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On two new Spondylomoraceae: Pascheriella tetras n. gen. et sp., and Chlamydobotrys squarrosa n. sp.

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(With 5 figures in text and Plate 9.)

1. Pascheriella tetras n. gen. et sp.

In recent years our knowledge of the family Spondylomoraceae, since the times of Ehrenberg represented by Spondylomorum quaternarium Sr. only, has been considerably extended due to the discoverv of a series of new forms. These are: Pyrobotrys incurva ARNOLDI (1), Chlamydosphaera Korschikowi Schkorbatow (12, 13), Chlamydobotrys stellata and Ch. gracilis recently described by me (4, 5); further two forms of Chlamydobotrys described and erroneously placed into the genus Spondylomorum by PLAYFAIR¹); and finally a second species of Spondylomorum, S. caudatum found by SCHILLER (11). SCHILLER'S paper on this organism is of special interest, as in connection with the discovery of several biciliate Spondylomoraceae, sometimes strikingly convergent in form with Spondylomorum quaternarium and widely distributed, doubts arose of the very existance of this latter, as it had been described by EHRENBERG, STEIN, and others. This question has recently been discussed by SCHULZE (15), whose conclusions are not in favour of Spondylomorum. I believe,

¹) PLAYFAIR'S works were inaccessible to me and known only from PASCHER'S Süßwasserflora and reports in Arch. f. Protistenkunde.

however, that SCHILLER's work may be considered as an important, though indirect, argument of the validity of the species in question. But it is quite impossible to make out what were the forms referred to by various writers as *Spondylomorum quaternarium*.

All these forms, morphologically closely approaching each other, constitute a small family, Spondylomoraceae, characterised by the absence of any general envelope (involucrum) round the coenobium, and by the method of formation of the latter. There is, however, another feature characteristic of the Spondylomoraceae. New representatives of the family having been detected, my attention was turned to the fact that they all were deprived of pyrenoids, that are characteristic of all of the Volvocaceae save PLAYFAIR'S *Volvulina*. It is possible, that PLAYFAIR'S data are correct, with respect to the pyrenoids, but his observations are in general too superficial and not to be taken for a firm base in such considerations. I myself had the opportunity to convince myself of this, and just for *Volvulina*, that was found by me near Kharkov. Unfortunately, the material was very scanty and in bad condition, so that I was unable to study the cell structure of this interesting organism and give a more detailed account of it.

The comparison of the above two families leads to the conclusion that the absence, resp. presence, of pyrenoids, that is a feature of no more than generic significance in the unicellular Volvocales, is in the coenobic forms correlatively connected with the family characters, as the absence, resp. presence, of the involucrum. Something like this may also be said of the number of the cilia. In the unicellular Volvocales we observe a very great diversity in this respect, the number of the cilia varying from one (Cylindromonas HANSG., Chloroceras SCHILL.) to five (Chloraster ST.) and even nine (Pocillomonas STEINECKE). Contrary to this, almost all of the coenobic forms are uniformly provided with two cilia, except for Spondylomorum out of the Spondylomoraceae and dubitable uniciliate Mastigosphaera SCHEWIAKOFF (9) from the Volvocaceae¹).

¹) Though *Mastigosphaera* has not as yet been found by any other observer, there may hardly be any doubt of the correctness of SCHEWIAKFF's data, the more so that after SCHILLER's detection of *Chloroceras* the uniciliate condition cannot be held incredible for the Volvocales. I must however mention an interesting phenomenon repeatedly observed by me in *Gonium pectorale*. Namely, under some unknown conditions the cells of young colonies may draw in one of the cilia, the other one preserving its full length and securing thus the motion of the colony. All intermediate stages were also observed. The process is obviously reversible, as it the same samples all mature colonies were biciliate. Likewise WISLOUCH,

In this consideration, it was very interesting to meet with an organism to be referred to the Spondylomoraceae, but with pyrenoids in its cells; as from the theoretical stand-point there were no grounds to believe that the above mentioned correlation between pyrenoids and other features characteristic of the Spondylomoraceae and Volvo-caceae actually exists, being at the same time absent in the unicellular Volvocales. *Pascheriella tetras* represents such an organism.

Of interest is its sudden appearance in the district, where it was found. In spite of gearly observations on the microflora of the river Lopan in Kharkov, and especially of the puddles in the town itself and its nearest environs, I have not as yet met with *Pascheriella*. But in the spring of 1927 I found it in a considerable abundance in the river and in two pools near the town. It soon disappeared from these natural localities, and it was only for several days that I could preserve it in vegetative condition in the laboratory. Some details of its development may, therefore, have remained unknown. Pure cultures were not obtained.

Pascheriella tetras offers a small colony, or, more correctly, coenobium of four losely coherent cells (Pl. 9 Figs. 1-2). Vegetative coenobia consisting of a greater or lesser number of cells were not met with. The young cells are thickly fusiform, almost elliptical in shape, with rounded ends. As they grow, they become relatively broader, attaining 15 μ in length and 10 μ in width.

The length of the whole coenobium is up to $25 \,\mu$.

The cell wall is relatively thick and well to be seen. It adheres to the protoplast all round and at the fore end is provided with a small truncate papilla, from which project two cilia approximately as long as the cell. Any other outgrowths of the wall are absent.

according to his verbal communication, has found the unciliate Gonium pectorale. According to Schiller in Chloroceras cornutum among the uniciliate individuals sometimes biciliate ones are met with.

SCHILLER is of the opinion, that multiciliate condition in the Volvocales was the primitive one, the forms with fewer, or no (as in Protococcales), cilia being the result of regressive evolution. *Chloroceras* he considers as a uniciliate form so to say *in statu nascendi*, in which the second cilium is about to disappear for ever.

It seems to me that PASCHER'S (8) critique of this view of SCHILLER is quite right. As to the very fact, I should like to point out that, in view of what occurs in *Gonium pectorale*, the facts referred to by SCHILLER might be explaned quite differently from the above cited, unless biciliate cells of *Chloroceras* be abnormal double-individuals, so common in the Chlamydomonadaceae.

It is not impossible that the case with *Mastigosphaera* is of the same kind as in *Gonium*.

The chromatophor is wallsided, entire, extending up to the fore end, where are placed two contractile vacuoles. On one side the chromatophor is strongly thickened and here, nearly in the middle or somewhat below, lies an elliptical pyrenoid surrounded with an envelope of starch grains. On the opposite side the wall of the chromatophor is very thin and permits to see the nucleus with the relatively large nucleolus, that is located also laterally, somewhat below the pyrenoid (Fig. 2) or, if the latter is nearer to the posterior end, above it (Fig. 1), but never above the middle of the cell. Here we meet with the same relations in the position of the nucleus and pyrenoid, as in the *Chlamydomonas* with similar proportions and structure of the body, as in *Chlamydomonas Dilli* DANG., *orata* DANG. (2), and some others.

The stigma in *Pascheriella* is a rather large, thick, irregularly rounded or somewhat ellyptical plate of a deep red tint, placed at the middle of the cell just above the pyrenoid or somewhat nearer to the fore end.

The arrangement of the cells in the coenobium is quite definite and constant. As is seen from Fig. 3 showing the pole view of the organism, the cells lie in two tiers, each of two cells. It the anterior pair the cells converge with their fore ends (Fig. 2), their long axes making angles of nearly 90°. The point of contact is thus approached to the fore end. The other two cells lie in the plane normal to that of the anterior cells, *i. e.* alternating with the latter, and are arranged in a reverse sense, diverging with their fore ends and touching each other nearer to the posterior ends. Sometimes the cells of either tier are not in contact with one another, but only with those of the other tier, and their position is then more parallel to the axis of the coenobium, as in Fig. 1.

Sometimes the cells of either tier are not in contact with one another, but only with those of the other tier, and their position is then more parallel to the axis of the coenobium, as in Fig. 1.1 When viewing the coenobium from the pole, one can see that the pyrenoids, stigmata, contractile vacuoles, and cilia, are arranged in quite a definite order. If we imagine two planes at right angles to one another and passing longitudinally through the cells of the coenobium, in other words two planes of symmetry of the latter, they will be disposed as follows. In the cells of either tier contractile vacuoles lie in these planes. The cilia, as is the rule in the Volvocales with two vacuoles, are in the planes normal to the planes of the contractile vacuoles, and therefore disposed also uniformly about the axis of the coenobium. All the pyrenoids and stigmata are replaced from the planes of symmetry in the same direction, from right to left. Slight deviations from the above described might, of course, be found, but this is a very characteristic and constant arrangement.

In the jar filled with water to the hight of about 20 cm Pascheriella tetras keeps to the bottom, showing thus negative geo-tactic reaction like that in Chlamydobotrys gracilis in SCHULZE's experiments (15), though not so clearly expressed. As to its be-haviour in natural conditions, it hardly was the same as in the room, the samples having been obtained from superficial layers of the water.

Passing over to the life-history of *Pascheriella*, it must be mentioned that both vegetative and sexual reproductions have been followed up, for which hanging-drop preparations were used, made just, or one to several days, before the observation. Vegetative multiplication apparently proceeds in a motile condi-tion. But in hanging drops coenobia stopped near the margin of the drop, their cilia being shortened and even aggregated before the beginning of division, probably due to abnormal conditions of the medium.

Owing to the rotation of the protoplast inside its wall, the first division plane is slightly oblique at the very beginning of division (Fig. 4), but later proves at an angle of about 45° to the axis of the cell. The process however is not confined to the rota-tion of the protoplast as a whole, the division being preceded, as in some of the Chlamydomonadaceae, by intracellular replacements. This is best to be seen on the nucleus, that to the beginning of division travels into the anterior half of the cell. In the meantime the purportied descends a little to take an element head position the pyrenoid descends a little to take an almost basal position, probably oving to the rotation of the protoplast; and the mouth of the chromatophor, till now almost invisible, becomes to a large opening, to the opposite sides of which contractile vacuoles opening, to the opposite sides of which contractile vacuoles diverge. The cell wall retreats somewhat from the protoplast, that lies now rather freely within it (Fig. 4 and Fig. 3 in text); but it remains not elucidated, whether this is due to the expansion of the wall itself, or the protoplast undergoes a slight contraction before division. Judging from the fact that at this time the wall is almost as broad as long, with broadly rounded ends, which does not occur in the vegetative individuals being not about to divide, the first supposition is more adequate.

These preparatory stages having been completed, a furrow appears on the fore end of the protoplast, between the contractile vacuoles, at first almost longitudinal, but later more or less oblique

to the long axis of the cell. In spite of the relative smallness of the cell, I succeeded to observe, at this time, that both cilia were in connection with one of the cell segments. Sometimes, due to the retreating of the wall, the cilia were unrooted out of the protoplast, with a small clump of the cytoplasm at their base, remaining yet in connection with the corresponding segment by means of a short and fine protoplasmic thread. Just after this thread has been torn (Fig. 3 in text) the movements of the cilia ceased.



Figs. 1-5 in text: Pascheriella tetras.

Fig. 1. Cell in division at the stage when daughter nuclei are not yet seen; pyrenoid becomes indistinct.

Fig. 2. Two young zygotes, formed by the cells of the same coenobium. In one of the zygotes two contr. vac. are yet seen.

Fig. 3. A stage of cell division, with shortened cilia and expanded cell wall.

Fig. 4. Formation of the two-celled sexual coenobia.

Fig. 5. Zygote formed by the posterior cells of the coenobium, the anterior ones being yet unchanged.

The stigma remains at this time unchanged, lying rather far from the division plane, and passes thus to one of the daughter cells. Its further fate could not be estabilished. I can only mention that each cell of the young coenobium has a single stigma, and it is probable, by analogy with many Chlamydomonads, that the mother stigma disappears after the first cell division.

As to the behaviour of the pyrenoid during the cell division, my observations are not sufficiently sure in this respect. The pyrenoid

undergoes no changes until the furrow at the anterior end has attained more considerable development (Fig. 4). Its outlines be-come then less distinct, probably due to the dissolution of starch round it, and this renders further observations on it very difficult. round it, and this renders further observations on it very difficult. So far as I could see, the pyrenoid does not divide, but remains in one of the cell segments, the division plane passing by it (Figs. 1 and 4 in text). Be our organism out of the group Protococcales, such a method of cell division would offer nothing extraordinary; but it was very surprising to meet it in a Volvocinea, because this case is seemengly unique for the whole group. It would be very desirable, of course, to study the process of the cell division on fixed and stained preparations, but unfortunately I was obliged to confine myself to the observation on the living organisms in hanging dupped drops.

Further history of the pyrenoids could not be followed up, as these were lost to view to the time of the second division. In all

the newly formed daughter cells pyrenoids reappear, however. Each of the first two division segments divide in their turn longitudinally relative to their morphological long axes. It is evi-dent that whatever the directions of the second division planes might be, the ultimate arrangement of the cells in the finished coeno-bium cannot be attained in this way, so that there are needed some further individual replacements of the daughter cells inside their general wall. The details of this process were not followed up. Young coenobia are liberated due to the mother cell wall being

converted into mucilage.

converted into mucilage. The sexual process, as it has been observed in hanging drops, proceeds as follows. On the second or third day after the prepara-tions had been made invariably took place the production of young coenobia, that showed no difference, either in size or structure, from ordinary vegetative ones. The only and relatively rare exception was that sometimes the cells of the mother coenobia divided only once. Such a case is shown in Fig. 4 in text. In one of the mother cells we see two yet unfinished daughter cells without cilia, but with stigmata, which shows that no further division will take place. In the other cell the two daughter cells are already walled and with cilia. As is seen from the figure, the mother cells are of a smaller size, than those of the full-grown coenobia, which obviously is the cause of the lesser number of daughter cells arising from them. The two-celled coenobia thus produced prove to be sexual like the four-celled ones of the same generation. It is yet not impossible

the four-celled ones of the same generation. It is yet not impossible

that two-celled coenobia may be formed in the course of vegetative multiplication too; but such were not observed in my case.

After a short, no longer than several hours, period of time, the above described coenobia apply to the cover slide and cease moving, their cilia being neither drawn in, nor aggregated, however. As it will be seen from the following, the stopping of the coenobia is probably due to the cell walls becoming gelatinised and adhesive. Junction of the cells becomes more and more lose, until they are completely separated, after which fusions begin. It is of much interest, that generally the cells of the same

It is of much interest, that generally the cells of the same coenobium function as gamete partners. This is evident not only from immediate observation, but also from the fact, that in the places where sexual coenobia have not been gathered too densely, the zygotes are usually grouped in pairs (Fig. 2 in text). Commonly, in my case at least, the gametes move very lazily, stirring at the place of the desintegration of the coenobium though their cilia preserve their full length. It was also observed, however, that the gametes swam away without copulating with one another, and it is probable that their partners were of another origin. Such "illegal" fusions would especially be expected when sexual coenobia are gathered together, due to a certain kind of taxis; but this would be of course impossible to ascertain by immediate observation. At any rate, the fact is that ultimately all the gametes fulfill their destination.

Copulation begins by the fusion of the fore ends of the partners then becoming lateral, as is a general rule with the Chlamydomonads (Fig. 5). A somewhat earlier stage is represented in Fig. 6, where the gametes in fusion are seen from the pole, showing the characteristic position of their cilia, that diverge in pairs in two opposite directions and embrace the sides of the fusion body. The cilia are almost motionless at this time.

If copulation proceeds normally, the zygotes ball, draw in their cilia, and cover themselves with thin, smooth walls. The two chromatophores in the zygote are fused together by their edges, leaving an opening for the contractile vacuoles (Fig. 2, 5 in text). I have not succeeded to rear the zygotes to ripeness, and to observe their germination.

Somewhat obscure remained the behaviour of the cell walls of the gametes during copulation. The fact is that the gametes yet combined into coenobia are provided with clearly visible walls. But I have not succeeded, either before or during the fusion, to see them throw off their envelopes. The only probable supposition is that the latter undergo slight gelatinisation, thus becoming in-discernible. The same would be the cause of the disjunction of the gametes before copulation. If it be so, the gamete walls take part in copulation, forming the primary membrane of the zygote, as in some of the Chlamydomonads. In some cases walls seemed to be observable round the fusing gametes, but my drawings (Figs. 5 and 6) are too rough to represent the actual appearance of the cells.

are too rough to represent the actual appearance of the cells. As is seen from the preceding, copulation in *Pascheriella tetras* may be analogised with the cases of pedogamy (HARTMANN, 3), as the gametes are here nothing but quite young sister cells yet joined into typical coenobia and their actual nature being thus concealed for a short time. This is especially interesting in connection with recent experiments of SCHREIBER (14) and SCHULZE (15), who showed that *Eudorina elegans*, *Pandorina Morum*, *Gonium pectorale*, *Clamydo-botrys gracilis*, and even *Chlorogonium euchlorum*, are heterothallic, sex determination taking place at the germination of the zygote, obviously by reduction division starting the development of the latter latter.

It is more than probable, that the same occurs with most of the Volvocales, in which sexuality generally takes place. From the stand-point of our present theories of the sex deter-mination in plants and animals, the facts revealed by SCHREIBER and SCHULZE offer nothing extraordinary, and it is only astonishing, that both in higher and lower organisms the phenomena connected with sexuality are so strikingly similar. Much more obscure in this respect are organisms as *Volvox*, whose individuals may be either monoecious or dioecious. Such is also *Pascheriella tetras*, which is not only monoecious but even pedogamic, - a case of the rarest occurrence in the algae.

occurrence in the algae. It would presently be of little value to conjecture about the actual nature of the sex determining factors in *Pascheriella* and other homothallic forms. It is only by experiment that some know-ledge of the real causes might here be obtained. In face of this question however it will possibly be of interest to mention one peculiarity in the sexual process in *Pascheriella*. The fact is that the gametes arising from the same mother cell are not of two kinds only, either male or female, the cells of either tier being of both sexes. If it were so, copulations of the gametes from different tiers were to be expected. But this seemingly does not occur in *Pascheriella*. Of course, if all four gametes of the sexual coenobium

become disjoined before copulation, there may be no possibility to know the inter-relations of the partners. It often occurs, however, that disjunction is only partial, some two cells remaining in connection when copulation begins. So, in Fig. 5 we see two halffused cells viewed from the side, to one of which the third one is still attached, the fourth having swum away. Having been observing the whole process of the disjunction from the very beginning, I can say with confidence, that the cells involved in fusion are from the same tier. Still more convincing is Fig. 6. Here the cells of the anterior tier began to fuse, while those of the posterior tier, recognisable by their divergent fore ends, are yet joined. In Fig. 5 in text a reserve case is shown, the zygote being formed by the posterior cells. In all cases when inter-relations between the gametes could be established, they were as just described. As to the cells of different tiers, they show no attraction to one another, though there are those of different sex between them.

Diagnosis of the genus Pascheriella.

Coenobia of an even number of loosely cohering *Chlamydomonas*like cells, disposed in tiers, the cells of any one tier alternating with those immediately in front and behind. General gelatinous envelope is absent. Cells with two cilia and with pyrenoids.

Diagnosis of Pascheriella tetras.

Coenobia of four cells disposed in two tiers of two cells each, their fore ends converging in the anterior pair, and diverging in the posterior one. Cells thickly fusiform, almost ellipsoidal, rounded at the ends, with distinct wall bearing a small truncate papilla from the base of which project two cilia as long as the cell. Chromatophor wallsided, entire, with a pyrenoid in the lateral thickening in the middle of the cell or somewhat below, and with an elongated stigma just above the pyrenoid. Two contractile vacuoles in front and nucleus immediately above or below the pyrenoid. Dimensions: cells to $15 \,\mu$ long, to $10 \,\mu$ broad; coenobia to $25 \,\mu$ long. Vegetative multiplication by formation of daughter coenobia inside the cells of full grown mother coenobia. Sexual reproduction isogamic, cells of either tier of a young coenobium functioning as gamete partners. Zygotes rounded, covered with smooth wall, with two pyrenoids just below the middle and nucleus above them. Pascheriella tetras n. gen. et sp., and Chlamydobotrys squarrosa n. sp. 233

Found in the river Lopan in Kharkow and in puddles near the town.

2. Chlamydobotrys squarrosa sp. n.

After I had described *Chlamydobotrys stellata* and *gracilis* I found still one representative of this genus. It developed abundantly in a small pond in the environs of the rail-way station Lubotin near Kharkow. Unfortunately, I had then no time to study its life-history, which could have provided something of importance for a clearer distinguishing this species from the others, specially from *Chlamydobotrys gracilis* and *Pyrobotrys (Chlamydobotrys) incurva* ARN. The variability of these latter being uninvestigated, there was no certainty that *Chl. squarrosa* was nothing but an extreme variation of either of them.

Since then I often met with *Chl. gracilis*, but never saw it vary to such a degree as to produce something appoaching to *Chl. squarrosa*. On the contrary, the variability of this species proved very restricted, as is also evident from the recent experiments of SCHULZE (15). Therefore, I believe it will be reasonable to describe *Chl. squarrosa* as an independent species, and to contribute thus to the taxonomy of this yet very little known genus.

The coenobia of *Chl. squarrosa* consist of typically eight cells, as in *Chl. stellata*. These are disposed in four tiers, each formed by two cells only. In the anterior two tiers the cells are disposed crosswise to one another, which is to be seen in the coenobia viewed from the apex. The posterior cells are arranged in the same manner, but alternating with the anterior ones. The coenobium is thus built up as in *Chl. gracilis*.

From this latter *Chl. squarrosa* differs sharply in the form of the cells and in their relative position to the axis of the coenobium. Namely, the cells of *Chl. squarrosa* are irregularly pyriform, strongly inflated on the side turned to the axis of the coenobium, as in *Chl. stellata*. By these inflated sides the cells of either anterior tier are loosely attached to one another, and to those of the following lower tier. The outward sides of the cells are inflated much less, being sometimes almost straight (Figs. 11, 12). Towards the posterior end the cells are narrowed and terminate with a long tail-like outgrowth, pointed in the younger cells and slightly blunted in the mature ones. In this respect *Chl. squarrosa* approaches to *Chl. stellata* and *incurva*. But, in the former only very young cells are produced behind, the older ones being conversely ovoid; in the latter, unlike Archiv für Protistenkunde. Bd. LXI. Chl. squarrosa, the outgrowths are curved backwards. In Chl. squarrosa they are straight and spread so as to make right angles to the axis of the coenobium in the anterior cells, and about 45° in the posterior ones. Sometimes the ends of the anterior cells are directed somewhat forwards (Fig. 8). The cells are slightly compressed on the lateral sides.

The length of the coenobia attains 40 μ , that of the separate cells is to 30μ .

The cell wall is very thin and provided with a small wart-like papilla, placed asymmetrically to the cell axis. From the sides of the papilla project two cilia a little longer than the cell. The evenly green protoplast fills up the wall in younger cells, and in older ones to a more or less degree retreats from it at the posterior ends. The chromatophor is in general cup-shaped, extending up to the point of the insertion of the cilia, where two contractile vacuoles are located. The base of the chromatophor is contractile vacuoles are located. The base of the chromatophor is strongly thickened, occupying the whole posterior half of the proto-plast, as is best to be seen in some cells in Figs. 10 and 12. The pyrenoid is absent, and only minute starch grains are scattered through the chromatophor. The stigma is an irregularly outlined, elliptical plate of a considerable size, lying in the fore half of the cell, on the left side, in the cells viewed from the back. In the relatively small cavity of the chromatophor lies the nucleus, applied to the wall of the chromatophor on the inner side of the cell. Generally it is difficult to see due to the insufficient transparence of the abromatophor

transparency of the chromatophor.

Any developmental stages have not been observed. As is seen from this description, *Chl. squarrosa* shows sufficient morphological differences from other representatives of the genus to be treated as a separate species. Resembling *Chl. stellata* as to the number of the cells in the coenobium, it approaches, in the elongated form of the cells, to *Chl. incurva* and PLAYFAIR'S "Spondy-lomorum quaternarium var. rostrata", among which it may be the extreme in this respect. As to the differences from *Chl. incurva*, to which Chl. squarrosa is the nearest, they were pointed out in the preceding.

It may probably be here at right time and place to say some words of the validity of *Chl. incurva* as a representative of the Spondylomoraceae. The fact is that in his paper on the Volvocales SCHULZE made the review of the Spondylomoraceae, including into this family only Spondylomorum quaternarium ST. (SCHILLER'S work

on Sp. caudatum has issued somewhat later), and four species of Chlamydobotrys: gracilis, stellata, Korschikowii, and rostrata (Spondylomorum quaternarium var. rostratum PLAYFAIR). As to Pyrobotrys incurva ARN., SCHULZE is inclined to refer it to the Protococcales, emphasizing its habitual likeness with *Burkillia cornuta* W.&G.S. WEST.

Of course, this misunderstanding is largely due to ARNOLDI's actually rather superficial description of his *Pyrobotrys*, up to any clear indications of the cilia being absent. The figures of *Pyrobotrys*, made (not by ARNOLDI himself!) with no details from the glycerine preparations, and very roughly reproduced, show really a certain resemblance with still more schematical figures of *Burkillia*. There is no doubt, however, that the cilia, though neither described nor figured by ARNOLDI, do exist in *Pyrobotrys incurva*, since it was ob-served to swim independently. It must be mentioned, that the cilia in the Spondylomoraceae are very thin and unresistent, readily falling off by fixation. This was just the case with *Chl. squarrosa*, whose coenobia had mostly to be drawn without cilia. Also in PASCHER'S "Süßwasserflora", Vol. IV Volvocales, no mention is made of *Pyrobotrys incurva*, though possibly for another

reason.

With this view, the key for determining the species of *Chlamydo-*botrys, offered by SCHULZE, appears insufficient, the more so that now one more representative of the genus is added. Therefore, from my part I give the following key, that is in accordance with the actual stand of things.

1.	Mature cells distinctly caudate	2
	Mature cells rounded, ovoid or ellipsoidal	4
2.	Cell-ends curved backwards	3
	Cell-ends spreading, straight. Chl. squarrosa.	
3.	Coenobia elongated, typically of 16 cells with stigmata	
	Chl. incurva.	
	Coenobia rounded, of no more than 8 cells without stigmata	
	Chl. rostrata.	
4.	Coenobia no more than eight-celled	5
	Coenobia typically of 16 cells Chl. gracilis.	
5.	Cells ellipsoidal, slightly ovoid, with conspicuous papilla and	
	stigma Chl. Korschikowii.	
	Cells conversely ovoide, or pear-chaped, narrowed behind, in	
	youth slightly caudate and curved Chl. stellata.	
	The diagnoses of the four latter species being brought togeth	\mathbf{er}
in	SCHULZE's work, only those of the first two may here be give	n.
	16*	

Chlamydobotrys squarrosa sp. n.: Coenobia of eight cells disposed in four tiers, each of two opposed cells. First four cells arranged cross-wise, the others alternating with them. Cells crop-wise inflated anteriorily, on the sides turned to the axis of the coenobium, and anteriorily, on the sides turned to the axis of the coenobium, and slightly compressed on the lateral sides, produced behind into long, straight, pointed, or slightly blunted outgrowths, spreading at various, from 45° to 90°, angles to the axis of the coenobium. Cell wall thin, with a small wart-like papilla. Cilia two, a little longer, than the cell. Chromatophor cup-shaped, entire, with strongly thickened base, without pyrenoid; stigma flat, irregulary elliptical, at the an-terior half of the cell. Nucleus is placed anteriorily, under two contractile vacuoles. Dimensions: coenobia to 40 μ long, cells to 30 μ long. Development unknown. Found in Kharkow district in $30 \ \mu$ long. Development unknown. Found in Kharkow district, in a small pond.

Chlamydobotrys incurva (ARN.) KORSHIKOFF, comb. n. (cited from ARNOLDI'S paper 1): "Cellulis 8—16, seriatim dispositis, incurvatis, apicibus subrotundatis, partibus basalibus inter se conjunctis (bici-liatis?), chlorophoro parietali, pyrenoido destituto, stigmate singulo vel stigmatibus binis, nucleo in parte basali disposito, propagatione asexuali per divisionem cellularum in membrana maternali, sexuali isogametis (?) biciliatis, zygotis earumque germinatione ignotis; cellu-larum longitudo $12-28 \mu$; latitudo $6-12 \mu$; gametis $-6 \times 8 \mu$. Habitat in sinibus flumen Donez in provincia Charkov, Rossicae meridionalis."

Meridionalis." Pyrobotrys incurva ARN. is here included into the genus Chla-mydobotrys recently established by me, for reasons referred to in my russian paper on this subject (2). They are as follows. As is seen from ARNOLDI'S diagnosis, the organism is too super-ficially described, with respect to its morphology, that other forms might be grouped about it as a type. It is only the small biciliate cells produced by Pyrobotrys and supposed to be gametes, that permit to conjecture about the number of the cilia in Pyrobotrys. Further, the point of insertion of the cilia is also a matter of con-icatures, by analogy with other forms described later. It may have jectures, by analogy with other forms described later. It may be mentioned, however, that in the colonial Volvocales the condition is also not impossible of the cilia being attached to the free ends of the cells (*Raciborskiella* WISLOUCH). Ultimately, ARNOLDI has given no generic diagnosis, but only the specific one. Judging from the generic name of "*Pyrobotrys*" given by ARNOLDI in allusion to the form of the cells of the organism in question, one may conclude that ARNOLDI considered this character to be of generic value.

Pascheriella tetras n. gen. et sp., and Chlamydobotrys squarrosa n. sp. 237

Now however we see that no more than specific significance may be attached to this feature.

The same relates to the SCHKORBATOW'S genus "Chlamydosphaera", the name being due to the spherical form of the colony. This feature, again, cannot be taken for a generic characteristic; otherwise, be ARNOLDI and SCHKORBATOW right, all the species of *Chlamydobotris* had to be ranked as separate genera.

On the other hand, it would be incoherent to speak of "Chlamydosphaera squarrosa", or to place into the genus "Pyrobotrys" the organism with almost elliptical cells, as Chlamydobotrys stellata. But, this ought to be done, if the law of priority were kept in the establishing of the generic name for the whole group of forms.

It is for these reasons, that I have created a new name: *Chlamydobotrys*, to be applied to all the above mentioned forms treated by me as species of a single larger genus.

Bibliography.

- 1) Arnoldi, W. M.: Ein neuer Organismus aus der Volvocaceenordnung Pyrobotrys incurva. Jubiläumsband zu Ehren TIMIRIAZEFF's, Moskau 1914.
- 2) DANGEARD, P. A.: Memoire sur les Chlamydomonadinées. Le Botaniste 2 ser. 1898.
- BARTMANN, M.: Autogamie bei Protisten. Arch. f. Protistenk. 1909.
- 4) KORSCHIKOW, A. A.: Über zwei neue Organismen aus der Gruppe der Volvocales. Arch. Russes de Protistol. Vol. 2 1923.
- 5) —: Zur Morphologie und Systematik der Volvocales. Ibid. Vol. 3 1924.
- 6) PASCHER, A.: Die Süßwasserflora Deutschlands usw. Heft 4: Volvocales. 1926.
- 7) -: Neue oder wenig bekannte Protisten. XVIII. Arch. f. Protistenk. Bd. 52 1925.
- 8) -: Neue oder wenig bekannte Protisten. XIX. Ibid. Bd. 58 Heft 3 1927.
- 9) SCHEWIAKOFF, W.: Über die geographische Verbreitung der Süßwasserprotozoen. Mém. de l'Ac. Imp. des sc. de Pétersbourg 7 sér. Vol. 41 1893.
- 10) SCHILLER, J.: Über Bau und Entwicklung der neuen volvocalen Gattung Chloroceras. Österr. bot. Zeitschr. 1927.
- 11) —: Über Spondylomorum caudatum, seine Fortpflanzung und Lebensweise. Jahrb. f. wiss. Bot. Vol. 66 1927.
- 12) SCHKORBATOW, L. A.: De novo organismo "Chlamydosphaera Korschikowi" Schkorb. Notulae system. ex Inst. Kryptog. Horti Bot. Petropolitani Vol. 2 1923.
- 13) —: Über einen neuen Organismus aus der Gruppe der Volvocales "Chlamydosphaera Korschikowi". Arch. f. Hydrobiol. Bd. 17 1926.
- 14) SCHREIBER: Zur Kenntnis der Physiologie und Sexualität höherer Volvocales. Zeitschr. f. Bot. 1925.
- 15) SCHULZE, B.: Zur Kenntnis einiger Volvocales. Arch. f. Protistenk. 1927.

Explanation of plate.

Plate 9.

All the figures are made by use of ABBE camera-lucida from living (*Pascheriella tetras*) or fixed (*Chiamydobotrys squarrosa*) objects, and reduced by reproduction to 5,6 orig. The same concerns all the figures in text.

Figs. 1—6. Pascheriella tetras mihi. \times 1500.

Figs. 1-2. Two almost mature coenobia from the side.

Fig. 3. Coenobium viewed from the pole.

Fig. 4 Initial stage of division.

Fig. 5. Two cells of the coenobium in copulation, with the third one still attached to one of them.

Fig. 6. Copulation of the anterior cells of the coenobium, in the pole view. Posterior cells still joined.

Figs. 7—12. Ch/amydobotrys squarrosa mihi. Coenobia of different age. In all the figures, except in Fig. 8, cilia are not shown, as well as contrictile vacuoles, unseen in fixed cells. $\times 1000$.



Korshikov.

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