

# Fluorescence in Arthropoda

by

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Dr. Geoffrey Bond, Geologist at the National Museum, Bulawayo, Southern Rhodesia, recently informed me that the fluorescence of scorpions in ultra-violet radiation was a fact well known to many field mineralogists and geologists. At my request he kindly agreed to follow up the matter, and in May, 1952, wrote to say that he had tested a number of preserved scorpions of the genera *Parabuthus*, *Uroplectes*, *Hadogenes*, and *Opisthophthalmus* in the collections of the National Museum at Bulawayo with positive results. Not only did these specimens give out a pale green fluorescence, but also the alcohol in which they had been retained for some years; scorpions which had been dead a long time, either as dried or alcohol-preserved museum specimens, fluoresced less brightly than living ones. A number of tests with various species of scorpions in the spirit collection of the Natal Museum confirmed all Dr. Bond's observations.

Although the literature dealing with fluorescence is a considerable one, as can be seen from Ellinger's monograph on "Fluorescence microscopy in biology" (Biol. Rev. 15: 1940), the papers listed in his bibliography deal with bacteria or the tissues, organs, and fluids of animals and plants, rather than with whole organisms, either alive or dead.

The phenomenon of fluorescence not being mentioned in any of the recognised monographs on scorpions, it was decided to ascertain the reactions to ultra-violet radiation of living scorpions as well as other representative arthropods at the Natal Museum. This was made possible through the interest shown by Professor J. Fairbrother of the Department of Physics, Natal University, Pietermaritzburg, who kindly set up and lent the required apparatus. This consisted of a commercial 80-watt, high pressure mercury vapour quartz lamp, filtered through Wood's glass, the bulk of the radiation lying on the long wave-length side of 2,800A.

At least one living representative of a number of different orders of terrestrial Arthropoda was collected at Pietermaritzburg at various times during 1953 and tested for fluorescence, the species investigated being as follows:

<i>Class</i>	<i>Order</i>	<i>Species</i>	
<b>ARACHNIDA</b>	AMBLYPYGI (Whip-scorpions)	<i>Damon variegatus</i>	
	SCORPIONES	<i>Uroplectes formosus</i>	
	ARANEAE	<i>Harpactira</i>	
	SOLIFUGAE	<i>Solpugema hostilis</i>	
<b>INSECTA</b>	COLEOPTERA	<i>Hipporhinus furvus</i> (Curculionidae)	
	"	<i>Anthia unicolor</i> (Carabidae)	
	"	* <i>Ceratorhynchus derbiana</i> (Scarabaeidae)	
	"	* <i>Genyodonta flavomaculata</i> (Scarabaeidae)	
	"	* <i>Sternocera orissa</i> (Buprestidae)	
	ORTHOPTERA	<i>Liogryllus bimaculata</i> (Gryllidae)	
	ODONATA	* <i>Cordulegaster</i> sp. (Aeschnidae)	
	<b>MYRIOPODA</b>	DIPLOPODA- JULIFORMIA	<i>Doratogonus setosus</i>
		DIPLOPODA- ONISCOMORPHA	<i>Sphaerotherium giganteum</i>
		CHILOPODA- SCOLOPENDROMORPHA	<i>Cormocephalus nitidus</i> <i>Cormocephalus multispinus</i>
<b>CRUSTACEA</b>		ISOPODA	<i>Cubaris burnupi</i>
		AMPHIPODA	<i>Talitroides eastwoodae</i>
<b>ONYCHOPHORA</b>		<i>Peripatopsis moseleyi</i>	

In all specimens which showed a reaction the colour was the same and can be described as a light dove blue or light slate blue with a faint tinge of yellow. In some cases, where the reaction was less definite, the body appeared to be lightly dusted with a luminous blue powder.

The results in the various species of Arthropoda were as follows:

**ARACHNIDA.** *Damon variegatus*. This large whip-scorpion gave on the whole the most positive results of all the arthropod species. The chitinous scutes on both dorsal and ventral surfaces did not fluoresce at all, but the intersegmental membranes, especially on the ventral surface, did so in a striking manner. These membranes appeared as a number of patches

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\* Indicates pinned cabinet specimens.

of blue light, those between the numerous joints of the elongated tarsi of the first pair of legs showing up as a long string of minute blue points of light. Fresh blood from this specimen on a glass slide showed no reaction at all.

*Uroplectes formosus*. This species of scorpion reacted brightly but in a different manner to the whip-scorpion. All the chitinous sclerites of both dorsal and ventral surfaces and the appendages showed strong fluorescence, while the intersegmental membranes remained perfectly dark, the exact opposite of the case in *Damon variegatus*. Identical effects were obtained with numerous spirit specimens of various species of scorpions in the study collections of the Museum.

*Harpactira* sp. This large hairy four-lunged spider reacted in the same way as the whip-scorpion *Damon variegatus*, only the intersegmental membranes of the ventral surface showing somewhat faint fluorescence, and all the other surfaces remaining dark.

*Solpugema hostilis*. The ventral surface of a male specimen gave a quite definite reaction, while the dorsal surfaces in general did not. A positive reaction was obtained from the whole of the ventral surface except the intersegmental membranes connecting the larger joints of the appendages, and the terminal segments of the pedipalp (metatarsus + tarsus) which are provided ventrally with a stiff brush of modified bristles. The abdominal appendages reacted more brightly than the thoracic ones (coxae of the legs and pedipalpi), the latter being a dull grey-blue.

*Negative*: The whole of the dorsal surface was negative except for the light-haired portion of the sides of the abdomen and thorax between the dark coloured tergites and the light ventral sternites, which reacted with moderate fluorescence.

**INSECTS.** The strongly chitinised black carabid beetle, *Anthia unicolor*, did not fluoresce at all. The curculionid beetle, *Hipporhinus furvus*, also strongly chitinised, displayed no fluorescence at all except on the thick cushion-like pads on the ventral surfaces of the three tarsal segments of the legs, but these showed up conspicuously. The crickets *Liogryllus bimaculatus* fluoresced mildly, more so in a freshly moulted specimen.

Mr. B. Stuckenberg, Entomologist at the Natal Museum, drew my attention to the large conspicuous white or cream markings on the elytra of various beetles such as the buprestid *Sternocera orissa* and the scarabaeids (Cetoninae) *Genyodonta flavomaculata* and *Ceratorhynchus derbiana*. It was found that these light patches showed marked fluorescence when submitted to ultra violet radiation. A similar effect was observed in a large dragonfly, *Cordulegaster* sp., in which a series of cream coloured markings, alternating with darker coloured areas, is arranged along the abdomen. The only other structures to show fluorescence in these insects were the compound eyes.

**DIPLOPODA.** The body rings of the large juliform millipede *Doratogonus setcsus* showed a very slight reaction, as if they had been lightly dusted with bluish powder. The legs seen from the ventral side were the brightest part of the animal but only on the two middle segments of each leg, the basal and apical segments showing no fluorescence at all. In the large pill-millipede *Spaerotherium giganteum* there was no response from the dorsal shields and on the ventral surface only at the junction of the legs with the lightly chitinized sternites.

**CHILOPODA.** In the case of the large centipede *Cormocephalus nitidus* there was very poor fluorescence: in the much smaller species *Cormocephalus multispinus* it was definite on the legs and antennae but less so on the rest of the body.

**CRUSTACEA.** There was no response from the tergites of the large Natal isopod, *Cubaris burnupi*, a very faint one from the sternites but none from the legs. The amphipod *Talitroides eastwoodae* gave no response at all.

**ONYCHOPHORA.** In a number of specimens of *Peripatopsis moseleyi* there was no fluorescent effect whatever on either dorsal or ventral surfaces. Fresh slime discharged from the slime glands was equally negative.

Of considerable interest are the unexpected differences in the fluorescence of scorpions and Pedipalpi, the thick chitinous scutes being the fluorescing structures in the former, the thin and delicate connecting membranes of the joints in the latter. Although the two orders are not particularly closely related, the micro-structure of their integument is fairly similar, with pore-canals and glands in the various cuticular layers of both. Any suggestions or comments by readers of this journal would be greatly welcomed.