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CORRESPONDENCE

Darwinian style . . .

We read Ganeshaiah's article[1] with interest. The article is lucid, informative and analytical. It raises important issues on adaptation, natural selection and on Panglossian paradigm[2]. We would like to respond to the article as the author has used our paper[3] exclusively to prove his points of view.

Cardamom–honeybee system is an ideal system to test several hypotheses in pollination ecology. When we started our studies, one of the basic questions that bothered us was the great difference between corolla tube length and the pollinator's proboscis length. They just do not correspond and the honeybees do not seem to fit into the system at all. But several studies have proved beyond doubt that honeybees are the perfect pollinators of cardamom[4–6].

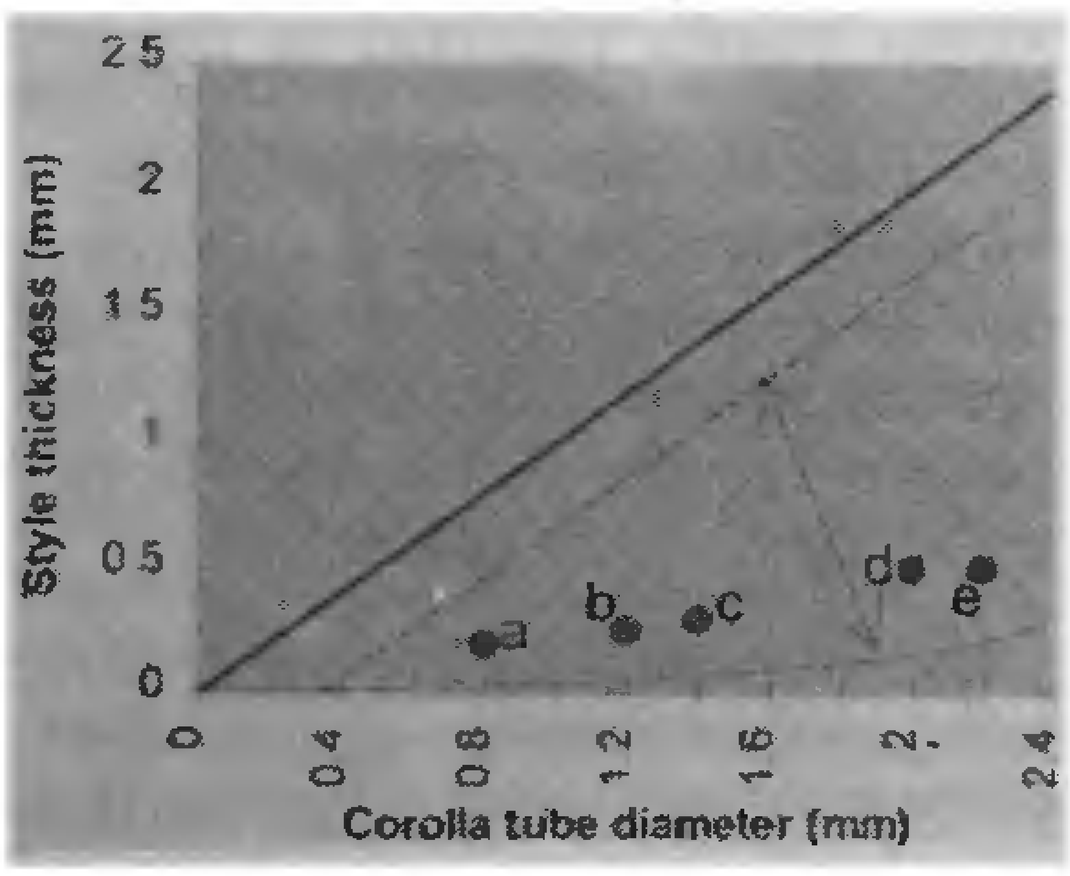

Figure 1. Relation between corolla tube diameter and style thickness. The top diagonal line indicates the limit of style thickness where it is equal to corolla tube diameter and a thickness close to it would result in little or no nectar available. The actual functional domain for style thickness may fall anywhere between the lower limit (curve) and the second diagonal line which approximately equals corolla diameter minus the proboscis thickness of pollinators (indicated by arrow). Style thicknesses of cardamom and its related genera fall within this domain. a: Cardamom; b: *Hedychium* sp. 1; c: *Alpinia* sp. 2; d: *Alpinia galanga*; e: *Amomum* sp. 1.

The style in the corolla tube of cardamom does not stand all by itself. It is supported by the stamen tube. Hence the morphospace available can be wider than envisaged by Ganeshaiah (see figure 3 in ref. 1). The functional domain for style thickness as proposed by him suggests that the difference between the diameter of the corolla tube and the style thickness should not be too high. Supposing the corolla tube diameter is 1 mm, the style thickness should be almost 1 mm. In case that the style would be so thick that the quantity of nectar available would be too less and probably there will not be any room for the proboscis even. Keeping this in mind, we plotted the style thickness of cardamom (*Elettaria cardamomum*) and its related genera, viz. *Alpinia*, *Amomum* and *Hedychium* (*Elettaria* is a monotypic genus), against their respective corolla tube diameters. We see that none of these species fall close to the upper limit of functional domain (Figure 1). And hence, we suggest that the functional domain should extend from the lower limit of the style thickness till about the diameter of the corolla tube minus the thickness of the proboscis of the pollinator. When the functional domain is wider, it is reasonable to assume that a selection on the thickness of style could operate to balance the cost/benefit for the plant and the pollinator. Within this functional domain, there is a possibility of existence of variation in thickness, and the plant population experiences a higher or lower probability of successful pollination of a larger or a fewer number of flowers, and in turn result in a greater or lower fitness. Since a thicker style allows bees to take more nectar (because they can draw it from a deeper level)[3], bees with a constraint on their crop capacity (40 μl)[8], would visit far fewer flowers. Thus it is reasonable to presume that the plant tends to offer less nectar on each visit, in order that more flowers are visited by a bee. This it achieves by reducing either the rate of nectar production or nectar availability. The latter is probably achieved by variation in style thickness. And definitely there should be a limit for the thickness up to which bees can effectively draw more nectar. Beyond this limit the quantity of nectar stored itself will be lower and the bee will be at a disadvantage.

With whatever information on style thickness we have at present, we hypothesize that style thickness also might have contributed for evolution of the system, even if we are dubbed as adaptaionists akin to 'smart, articulate tourist guides', at least, till more data is generated on more number of species.

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... or a Panglossian guile?

Belavadi and Vivek (BV) point out that the functional domain might not be along the diagonal of the morphospace limited by the diameters of corolla tube and of style as defined in my commentary[1] because (a) corolla has other structures as well in it (e.g. anther tube), and (b) there shall be a certain (minimum) threshold diameter of the nectar column in the corolla tube such that honey bee derives at least a certain amount of reward on visiting a flower. However, if we denote the vertical axis of morphospace (corresponding to corolla) as the effective diameter of the corolla available after accommodating for both (a) and (b) above, then effectively the functional domain defined and the argument thereof in my article do not change; natural selection would still shape the style to move the system to such newly defined functional domain.

Second, while I do not disagree with BV's suggestion that style could be subjected to natural selection, my caution was that one cannot be too sure. In fact one major reason for comparing their argument with the Panglossian paradigm was that they state in the abstract of their paper that 'plant facilitates pollinators to draw more nectar, by keeping the style within, and that the thickness of style may have some significance in the evolution of the system'. Till they demonstrate the role of natural selection, BV cannot escape from the pangs of the Panglossian paradigm.

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NEWS

Quasicrystals*

The past fifteen years have witnessed several fascinating discoveries in materials science. Among them the discovery of quasicrystals in 1984 by Dan Shechtman and his co-workers led to a paradigm shift in our understanding of atomic configurations in the solid state[1]. Equally remarkable is the discovery of a new allotrope of carbon by H. W. Kroto *et al.*[2] in 1985. This beautiful molecule has been christened as Buckminsterfullerene. In 1986, J. G. Bednorz and K. A. Mueller astounded the world by their announcement of a high temperature superconducting ceramic material[3]. This succession of new materials has presented the materials scientists with an embarrassment of riches. These three seminal discoveries have attracted an extraordinary effort from the scientific community. Thus we find in 1995 W. W. Mullins in his Von Hippel Award address before the Materials Research Society of the USA emphasizing them as milestones in the evolution of materials science[4]. In 1996 Alan Cottrell in the Inaugural Hirsch Lecture at Oxford University, UK described the three developments as 'surprises in materials science' and forecast future surprises[5]. In all the three areas the Indian scientists have made significant contributions. Here we report the developments in one field, namely quasicrystals, as captured in a recent conference. This conference was a continuation of the international meetings on quasicrystals, with the first five meetings being held at Les Houches (France, 1985), Beijing (China, 1987), Vista Hermosa (Mexico, 1989), St. Louis (USA, 1992) and Avignon (France, 1995). The ICQ6 was organized under the joint Chairmanship of T. Fujiwara and S. Takeuchi and sponsored by the Yamada Science Foundation, Japan (under the banner of Yamada Conference, XLVII) and supported by various societies such as the Physical Society of Japan, the Japan Institute of Metals and the Japan Society of Applied Physics. Nearly 200 delegates participated in the conference from more than twenty countries, mainly from Japan, Germany, France, China, USA and India. This time, there were five participants from India – S. Ranganathan (IISc.), U. D. Kulkarni (BARC), N. K. Mukhopadhyay (NML), Arvind Sinha (NML) and Alok Singh (IGCAR). S. Ranganathan chaired one session. The conference was divided into 19 sessions where 45 and 145 papers were presented in oral and poster sessions respectively. A night session was also organized on 28 May at the National Olympic Youth Memorial Centre for young researchers.

Major results reported at the conference

The topics of presentation were classified into eleven categories. The topics along with the number in square bracket, indicating the number of papers in the particular topic, are as follows:

(i) Mathematical physics and generalization of crystallography [32]; (ii) Crystalline and related cluster compounds [12]; (iii) Metallurgy: Sample preparation and phase diagram [22]; (iv) Phase stability [20]; (v) Defects: Point defects, phasons, dislocations and diffusions [7]; (vi) Dynamical properties: Phonons and phasons [9]; (vii) Mechanical properties: Elastic and plastic properties [15]; (viii) Electronic properties: Optical, transport and magnetic properties [45]; (ix) Applications: Processing, coating and nanostructures [5]; (x) Structure [15]; (xi) Surface [8].

Subjectwise, the themes can be broadly grouped as synthesis, structure, stability,

*Report of the Sixth International Conference on Quasicrystals (ICQ6) held in the University of Tokyo, Japan from 26 to 30 May 1997.