



Minotaur beetles fight for over 12 hours

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Introduction

Minotaur beetles, *Typhaeus typhoeus* L. (Coleoptera: Scarabaeoidea: Geotrupidae), Figure 1, do not fight above the ground, as many other scarabaeoid beetles do (Arrow, 1951). In fact, they spend very little time up there because they are mostly nocturnal burrowing dung beetles and generally come out to forage in the evenings; therefore their underground fights have only been described previously in detail in an artificial burrow cast in plaster-of-Paris (Palmer, 1978).



Figure 1. *T. typhoeus*: top, the male, 16 mm, has three forward pointing horns and the central one is shorter; right, the female, 18 mm, has spurs on the sides of a transversal ridge, one of which is visible on the photo.



The fight that I'm going to describe here was inside a terrarium filled with moist sandy soil where the beetles were not so restricted. It happened because I was trying to find out if a 'ménage à trois' would work out in the terrarium. Lots of beetles have been successfully reared in such terraria but only with one male and one female at a time (Main 1916-7, 1917; Brussaard, 1983). They form pairs and there is strong male-female co-operation during the nesting period when they build a nest at the end of a rather deep burrow, sometimes down to 1.5m; it is a labour intensive process. At the bottom of the burrow, on side branches, the female prepares a brood mass of compressed dung next to each egg. The male tasks are uppermost: removal of the soil, collection of the dung and, most importantly, defence of the burrow.

Methods

I collected *T. typhoeus* in pitfall traps in Hilly Fields, Colchester, TL985254, on 6 November 2008, and kept them in a well ventilated unheated garage where they spent their maturation period in jars filled with moist sandy soil, feeding on rabbit dung. Dung beetles which have spent their larval stage inside brood masses emerge rather weak and sexually immature; therefore they have to undergo a period of maturation feeding in order to be able to reproduce (Cambefort & Hanski, 1991). In *T. typhoeus* this period lasts about four weeks (Brussaard, 1983) at the end of which they actually put on some weight (pers. observ.).

From 31 December 2008 onwards I moved some of the beetles to a terrarium, also in the garage. The terrarium follows the specifications as given in Brussaard (1983); it consists of two vertical glass panes, 60x100 cm, 11 mm apart, filled with moist sandy soil from Hilly Fields; on the top there is a feeding table, 60x60 cm, covered with a mesh a corner of which is just visible in Figure 2.

Events leading to the fight

The protagonists of this fight were two unmarked males of identical size/weight, ~ 19 mm/0.7g, and a female with a reddish tan, ~ 18mm/0.6g; her tan proved a very useful marker.

The males had been in the terrarium since 12 January and had fought previously at least twice for about 50 minutes at a time at the ends of existing burrows; first for another female and then for this one.

Eventually, one pair settled down and by 26 January they had completed their first brood mass, Figure 2, at the bottom of burrow C. While they nested the other male had stayed on the opposite side of



Figure 2. Photo of the terrarium taken shortly before the fight started. The main burrows are labelled C (the original principal burrow with a brood mass at the end of it, bottom arrow); B, joining C in the centre, middle arrow; and A, joining B higher up. The intruding male is in A, arrow; the other beetles are in B and had been working along the dotted burrow. At the top a corner of the feeding table is just visible.

the terrarium mostly at the top of burrow B, Figure 2. After that a stalemate ensued.

Things perked up on the morning of 26 February; first, I saw that the female had resumed digging on the other side of the terrarium in different burrow, B, with a male, of course. Unfortunately, then I could not tell one male from another, so cannot say whether she had swapped partners. Their digging is normally team work: the female leads the way down ahead; she pushes up a plug of sand most of the

way up and then the male comes down, manoeuvres himself to the lower level of the plug and then pushes it out of the burrow.

Meanwhile, the other male had taken position in burrow A, Figure 2.

The following day, early in the morning, there was a male still there, very much on its guard; as soon as he felt any movements he slid downwards rapidly and stood still, facing up, with all his legs retracted; this is their normal burrow guarding behaviour.

Then things took another twist. The male in burrow A moved closer to the junction with burrow B, to the place shown in Figure 2 when the photo was taken at 07.49 hrs.

Two hours later I noticed that the connection between burrows A and B had changed. Curiously, now two rabbit pellets were there instead of the male, and the connection was plugged. More importantly, in burrow B there were now two males each pushing up a plug of soil.

The fight

Suddenly, the male at the top turned round and pushed the other one downwards, head-to-head, so that one of them, probably the intruder, was sent down a considerable distance along burrow B, Figure 3.

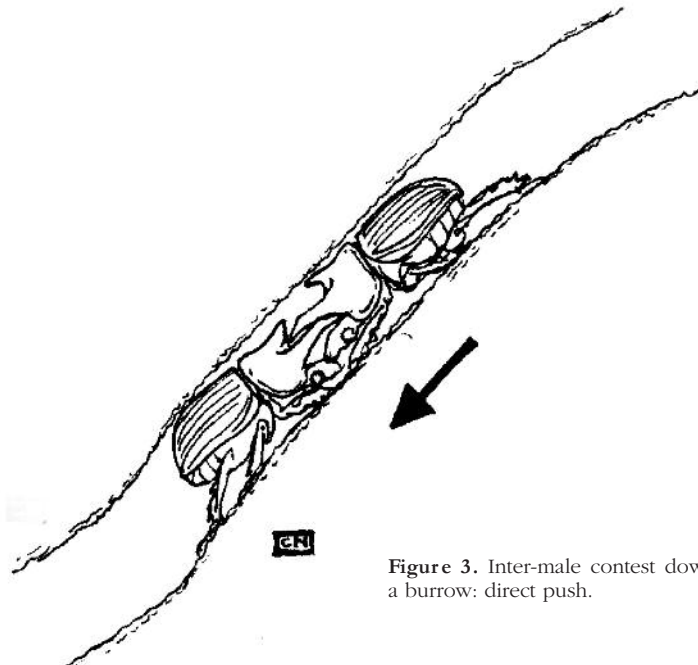


Figure 3. Inter-male contest down a burrow: direct push.



The males reached the junction with burrow C in six minutes and down they went along it until they stopped just above the brood mass, at 58 cm depth, and started fighting. Somehow they managed to drag a rabbit pellet all the way.

Once they reached the end of the burrow the beetles fought each other round in circles so that soon they were visible in an arena which had just enough room for them. As it was more or less clear of soil I could observe their tactics and take photos/videos by placing a light behind. They seemed oblivious of external noises and the light.

As they moved round and round the one behind bumped the other on the elytra with its horns, sometimes rhythmically which was quite funny to watch. Or, they got locked head-to-head but with their bodies rotated, see Figure 4.

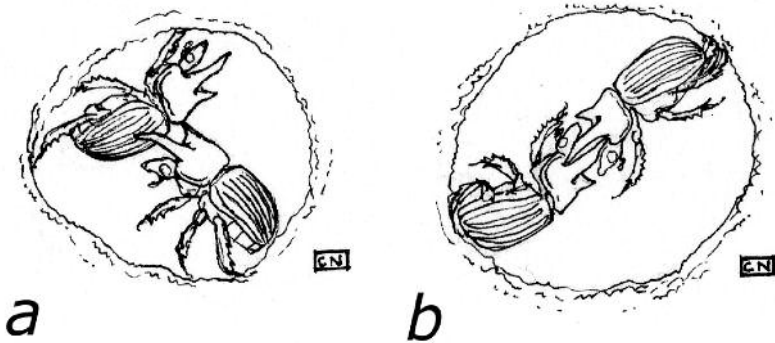


Figure 4. Inter-male fighting positions. *a*, direct push: bumps from below while moving clockwise. *b*, pressing contest: locked horns with one beetle rotated.

Sometimes one managed to drive the other back up the tunnel but he always came back down promptly and the fighting resumed. In a previous fight I actually saw the winning beetle chasing the loser for quite a distance and then turn back down only when the other had reached a safe distance.

As the fight went on they moved slower and slower, so that sometimes they 'froze' in a particular position. Also they took longer rests when they faced each other, Figure 5*a*. The arena kept growing and changing shape and towards the end it was quite disorganized.

Even though it was all extremely exciting to watch, a movie that I have made with short clips of their fight looks as if it is being played in slow-motion, quite boring at times, particularly towards the end (Fremlin, 2010).

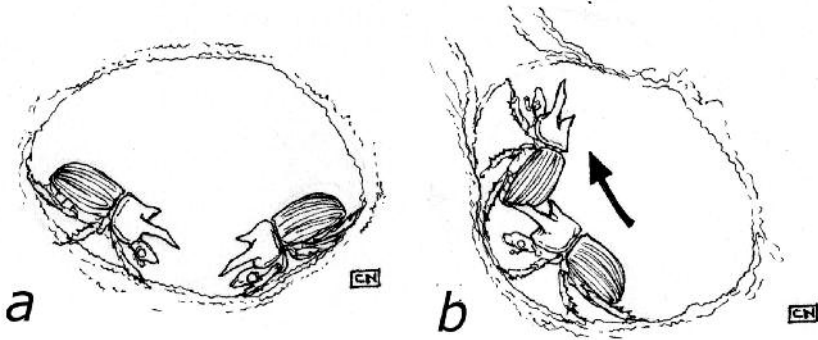


Figure 5. Inter-male contest, continuation. *a*, resting position: facing each other. *b*, exit position: direct push from behind.

By 22.40 hrs, just less than 13 hrs from the start of the fight, I saw one beetle being pushed up on to the left, Figure 5*b*, then he managed to dig his way straight up to the top, close to the edge.

Discussion and conclusion

The males fought for access to a female. They fought at the end of an existing burrow, thus at a rather deep level, and for nearly 13 hours, a remarkably long time, because they were an equal match.

Palmer (1978) reported fights of only up to 75 minutes just below the surface in rigid plaster-of-Paris tunnels and the bigger beetle always won.

He described three positions: 1) direct push, when the beetles face each other head-to-head; 2) defensive block, when the defendant blocked the tunnel sideways; 3) pressing contest, when the beetles face each other but one of them is rotated.

I was able to observe a direct push, head-to-head, when they came down all the way to the bottom of burrow C, possibly like in Figure 3. But then because of poor visibility I could not tell whether one of them was rotated or not, that is if it was either Palmer's 1) or 3). In the arena they sometimes fought in that position.

As for the defensive block, 2), there was a lot of pushing from behind; either on the rear end or in the middle of the body but the beetle being attacked did not block anything, just kept moving. In other words, in loose soil I did not observe a defensive block, an 'impregnable position'.



The beetles did lock horns with one rotated many times inside the arena, Palmer's pressing contest, 3), Figure 4*b*. This is also a characteristic underground fighting position in other dung beetles (Madewell & Moczek, 2006; Watson & Simmons, 2010).

When fighting their bodies fit perfectly; take the unequal length of their horns and how they interlock in the pressing contest and also with the rump of the beetle being pushed out, Figures 4*b* & 5*b*. Fabre (1910) remarked that their three points described a concave arc in which one may fit the roundness of a dung pellet.

It is not known how common fights of this kind are among beetles in the wild and what their tactics are. In this fight, the invading male did not attack directly the occupied burrow from above the ground, like they did in burrows cast in plaster-of-Paris (Palmer, 1978). Instead he moved himself to a strategic place close to the active burrow B-C, probably by above the ground movements, and then attacked sideways from inside that burrow. Their burrows have nicely tampered smooth walls, no doubt strengthened as they go up and down; they are their underground highways.

How did he know where the others were?

I have already remarked that he was very sensitive to external vibrations when guarding the entrance to his burrow. It seems likely that he could have easily detected the vibrations generated by the active pair via his feet and body hair and then attack them by stealth.

They can be rather noisy, there are reports that they stridulate when courting (Main, 1916-7; Brussaard, 1983) and fighting (Palmer, 1978).

Another possibility would be by scent detection, but this seems rather unlikely because odours do not travel so well underground.

During this fight the beetles did not feed and I am not sure if they fed afterwards. And this would be worth studying because in spite of both looking rather weak at the end of the fight, and probably having lost weight (Knell & Simmons, 2010), they were able to pair up successfully afterwards. One pair completed a brood mass in the terrarium and the other collected a lot of dung pellets for his mate in a deep bin and the results of their labours are not known at the time of writing because they are due to emerge in the autumn of 2010.

I hope in the future to try to rear two couples in the terrarium, rather than a 'ménage à trois' which didn't work out. Of course, it will be much better if I can devise a marking system that will allow me to identify them while the action is going on.



There is indeed a lot more to be done with these engaging dung beetles.

Acknowledgments

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