(Contribution from the Zoological Laboratory of the Johns Hopkins University.)

Concerning the scientific name of the common large amoeba, usually designated *Amoeba proteus* (Leidy).

By

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(With plates 1—3.)

Stiles (1905) maintains that according to the Rules of Zoological Nomenclature the scientific name of the common large amoeba, usually called *Amoeba proteus* (Leidy), should be *Chaos chaos*. Schaeffer (1926) agrees with Stiles in reference to the generic name but he contends that the specific name of this animal should be *diffluens* in place of *chaos* [1]).

In support of these contentions they present the following evidence: In 1755 Rösel von Rosenhoff described and figured an amoeboid form which he called „der kleine Proteus". Linnaeus in 1758 gave this organism the name *Volvox chaos*, but in 1767 he changed it to *Chaos protheus*. Stiles assumes that the amoeboid organism studied by Rösel is generically and specifically like *Amoeba proteus* (Leidy, 1879) [2]), and he asserts that since Linnaeus called this organism *Volvox chaos* and *Chaos protheus* before it was called *Amoeba proteus*, the two former names have priority and consequently should, according to the Rules of Zoological Nomenclature, prevail. He contends that since *Volvox* had previously been

[1]) We are indebted to Dr. C. W. Stiles, Prof. M. M. Metcalf, and Prof. A. A. Schaeffer for valuable criticism of the manuscript of this paper.

[2]) By *Amoeba proteus* (L.) we mean organisms like those described and figured by Leidy (1879) under this name.

used as a generic name for another organism, i. e. the organism now known as *Volvox*, and *chaos* preceded *protheus* as a specific name for Rösel's „kleine Proteus", the name of Rösel's organism and *Amoeba proteus* (Leidy) should be *Chaos chaos.*

Schaeffer (1926) holds that Rösel's „kleine Proteus" is not specifically like *Amoeba proteus* (Leidy), but that it is like *Pelomyxa carolinensis* (Wilson, 1900) and, accepting the contentions of Stiles regarding priority, he concludes that the name of these organisms, not that of *Amoeba proteus* (Leidy), should be *Chaos chaos.* Obviously the validity of Stiles' conclusion depends upon whether Rösel's „kleine Proteus" was generically and specifically like *Amoeba proteus* (Leidy) and the validity of Schaeffer's conclusion upon whether it was generically like *Pelomyxa carolinensis* (Wilson). We shall present evidence in the following paragraphs which strongly indicate that it was neither generically nor specifically like either; that indeed it was not a rhizopod at all, but a myxomycete in the plasmodial stage.

1. Size: Rösel has 19 figures of his „kleine Proteus" one of which he asserts is natural size (Pl. 1 Fig. A). If this is true the specimen drawn was approximately 1,5 mm in diameter in spherical form. This is, as Schaeffer points out, much larger than *Amoeba proteus* (Leidy), but it is about the size of *Pelomyxa carolinensis* (Wilson) [1]). There are, however, also numerous myxomycetes which in certain stages of the plasmodial phase correspond to this in size. In size, therefore, Rösel's „kleine Proteus" resembles both plasmodia of myxomycetes and *Pelomyxa carolinensis* (W.) much more closely than it does *Amoeba proteus* (L.) [2]).

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[1]) Leidy (1879, p. 33) says: "it is not unfair to suppose that the figure is somewhat exaggerated". Schaeffer does not agree with this. He says (1926, p. 43): "Roesel is generally considered as having been a reliable investigator and a very capable draughtsman. His figures may therefore be credited with general accuracy". Pallas (1766) agrees with Schaeffer in certain respects. He says that his *Volvox proteus* (probably Rösel's „kleine Proteus") is nearly as large as *Volvox globator* and that this is "hardly larger than a grain of millet". Pallas consequently agrees with Schaeffer in the contention that Rösel's organism is much larger than *Amoeba proteus* (L.) but he evidently does not agree with him in the contention that Rösel's figures are accurate for if he did he certainly would not have compared the size of the organism figured by Rösel with that of a grain of millet which, as is well-known, varies greatly in size and is usually much larger than Rösel's organism if his figures are accurate.

[2]) Chalkley (1929) has probably made the most accurate measurements concerning the size of *Amoeba proteus* (L.) that have been made. His results show that the diameter of an average sized specimen in spherical form is approximately

2. Form: Rösel's figures indicate that „der kleine Proteus", in the rounded condition (Pl. 1 Fig. B), possessed a protuberance on the middle of the upper surface and that it at times stretched out in such a way that it consisted of two large portions connected with an elongated strand which sometimes broke, resulting in fission (Pl. 1 Fig. G). They also indicate that the pseudopods were at times branched and pointed (Pl. 1 Figs. O, P). These are characteristics which are very rarely if ever found in *Amoeba proteus* (L.) or *Pelomyxa carolinensis* (W.), but are frequently seen in plasmodia of myxomycetes, especially pseudopods which are pointed and branched [1]).

3. Structure: Rösel's figures and his description indicate that „der kleine Proteus" contained numerous very small hyaline granules „hellen und durchsichtigen Körnern". No large granules or vacuoles of any kind are represented or described [2]). In this respect „der kleine Proteus" does not resemble either *Amoeba proteus* (L.) or *Pelomyxa carolinensis* (W.), for both usually contain numerous large conspicuous food vacuoles, water vacuoles and granules of various sorts. That this obtains for *Amoeba proteus* (L.) is well known and Wilson says (p. 537): "In the Pelomyxas recognizable pieces of *Stentor* were commonly present and sometimes a whole Stentor still rotating", and he says he also found numerous hyaline vacuoles, many of which were 40 microns in diameter. The plasmodia of various myxomycetes usually contain no conspicuous granules or vacuoles and they resemble fairly closely the structure represented in Rösel's figures.

Rösel's figures indicate that „der kleine Proteus" had at the surface a fairly thick hyaline layer. In this respect it resembles

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0,134 mm and that the volume is approximately .0024 c. mm. According to Rösel's figures the volume of his organism was approximately 3,375 c. mm, that is, 1406 times as large as *Amoeba proteus* (L.) of average size. It is consequently probable that while Rösel's figures may have been somewhat exaggerated, it was not sufficiently exaggerated to warrant Leidy's conclusion that the organism Rösel studied was no larger than *Amoeba proteus* (L.).

[1]) It is difficult to understand how Schaeffer can hold that Rösel's figures are accurate and at the same time contend that the organism figured by Rösel is like *Pelomyxa carolinensis* (Wilson), for there is no evidence indicating that latter ever has pseudopods which even remotely resemble those represented in several of Rösel's figures (Pl. 1 Fig. N—P).

[2]) Schaeffer (1926 a, p. 104) says Rösel (1755) described crystals in his „kleine Proteus". We are unable to find anything in the nature of a description of crystals in Rösel's work.

the plasmodia of some myxomycetes and does not resemble either *Amoeba proteus* (L.) or *Pelomyxa carolinensis* (W.), for the hyaline surface layer in both is, except at the tip of actively extending pseudopods, very thin and inconspicuous. Referring to *Pelomyxa*, Wilson (p. 542) says the "clear peripheral (ectosarcal) region" was "very narrow, being conspicuous only at the ends of expanding pseudopodia". Rösel's figures and description further indicate that his „kleine Proteus" had no contractile vacuole. In this respect it resembles plasmodia of myxomycetes, but not *Amoeba proteus* (L.) and probably also not *Pelomyxa carolinensis* (W.), for, while Wilson says he did not observe a contractile vacuole, he admits that there were large hyaline vacuoles which seemed to disappear from time to time, and Kepner and Edwards (1917) who maintain that they made extensive observations on feeding in this form [1]), clearly figure a large vacuole which in every way resembles a contractile vacuole. There is nothing in Rösel's drawings or descriptions indicating that he saw a nucleus or nuclei. Nothing definite can be said therefore concerning the similarity between „der kleine Proteus" and other forms in this respect. However, it may be said that since Rösel saw and figured the nucleus in a bell animalcule he probably would have seen the nucleus in his „kleine Proteus" if it had been like that in *Amoeba proteus* (L.). Concerning structure as a whole Rösel's „Proteus" then clearly resembles plasmodia of myxomycetes more closely than either *Amoeba proteus* (L.) or *Pelomyxa carolinensis* (W.).

4. Color: Rösel tinted his figures light yellow, indicating that this was the color of his „kleine Proteus". It is well known that the plasmodia of many myxomycetes are yellow but there is no indication that either *Amoeba proteus* (L.) or *Pelomyxa carolinensis* (W.) is yellow, unless it contains colored food vacuoles. Rösel's descriptions and figures do not, however, indicate that the organism he studied had food vacuoles. It is therefore obvious that the color of Rösel's „kleine Proteus" was not due to the presence of food vacuoles. In color his organism consequently resembles myxomycetes much more closely than it does *Amoeba proteus* (L.) or *Pelomyxa carolinensis* (W.).

5. Habitat: Rösel says that he found „der kleine Proteus" in water in which *Volvox* was found: („Ich habe selbiges in eben

[1]) The organisms studied by Kepner and Edwards (1917) were much smaller than those described by Wilson. Schaeffer (1926) however, agrees with Kepner and Edwards in their contention that the organism they had is generically and specifically the same as the one Wilson had.

dem Wasser, wo ich das Kugelthier [*Volxox*] gefunden, in ziemlicher Menge entdecket") and that the water was taken from a quiet pool in which he frequently collected *Hydra*. He evidently took water from this pool to his room and put it into glass dishes, probably ordinary drinking glasses, for he says that he found his „Proteus" on the sides of the glass. „Es hielte sich an der Seitenfläche des Glases auf." Schaeffer (1926, p. 42), referring to „der kleine Proteus" says: "The amebas were found in considerable numbers moving around on the sides of the glass in which Rösel discovered *Volvox*".

The senior author has made a great many observations on the habitat of *Volvox* extending over 25 years and over a large and varied territory. In these observations he found that the water in which *Volvox* became abundant was always fairly clear, and that it contained but little organic substance, and but few bacteria and protozoa. He never found *Volvox* in water that was favorable for the growth of *Chilomonas* and ciliate infusoria, e. g., *Colpidium*, *Paramecium* and *Stentor*. Now, it is well-known that *Amoeba proteus* (L.) will not thrive in solutions that are unfavorable for the growth of bacteria, *Chilomonas*, *Colpidium* and the like; and judging from Wilson's statements the same is true for *Pelomyxa carolinensis* (W.). Wilson says he found this organism in abundance in a tub into which he had put sand 4 inches deep, a little mud, "a good handful of *Nitella*, two or three opened mussels and a crayfish, cut into a couple of pieces" and well-water enough to fill it. He asserts that when *Pelomyxa* was found, *Tubifex* and *Stentor coeruleus* were abundant, the latter in the mud and sand on the bottom of the tub and the former in the debris and growth on the sides of the tub. It is well known that *Tubifex* and *Stentor coeruleus* thrive in water that contains much organic material and numerous bacteria and infusoria, and since they were abundant when *Pelomyxa carolinensis* was abundant, it is evident that the latter also thrives in water that contains much organic material, and numerous bacteria and infusoria. Kepner confirmed this contention. He (1930) says in a personal communication that he found *Pelomyxa carolinensis* (W.) "in abundance in the sediment of a stream 25 yards below the outlet of a sewer pipe", i. e., in water that contained a great deal of organic material in solution. This solution doubtless contained numerous bacteria, colpidia, paramecia and other similar organisms that served as food. In fact when Kepner and Edwards made observations on this organism in the

laboratory, it was feeding freely on *Chilomonas*, *Colpidium* and *Paramecium*. Moreover, the hydrogen-ion concentration of solutions most favorable for the growth of *Amoeba proteus* (L.) and probably also *Pelomyxa carolinensis* (W.) is around p_H 6,6, while that most favorable for the growth of *Volvox* is according to Uspenski and Uspenskaja (1925) around p_H 7,6. Evidently then solutions which are favorable for *Amoeba proteus* (L.) and *Pelomyxa carolinensis* (W.) are not favorable for *Volvox*. If this is true it is obvious that Rösel's organism, which apparently thrived in a solution which was favorable for *Volvox*, must have been radically different from either *Amoeba proteus* (L.) or *Pelomyxa carolinensis* (W.).

Plasmodia of aquatic myxomycetes live in fairly clear water which is definitely alkaline, and they do not require bacteria, infusoria or other organisms for food. This is clearly indicated by the results of observations made by Ward and by the junior author. Ward (1884) describes and figures a myxomycete which he found on the roots of hyacinth bulbs, growing in Sachs solution. Some of the plasmodia of this organism, judging from Ward's description and figures, resembled fairly closely Rösel's organism in form, size, structure and habitat. He says (p. 83) referring to a plasmodium which was "more than a millimeter in length": "Its changing outlines were very irregular: short and long pseudopodia would be put forth together or separately, and withdrawn or extended, the fine granules (as well as fewer larger ones and nuclei) flowing quickly down the central portion. The general hue was a pale dirty yellow, the very clear ectoplasm being colourless, in thin parts at any rate". He says nothing about the organic content of the water in which the myxomycete was found but it is well known that water in which hyacinths grow is ordinarily poor in organic material and infusoria and is not favorable for the growth of amoebae.

The junior author made extensive observations on a myxomycete, probably *Didymium squamulosum* (Macbride, 1922), that frequently appears in cultures containing timothy hay. He found that bacteria and *Colpidium* and other ciliates became fairly abundant in a few days after the hay was added, and then gradually decreased until at the end of about 12 days there were but very few present; that flagellated swarm cells of this myxomycete then appeared and sometimes became so abundant that they almost completely covered the bottom of the finger bowls containing the solution; that after a few days these cells lost their

flagella and began to fuse, forming amoeboid plasmodia which varied greatly in size and often appeared strikingly like amoebae, that after a time many of these plasmodia collected on the side walls of the finger bowls and that some of these produced sporangia under the water and others above the water. He found, moreover, that the solution was invariably distinctly alkaline when the myxomycete developed and that there were no amoebae and but very few infusoria. The habitat of Rösel's organism was therefore much more nearly like that of the plasmodia of at least some myxomycetes than that of *Amoeba proteus* (L.) or *Pelomyxa carolinensis* (W.).

6. Behavior: Rösel says he found his „kleine Proteus" only on the sides of the glasses, not on the bottom. The junior author in observations on the myxomycete *Didymium*, found that, whereas the plasmodia for some time after they began to form, remained on the bottom of the dishes containing the hay infusion in which they developed, they invariably, after reaching a certain size, crept up the sides of the dishes. In hundreds of cultures of *Amoeba proteus* (L.) we have on the contrary, never seen any indication of a tendency to aggregate on the sides of the dishes. Wilson (1900) says *Pelomyxa carolinensis* (W.) was found on the sides of the tub, but the sides of this tub were well covered with debris and growth of various kinds, including *Stentor* on which they fed. „Der kleine Proteus" is then, in respect to the behavior resulting in aggregation on the sides of the dish, more nearly like plasmodia of myxomycetes than like *Amoeba proteus* (L.) or *Pelomyxa carolinensis* (W.).

7. Distribution: Schaeffer (1926, p. 44) says that *Pelomyxa carolinensis* (W.) has never been reported from Europe. Myxomycetes are, however, as is well known, abundant in various parts of Europe. These facts therefore favor the contention that Rösel's organism was a myxomycete in the plasmodial stage rather than *Pelomyxa carolinensis* (W.).

Taken as a whole the evidence presented in the preceding paragraphs indicates that Rösel's „kleine Proteus" resembles plasmodia of myxomycetes in certain phases much more closely than it does *Amoeba proteus* (L.), in size, form, structure, color, habitat and behavior, and that it resembles these plasmodia much more closely than it does *Pelomyxa carolinensis* (W.) in form, structure, color, habitat, behavior and distribution.

We do not claim that we have unequivocally demonstrated that Rösel's „kleine Proteus" was a myxomycete. All we claim is

that the characters of this organism, so far as they are known, are more nearly in accord with those of plasmodia of myxomycetes than they are with those of rhizopods.

That it is impossible to be certain as to details regarding RÖSEL's organism is clearly indicated by the fact that SCHAEFFER contends it is *Pelomyxa carolinensis* (W.) and LEIDY, STILES and others contend that it is *Amoeba proteus* (L.), two organisms which differ radically both in size and in structure; that Prof. MACBRIDE (personal communication) says: "I believe that the artist (RÖSEL) probably was watching what LEIDY calls *Biomyxa vagans*"; and that Prof. WESTON (personal communication) says: "My own reaction is that ROSENHOF's organism may well have been the plasmodium of a Myxomycete temporarily occupying an aquatic habitat like that discussed by MARSHALL WARD in his paper."

It is moreover not always a simple matter to differentiate rhizopods from plasmodia of myxomycetes even by highly trained observers with active specimens before them, as is clearly indicated by the following statements:

DE BARY (1864, p. 87) says: „Bei den auf faules Holz, Lohe usw. gemachten Aussaaten traten zwischen den cilienlosen Schwärmern nach einiger Zeit größere amöbenartig bewegliche Körper auf, welche oft von EHRENBERG's und DUJARDIN's *Amoeba radiosa, verrucosa, diffluens* nicht oder kaum unterscheidbar waren"; and CIENKOWSKI (1876, p. 16) says: „Außer den echten Amöben giebt es noch viele Monern und nackte Rhizopoden, die durch ihre Beschaffenheit, Bewegungsart, so lebhaft an Myxomycetenplasmodien erinnern, daß sie den Zweifel erwecken, ob sie denn wirklich als selbständige Wesen zu betrachten seien und nicht vielmehr nur abgerissene herumirrende Plasmodienstücke vorstellen."

In view of these statements one would hardly expect to be able to ascertain with certainty whether RÖSEL's „Proteus" is a myxomycete or a rhizopod. The evidence presented above shows conclusively, however, that its characteristics so far as they are known resemble those of myxomycetes more closely than those of rhizopods. Obviously then if the name given to RÖSEL's organism is to be used at all it must be used in reference to myxomycetes. What then is the correct scientific name of the common large amoeba usually called *Amoeba proteus* (LEIDY)?

LEIDY (1879, p. 30) gives the following synonyms for *Amoeba proteus* (LEIDY):

Der kleine Proteus	Rösel, 1755
Volvox Chaos	Linnaeus, 1760
Volvox Proteus	Pallas, 1766
Chaos Protheus	Linnaeus, 1767
Proteus diffluens	Müller, 1786
Vibrio Proteus	Gmeling, 1788
Amiba Roesili	Bory, 1824
Amibi divergens	Bory, 1822
Amibi Mülleri	Bory, 1824
Amoeba princeps	Ehrenberg, 1831
Amiba princeps	Dujardin, 1841
Amoeba ramosa	Fementrol
Amoeba communis	Duncan, 1877
Amoeba chaos	Leidy, 1878
Amoeba proteus	Leidy, 1878.

Schaeffer (1916) and Stiles (1905) give essentially the same lists. Schaeffer, however, later (1926) as stated above, contends that „der kleine Proteus" is synonymous with *Pelomyxa carolinensis* (W.) not with *Amoeba proteus* (L.), and Stiles (1923) contends that *diffluens* probably is not synonymous with *chaos*. Referring now to this list of names in the order presented we find the following:

Linnaeus and Pallas merely re-named the organism described by Rösel. There is no indication that they made any observations on the organism. The names, „der kleine Proteus", *Volvox Chaos*, *Volvox Proteus* and *Chaos Protheus* are therefore absolute synonyms. The last three names are the first applied to this organism under the binomial system. The earliest one of them that is available is therefore, according to the Rules of Zoological Nomenclature, the correct name of Rösel's „Proteus", but it is by no means a simple matter to ascertain which of these names is the earliest available one.

Everyone agrees that *Volvox Chaos* was used first. But Stiles, Schaeffer and others contend that while *chaos* in available as a specific name for Rösel's „Proteus", *Volvox* had been used earlier as the generic name of the organism now consistently known by that name, and is therefore not available as a generic name for this organism. They consequently conclude that *Chaos chaos* is the correct name for it. This conclusion appears to be valid, however, only if Rösel's „Proteus" and *Volvox* belong to the same kingdom, i. e. if both are either plants or animals. If *Volvox* is a plant as many contend and Rösel's „Proteus" is an animal as Leidy, Stiles, Schaeffer and many others hold, it seems to us that the correct

name of Rösel's „Proteus" is *Volvox Chaos*, for there does not appear to be anything either in the Rules of Zoological Nomenclature or in the Rules of Botanical Nomenclature which forbids the use of the same generic name for two genera if one is a plant and the other is an animal.

We hold that Rösel's „Proteus" is a myxomycete. If this is true, and if myxomycetes are plants and *Volvox* is also a plant, then the correct name of Rösel's „Proteus" is *Chaos chaos*. There are, however, many who contend that myxomycetes are animals. The facts presented consequently seem to demonstrate that it is impossible definitely to ascertain what, in accord with the Rules of Nomenclature, is the correct name of Rösel's „Proteus".

Müller (1786) clearly made original observations on the organism he designated *Proteus diffluens*. He presents 12 sketches all apparently of the same individual. These figures indicate that the organism observed changed greatly in form, that it had fairly long, blunt pseudopods, and that it was somewhat granular in structure. He describes it as follows: "A most curious little animal, a pure mucous, gray mass filled with large globules and lesser blackish ones, that can change form in a short time. It is really translucent gelatinous material without any fixed order at any part of its margin; it flows off into one or more little branches, differing in length or direction, after which the globules soon turn toward a different part of the body; this dilates, then throws off shoots from its margin with the globules immediately following, making a new form of the little creature . . . It is many times smaller than Roeselii („der kleine Proteus"), absolutely invisible to the naked eye, possibly a young Roeselii, i. e. a „kleine Proteus", junior. It is very rare, for only once or twice in very many investigations of infusoria has it come before me".

Bory (1822), Ehrenberg (1838), Leidy (1879), Stiles (1905), Schaeffer (1916) and others hold that Müller's organism is specifically like Rösel's „Proteus". Dujardin (1841) does not agree with this and Bory (1822), Schaeffer (1926) and Stiles (1923) later also changed their views. Schaeffer now contending that it is like *Amoeba proteus* (Leidy) and Stiles that it is a new species.

According to Müller's figures (Pl. 2 Figs. 1—12) and description his *diffluens* has only two kinds of globules, no nucleus, no contractile vacuole, no crystals, and it is entirely invisible to the naked eye. We do not understand how, therefore, it can be maintained that this organism is like either Leidy's *proteus* or Rösel's „Proteus",

for judging from the facts presented by Müller, it certainly is very much smaller than the latter and it certainly differs greatly in structure from the former.

The fact of the matter is that Müller's description is so meager in details that no agreement can ever be reached concerning the species of the organism described and probably not even concerning the genus. The same may be said in reference to the description of Gmeling, Bory, Dujardin and Fromentel.

Ehrenberg (1838) presents three well-executed figure of a specimen of the organism which Leidy says is specifically like *Amoeba proteus* (L.). These figures show that this specimen changed greatly in form and that it had long pseudopods which were clear and blund at the distal end, several large foods vacuoles, some green, others brownish, a considerable number of smaller rounded bodies or vacuoles, and innumerable very small vacuoles, about 2 microns in diameter, densely scattered through the entire organism (Pl. 3 Figs. X 1, 2, 3). And he says the specimen studied varied from $^1/_6$ to $^1/_{12}$ line (.176 to .352 mm) in diameter, probably in rounded form, although this is not definitely stated.

Ehrenberg described the organism studied as a new species and named it *Amoeba princeps* Duncan (1811), Leidy (1879), Stiles (1905), Schaeffer (1916) and others hold that it is specifically like *Amoeba proteus* (L.).

Ehrenberg's description indicates that the organism he had was somewhat similar to *Amoeba proteus* (L.) in reference to size, form and certain structural characteristics. It probably therefore can be considered as generically like *Amoeba proteus* (L.). But he gives no information concerning nuclei, contractile vacuoles, crystals or surface characteristics; and in the absence of information concerning these it is, in our opinion, impossible to be at all certain that the organism described by him should be considered specifically like the one described by Leidy. If this is true, Ehrenberg's generic name has priority over Leidy's in reference to the organism described by Leidy, but his specific name does not.

Duncan (1877) described and figured (Pl. 2 Figs. 1—7) an organism which he held to be specifically like *Amoeba princeps* (Ehrenberg) but which he says „ought to be called *Amoeba communis*, as it is plebeian to the regal *Villosa*". He maintains that there are only two species of *Amoeba*, one with a fibrous tuft at the posterior end and one without such a tuft. On the basis of this criterion *Amoeba proteus* (L.) is specifically like *Amoeba communis* (D.).

Leidy (1879), Stiles (1905) and Schaeffer (1916) also hold that they are the same, but presumably for other reasons.

Whatever the justification for this conclusion may be, it must be conceded that the organisms described by Duncan differed radically from *Amoeba proteus* (L.) in at least two very important respects: (1) His figures and descriptions show that the nucleus was nearly spherical, that it consisted of a central granular mass surrounded by a hyaline layer and that the central mass often contained a prominent "nucleolus". The nucleus of *Amoeba proteus* (L.), as is well known, is disc shaped, usually biconcave, contains a granular surface layer and no nucleolus (Pl. 2 Fig. 6). (2) There is nothing in Duncan's figures and descriptions which indicates that his organisms had crystals of any kind. *Amoeba proteus* (L.) on the contrary always contains numerous prominent crystals. In view of these profound differences it seems to us that while Duncan's *Amoeba communis* can probably be considered generically the same as Leidy's *Amoeba proteus*, it must be considered specifically distinct.

The evidence presented indicates that „der kleine Proteus" (Rösel) is a myxomycete, i. e. a plant and that the name of this organism is consequently not involved in the application of the priority rule to animals [1]). This evidence indicates that *Proteus diffluens* (Müller) is probably a rhizopod but that the description of this organism is not sufficiently extensive and precise to make specific or generic identification possible. It indicates, moreover, that this obtains for the descriptions of all the different organisms listed as being like *Amoeba proteus* (Leidy) except *Amoeba communis* (Duncan) and possibly *Amoeba princeps* (Ehrenberg). Since it is impossible to identify any of these organisms, except the two mentioned, in reference to species or genus, their names, no matter what they are or how or when or where they were obtained do not belong to any organisms and therefore cannot be involved in the application of the priority rule to Leidy's *Amoeba proteus*, or to any other organism. The evidence presented indicates, furthermore, that the description of *Amoeba princeps* (Ehrenberg) is inadequate for specific identification but that this form is probably generically the same as Leidy's *Amoeba proteus*. It also indicates that Duncan's *Amoeba*

[1]) Even if Rösel's "Proteus" were an animal its name could not be involved in the application of the priority rule, for the description is so inadequate that no agreement among investigators can be reached as to its species or genus.

communis is generically the same as Leidy's *proteus* but it clearly indicates that this form is specifically distinct from Leidy's although Duncan's description is probably not adequate to identify the species. As a matter of fact the only adequate specific description among those listed is Leidy's description of the organism which he designated *Amoeba proteus*. It is consequently obvious that in accord with the priority rule the name *Amoeba proteus* must be retained for the organism described by him under that name.

Schaeffer (1916) maintains that among rhizopods having the characteristics of *Amoeba proteus* (L.) he found three distinct types, and he contends that each of these three types retained in isolation cultures its distinguishing characteristics for a considerable number of generations. On the basis of these results he divided Leidy's *Amoeba proteus* into three species *Amoeba proteus*, *Amoeba discoides* and *Amoeba dubia*. Later (1926) he elevated these three species to three new genera, namely, *Chaos diffluens*, *Metachaos discoides* and *Polychaos dubia*.

For the attempt to create out of Leidy's *Amoeba proteus* three new genera we find no reason whatever, either logical or utilitarian. We have, however, in accord with Schaeffer's contention, found among amoebae which agree with the description of Leidy's *Amoeba proteus*, individuals which also agree with Schaeffer's description of *Amoeba proteus*, *Amoeba dubia* and *Amoeba discoides* respectively and we have found that if specimens which agree with *Amoeba proteus* (L.) and *Amoeba dubia* (S.) are cultured separately they retain for many generations, probably indefinitely, their differentiating characteristics, but we have not found that this obtains for *Amoeba discoides* (S). Dawson (1928) and others have obtained similar results. Schaeffer's division of *Amoeba proteus* (L.) into three species therefore receives no support from the results of these observations, but there is evidently considerable reason for the division into two species. In spite of this, it would, however, probably be more expedient, at least for the present, to retain Leidy's species and divide it into varieties as suggested by Carter (1919). At any rate there are many recognized varieties of various organisms with far greater differences than those found in the two or three types under consideration and equally permanent, if not more so. Jennings (1908), for example, found among specimens of *Paramaecium caudatum* eight different types, each with distinguishing characters which were apparently indefinitely permanent. Indeed, if all organisms that breed true, vegetatively, were considered to be species, there would

be endless numbers, for every individual that reproducts asexually breeds true in certain respects. The mere fact then that an organism retains for a number of generations differentiating characters does not appear to be sufficient reason for setting it off as a distinct species. What characters should, in the interest of all concerned, be considered in differentiating species has never been and probably never can be precisely determined, but from a utilitarian point of view it is obvious that the number of species created should be limited. Excessive splitting of recognized species so prevalent among some enthusiastic systematists should therefore be guarded against.

Similar reasons lead to the same conclusion regarding changing the names of organisms. The chief aim of the rules of nemenclature is to stabilize names and to eliminate duplicates, and changing names to a certain extent doubtless facilitates the attainment of this aim. To accomplish this it is, however, evident that there must be conclusive proof that proposed changes are in full accord with the rules, and even then it probably would often be expedient to set the rules aside and retain the old names. It certainly seems clear that before it is proposed to change a name there should be at hand, indicating that the proposed change is demanded by the rules, evidence which is far more conclusive than that presented by Stiles (1905) and Schaeffer (1926) in favor of the change in the name of *Amoeba proteus* (L.) to *Chaos chaos* or *Chaos diffluens* on the one hand and the change of the name of *Pelomyxa carolinensis* (W.) to *Chaos chaos* on the other.

This is especially true for *Amoeba proteus* (L.), a name that has for many years been very consistently applied in an extensive literature to organisms which are in accord with those described by Leidy under that name.

Summary.

1. In 1755 Rösel von Rosenhoff figured and described an amoeboid organism which he named „der kleine Proteus".

2. Stiles (1905) maintains that according to the Rules of Zoological Nomenclature the name of Rösel's "Proteus" should be *Chaos chaos*. He holds that Leidy's *Amoeba proteus* in specifically like Rösels's "Proteus" and that its name should therefore also be *Chaos chaos*.

3. Schaeffer (1926) agrees with Stiles in reference to the generic name of Leidy's *Amoeba proteus* but not in reference to the

specific name. He holds that Wilson's *Pelomyxa carolinensis* is specifically like Rösel's "Proteus" and that the name of this organism should be *Chaos chaos.*

4. We have presented evidence which indicates that Rösel's "Proteus" is neither generically nor specifically like either Leidy's *proteus* or Wilson's *carolinensis*, that is in fact a myxomycete, an organism usually classified as a plant, and that there is consequently no sound basis for the change of the names of these organisms to *Chaos chaos.*

5. The evidence presented indicates, moreover, that among the descriptions of the rhizopods considered to be like Leidy's *Amoeba proteus* none is sufficiently extensive and precise to identify the genus except that of *Amoeba communis* (Duncan) and possibly that of *Amoeba princeps* (Ehrenberg); that these two forms are probably generically the same as *Amoeba proteus* (Leidy), that *Amoeba communis* is specifically distinct but that Ehrenberg's description is too inadequate to identify the species, and that Leidy's description is the only one that is fully adequate for specific identification.

6. We conclude that according to the Rules of Zoological Nomenclature the name *Amoeba proteus* must be retained for the organism described by Leidy under that name.

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Explanation of Plates.

Plate 1—3.

Plate 1.

Photographic reproduction from Rösel von Rosenhoff (1755). Figs. A—W, drawings of an amoeboid form designated „der kleine Proteus". A, natural size; G, in process of fission. The granular portion of all these figures are light yellow in the original. Note that there are no large vacuoles represented, nothing that can be interpreted as representing food vacuoles, contractile vacuoles or nuclei.

Figs. 1—3, *Volvox*. 1, probably natural size. Note that if this is true, indicates that „der kleine Proteus" is considerably larger than *Volvox*.

Plate 2.

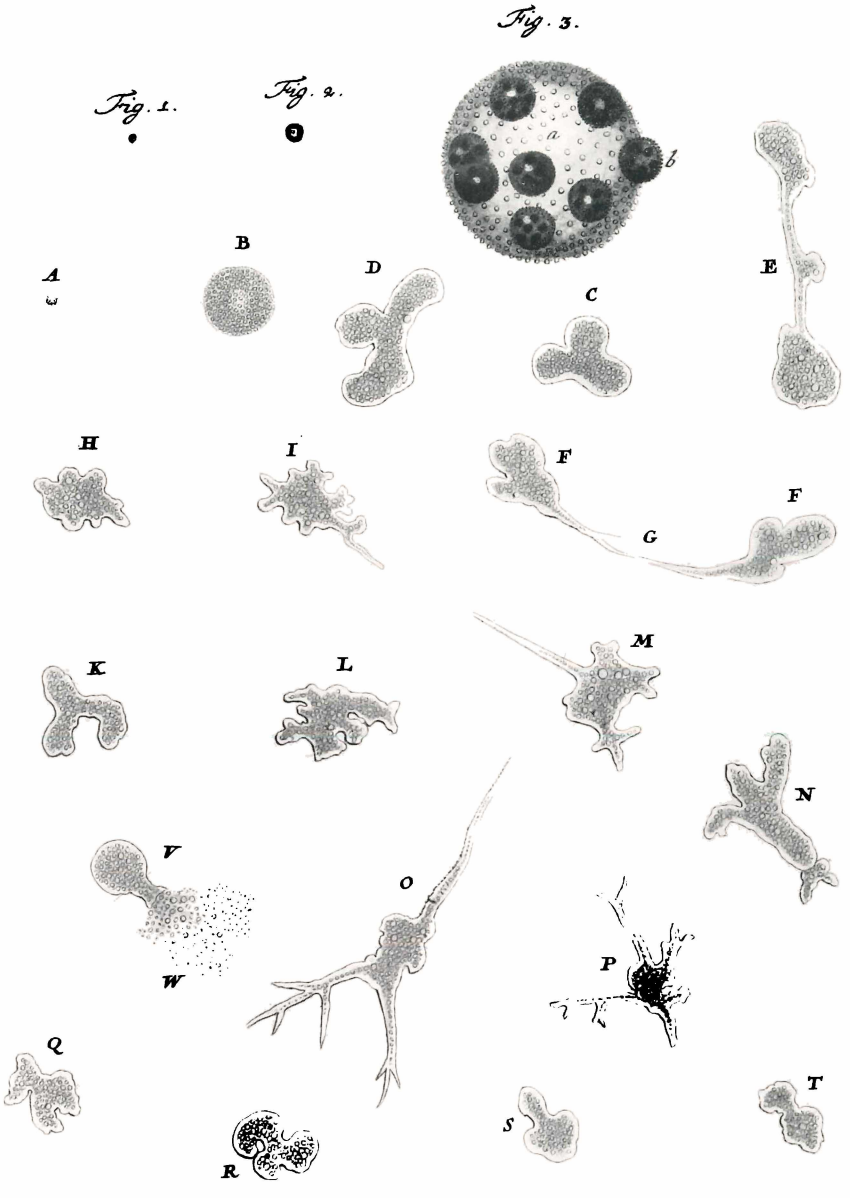
Upper portion, photographic reproduction from Müller (1786) Tab. II. Figs. 1—12, drawings probably of the same individual. Note absence of nucleus, contractile vacuole and food vacuoles.

Lower portion, photographic reproduction from Duncan (1877) Pl. 5. Figs. 1—7, *Amoeba communis*; b, nucleus; a, food vacuole; c, contractile vacuole. Fig. 6, nucleus. Note that the nucleus has a hyaline surface layer and a nucleolus and that no crystals are represented.

Plate 3.

Photographic reproduction from Ehrenberg (1838). Figs. X, 1, 2, 3 "*Amoeba princeps*"; XI, 1—4, "*Amoeba verrucosa*"; XIII, 3—7, „*Amoeba diffluens*"; XIII, 2—4, "*Amoeba radiosa*".

The three figures of "*Amoeba princeps*" are probably of the same individual. The dark masses represent food. Some of these are green in the original, others yellowish. Note that there is nothing in these figures which resembles contractile vacuoles or crystals, but that there are a number of ellipsoidal outlines which somewhat resemble outlines of nuclei.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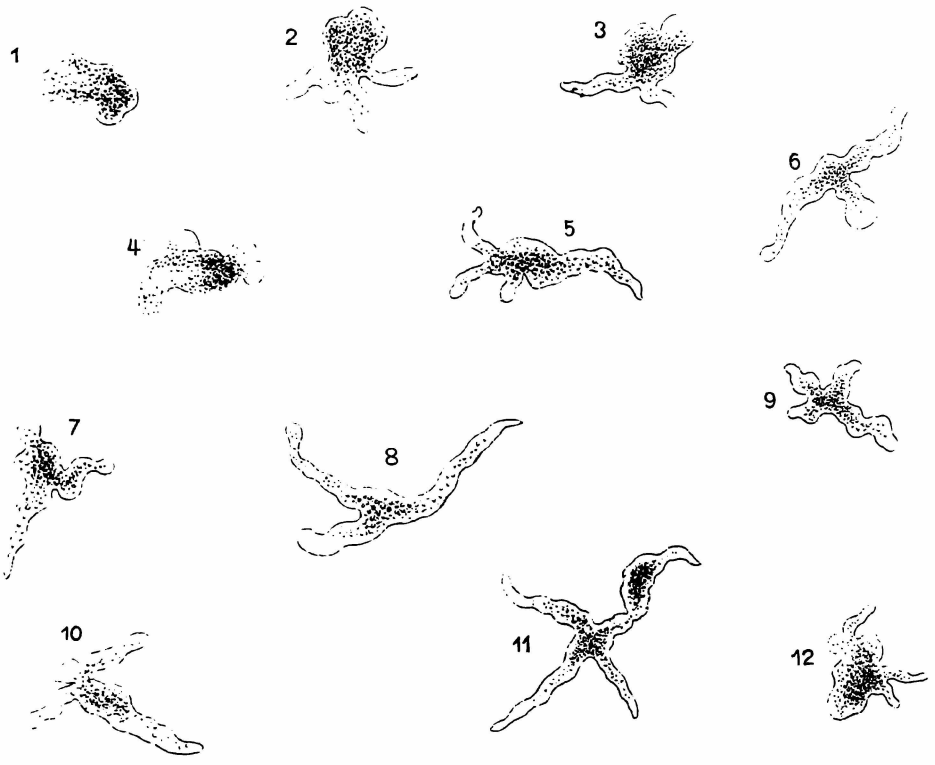

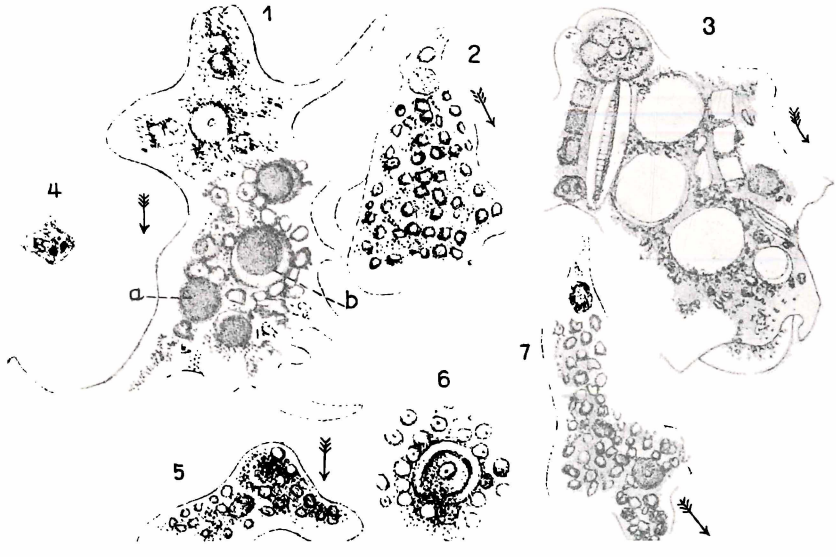

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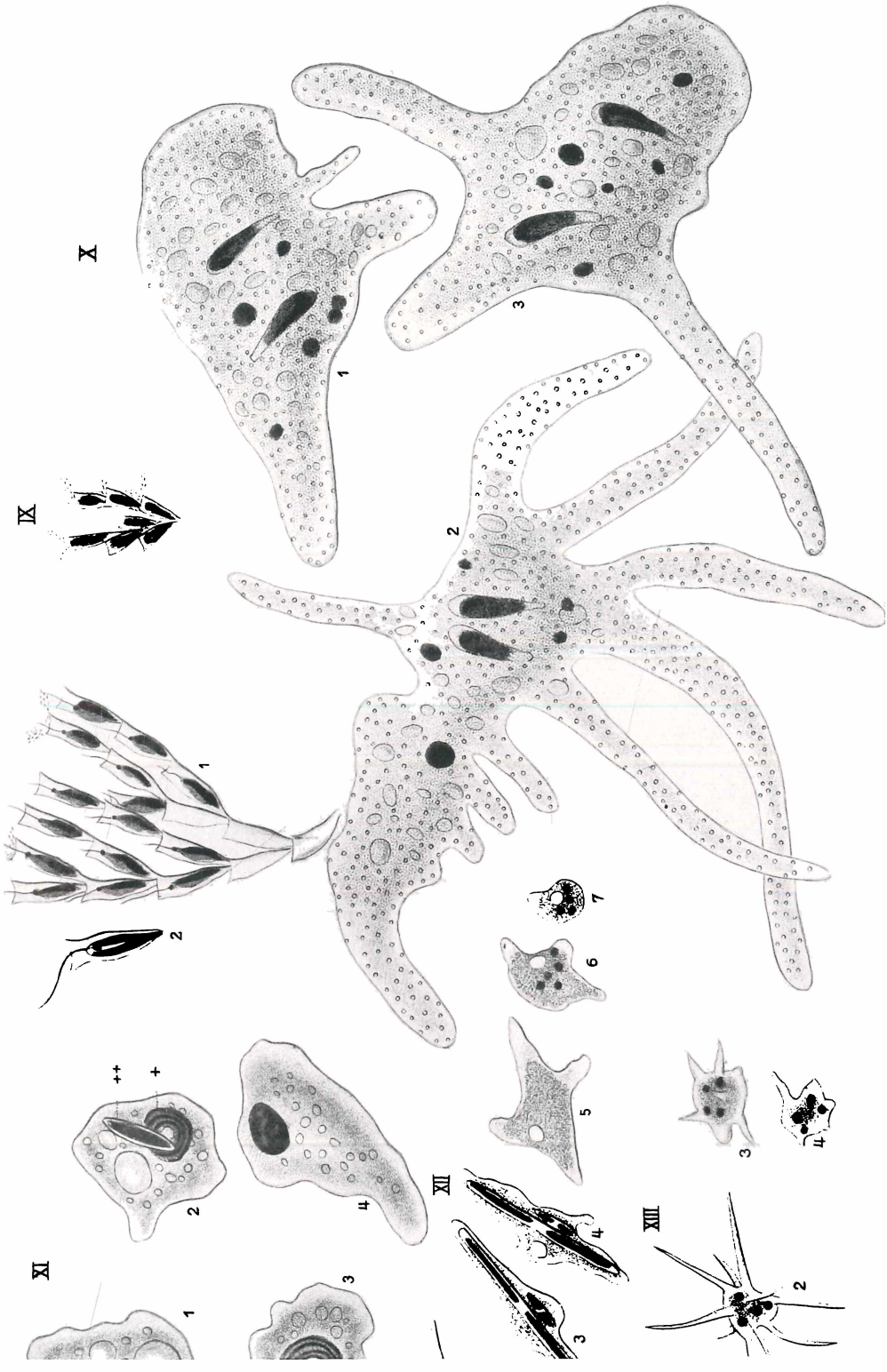
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