Possible interaction between practising physicists and IAPT

In 1977 the UGC organized at University of Mysore a Southern Regional Conference on COSIP (College Science Improvement Programme). Science teachers and principals of colleges in Andhra Pradesh, Karnataka, Kerala and Tamil Nadu identified at that time for COSIP attended. Professors in university departments involved in COSIP all over the country and some senior professional scientists like Raja Ramanna also attended the conference. Following a lecture by Ramanna, there was a discussion during which the need for interaction between professional scientists and college science teachers was brought out as a means for improvement in science teaching. As it very often happens in our country there was no follow up on the suggestion and now in 1993, 16 years after the conference, we find we are again at the origin.

G. Venkataraman has deplored (*Curr. Sci.*, 1993, 64, 546) that 'there is hardly any evidence of purposeful linkages between professional physicists and IAPT' (Indian Association of Physics Teachers).

In 1993 we are better placed than in 1977. As observed by Venkataraman we have 'a fairly active association of physics teachers' *(ibid)* with about 2500 life members spread almost evenly all over the country, and there is the monthly Bulletin of IAPT that takes messages to all its members regularly. Professional physicists could use this Bulletin to share their ideas on improvement in physics education. Also periodic interactions between professional physicists and physics teachers, especially of schools in remote areas, would be a great source of inspiration for the teachers. Some physicists at Indian Institute of Science, Bangalore have been doing this in certain remote areas in Karnataka. Such programmes could be arranged through IAPT.

On behalf of IAPT may I extend an invitation to all professional physicists to join IAPT and serve the country in improving the quality of training in physics imparted to our young students in the lecture classes and in the laboratories.

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SCIENTIFIC CORRESPONDENCE

On the 'monocarpic' flowering of bamboos

Bamboos have age-old connections with human civilization. They have fascinated craftsmen and scientists for a long time. They are cheap and can be used for a variety of purposes. They are also good for afforestation, social forestry and soil conservation[1]. The major use of bamboos is in the paper and rayon industries. Bamboos are peculiar in their flowering behaviour. In most species of bamboos, all members of a species in an area, after growing for a species-specific period of 3–120 yr by rhizome and branch production, produce wind-pollinated flowers, set large quantities of seed and die. Most of these seeds, which are produced over a few months, fall on the ground and germinate with the onset of ensuing monsoon. This phenomenon of death of the parent plant after flowering and setting seeds only once in the life cycle, at the end of the vegetative growth phase, is known as 'monocarpic' or 'semelparous' flowering. The semelparous species differ from their iteroparous (those which continue to flower annually for many years after reaching maturity) mast seeding counterparts in that the timing of seeding is set by an internal physiological calendar rather than by a weather cue[2]

Bamboos are members of the grass family. Monocarpic flowering is very common among the members of this family. Most of them are seasonals or annuals, growing for a season or a year and dying after flowering and setting seeds. Grass family is one of the largest families of flowering plants and contains about 10,000 species and between 650 and 765 genera In spite of its size, the family is a coherent one. Its members exhibit characteristic combinations of unusual morphological and anatomical features. Their phyllotaxy is basically distichous Ligulate sheathing leaves are with an epidermis containing long cells, short cells, silica bodies and stomata with subsidiary cells and dumb-bell-shaped guard cells. Flowers are reduced with uniform construction in spikelets. Caryopses are with abundant, starchy endosperm and a laterally placed, very peculiar embryo. Grasses have a high capacity for hybridization and polyploidy. Their morphology, anatomy, habitat and reproductive cycles contribute to the competitive success and versatility of the members of the grass family. They have intercalary meristem in stems and leaves, and protective leaf sheaths. Their habit is mostly herbaceous, with short life cycles. Seed production is regular and abundant and their dispersal is highly efficient. They also exhibit a propensity for vegetative reproduction[3].

Probably because (i) most of the bamboos grow as thick forests before flowering and seeding, (ii) culms (stems – a vegetative plant part) are the produce of economic importance as against seeds in the case of cereals (common members of the grass family everybody is familar with), and (iii) the whole forest, which is very conspicuous because of its size (50–100 ft), dies after seeding, the monocarpic flowering in bamboos has attracted much attention.

On the question of 'why does the parent die?', Janzen[2] in his famous article 'Why bamboos wait so long to flower' states. 'It is perplexing that the adult mast seeding bamboos die after bearing seed in a mast year. The literature marvels over the phenomenon but takes little effort to explain it.'

Nicholson[4] postulated that the death of the adult bamboos removes the intense shade they cast, thereby helping the establishment of the seedlings. Janzen[2] interpreted the death of the adult as being due to the heavy selection for producing a large seed crop which allows only a small amount of the resources to be saved for the establishment of the adult after seeding. A small amount of resources may not be sufficient to maintain an adult plant in the face of competition with a large number of its own seedlings and other species of plants, the challenges by herbivores and diseases faced by the adult and the challenges of many herbivores attracted by the seeds and the seedling crop. Holding back enough resources by the parent plant would jeopardize the size of the seed crop. In support of this view Janzen points out the survival of flowering by some of the long-lived and larger species of bamboos when they are protected from normal forest competition and provided with heavy doses of fertilizers[5,6]. It is not known how long they survived and how healthy they grew. One more physiological problem faced by a semelparous mast seeding bamboo becoming iteroparous, according to Janzen[2], is that it would need two in-built calendars instead of one: one to tell how long it has been since it germinated and the other to tell when it flowered last.

About Nicholson's[4] postulation, Janzen[2] states that 'its evolution probably requires that the seeds of an individual parent (clone, clump) usually end up directly below the parent. Otherwise, the individual parent would be dying to open a site for the offsprings of other individuals, which is not too likely unless the members of a cohort are closely related, which they, of course, may be after many generations of inbreeding. To create an open area beneath itself, all it need do is drop its leaves for a year and live off reserves stored in the rhizomes or photosynthates from a few leafy stems'.

Flowering culms of bamboos when cut down give new coppices which also flower and set seed. In the case of rice also, when the stumps after a harvest are allowed to remain in the field and moisture is retained, they produce coppices which give a minor crop. This phenomenon is fairly common among the grasses. The questions which remain to be considered are: (i) whether individual parents die for their own offsprings, and (ii) whether the seeds of an individual end up directly below it or reach below some other individual. It is to be kept in mind that most of the members of the grass family are wind-pollinated. Profuse seed set can take place only when many individuals are flowering in the same or nearby areas at the same time. Under such circumstances, wherever an efficient seed dispersal system exists, the seeds will be widely dispersed. In other cases the seeds will end up directly below their parents. When all the individuals of the flowering cohort produce seeds and die, it does not matter much whether the seeds of an individual parent reach directly below the same parent or another parent. If the parent is considered as dying to remove the intense shade they cast, the death, after producing a seed crop, of those species of bamboos which do not grow tall and cast a considerable shadow on the ground as well as those members of the grass family which do not grow more than a few inches will appear as committing suicide for no apparent reason.

Most of the bamboo species for which chromosome numbers are known are polyploids. Among them those which are hexaploids are much larger than their tetraploid relatives and the true diploids are still smaller[7]. It needs to be looked into whether a parallel can be drawn between their size and the extent of the period of their vegetative growth.

Now the question is whether to consider 'monocarpy' in bamboos as something very peculiar or accept it as a feature they share as members of the grass family. It is possible that the extension of their life cycles is a consequence of polyploidy. What is interesting in bamboos is the extension of the length of their intermast period. Once we get to know how this takes place, we may be able to either lengthen or shorten the intermast period for the benefit of mankind.

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