

V. YA. FET

Wanderings under the Constellation of **SCORPIO**



Iomachus politus (Tanzania) and *Pandinus imperator* (West Africa).
Photo by J. O. Rein

Skin (cuticle) of all scorpions fluoresces under ultraviolet light, glowing blue-green. With a good UV light, one can see a large scorpion at 5—10 m in the dark



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“So, you like scorpions,” say those who enter my office for the first time, looking at the photographs, printouts, and clippings on my walls. “Well, I like to study them, but I do not particularly like them,” I’d like to reply, but this is hard to explain seriously. Of course, a zoologist cannot study all animals at once, so each of us specializes: some in polar bears, some in bats. Certain species are clearly more attractive than others (at least until you get closer to them): charismatic pandas and turtles; butterflies, after all. But scorpions... you cannot even pat them!

How to become a scorpionologist

So, why scorpions? The answer is simple: “It just happened this way.” In 1968, as an eighth-grader at School No 130 in Akademgorodok (Novosibirsk), I was able, for the first time, to sort collections that the Institute of Physiology researchers brought from the Karakum Desert. Giant tenebrionid beetles, wolf spiders in their sand-colored camouflage, and especially amber-segmented eight-legged scorpions with their delicate pinchers and dangerous stinger needles captured my imagination forever.

Even more tempting was the possibility of traveling beyond my native neighborhood and my city. I read mostly Gerald Durrell (1925–1995) at that time; I even wrote him a letter. Most surprisingly, I received an answer, which was surreal in those times of isolation. The letter said that, unfortunately, all jobs at Durrell’s zoo on Jersey Island were taken. But then there was no lack of domestic geographic space.

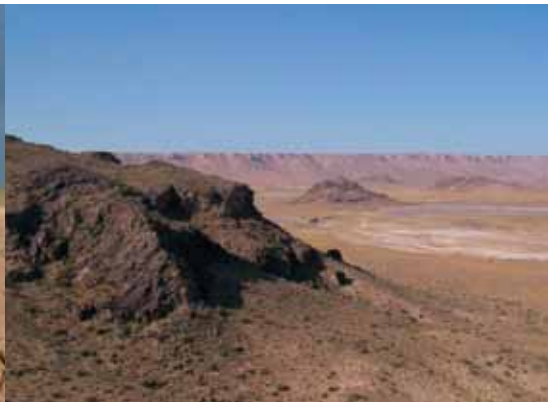
In 1976, I left Russia to become a zoologist in Central Asian deserts. Many of my friends did not understand this choice, and I myself certainly did not completely understand it then. Among real reasons for such «self-exile» was «romantic» desert life as well as a desire to «do real science» such as was done by Durrell or by pre-revolutionary Russian naturalists.

Whatever the reasons, I spent the following eleven years of my life working as a zoologist in *zapovedniks* (nature reserves) of the now-independent Turkmenistan, at that time a faraway periphery of the vast empire, at its very border with Iran. There, among sands and rocks, I often

encountered dangerous tail-stingers, collecting them in alcohol-filled vials along with the rest of numerous but poorly known desert fauna. Our living conditions were Spartan, but distance from the authorities provided freedom so precious to a Soviet intellectual. At least a hundred researchers and students from Moscow, Leningrad, Kiev, and the Baltics passed through our house every year. They were indeed the people who largely «did real science» of my dreams.

However, the blessed research days of those insane enthusiasts in Central Asian *zapovedniks* came to an end. In 1986, my friend Andrei Nenilin, a talented zoologist from Tashkent, died tragically. It happened when we had just finished a manuscript on world scorpion geography (it was published many years later). In 1988, our family moved to provincial America, where I started teaching biology to the new, computerized, generation: first in New Orleans, and then in West Virginia, in the foothills of the Appalachian Mountains. As far as scorpions were concerned, they steadily penetrated my consciousness, and formed a stable and already unalienable component of my being.

There are about 200 genera and 12 families of scorpions in the world; only one family is dangerous for humans



A. Gromov, the discoverer of the rarest scorpion *Pseudochactas*, near Bukhara, Uzbekistan.
Photo by the author

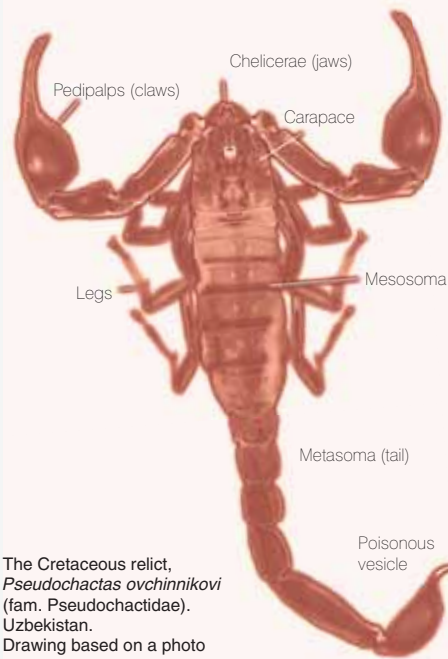
Scorpion hunters in Turkmenistan.
Photo by the author

With a magic lantern

In the early 1990s, I went for scorpions to Mexico, to the beautiful desert adjacent to the Sea of Cortéz (this is how Mexicans call the Gulf of California). My family took part in several fantastic expeditions led by our friend, the outstanding American zoologist Gary Polis, who tragically died in one of the trips to the Sea of Cortéz in 2000. Every night we counted *Centruroides* scorpions that crawled out of crevices in giant columnar cacti onto the warm black basalt of the volcanic islands pushed up from the ocean bottom so recently that no soil cover had been formed.

The scene changes: the cold and rainy spring of 2002 in the Babatag Mountains, at the border of Uzbekistan and Tajikistan. Together with Alex Gromov, the discoverer of *Pseudochactas*, we are looking for this rarest of scorpions. Border guards advise us not to wander toward the Afghanistan border, which has been land-mined “just in case.” We find our Cretaceous relict right by the creek where local shepherds drive their cow herd twice a day — up the creek in the morning, back down in the evening. The rare creatures are sitting right on the mud. (Taking their pictures under an electron microscope, I still see this sticky Babatag mud.)

Spring of 2005: we are in the Balkan Mountains, next to the highway leading north from Sofia, with the wonderful zoologist Alexi Popov, the current director of the National Museum of Natural History in Bulgaria. Just after it got dark, with cars flying by, on the limestone precipice right next to the road, in the rays of my “magic



The Cretaceous relict, *Pseudochactas ovchinnikovi* (fam. Pseudochactidae). Uzbekistan.
Drawing based on a photo taken by M. Soleglad

Opisthacanthus rugiceps (fam. Hemiscorpidae). Swaziland.
Photo by T. Ezendam



flashlight” we see glowing constellations of five, eight, twenty scorpions!

These and other expedition episodes reveal the main field “motif”: a chaotic night wandering along various surfaces (sand, basalt, limestone) with a special ultraviolet light. While Nabokov attracted his night moths by the light of a lantern, we go after our beasts Diogenes-style.

So, how do we catch them? With long forceps, carefully, grabbing their tail, obviously “created” for this purpose. Technically, scorpions have no tail. The term “tail” in zoology is reserved for vertebrates and refers to anything further than the anal opening: a tail carries “postanal” vertebrae. This is why it is wrong to think that a snake is just a big tail with a head on one end. However, anatomists also have a term “postcranium”: everything beyond your head.

A scorpion’s “tail” (whose anal opening is located between its fifth segment and the poisonous vesicle) scientifically is called “metasoma”; in Russian we have a special wonderful neologism for it: *zadnebryushye* (rear-belly). How ridiculous and how beautiful all these Russian zoological terms are, those *nogoshchupaltsa* (pedipalps), *vertlugs* (trochanters), and *dykhal'tsa* (spiracles) in groups such as *rotonogie* (mouth-legged, Stomatopoda) or *neravnokrylye* (uneven-winged, Heteroptera) — the technical vocabulary of a specialist that expands far beyond Dahl’s dictionary. These terms were invented to describe truly alien bodies.

Such words were created, or creatively translated from German and Latin, by dozens of enthusiastic researchers, caricatured by Bulgakov in his Professor Persikov of *The Fateful Eggs*. One of those was M. P. Bogdanov, a Moscow zoologist and the author of an unforgettable book on fleas and bedbugs. Another was N. A. Kholodkovsky (1858—1921), the author of famous entomology textbooks and well-known translator of Goethe’s *Faust*.

My childhood hero was, and still remains, Aleksei Andreevich Byalynitsky-Birula (1864—1937), for some time Director of St. Petersburg Zoological Museum and the author of the first (and only) book on Russian scorpions, published in the tragic October of 1917. One of the most prominent scorpologists of his time, Birula, in 1900, also sailed as a zoologist in the legendary polar expedition of Baron Eduard Toll, along with Lieutenant (later Admiral) Kolchak, which was enough to send Birula to the Communist concentration camp in Solovki later. Birula died, exiled, in Kazakhstan, but he had had time to publish a remarkably well written small book, in the series *Fauna of the USSR*, on solpugids — another order of nocturnal arachnids — hairy and aggressive. Even now, I receive e-mails from Iran and Turkey asking for Birula’s papers on Iranian and Turkish scorpions, published over 100 years ago.



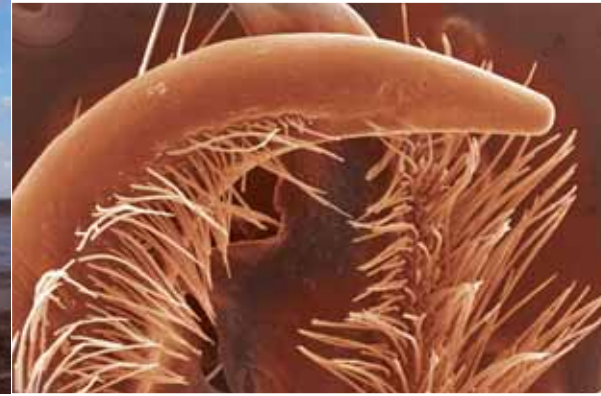
The best time for scorpion hunting is just after sunset when they themselves start hunting. Turkmenistan. Photo by A. Gromov

On eccentricities in food and love

The “hunt” in places with abundant scorpions looks like collecting berries on a farm. Soon there is nowhere to put them, I run out of storage space. Ziplock bags or plastic vials fill all pockets and backpacks (you cannot put the beasts together since they might eat each other); in the dark you juggle ultraviolet and regular flashlights; the wire from the motorcycle battery that feeds the UV light gets tangled; by mistake you open an occupied vial — the angry critter runs along your sleeve and rapidly falls away.

In some places the catch is 100 or 150 a night. One really does not need that many — a few specimens are enough for DNA analysis; but there are different species (some rare), and the hunter’s passion drives you. One does not have to hunt all night long since after 2 am soil and rocks cool down, in California and Uzbekistan alike, and scorpions crawl back to their shelters and burrows. The optimal work time is right after the sunset when sand and stone are still warm, and scorpion multitudes appear everywhere with their pedipalps (pinchers) stretched out, waiting for their prey to come. We even have a special term in ecology for this feeding strategy: we call it *sit-and-wait*.

Scorpion population density sometimes is truly incredible. Gary Polis calculated that sand deserts have approximately one scorpion per square meter; this is more than the number of any other animal (except ants and termites). Not all of them, as we know from mark and recapture studies, come out to the surface at the same time.



Left, a chelicera of *Anuroctonus pococki* (fam. Chactidae). Below, the fixed pedipalp (claw) finger of *Serradigitus gertschi* (fam. Vaejovidae). Under a scanning electron microscope. Photo by D. Neff and M. Brewer

Indian scorpion *Mesobuthus tamulus* (fam. Buthidae) with its prey. Photo by J. O. Rein



Sand deserts have approximately one scorpion per square meter — more than any other animal (except insects)



Here arises a question: what do these hordes eat and how do they reproduce in such an impoverished ecosystem?

First, they are not picky in their diet: they eat everything or rather everybody since they are predators, even cannibals. But they eat little, incredibly little: one cricket a month is plenty for them. Due to amazingly slow metabolism, whose rate is lower than in any other animal, a cricket's calories are burned by a scorpion very effectively. When they do not eat or reproduce, scorpions fall into an almost cataleptic state; their life then is truly a dream.

Scorpions also reproduce in a strange way. All "normal" invertebrates lay eggs. Even aristocratic spiders, those silk web architects, simply pack their fertilized eggs in a silk sac and glue them to their webs, which is fine with parasitoid wasps. Scorpions are very different: a female carries embryos inside (sometimes over a year!) and gives birth to live "scorplings," and not to a single one but to two or three dozen! Moreover, she carries her young ones on her back until they can fend for themselves.

Besides, a female scorpion can store sperm and have litters without new fertilizations. The latter are performed by a technique not familiar to us mammals: the spermatophore (sperm package) is deposited by a male onto substrate; then the modest groom grabs his bride leading her, claw-in-claw, to the "gift." The walk becomes a mating dance, which can last for hours. This *promenade à deux* was first described in the Languedoc (or Occitaine) scorpion near Avignon by the great French entomologist and writer Jean-Henri Fabre in his *Souvenirs entomologiques*.

Sometimes, dancing lovers run around the dunes, holding each other by one claw like figure skaters, running in curves, without any music. All this happens under the cover of night, which in the last 50 years is occasionally interrupted by ultraviolet lights of visiting zoologists.

How scary is a scorpion?

Oh, venom. I almost forgot. Well, I always forget about it. Recently, while having breakfast with Christian Komposch, a zoologist from Graz, we talked about the Alpine representatives of my favorite genus *Euscorpis*, European scorpions of a specific kind, subfamily-level relicts, with their closest relatives living in Mexico. The smallest of those (less than 30 mm in length), *Euscorpis germanus*, lives in the valleys of the Austrian Alps, up to 2200 m above sea level. It looks like in the Alpine ecosystems this lithophile (rock-dweller) has no enemies, the only limiting factors in its distribution being the substrate and its temperature. But why does nobody eat scorpions? The two specialists had a serious discussion of this issue while enjoying Viennese coffee and *kuchen*, and then it downed on them: scorpions bite!

Unlike other invertebrates, scorpions are viviparous. After the numerous scorplings are born, the mother carries them on her back until they grow up a little

No, not exactly — they don't bite. They sting! Unlike a bee's attack, when the barbed stinger stays in your body, unlike the bite of a spider's poisonous jaws (chelicerae), a scorpion's sting, tail-strike-forward, is a classic subcutaneous injection, just like a hospital shot. The muscles inside a poisonous vesicle inject venom from the toxic gland: a fantastically complex mixture of several dozen (!) various toxins.

Unlike the giant protein molecules of a bee, spider, or snake, a scorpion's toxins are small (30–50 amino acids) oligopeptides, which selectively target membrane channels through which our cells pump ions of sodium, potassium, and chlorine. Closing these channels like miniature bathroom plugs, scorpion toxins prevent membranes from repolarization, thus causing paralysis at cell level. Scorpion venom is a neuroparalytic weapon used for both defense and attack.

At this point one has to insert a politically correct note that, out of 1500 known scorpion species, only 30 to 40 are deadly for humans. The venom of all others is much weaker and is usually dangerous only for insects. Among all other things, scorpion venom is also used in medicine.

But even three to four dozen species is quite enough. The deadly ones are not found everywhere, but in those areas where they live humans have hated and feared scorpions since times immemorial, and not without reason. The Middle East is especially notorious in this respect. The scorpion genera *Leiurus* and *Androctonus* (the latter is translated as "man-killer") are as common as kitchen cockroaches in all deserts from Egypt to Iran. At night they might crawl into clothes and shoes, so if you camp out in Turkey or Israel, please, shake your things well before putting them on in the morning. Even better, buy a small ultraviolet light (they are cheap and easy to find now) to examine the perimeter around your tent before you go to bed — we used to do this in the Mexican desert.

Almost all species dangerous for humans belong to the same family, Buthidae. In Ancient Sumer, these terrible animals guarded no less than the Gate to Hell. There are plenty of buthids in all deserts of Central Asia, but those are not too dangerous. Species of the genus *Mesobuthus* are found up to 50°N in Kazakhstan; one can also find them in the Russian Federation (Kalmykia, south of the



Female of *Euscorpis coninnus* (fam. Euscorpidae) with her offspring. Piedmont, Italy. Photo by G. Colombo



Female of *Opisthacanthus validus* (fam. Hemiscorpiidae) giving birth. South Africa. Photo by T. Ezendam

Feeding female of *Centruroides margaritatus* (fam. Buthidae) with the young on her back. Honduras. Photo by J. O. Rein

Astrakhan Region, Northern Caucasus). Representatives of the genus *Euscorpius* can be found even in Sochi. They also inhabit the southern coast of the Crimea; according to our preliminary genetic data, they were introduced by Ancient Greeks from the Aegean Sea islands.

The Crimean scorpion was first observed in the time of Catherine the Great by the famous traveler Peter Simon Pallas (1741–1811) as he relaxed in Yalta and Alupka between his Siberian expeditions. A hundred years later, another great zoologist and the rector of St. Petersburg

UV rays, the stone wall crawling with scorpions. The guards froze and had no more questions.

Messengers of an alien world

Biodiversity is a key word: using it, one can sometimes obtain a small grant. It is assumed that all living creatures must be protected since they all “benefit” their ecosystems. This refers to scorpions as well. Of course, not all creatures have equal impact: among them one can find,



The scary *Parabuthus liosoma* — a representative of the only dangerous for humans family Buthidae. Tanzania. Photo by J.O. Rein

**Scorpion venom is
a powerful neuroparalytic weapon**

University, Karl Fyodorovich Kessler (1815–1881), described the “Mingrelian scorpion” in the first survey of scorpions of the Russian Empire, published in 1874.

In 1985, I had a chance to collect *Euscorpius mingrelicus* with the help of my ultraviolet light, in the Batumi Botanical Gardens, above the Black Sea coast. Scorpions were sitting there in every crack inside the gardens’ stone fence. Then, two border guards appeared from the bushes and demanded to know if I was signaling across the border to Turkey. I had to demonstrate to them, under

so to say, key species. But how much do we know exactly? We just started studying nature: Fabre taught schoolchildren in Provence at the same time when my grandfather studied medicine in Paris.

I already mentioned relict scorpions. One has to admit that humans have no “deep-time” sensation: we have difficulty imagining a thousand years, so how can we feel the difference between two million and ten million? Scorpions are a great object to test your emotions in feeling the time flow: with those creatures, we easily operate the figures of hundreds of millions years. They are so deep down the geological scale that we lose the trace of origins not only of Cenozoic youngsters (snakes, whales) but also of respectable Mesozoic reptiles.

Thus very often, when I listen to colleagues who study rodents or plants, I have this funny thought that in their field even a dozen million years is serious antiquity. Well, in scorpions, even Carboniferous fossils (300 million years) look like modern species. To use a cliché, scorpions indeed are “living fossils” — so little have they changed since those unimaginable times when there were neither birds in the sky nor flowers in the meadows — in fact, there were no meadows. That scary ancient world, so alien to us humans, can be understood and outlined only through the force of imagination based on knowledge.

It is this imagination that brings me back to Babatag, to the Surkhan-Darya Valley, the abode of tiny *Pseudochactas*. The description of this scorpion by Gromov, an Almaty zoologist, appeared in the *Zoological Journal* (Moscow) in 1998. Then, my Californian colleague Michael Soleglad (in my opinion, the most brilliant scorpologist of our time) jokingly called this description a hoax, but a “way too smart” one. It looked as if the author had taken all the most primitive features from all scorpion groups and pasted them together: two ventral keels on the fifth tail segment, not heard of since Paleozoic fossils; a suspiciously low number of sensory hairs on the pedipalps; two rows of spinules on legs, and so on.

Later, when I caught that tiny rarity myself, I saw that *Pseudochactas* did not have “a duck’s bill and a beaver’s tail sewn together,” which the first platypi brought to Europe by sailors were suspected of. (The suspicion was not unfounded — there was no lack of skillfully stuffed dragons and mermaids in European curiosity cabinets.)

A platypus, by the way, being a Mesozoic relict, can’t hold a candle to our scorpion: *Pseudochactas*’ lineage is probably comparable in its age to coelacanth, the famous Old Fourlegs (lobe-finned fish). This hermit of Uzbekistan has probably been sitting on its mud in Babatag valleys since the Cretaceous period. Dinosaurs walked by without noticing it, as cows do now.

Scorpions as a group appeared at the stage of life in the Silurian, over 400 million years ago—way before any dinosaurs. Then, they were marine bottom giants, over

a meter in length. But they should not be confused with another, long extinct, marine group—sea scorpions, or eurypterids, which could have been unrelated to our heroes. This subject, by the way, is still a real bone of contention among scorpologists. It is amusing and touching to watch an American and German scientists involved in a fierce Swiftian but Quixotic argument on behalf of creatures and events of half a billion years ago.

After everything I said above, I have to admit that it is hard to decide what is more interesting to write about: the fantastic ancient creatures themselves, with their nocturnal life, deadly poison, and unique adaptations gained in half a billion years of evolution, or those unusual people who catch and study them. Not only is the famous geographer Jacques Paganel from *Les Enfants du Capitaine Grant* still alive, but also the absent-minded entomologist Cousin Benedict from *Un Capitaine de quinze ans*. Jules Verne wanted to make fun; instead, he created, as he often used to do, another immortal image of a scientist with his selfless passion for knowledge.

Gary Polis used to say to his colleagues and students: “Scorpions live everywhere (or almost everywhere), so why should we not study them in the most beautiful places on Earth?” Following this principle, Gary visited sand deserts of Namibia and Australia, comparing their scorpions to those of Coachella Valley, not far from his parents’ house in San Diego County, California. My other colleagues are attracted by rain forests of Borneo or South America, or by the Pacific islands. As for myself, in the deserts and mountains of North America I still feel a strong pull of Europe — that old land whose nature and geography are not less complex than its history, and much more ancient.

Recently, I was lucky to visit Greece and Bulgaria several times, and I fell in love, forever, with this exaggerated Crimea, the core of our civilization. There are plenty of scorpions in the Balkans: rock-loving brown *Euscorpius* (same as Durrell carried as a kid in a matchbox on Corfu Island; see his *My Family and Other Animals*); large yellow *Mesobuthus* (the westernmost relatives of the species from Central Asia); and giant black relict *Iurus*. And if you get to Turkey, just in the mountains above the Antalya resort, you might find the prized and very rare relict *Calchas*, described by Birula and named after Homer’s prophet.

Later, when I return home to West Virginia, my students and I will discover, under an electron microscope, those bristles and spines on the bizarre ancient creatures previously unknown to the world. Who will benefit from this? Who will become happier? We will.