

# Zoologischer Anzeiger

herausgegeben

von Prof. **Eugen Korschelt** in Marburg.

Zugleich

Organ der Deutschen Zoologischen Gesellschaft.

Bibliographia zoologica

bearbeitet von Dr. **H. H. Field** (Concilium bibliographicum) in Zürich.

Verlag von Wilhelm Engelmann in Leipzig.

XXXVIII. Band.

21. November 1911.

Nr. 22 / 23.

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## I. Wissenschaftliche Mitteilungen.

### 1. On an unusual condition observed in *Halteridium*.

By H. M. Woodcock, D. Sc., Lister Institute of Preventive Medicine, London.  
(With 22 figures.)

eingeg. 5. September 1911.

In a chaffinch which was well infected with *Halteridium* (*Haemo-proteus*) *fringillae*, I have recently observed an interesting and peculiar condition of certain parasites. As this is the first occasion on which I have seen exactly this condition, notwithstanding a considerable amount of time and attention directed to the study of *Halteridium*, and as I am not aware of its having been noted by any one previously, I think it is worth a brief description.

In the first permanent preparations made<sup>1</sup> from the blood of this particular bird, many of the Halteridia, intermediate-sized forms as well as large ones, were found to have two nuclei. By this I do not mean merely that they show what I have previously described<sup>2</sup> as the binu-

<sup>1</sup> The smears were fixed with osmic acid vapour, then passed through absolute alcohol, and stained with Giemsa.

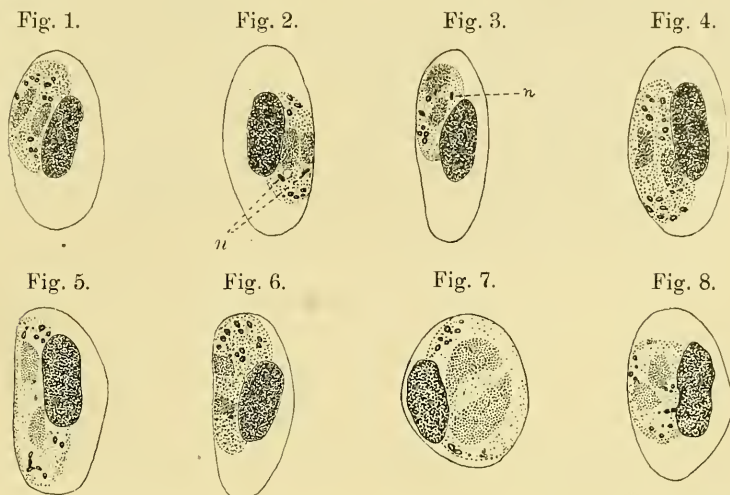
<sup>2</sup> Quart. Journ. Micr. Sci., 53, 1909. p. 339.

cleate condition, but that the large, principal nucleus is double (figs. 1—8). Several of these individuals show the small chromatic element in addition, and in such cases this also is usually double (figs. 2 and 3). The position of the two nuclei vis-à-vis of each other varies considerably, as will be seen from the figures. The line joining them may be approximately parallel either to the short or the long axis of the parasite, or it may run obliquely. In the intermediate-sized forms the body certainly appears single; so far as the cytoplasm is concerned there is not the least indication that two individuals are present. This is the case also in some of the larger parasites (figs. 4—7). Apart from the double character of the nucleus the parasites are typical Halteridia, both as regards general form and contour and the position in the corpuscle. In other large forms, however, the cytoplasm shows a distinct split, usually running more or less longitudinally through the middle of the body. This split is either incomplete (fig. 12) or practically complete (figs. 9, 10); in the latter case the appearance is presented of two individuals, each with a single nucleus, the two parasites lying parallel to each other on the same side of the blood-corpuscle, between the nucleus and the longer edge, i. e. in the customary position.

Parasites such as those described occur fairly frequently in the first preparations made. In the next smears prepared, however, five days subsequently, while Halteridia showing this condition are still present, they are much more infrequent — rather scarce, in fact. And in preparations made ten days later again, I have not observed any parasites with the double nucleus.

On first studying this condition, I thought the most likely explanation was that it represented different stages in the binary fission of a single individual. This seemed indicated by the fact that in the intermediate-sized forms, the body appears single, although possessing two nuclei, and only in the large examples is a splitting of the cytoplasm apparent. After prolonged examination of my slides, however, I have come to the conclusion that this cannot be the correct explanation in some cases, at any rate, for I have been able to find two or three parasites in which the double-nuclear condition is present, where one of the two nuclei is distinctly male in character and the other female; i. e., one is large and diffuse and stains bright red, the other small, compact and stains a darker red (figs. 11 and 12). Moreover, the cytoplasm in one part of the body, on the side of the female nucleus, may be denser and stain a somewhat deeper blue than that in the other half of the body, in which the male nucleus lies. The limit or periphery of the body of the parasite is quite even and regular and has the typical contour of an adult ordinary individual. Nevertheless, it is obvious that, in such cases, there

must be really two individuals present, namely gametocytes of opposite sex, which have undergone cytoplasmic union and simulate a single parasite.



Figs. 1—8. *Halteridium fringillae*, from a chaffinch, showing double-nuclear parasites. *n*, chromatic grain (small nuclear element); *p*, pigment.  $\times 2000$ .  
Figs. 2, 3 and 6. Female forms. Figs. 5, 7 and 8. Male forms; the others uncertain.



Figs. 9—14. *Halteridium fringillae*.

Figs. 9 and 10. Parasites showing a distinct split in the cytoplasm (*c. s.*).  
Figs. 11 and 12. Parasites in which one of the nuclei is male in character (*m. n.*), the other female (*f. n.*); in the former a distinction in the cytoplasm of the two halves is also apparent. Fig. 13. Adult female gametocyte. Fig. 14. Adult male gametocyte.

Hence it seems to me most probable that the same explanation holds throughout. Of course, where both nuclei are either of male (fig. 7) or else of female character (fig. 6), there is not the same ready means of settling the question as in the above instances. A point which in my opinion also weighs considerably in favour of the view that two individuals are concerned is this. Binary fission of adult or nearly adult sexually differentiated gametocytes (of either sex), to give rise to two intermediate-sized individuals is a phenomenon that has been hitherto quite unknown among Haemosporidia (with one exception, to be mentioned shortly); indeed, I am not aware of anything exactly comparable to such a feature among the Protozoa.

On the other hand, in an ordinary infection (not including in this category an extraordinarily strong one like that discussed immediately), whenever I have observed a red blood-corpuscle invaded by two Halteridial parasites, these have been generally situated either on opposite sides of the host-cell nucleus, or else obliquely, towards the opposite ends. I have only rarely noticed instances where two (and only two) young individuals lie on the same side of the cell-nucleus, and fairly close together.

I may refer here, however, to a case which I observed while at Rovigno, of an extremely heavy infection of a little owl (*Athene noctua*) with *Halteridium* (*Haemoproteus*) *noctuae*, which is most instructive in this connection. In the bird in question, nearly every red corpuscle is infected with the parasites; and in general there are two, three or more individuals — sometimes as many as 6 or 7 small ones<sup>3</sup> — in one corpuscle (cf. figs. 15, 18, 19, 21). In this case it is not at all difficult to find corpuscles containing a cytoplasmic mass which possesses three or four nuclei (fig. 20). Such a condition is the result, I am certain, of the fusion of the cytoplasm of three or four parasites as they have grown in size and come into contact with each other, thus forming a kind of plasmodium (figs. 18—22), which may be indefinite or irregular in form. I cannot consider that such stages should be interpreted in the opposite sense, i. e. as indicative of a schizogonic multiplication. For one thing, the growing plasmodial body contains numerous pigment grains; the young separate individuals in a cell possess little or no pigment. And in spite of the abundance of the material I have not found anything to suggest that such a multinucleate parasite divides up into, or gives off, small uninucleate portions, leaving behind a cytoplasmic residuum containing the pigment. Further, even when there happen to be only two parasites

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<sup>3</sup> A similar instance of a multiple infection of a red blood-corpuscle with small Halteridial parasites is figured by Aragao. Arch. Protistenk. 12. 1909. pl. 3, fig. 24.



in a corpuscle, stages can be found showing clearly that as they grow and elongate in the direction of the length of the corpuscle, the two individuals may come into contact (cf. figs. 15 and 16).

It is this feature in regard to which this particular infection of a little owl has an important bearing on the case of the chaffinch-infection under consideration. If fig. 17 is compared with figs. 5 and 6, it will be realized, I think, that the same explanation will apply equally to both cases. If different stages in the relation of two individuals in one corpuscle to each other (such as are drawn in figs. 15 and 16) had been met with alone, it might have been more difficult to decide in which order the series should be taken; but when in the same smear and within a few

Fig. 15.



Fig. 16.

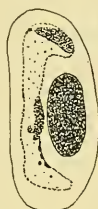


Fig. 17.

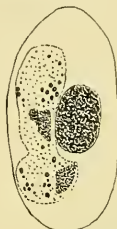


Fig. 18.



Fig. 19.



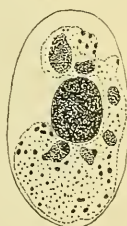
Fig. 20.



Fig. 21.



Fig. 22.



Figs. 15—22. *Halteridium (Haemoproteus) noctuae*, from the blood of a little owl, showing different stages in the growth and cytoplasmic fusion of two or more individuals in a single corpuscle. In the case of these small forms, and particularly where there are three or more parasites in one cell, it is difficult to distinguish whether they are male or female.  $\times 2000$ .

fields all manner of plasmodial appearances are seen, the result of 3, 4 or more individuals being crowded in a single corpuscle, one is quite unable to regard the process in the former case as binary fission. All things considered, therefore, we must conclude that figs. 1—8 of the condition seen in the chaffinch represent a double infection of a corpuscle, just as it is almost certain that figs. 11, 16 and 17 represent a similar condition.

The interesting and peculiar features about this case, and the reasons which made me hesitate at first as to its true meaning, are these: In the chaffinch in question, the infection is not, comparatively speaking,

a heavy or very abundant one; and I have only seen three or four instances of the ordinary double infection. It is a remarkable fact, besides being of most unusual occurrence, that in such a number of cases two (and only two) small Halteridial individuals should have entered the same corpuscle close together, have undergone cytoplasmic union while young, and assumed just the same form and increased in size as an ordinary single gametocyte (of either sex), ultimately tending to separate as they become adult. I am unable to say, however, whether two such individuals would become, as a rule, fully mature. The great majority of these double parasites which I have seen are nothing like double the size of a ripe gametocyte (cf. figs. 13, 14), hence each half has not nearly attained the maximum size; the parasites of figs. 7 and 11 have as large a bulk as any I have noticed.

In conclusion, I should like to point that what appears to me to be a quite parallel state of affairs in *Haemocystidium* has been described and figured by Dobell<sup>4</sup>, though that author has regarded the condition as representing schizogony (in the small forms) or nuclear division (in the adult gametocytes). On the same grounds as those discussed above, I feel fairly certain that Dobell's figures 14 and 16, pl. 7, of very large gametocytes of either sex, each with two nuclei, are really instances of a double infection of a corpuscle by gametocytes of the same sex, just as his figs. 17 and 18 show double infection of a corpuscle with gametocytes of opposite sex. Dobell says that double infection of a corpuscle is not uncommon, but apparently does not take into consideration the possibility that the two individuals in one corpuscle may be of the same sex; and there is no reason to suppose this cannot occur, just as readily as double infection with individuals of opposite sex. Now a corpuscle infected with two gametocytes of the same sex (either male or female), would present the same appearance as shown in Dobell's figs. 16 and 14, respectively; and I have little doubt that is really the condition there represented. Similarly, with regard to the schizogony of small forms, which Dobell says is most usually of the nature of binary fission, I think it is much more probable that the author's figures 4—7 should be read in the opposite direction, as indicating successive stages in the cytoplasmic union of two small individuals which have entered the same corpuscle; granted the occurrence of double infection, the two parasites must enter the cell as small forms. Dobell says the infection is often quite intense; this explains the occasional (infrequent) occurrence of three or four small parasites in a corpuscle, which have united. In short, Dobell's figures are quite comparable to my

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<sup>4</sup> Festschrift R. Hertwigs. Bd. I. 1911. p. 123. pl. 7.

figs. 15 — 20, showing different degrees of infection of the red corpuscles of the little owl with *Halteridium*; and I should say the explanation I have given above applies equally to the case of *Haemocystidium*.

The Lister Institute, August 31 st., 1911.

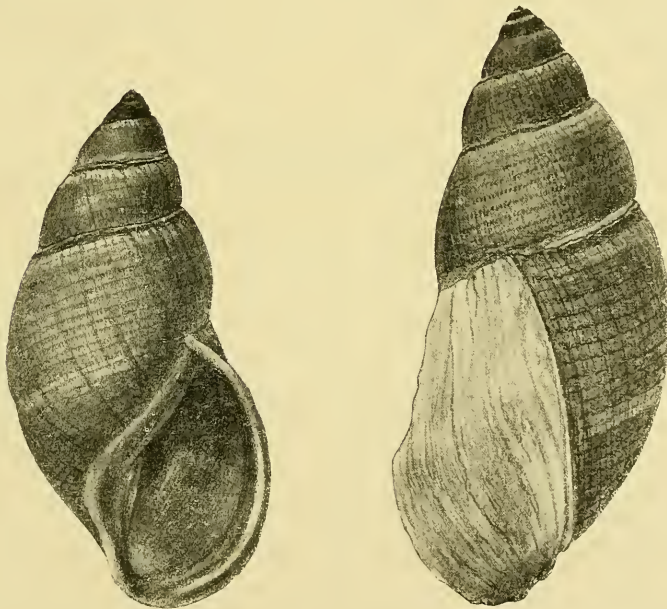
## 2. Über einen eigentümlichen Schalendefekt eines Thaumastus.

Von Dr. H. Simroth.

(Mit 1 Figur.)

eingeg. 8. September 1911.

Das Interesse, welches neuerdings die Bildung und Regeneration der Gastropodenschale gefunden hat (vgl. u. a. die Arbeiten von Biedermann, Korschelt, Tschow) veranlaßt mich, die Aufmerksamkeit der Fachgenossen auf einen eigentümlichen Fall zu lenken, der kürzlich von Strebel<sup>1</sup> beschrieben wurde und der mir eine besondere Erklärung zu fordern scheint.



*Thaumastus melanocheilus* f. *granocinctus* Pilsbry. Links normales, rechts abnormes Exemplar. Nach Strebel.  $\frac{4}{5}$  der nat. Gr.

Von der peruanischen Bulimulidenform *Thaumastus melanocheilus* forma *granocinctus* Pilsb. fand sich neben normalen (linke Figur) ein abnormes Exemplar (rechte Figur), von dem Strebel folgendes sagt: »Das

<sup>1</sup> H. Strebel, Conchologische Mitteilungen aus dem Naturhist. Museum in Hamburg. Abhdlgn. aus dem Gebiet der Naturwissenschaften, herausgeg. v. naturw. Ver. in Hamburg. XIX. 1910. 35 S. 3 T.

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Zeitschrift/Journal: [Zoologischer Anzeiger](#)

Jahr/Year: 1911

Band/Volume: [38](#)

Autor(en)/Author(s): Woodcock Harold Mellor

Artikel/Article: [On an unusual condition observed in Halteridium. 465-471](#)