that are thus united. The question of how syzygies are to be reckoned depends — so far as the literary history of the term has any weight — on the exact meaning of the word. Does it mean the pair of ossicles, or the suture between them? It can hardly, one would think, mean both, any more than the same word can mean bricks at one moment and mortar at another. And yet at the outset, as we have seen, the use of the term is very loose. The apparent distinction between »Syzygie« and »Syzygium« is purely accidental, for in Müller's later paper »Über die Gattung *Comatula*« (Phys. Abh. Akad. d. Wiss. Berlin 1847, p. 237—265: 1849) we read on p. 248: »Das erste Armglied scheint ein Syzygium zu haben .... das folgende Glied ist wieder ein Syzygium.« Here is a curious mixture of the thing possessing and the thing possessed. How can a brachial both have a syzygy and be a syzygy? The first »Syzygium« must mean »syzygial suture«, and the second »Syzygium« must mean »syzygial pair«. One finds precisely the same confusion in P. H. Carpenter's writings: thus, on p. 53 of the Challenger Report on the Stalked Crinoids I read: »the alternation of syzygies and muscular joints«; and »the two outer radials, even when they are united by syzygy«; and »the supposed syzygies are really articulations of a peculiar type«; in all of which sentences »syzygy« undoubtedly means, as defined by Carpenter himself, an immoveable sutural union between two ossicles. But on p. 51 of the same work, »syzygy« is used for what is elsewhere called »a syzygial pair«, as thus: »the axillary is a syzygy«; »the second radial of *Metacrinus angulatus* is a syzygy«. Even Jeffrey Bell, whose sense of style usually saves him from such absurdities, appears to me, in his »Catalogue of the British Echinoderms in the British Museum«, to explain the word »syzygy« as meaning a form of suture (p. 9), whereas in his descriptions he invariably uses it to denote a syzygial pair. This protest is no hypercritical pedantry: it really is often very difficult to follow descriptions in which these and other terms are so loosely used. A student for example is told that a syzygy is »an immoveable sutural union«, as contrasted with a »muscular joint«; and then he is told that »the third, eighth, and twelfth joints of the arm of *Antedon rosacea* are syzygies«. How can he understand this to mean that there are syzygies between the third and fourth, ninth and tenth, and fourteenth and fifteenth ossicles respectively?

2) The employment of the term Syzygy. — In describing the distribution of syzygies in an arm, it is the custom to reckon each syzygial pair as one ossicle. Now if »syzygy« means a pair of ossicles immovably united, it is consistent with the meaning to reckon the syzygies in that manner. But if »syzygy« means an immoveable sutural

union — and this is the original definition and the universally accepted meaning of the term — then it is inconsistent with the meaning to reckon syzygies in the above-mentioned manner: the units must be unions or joints, and not ossicles. For instance one would say of *Antedon rosacea* »the third, ninth, and fourteenth joints are syzygies«; and such a mode of expression would be short, simple, intelligible, and consistent.

Usage, however, counts for much; so I have tried to find out how the usage arose, and how far it is carried out. Here again there is confusion, the usual consequence of a confused terminology. In his memoir »Über den Bau des *Pentacrinus*«, on p. 217, Müller reckons each brachial as an independent unit, saying »An der inneren Seite eines Armes ist es immer das dritte Glied, welches die erste Pinnula trägt, oder das Glied über den beiden Syzygialgliedern.« It is when one comes to tabulate the arrangement of the pinnules that the point of counting a syzygial pair as one ossicle becomes apparent; for, as Müller says (op. cit. p. 218), »beim Alternieren der Pinnulae die beiden Glieder, die ein Syzygium bilden, immer nur für ein Glied zählen, daß das Hypozygale ohne Pinnula ist und daß die Pinnula jedes Mal am Epizygale steht«. In the words of P. H. Carpenter (Challenger Report on Stalked Crinoids, p. 50), »the hypozygal entirely loses its individuality as a separate segment of the arm, and bears no pinnule as the epizygal and the remaining brachials do .... The double or syzygial [ossicles] thus formed resemble the ordinary brachials in bearing but one pinnule, and they are therefore best considered as single [ossicles]«. So obvious is this to Carpenter that, on p. 80 of his Challenger Report on the Comatulae, he hurls scorn and sarcasm at Prof. Perrier, who has followed the simpler method of reckoning the hypozygal and epizygal as two brachials.

So then Müller and P. H. Carpenter, not to mention other writers, reckon a syzygial pair as a single ossicle. Oh! no, nothing of the sort: Only when it pleases them to do so, and when it fits in with their general statements. Look at Carpenter's description of *Actinometra pectinata* for example (Challenger Report; Comatulae p. 285), — »The first pair of pinnules (on second and third brachials) ...« What does this mean? In this species the brachials that I should call II $Br_{1\text{ and }2}$ and II $Br_{3\text{ and }4}$, are respectively united by syzygial suture; therefore one supposes that, in accordance with Carpenter's system, they are reckoned as two brachials; and one infers that the first pinnule, which is said to be on the second brachial, must be borne by II Br_4, since that is the epizygal of the second syzygial pair. But this inference postulates too great consistency; one soon discovers that II Br_1 and

II Br_2 are reckoned as independent units, and that the first pinnule is on II Br_2. Very well, then the second pinnule is of course on II Br_3. Wrong again! it is on II Br_4. In short, words are so juggled with that one must gather everything from the illustrations.

Now the object of all this confusion seems to be the maintenance of Müller's statement that »das erste Glied der Arme der Comatulen immer ohne Pinnula ist«, and the retention of »the third brachial as a syzygial [ossicle] as a condition which is common to by far the larger number of Comatulae«. And the difficulty is supposed to be evaded by such an expression as this: »A syzygy *between* the first two brachials, and another *in* the third«; in addition to the ineptitude I have italicised, the word syzygy here means union, though in the remainder of the very same sentence it means a syzygial pair of ossicles. But all these difficulties would never have occurred had the word syzygy always been used in its original sense as defined by Müller, and had the primitive brachials always been reckoned as the morphological units which they are. The formulae of Bell or of Carpenter could have been constructed just as well by basing them on joints (i. e. unions) and not on ossicles.

3) The reform proposed. — I have no wish to upset things and so make confusion worse confounded; but I do ask the describers of crinoids to settle the meaning of the terms they employ. And when they are settling these matters it would be as well if they extended their observations beyond the limits of three or four genera of recent crinoids and considered the difficulties presented by other forms. The evidence of palaeontology shows that a syzygy is a specialised form of joint, gradually acquired, and more common in the later than in the earlier crinoids. Moreover, such extreme specialisation of arrangement as enables our systematists to construct their beautifully comprehensive formulae, is found only in the Antedonidae. Consequently in the earlier crinoids one often comes upon cases in which a syzygial union seems to have existed without much modification of the size of the ossicles. In many of these cases, as Carpenter admits, it is ridiculous to reckon two brachials as one element even though they be united by syzygy. In other cases, in *Bathycrinus* for instance, as Carpenter points out, there is a modification of ossicles and an absence of pinnules without true syzygy. The argument of expediency, though not particularly scientific, has its weight when we consider that the difficulty, experienced by the highest authorities, of determining from external appearances whether certain unions are syzygial or not, must result, on Carpenter's system, in a corresponding uncertainty as to the actual number of the ossicles. In fine, to make the

syzygy paramount and to overlook the primitive number of brachials, would mislead in other cases than that of the almost universal two primibrachials of the recent crinoids, in which even Carpenter sees the danger of misleading. Indeed in every case it seems to me that, even if the mode of description of the syzygies adopted by Müller and others be simple and clear, its clearness has been obtained only by obscuring more important facts, just as a candle-flame, however much light it may throw, will cast a shadow if placed before the sun.

I propose then: —

a. That the term »Syzygy« should invariably be used in accordance with its original definition, for »an immoveable sutural union«.

b. That the term »joint« be restricted to its primitive sense, as translated by the German »Gelenk«, and never used in its secondary sense, as translated by the German »Glied«.

c. That the German »Glied« be rendered by ossicle or segment, either brachial or columnal as the case may be.

d. That two ossicles united by syzygy be termed a syzygial pair, or simply a pair.

e. That in reckoning the number of ossicles or describing the position of pinnules, each ossicle be a unit, no matter what its mode of union with other ossicles: e. g. in *Antedon rosacea* pinnules are borne by $IIBr_{2, 4, 5, 6, 7, 8, 10, 11, 12, 13, 15,}$ and not by $IIBr_{1, 3, 9, 14.}$

f. That in formulating or describing the position of syzygies (which are joints between ossicles) the units should be joints: e. g., in *Antedon rosacea* the 3rd, 9th, and 14th joints are syzygies; in other words, there are syzygies between the 3rd and 4th, 9th and 10th, and 14th and 15th brachials respectively.

However revolutionary the results of these proposals might be, the proposals themselves can hardly be described as such. I merely desire that a writer should give his terms the same meaning in his systematic descriptions as he does in his morphological discussions. Of the three writers alluded to in these pages, two have passed beyond the reach of criticism; the third, my friend Prof. Jeffrey Bell, with whom I have discussed this matter, agrees that some such reform as the one here proposed is certainly desirable, and kindly permits me to publish his opinion.

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