Commentary

G Neuweiler: An appreciation

G Neuweiler, incumbent of one of the most prestigious chairs in zoology in Europe since 1980, retired from office on 1st October 2003. His successor in the Zoologisches Institut der Ludwig-Maximilians-University is a former student, Benedikt Grothe. Neuweiler was the fifth incumbent of this chair established in 1828, succeeding such illustrious zoologists as von Seebold, Richard Hertwig, Karl von Frisch and Hansjochem Autrum. Neuweiler has earned his respite, but not repose, after a forty-year academic career involving teaching, research and steering of the course of science policy after the 1970s in Germany and in post-merger Germany. Along with S Krishnaswamy, Neuweiler was the co-architect of the Indo-German Project on Animal Behaviour, a bi-national venture under the 'Cultural Exchange Programme' of the UGC and DAAD, between 1978 and 1988. The IGPAB was a collaborative programme in research and teaching between the Zoology Department (first of Frankfurt University and after 1980) of the University of Munich and the School of Biological Sciences, Madurai Kamaraj University (MKU). The project led to significant findings on the biology, behaviour and the neurophysiology of echolocation of nine species of insectivorous bats of the Madurai. Further, Neuweiler was responsible in great measure for the extremely successful 'All India Intensive Training Courses in Neurophysiology' offered at the SBS/MKU in 1978, 1979 and 1981.

G Neuweiler addressing a session of the Indian Academy of Sciences, held in the School of Biological Sciences, Madurai University in November 1985.

Gerhard Neuweiler was born on 18th May 1935 in Nagold in the Black Forest as the fourth son of the school teacher Friedrich Neuweiler and his wife Luise. He went to school in the nearby town of Calw (the birthplace of Hermann Hesse) and later studied biology, chemistry, physics and biochemistry in the Universities at Tübingen and Munich between 1955 and 1962, obtaining his doctorate in 1962 *summa cum laude*. His research superviser was Franz Peter Möhres, first incumbent

of the first chair in zoophysiology of Germany. In 1963, when it was customary for his countrymen to make a bee-line to a university in the USA, Neuweiler came to the Zoological Research Laboratory, University of Madras as a DAAD post-doc. The reason he gave was: India was where the flying foxes were, and his doctoral thesis had been on the physiology of vision in the flying fox. The move resulted in a landmark research publication on the biology and behaviour of the Indian flying fox *Pteropus giganteus*. On his return to Tübingen he chose in 1970 for his *Habilitation* thesis (1978) the theme "Neurophysiological investigations on echolocation by the greater horse shoe-nosed bat *Rhinolophus ferrumequinum*". That year the neurophysiologist, who would make authoritative scientific contributions to the neuronal bases of the comparative physiology of animal behaviour, was born. I had the privilege of listening as a guest to his lucid introductory lectures; and to marvel at his pedagogical skills after he had become senior lecturer and earned the *venia legendi* (the right to deliver lectures), on neurophysiology. This was in the Zoologisches Institut, in a big lecture hall of the University of Tübingen. Neuweiler's subsequent work and career, tilted toward an upward trajectory. He became reader first and soon afterwards was offered the post of professor in Berlin University in 1971 (which he turned down), the Chair in zoology at Frankfurt University (which he occupied between 1972 to 1980) and finally took up the Chair in zoology at the University of Munich. Neuweiler's career and science were shaped also to a large extent by the forces, traditions, ideas and idealistic milieu prevailing at that time in the schools, universities and centres of learning of Germany and Central Europe. Neuweiler became well known in academic circles for an open article he wrote in 1969, when the student unrest in Europe and the USA was in full spate. In it he criticised the autocratic attitudes of the German Ordinarius Professors and cited his own boss as a exemplar embodying these qualities. The unusual feature of the article, as *Die Zeit*, the newspaper that carried it said, was that G Neuweiler was the author's real name. He was then a mere '*Wissenschaftlicher Assistent*' (Scientific Assistant, roughly comparable to an American post-doc). The period was one of enforced servility of *Assistents* to the all-powerful Professor (*Ordinarius*). That was courage of conviction of a high order. Later, when he became an Ordinarius himself, Neuweiler was a model of fair-play and transparency in his transactions with his colleagues and students. At one stage he agreed with the complaints of his students that regardless of the placement of Neuweiler's name in the list of authors, the research paper was attributed to him, owing to his standing in science. Solution: they would write papers without names of authors and the attribution would read 'Arbeitsgruppe Neurophysiologie'. (When my opinion was sought on the matter I said 'the day my name cannot appear on a paper I quit this vocation'.) Neuweiler told me that H Autrum, editor of *Journal of Comparative Physiology A*, also felt that the idea was good but that there could be problems in citation.

Neuweiler's scientific contributions have been in the general area of the neurophysiology of echolocation in insectivorous bats. He worked out in detail the fine structure of the collicular responses to frequency modulated echolocating sounds in the greater horse shoe-nosed bat *Rhinolophus ferrum-equinum*. In the field of bat echolocation the biologists working in the USA were the leaders until Neuweiler and his students began their researches. In a far-sighted move Neuweiler had invited all the neurophysiologists working in the area to his laboratory as his guests. He had also convinced the Alexander von Humboldt Foundation and the German Research Union (DFG) of the need to offer bigger salaries to his guests from the USA to make it attractive for them to cross the Atlantic. He himself either did not find the time or had no inclination to stay long in any laboratory in the USA. These collaborations with his American counterparts resulted in first rate work on the adaptation of the peripheral auditory system of insectivorous bats for reception and analysis of the various components in orientation sounds and echoes (Suga *et al* 1976).

Ever since 1963 at the University of Madras (where I was then a Ph.D. research student) I have had a ringside view of the life and work of Gerhard Neuweiler. The friendship we then struck has grown in these forty years, often resulting in consultation, collaboration, and material, spiritual, and mutual support. Even though his stay in the India of forty years ago could not be described as comfortable, it changed his outlook and philosophy of life, profoundly and irrevocably. In a recent letter he wrote (I translate freely): "20.4.2003. Forty years ago began a one and a half year adventure, which has made of me what I am today. I came to a culture, of which I did not have the faintest appreciation, which yet overwhelmed me by its pragmatic wisdom with its attendant dynamism and aesthetic intensity. I

learnt in India that to forego possessions sets one free – yet I possess half a house. I also learnt, first and foremost, that there can be nothing more rewarding than to learn to reflect upon the different values of other cultures and thus to free oneself of prejudices and presuppositions'. He is fond of alluding to India as his second home.

Based on his laboratory neurophysiological and field ethology studies at Madurai Neuweiler confirmed that bats which forage in open spaces indeed have the most sensitive hearing for the frequencies of the 'constant frequency-CF' part of their own echolocation calls. For example, among the Madurai bats, the frequency at which hearing is most sensitive is 18 kHz (best hearing frequency-BHF) in *Tadarida aegyptiaca*; 25 kHz in *Taphozous melanopogon*; 35 kHz in *Rhinopoma hardwickei*, and 50 kHz in *Pipistrellus mimus*. The higher the BHF in these species the lower they fly, and the more restricted their foraging area. Neuweiler (1984, 1990) has summarized the findings and reported that the insectivorous bats of Madurai foraged in three modes: (i) Surface gleaning, (ii) Foraging within foliage and (iii) Open air foraging. An important outcome of the study was the demonstration that the constant frequency/frequency modulation (CF/FM) features and the bursts of trains of 150 to 250 ultrasonic pulses per second emitted by the bat species while hunting, adaptively varied according to the mode of foraging and topographic features of the feeding habitat.

This comparative study on audition conducted by Neuweiler, his students and my students K Sripathi and G Marimuthu, was unique in that they employed bat species from a single community living around the MKU campus. This area is diversified and comprises cultivated land, paddy fields, numerous ponds, a river, open grassland, scrub jungles and orchards, offering sumptuous resources for insectivorous, carnivorous and frugivorous bats. Neuweiler often told me that the best days of his life were those which he spent in Madurai doing field work at night with me, my students and technicians. He summarized his findings in the best review of the subject of audition in bats in 1990. He, more than any other neuroethologist, established that hearing in bats is a paradigm for mammalian (if not vertebrate) audition. In spite of his total devotion to research and teaching Neuweiler never turned away from the broader issues of science policy as reflected in the many public offices he held.

References

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