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Voices of diversity

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'— then you don't like all insects?' the Gnat went on.....
'I like them when they can talk,' Alice said.

Through the Looking Glass, Lewis Carroll

Take a stroll at dusk and listen in the dark to the chorus of voices that stir the air: melodious trills of the field crickets at your feet; the soft, tinkling chimes of delicate tree crickets; the zzips and buzzes of meadow bush crickets, the loud, harsh notes of katydids high in the trees and the barely audible, rapid clicks of bats flitting by. Take a walk in the noonday heat and listen carefully to the grass, and hear the clicks, buzzes, and claps, the noisy medley of grasshoppers obscured occasionally by a head-throbbing din from the trees: a resonance of cicadas. Surely this describes an idyllic forest; but no, this is our campus! An urban campus in a sea of automobile noise and noxious fumes, an oasis nevertheless to so many species big and small. Many of the voices belong in fact to those small, inconspicuous, much trampled upon, six-legged creatures called insects, in particular to a group that I have grown to know and love, the Orthoptera or 'straight-winged'.

The Orthoptera are a group of insects with an ancient lineage, related to the stick insects (Phasmida), cockroaches and mantises (Dictyoptera). They are hemimetabolous, which means that the little nymph just hatched from the egg looks like a miniature of the adult, unlike the holometabolous flies, moths, butterflies, wasps and bees that hatch first into grub-like larvae with enormous appetites, later entering an apparently quiescent pupal phase before turning into beautiful, winged adults. Most adult Orthoptera have wings which, in the males (and, in some species, also females) are often employed as musical instruments to attract and serenade potential mates. Depending on the type of instrument, the Orthoptera divide into two groups: those that sing by rubbing the forewings together (the crickets or Ensifera), and those that rub their hindlegs on their wings or abdomens, or clap the wings together while flying (the grasshoppers or Caelifera). Both groups also have species that are mute and do not sing at all. Ensiferan females are usually mute and, since they are nocturnal, one could say that they are neither seen nor heard! Most cricket and grasshopper species can, of course, hear (those serenades surely do not fall on deaf ears), the Ensifera with ears on their forelegs and the Caelifera with ears on their abdomens. When did all the serenading begin? Deep in the past, in the Paleozoic era, about 300 million years ago, for fossils of cricket wings from the Permian period show singing structures just like those of crickets today. So the chirp of the cricket could have been the first

voice to break the silence of the night on earth; today we have thousands of singing cricket species, each with its own special song, evolved over millions of years.

We are privileged to share this campus with several interesting species of crickets. The field crickets, the most melodious songsters, are usually brown or black all over, live in leaf litter or burrows in the soil and only come out at night to sing. Bush crickets are typically green, some brown and live in a variety of habitats: in the grass (meadow katydids), bushes, leaf litter and in the trees. Apart from the typical, short, rhythmic chirps of *Gryllus* that one may hear the world over, we have several interesting singers among our field crickets, including one with the cadence of a koel! One of my favourite pastimes is to track singing crickets in pitch darkness, locating by ear alone, but the 'cuckoo cricket' has proven extremely difficult, responsible for frustrating and sleepless nights. We also have one or two species of deaf-mutes with neither wings (to sing or fly with) nor ears, as well as species with ears but no wings. I am struggling to find their respectable (Latin) names, for crickets with no wings and no ears are outcasts of taxonomy, hard to classify! The most exciting find, however, came unexpectedly one morning in Jubilee Gardens, when I heard an unfamiliar voice, an irregular, relatively unappealing trill emanating from the grass. I waited and slowly tracked the source, and could not believe what I saw, for singing before me was a field cricket with four bright, chrome-yellow spots on his wings! Brightly coloured crickets are not entirely unknown, but they are the exotics of the rain forests of Borneo and Africa, clad in tribal colours that one has to mount expeditions to see; no self-respecting field cricket in an urban backyard is known to sport such gaudy colours.

The bush crickets, sadly enough, I have not been able to come to grips with, since many are high up in the trees, but their voices are loud and distinct in the night, and I know there are at least seven to eight species up there. The ones in the bushes, alas, are being driven off their homes with the recent frenzy of cutting and clearing that has gripped this campus. All they need are those roadside bushes; they do not eat grass or live up in the trees, and they are disappearing before our eyes. Among the meadow bush crickets, however, there appear to be a handful of species (five-six), of which two are exceedingly common, belonging to the Conocephalinae and Phaneropterinae: Latin and Greek? Yes, of course! Greek, at least, for 'cone heads' and 'visible wings', respectively. Both are slender and green and share the same clumps of grass, so I was convinced that they must sing differently. Both have beautiful singing instruments, but whenever I have tracked the buzzing in the grass, it has turned out to be a cone head. I have never seen or heard the phaneropterines sing and I wonder whether they are not holding concerts in the ultrasonic, the private frequency channel inaudible to us mere humans? Another interesting species is a loud, almost monstrous, rasping, brown bush cricket that lives in the leaf litter and can be heard through the monsoons in the main quadrangle. The resonator on his wings has the most fantastic contortions of any I have seen: a biophysicist's nightmare.

Among grasshoppers, surely the most abundant must be *Aulacobothrus*, the small, brown, singing gomphocerines (Subfamily Gomphocerinae), that scatter like popcorn when one walks in the grass. Another lovely gomphocerine with the unlovely name of *Brachycrotaphus* resembles the dry, dark brown, elongated tip of a species of grass and makes a long, loud series of clicks. Yet another, rarer species sounds like a metallic tambourine. Among the Oedipodinae or band-winged grasshoppers, the most spectacular is *Gastrimargus africanus*, green with bril-

liant yellow hind wings that are only flashed in flight, aerial displays often accompanied by a loud clapping of the wings. My favourite oedipodine I call the double-clicker (I am unsure of his scientific name), brown and cryptic, impossible to see on the soil and leaf litter, who produces pairs of clicks, rubbing his hind legs in slow motion and showing off their brilliant red. I could go on with this list of wonders, the acridines with their madly conical and comical faces (*Acrida*, *Gelastorhinus*), grasshoppers that look like lizards (*Leptacris*) clinging motionless to grass stalks in the night, presumably sleeping; grasshoppers like pebbles, like toads, like blades of grass, like miniature lilac flowers....

The abundance and diversity of this insect life is in fact key to the presence of the vertebrates. Orthoptera form a major part of the diet of several species of birds, bats, lizards, frogs, spiders and even other insects such as mantises and ants. For birds, insect larvae and adults are the equivalent of baby food, for most birds, even seed-eaters, start life as insectivores. Thus, breeding cycles of birds are often matched with periods of insect abundance. Although the grasshoppers on our campus show a peak of abundance at the start of the monsoon, different species appear to have different life-cycle periodicities: some univoltine, with just one generation per year (the adults usually appearing during the monsoon), some bivoltine with two generations and others that are continuous breeders. Among the bivoltine species of grasshoppers, bush crickets and mantises, often the monsoon generation is coloured a lovely green to match the fresh grass, while the summer generation is bleached light brown to blend with the dry and withered stalks! Different species of grasshoppers and crickets also have different tastes, for some will feed only on nectar and pollen, some on the fresh shoots of a given species of grass, and yet others on the mature and fruiting stages of grasses. There are the picky gourmets, specialists who would die rather than eat something exotic and, at the other extreme, generalists and omnivores who will eat just about anything to survive. A diversity of species, of voices, of colours, of tastes, of life cycles, of habitats, of genes... biodiversity!

We are fortunate to live on a campus with such an amazing diversity of life forms, particularly insects. And why do we have this richness around us? Because we have, so far, largely desisted from the practice of landscaping, so common in the West, and still have pockets where nature takes its course. But, unfortunately, this is fast changing, with more and more areas being cleared of natural vegetation and converted into lawns, gardens and concrete paving. This spells disaster in many ways because a plethora of plant species supporting a rich diversity of insect and vertebrate life is replaced by a single species of grass, often exotic, mowed over, sprayed with pesticides, inedible and usually toxic to the majority of insects, unsuitable as homes for most. So they disperse or die out and, with them, the birds and reptiles and mammals that they sustained. And the few patches that are exempt from this fate are ravaged every year by fire in the dry season, set ablaze by vandals, high-school dropouts who find relief from their boredom or frustration in this destruction of life around them. And nobody cares....

What are we left with? Sterile, green patches of exotic grass with a few, very few species, the omnivorous or the pesticide-resistant: the crows, pigeons and rats of the insect world; the great survivors whom I salute for they have resisted successfully our attempts to exterminate them. But is that what we want? A world of concrete and automobiles, of crows, rats and pigeons, of mosquitoes, cockroaches and flies? Of computers and televisions where we can lose ourselves and our children in a world of virtual reality, in Nature Specials of animals and

plants that once were, or now exist, clinging on precariously in a few, far-flung national parks that are themselves being ravaged with every passing day?

Biodiversity, the diversity of life, is all around us, not confined to the boundaries of reserves and forests; and conserving biodiversity is more than setting aside game parks and maintaining zoos. Biodiversity conservation, like so much else in life, begins at home. Many of the wonderful insects on campus that I have described I have not seen in forests. Where do they belong? To grassland and scrub that exist no more except in this fractured, fragmented state. And even from these last vestiges we drive them out: the oedipodine eggs I saw being laid now repose forever under concrete, and very few of the clicking grasshoppers appeared last monsoon; the second patch where a mass egg-laying occurred was ravaged by fire, the third uprooted and turned into a lawn. Will this destruction never end? The voices of diversity are constantly around us, but we choose to ignore them: we hear, but do not listen.

Take a stroll in the dusk and listen to the heavy silence of death that hangs in the still air; to the thin, reedy monotone of a defiant field cricket that still holds out, a faint echo of the symphony that was. Take a walk in the noonday heat and hear the crackling of the dead, burned grass at your feet; or feel the soft, plush carpet of lawn beneath: beautiful, green, silent and sterile. Hear the drone of automobiles, the throb of diesel generators, the whine of drilling machines, the synthetic sounds of multimedia. Are these the voices of the future? Yes, they are; unless we care enough, respecting all these species that have evolved over millions of years, that have the right to exist, to co-exist and share this earth with that recent accident of evolution, a species that dominates and destroys, yet has the audacity to bestow upon itself the misnomer *Homo sapiens*! The choice is ours, and time is running out.

Recommended reading and references

General

1. *The insect world of J. Henri Fabre* (excerpts translated from the original French by Alexander Texeira de Mattos), Beacon Press, Boston, USA, 1991.
2. DETHIER, V. G. *Crickets and katydids, concerts and solos*, Harvard University Press, 1992.
3. RENTZ, D. C. F. *Grasshopper country*, UNSW Press, Australia, 1996.
4. WILSON, E. O. *The diversity of life*, W. W. Norton, 1992.
5. GRIFFIN, D. R. *Listening in the dark*, Cornell University Press, 1986.
6. CARSON, R. *Silent spring*, Houghton Mifflin & Co., USA, 1962.

Technical

1. CHOPARD, L. *The fauna of India and the adjacent countries* (Lt.-Col. R. B. Seymour Sewell, ed.), *Orthoptera, Vol. 2: Grylloidea*; Baptist Mission Press, Calcutta, India, 1969.
2. DIRSH, V. M. *The African genera of Acridoidea*. Cambridge University Press, 1965.
3. GILLOTT, C. *Entomology*. Plenum Press, 1995.

4. KUMAR, P. AND VIRAKTAMATH, C. A. Illustrated keys for identification of common species of short-horned grasshoppers (Orthoptera: Acridoidea) of Karnataka and notes on their ecology and behaviour, *Hexapoda*, 1991, **3**, 53–70.

5. ROWELL, C. H. F. AND FLOOK, P. K. Phylogeny of the Caelifera and the Orthoptera as derived from ribosomal gene sequences. *J. Orthoptera Res.*, 1998, **7**, 147–156.

6. RUST, J., STUMPNER, A. AND GOTTWALD, J. Singing and hearing in a fossil bushcricket. In *Proc. 27th Goettingen Neurobiology Conf.* (N. Elsner and U. Eysel, eds), Georg Thieme Verlag, 1999.

7. SHAROV, A. G. *Phylogeny of the Orthopteroidea*, Israel Program for Scientific Translations, Jerusalem, 1971. (Translated from *Akademiya Nauk SSSR, Trudy Paleontologicheskogo Instituta*, 1968, **118**).