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**Autor:** Burgdorfer, W.  
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### Summary.

After a detailed description of the anatomy of *Ornithodoros moubata*, the presence and behaviour of the agent of African relapsing fever, *Borrelia duttonii*, in the tick is discussed, as far as its transmission to warm-blooded animals. The results obtained are summarised in tables 20 A-D as follows:

1. If a tick sucks the blood of an infected man or animal (see fig. 20 A), the spirochaetes are carried with the absorbed blood via the pharynx (Ph) and oesophagus (Oe) into the middle intestine (MD), e.g., stomach, in the cavity of which they are found in continually decreasing numbers during 16 days. A few hours after the tick's feeding the agents already begin to gather on the periphery of the gut wall, attacking its epithelium cells and boring through the strata of the gut wall. At the earliest after 24 hours they penetrate the body cavity fluid (see fig. 20 B).

The development cycles (granulae) of *Borrelia duttonii* described by *Dutton & Todd*, *Leishman* and other authors cannot be seen either in the gut contents or in the gut wall. From the beginning of infection there are certainly, in the contents of the gut, a few and later more and more immobile, degenerated spirochaetes, but these are dead forms, incapable of developing and which have nothing to do with development stages.

2. In the haemolymph, shortly after the first arrival of the agents, a considerable multiplication of spirochaetes generally takes place. Their number and the time of occurrence varies, however, from tick to tick. This multiplication of the agents is due on one hand to division of the forms already in the body fluid; on the other hand to the continual liberation of fresh spirochaetes from the gut wall.

3. From the haemolymph the agents of relapsing fever infiltrate the various organs of the tick and their presence is proved at the earliest on the third day in the salivary glands (Sp), in the coxal organs (Co) and also in the central ganglion (Ce); in the Malpighian tubes on the fourth day (see fig. 20 C). The cavity of the last named organs and also the anal excretions of the tick remain constantly without spirochaetes. The central ganglions, the coxal organs and the Malpighian tubes in the nymph as well as in the adult tick are centres in which the spirochaetes multiply by simple and by multiple transverse division. *Borrelia duttonii* behave differently in the salivary glands: only the glands of nymphs show a strong permanent infection. The glands of the adult tick, how-

ever, are only strongly infiltrated temporarily and remain usually only slightly infected. Neither in the above mentioned organs nor in the immature or mature eggs of *Ornithodoros moubata* can be confirmed the presence of "granulae" described by *Leishman* and others.

4. The behaviour of *Borrelia duttonii* towards certain tick organs is also examined experimentally with the so-called "glass capillary test". These capillaries, containing fragments of uninfected salivary glands, central ganglions and coxal organs, are introduced surgically into infected ticks. It can be shown that in nymphal ticks all these organs, in adult ticks only the central ganglions and the coxal organs are attacked by the spirochaetes. From these results it is deduced that still unknown substances of certain organs might exert an attraction on the spirochaetes in the haemolymph. On such substances, in which the central ganglion and the coxal organs must be particularly rich, depends the infiltration and perhaps also the multiplication of the agents. The negative behaviour towards the salivary glands of adult ticks as also towards other tick tissues would be explained by the fact that these substances are only scantily present or altogether absent.

5. With regard to the existing development theories of *Borrelia duttonii* at temperatures below 25° C., the infection course in the tick at a temperature of 20° C. has been investigated. This low temperature merely reduces the activity of the spirochaetes and thereby slows down the infection. In the contents of the stomach for example living spirochaetes can be found even after 35 days. In the tick organs the presence of the agents can be first detected on the 13th day after infection. A fragmentation of the spirochaetes into "granulae" was not found.

6. The various possibilities of the transmission of *Ornithodoros moubata* to warm-blooded animals have been examined next. In contrast to the results of other investigators it is shown that the transmission of the relapsing fever can be made by the tick bite alone as well as by the secretion of infectious coxal fluid (see fig. 20 D).

Transmission is possible by:

1. *nymphal ticks*

- a) by the bite, injecting the spirochaetes directly into the wound with the saliva;
- b) by the coxal fluid, the agents being washed into the bite wound or penetrating the unwounded skin;

2. *adult ticks*

- a) by the coxal fluid (as 1 b);
- b) by the bite via saliva (rarely).

### Résumé.

Après une description détaillée de l'anatomie d'*Ornithodoros moubata*, l'auteur étudie le développement et le comportement de l'agent pathogène de la fièvre récurrente, *Borrelia duttonii*, dans la tique, jusqu'à sa transmission sur l'animal à sang chaud. Les résultats obtenus, montrés dans les figs. 20 A-D, se résument comme suit :

1° Lorsqu'une tique se gorge sur un homme ou un animal infectés (voir fig. 20 A), les spirochètes passent avec le sang absorbé par le pharynx (Ph) et l'œsophage (Oe), pour arriver dans l'intestin moyen (MD) ou « estomac », où ils peuvent être observés pendant 16 jours en nombre continuellement décroissant. Peu d'heures après le repas sanguin, l'agent pathogène commence à se