The Power for Change

The Power for Change
Botanic Gardens as Centres Of Excellence in Education for Sustainability

Proceedings of the 4th International Congress
On Education in Botanic Gardens, 8-12 November 1999
Hosted by the Tropical Botanic Garden and Research Institute,
Thiruvananthapuram, Kerala, India.

Plants for the Planet

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The Botanic Gardens Conservation International team worked hard to develop a strong programme that provided a diversity of presentations and workshops addressing the congress themes and the inspirational work from botanic gardens around the world. We are appreciative to the presenters whose contribution to the congress made it such a success by sharing their ideas, raising issues for concern and illustrating the creative ways that these issues are being addressed in local and regional areas.

In addition, we are very grateful to the following sponsors and individuals who supported the congress and congress delegates through donations and coordinating fund raising events: Air India; British Airways Assisting Conservation; The British Council (Chennai); Morel Trust; Tata Tea Ltd; Kochi; Zandu Foundation for Health Care (Mumbai); and Dr. Hew Prendergast, Robert Brett and Gail Reeves from the Royal Botanic Gardens Kew, UK.

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International Organising Committee
4th International Congress on Education in Botanic Gardens

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FOREWORD

On behalf of Botanic Gardens Conservation International I am pleased to write the foreword for the congress proceedings of the 4th International Congress on Education in Botanic Gardens held in Thiruvananthapuram, India, 8-12 November 1999.

India is celebrated for its biological and cultural diversity making it a very appropriate venue to debate the importance of botanic gardens as centres of excellency in education for sustainability. Throughout the congress, delegates from 22 countries took the opportunity to share ideas, and resources and discuss concerns relevant to the congress themes: Education for Sustainability, Beyond the Limits: Rural and Community Outreach, Development Education and Environmental Ethics, Teaching our Traditions-Medicinal Plants and Ethnobotany, and New Trends in Science Education. The keynote speakers challenged our thinking in these areas and the other presenters showcased the crucial work that is being carried out in botanic gardens to address environmental and sustainability issues and implement the recommendations of international conventions and guidelines such as the Convention on Biological Diversity and Agenda 21.

The importance of partnerships with communities, governments and non-government organisations was highlighted throughout the congress. Only by working together and sharing ideas and resources, skills and knowledge can we hope to work towards a more sustainable future.

BGCI is very grateful to the Director and staff of the Tropical Botanic Garden and Research Institute, Thiruvananthapuram, India for organising a successful congress and a diverse programme that so inspired congress delegates, and express our thanks to all of the sponsors who supported the meeting.

I hope that the work presented in these congress proceedings will be an important reference work for readers and inspire botanic gardens staff and others throughout the world to use the illustrated education programmes as models for developing similar programmes in other parts of the world.

30th January, 2001 Peter S. Wyse Jackson
Botanic Gardens Conservation International

Education for Sustainability

RECONSTRUCTING AND REPRESENTING NATURE: THE CHALLENGE FOR BOTANIC GARDEN EDUCATORS

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I am pleased to be at your conference and to have the opportunity of presenting a keynote that will suggest some guidelines for botanic gardens seeking to become centres of excellence in education for sustainability (EfS). My letter of invitation suggested that you would be particularly keen to explore how plants raise development and environmental issues and how you might explore such issues in your work.

My approach is in two parts. The first theoretical part suggests that Ayruvedic philosophy and medicine shares with critical theory and critical EfS certain assumptions about the health of the individual and society and the links between health, education and sustainability. Ayruvedic medicine and critical EfS suggest that doctors and teachers require appropriate theoretical knowledge, clarity of reasoning, wide practical experience, and personal skills. The second more practical part suggests how the critical educators for sustainability might explore development and environmental issues in a botanic garden. Three case studies, each using one of the healing plants of India as a focus, have been chosen to illustrate the issues raised by genetically modified plants, new gardening in Britain, and community gardening around the world. The case studies respectively serve to illustrate the importance of the content and pedagogy of the botanic garden curriculum and the locations where it is delivered.

The theme that runs through my keynote is the social construction and presentation of nature. At a time of profound social change, that encompasses the process of globalisation, nature is being increasingly capitalised (given a price and made the subject of market transactions) and enframed (represented by texts of all kinds as in advertisements, television documentaries, environmental campaigns, and brochures for botanic gardens) (Braun and Castree 1998). The rise of biological and information technologies, together with the increasing significance of the cultural economy, means that nature and society are increasingly inseparable. Nature is both the site of new forms of capital accumulation and the source of increasing numbers of signs and symbols that pervade our everyday lives. Societies that formerly expanded outwards to push back the frontiers of non-commodified nature and create such phenomena as commercial agriculture, now turn inwards to remake these social natures afresh and commodify such new ones as the human body. This process

is legitimated and challenged by the various discourses of environmentalism (Dryzek 1997) as new natures are constructed both in reality and in our imaginations. The discourse of sustainable development can mask the ways in which nature is constructed in ways that disadvantage the poor, women and certain races, and we will see that environments, meanings and educations created in the name of sustainability are often challenged.

Such challenges should extend to botanic gardens. At a time when dominant forms of nature are being constructed and represented in unsustainable ways, can botanic gardens and their educators reconstruct and represent nature in more sustainable ways? For guidance as to how this might be done let us look first to Ayurvedic philosophy and medicine.

AYURVEDIC PHILOSPHY AND MEDICINE

Ayurvedic philosophy (Patnaik 1993) maintains that people's highest goal is to understand the principle of Brahman, the unity of life, or how we are linked to the rest of human and non-human nature. Such understanding promotes health, or a sound body, mind and soul, because people are not isolated from their own energies or from the energies in the world that surrounds them. Mental health depends on their ability to live in harmony with their inner nature; spiritual health on their ability to live in harmony with external nature. The physical, mental and spiritual health of individuals and the health of society are all related, and by using healing plants to improve people's physical and mental health, the Ayurvedic doctor seeks to promote their spiritual health and the health of society.

Ayurvedic philosophy further maintains that people are the highest form of life and that they should act as stewards, ensuring that the fragile balance of nature and living organisms is not disturbed. They should live sustainably, preventing pollution and the wanton destruction of nature, replacing what they take from nature, and reconstructing damaged nature. Ayurvedic doctors are the guardians of the knowledge and values that enables society to live in this way. Professional ethics require them to devote themselves to the health and sustainability of society while their training ensures that they have appropriate theoretical knowledge, clarity of reasoning, wide practical experience, and personal skills.

CRITICAL SOCIAL THEORY AND EFS

Like Ayurvedic medicine, critical EfS is based on theory that seeks to heal the separation or alienation of people from the rest of nature. This critical social theory is based on dialectical and systemic materialism and unites the study of nature and society through such philosophical frameworks as that provided by critical realism (Collier 1994; Dickens 1996; Soper 1995). It rejects the modern scientific notion of an objective, knowable nature, outside society, and like the traditional wisdom of India, pictures a total reality that is the product of ecological and social processes. Ecological processes result from structures in the physical and biological worlds (ecological relations) that allow a realist concept of nature. This suggests that nature is the permanent ground of all human activity and environmental change that sets elastic limits on how we live or might try to live. Social

processes are a distinct subset of ecological processes since humans have the ability to form social relations that affect their behaviour and ecological relations. Habits, customs, laws, language, and such institutions as botanic gardens, are the outcomes of unique articulations of social relations in time and space. They are products of class, gender, political, spatial and other relations that act back on ecological relations ensuring that all places, environments and natures are socially constructed, both in a material and discursive sense.

The critical social theory of the environment that has developed over the last twenty years (Goldblatt 1996) leads to distinctive kinds of environmental politics and education. Environmental politics becomes a struggle over social relations, their impact on ecological relations and on our physical, mental, spiritual and social health. Production and consumption within the capitalist world economy is ecologically unsustainable because it fails to reproduce the conditions of production (ecological resources and services) on which it depends. At the same time it is socially unsustainable, because it requires social relations based on inequity and domination at all scales from the local to the global. Radical environmental politics seeks to democratise social relations in order that mutually beneficial relations between humans, between humans and other species, and between organisms and their environment, can be sustained. It seeks to change the institutions, beliefs and practices that reproduce unsustainable social relations and to this end engages in action at many sites (the family, community, the economy, the state, botanic gardens). Such action aims to end domination, democratise and decentralise power and establish an economy that meets social needs in an ecologically responsible way (Hartmann 1998).

Like Ayurvedic medicine, critical education for sustainability that draws on critical theories of the environment and education, seeks to enlighten people as to the unity of nature and society and the manner in which changed social relations might promote more sustainable and healthy ways of living (Huckle 1993; Huckle and Sterling 1996; Fien and Tilbury 1998; Plant 1999). It too is guided by a stewardship ethic and recognises that such an ethic is more likely to emerge once people realise that the world they inhabit is their own construction and responsibility. Critical and participatory forms of democracy, citizenship and education can then allow them to turn the actions whereby they construct nature into the objects of explicit and discursively justified communal choice (Dryzek 1996). A process of praxis, or critical action research (Rahman 1993), allows them to create socially useful knowledge, by testing a wide range of ideas and values in action. In such settings as those provided by the Local Agenda 21 process, it can enable sustainability to be translated into a regulative social principle, expressed in laws and an ecological social contract between the state and the responsible citizen (Selman 1996).

Critical environmental educators, like Ayurvedic doctors, are committed to the welfare of their students and society and require an appropriate professional education. They should be able to use critical theory of the environment to enlighten and empower their students and critical pedagogy (Gadotti 1996) to clarify reasoning in ways that counter dominant ideology and charges of indoctrination. They should have experience of assisting the transition to sustainability in a wide range of sites and the personal skills to inspire their students with visions of more sustainable futures. Topics suggested by three of the healing

plants of India suggest how such professionalism might currently inform the EfS carried out by botanic garden educators.

BLACK PEPPER, GENETICALLY MODIFIED PLANTS AND CRITICAL KNOWLEDGE

Black pepper, long a key item of Indian trade, is used in the mixed spices that form the basis of curry powders and to alleviate colds and coughs. It is just one of the many plants that has been subject to bioprospecting; the process whereby a handful of transnational seed, agrochemical and pharmaceutical companies assert property rights over species with the help of governments and intellectual property regimes. The companies suggest that they will use their newly acquired rights in nature to develop more sustainable forms of agriculture that help to solve the world's food crisis. Their critics reject such property rights, seek a different approach to biotechnology, and argue that the world's food problems are best tackled by forms of sustainable development that improve traditional agriculture through land reform, permaculture, intercropping, composting, cheap credit, and other innovations.

How should botanic garden educators present the debate on biotechnology? How should they encourage people to recognise what Riffkin (1999) has described as the hard and soft paths to a future shaped by this technology (Figure 1)? Clearly the two paths are informed by different views of nature, different kinds of knowledge, and serve different political interests? Vandana Shiva reminds us that in educating for sustainability we have to reveal these interests and persuade people that no technology is inevitable or beyond our control. We also have to facilitate community empowerment in order that they can act.

> Ordinary people just need to realise that gene technology is not a cosmic phenomenon, globalisation is not a cosmic phenomenon, patent rights are not a cosmic phenomenon. They are human endeavours. They are not beyond our control. Community empowerment is to me the heart of resistance. People just need the right information in order to act.
> (Vandana Shiva 1997, pp28-29)

Community resistance to hard applications of biotechnology can be found in the North and South. How should botanic garden educators encourage consumers in the North to network with farmers in the South? How should they tell the stories of farmers, such as those in India, who are caught up in a growing ecological and social crisis, partly caused by green revolutions that failed to deliver what they promised (Vidal 1999b)? How should they counter the public relations and media rhetoric of the biotechnology companies and their supporters in government who regard trade liberalisation and biotechnology as the keys to food security? And having engaged visitors in the politics of biotechnology, bioprospecting and intellectual property rights in nature, should botanic garden educators suggest, as Shand (1997) recommends, that the conservation of biodiversity depends on the conservation of human diversity?

Hard Path	Soft Path
Nature as external to society and to be 'tamed', 'mastered' and 'controlled'.	Nature as a seamless web of symbiotic relationships and mutual dependencies that includes society or human nature.
The world is seen in reductionist terms and scientists regard themselves as grand engineers, continually editing, recombining and reprogramming the genetic components of life to create more compliant, efficient and useful organisms that can be put to the service of humankind.	The world is seen in dialectical and systemic terms with the earth and its living things constituting a single (differentiated) organism – the biosphere. Scientists and others should engage in subtle forms of manipulation that enhance rather than sever existing relationships.
Molecular biologists insert alien genes into the biological code of food crops to make them more resistant to herbicides, pests, bacteria and fungi. They envision these engineered hybrids living in a kind of genetic isolation, walled off from the larger biotic community, and ignore the environmentalists' fears of genetic pollution.	Ecologists use the new genomic information to help them understand how environmental factors affect genetic mutations in plants. They use the new scientific knowledge to improve classical sustainable farming methods, such as breeding, pest management, crop rotation.
Uses the new genetic science to engineer changes in the very blueprint of species.	Uses the same genetic science to create more integrative and sustainable relationships between existing species and their environments.
Privately financed, centralised, corporate control. Establishes ecological monocultures and erodes biodiversity and human diversity.	State financed, decentralised, community control. Promotes biodiversity and human diversity.
Promotes academic knowledge over local knowledge.	Values local knowledge.

Figure 1: Two views of biotechnology (based on Riffkin 1999)

> We cannot save the world's biological diversity unless we nurture the human diversity that protects and develops it. We cannot afford to undervalue the traditional knowledge of rural people. Without it we lose our last, best hope for salvaging and developing the living resources upon which we all depend.
> (Shand 1997)

Clearly your answers to such questions determine the kinds of knowledge you will need to educate for sustainability. Giving soft paths to a future with biotechnology more visibility and consideration in your botanic garden means giving greater attention to new approaches to the natural and social sciences, people's local knowledge of plants, and political struggles for alternative futures. The content of your displays, presentations and lessons, may well be challenged for in some botanic gardens you are likely to upset existing interests.

THE HUNDRED LEAF ROSE, THE NEW GARDENING AND POSTMODERN PEDAGOGY

The hundred leaf rose is widely used in India for perfumes, to make a gentle laxative, and to flavour sweet dishes. It provides a bridge to gardening in Britain where roses remain one

of the most popular plants. Gardening in Britain is currently big business, with consumers spending £3 billion each year (£80 million on garden gnomes!) and the industry growing at 20% a year (Vidal 1999a). Much of this growth is prompted by a new kind of gardening programme on television, that fosters the cult of the instant garden; through which people are encouraged to express themselves and make an aesthetic or lifestyle statement through their gardens. The new gardening is made possible by new technologies in container growing that allow 'just in time' gardens, and seeks to sweep away the mystique of seeds, catalogues and cuttings that surrounded the old gardening programmes. It is presented as entertainment and fantasy by the media with gardens becoming fashion led living spaces. Plants are valued like furniture; the new gardener wants them instantly and will dispose of them once the fashion passes.

Like the gardens of the past, the instant garden reflects social and cultural trends in contemporary Britain. In disorganised capitalism or what some label postmodernity, the foundations of social structure and agency shift from the sphere of production to that of consumption. Identity and politics are increasingly focussed on the goods, services people consume and the images and meanings which surround these commodities. Those with money, can select from an increasing range of gardens: wildflower, cottage, organic, religious, minimalist, etc. Style, image and presentation are everywhere, and the garden is increasingly a statement of ownership, freedom, lifestyle, pleasure, and identity. Many public parks and gardens lie neglected and the dominant designs express control over nature rather than stewardship.

David Hartley (1997) describes the postmodern society that has produced the new gardening and the new gardener.

> Capitalism in its quest to establish insatiable demands has commodified not just a material world, but the social and psychological. Our identities are literally wrapped up in the packages which we buy. We display our identities, for a price, in style, a style whose life-span is short, soon to be re-made from the re-stocked shelves which lure us to them. Images are traded. Bodies are cared for. And we consume the info-products as easily as we consume those material products that are essential to our physical survival. The fix is quick, but it is fleeting. It all costs money. Those who lack it can 'choose' either to languish as non-consumers (and therefore as non-beings) or to steal it, at risk to themselves and to others.
> (Hartley 1997, p73)

How should botanic garden educators respond to such changes? Clearly there is a role for cultural theory in informing the content of displays, publications and lessons, but I wish to focus on the shifts in pedagogy or the teaching and learning process. The new gardening suggests that postmodern individuals are rather different from modern individuals, in the ways that Thompson suggests (Figure 2).

The Enlightenment Subject	The Postmodern Subject
• Is HOMOGENEOUS – all subjects share the same basic nature; • Is UNIFIED – individual subjects do not possess internal contradictions; • Is RATIONAL – characterised by the power of conscious reason; • Is AUTONOMOUS – able to exercise its reason in order to be self-governing; • Is STABLE IN IDENTITY – unchanging over time; • Is an INDIVIDUAL – possessing unique qualities and abilities (although not different basic natures) that mark it out as distinct from all others. **A sovereign individual, with a solid and stable core, possessing powers of rational autonomy.**	• Is HETEROGENEOUS OR FRAGMENTED – patched together out of a variety of different bits of values, identities and beliefs; • Is DISPERSED OR DECENTRED – characterised by all sorts of internal divisions, such as that between consciousness and unconsciousness; • Is SOMATIC - inseparable from the body and its needs and desires; • Is CREATIVE – while lacking the modernist power of autonomy, it may be inventive in ways unknown to the modernist subject; • Is UNSTABLE – changing over time; • Although not a self-contained individual, the patchwork of which it is composed may mean it is at least IDIOSYNCRATIC. **A complex combination of relatively random components**.

Figure 2: The modern and postmodern subjects compared (Thompson 1998, p148)

Disorganised capitalism encourages and requires more fragmented, decentred, somatic and reflexive individuals, who are able to assess and criticise their own values and behaviour and alter them if necessary. The unified knowable self has ceased to exist and teachers should therefore learn to work with people's diverse identities, desires, and pleasures, engaging them in dialogue and activity that draws on their grounded cognitive and aesthetic understandings of plants and nature. Such activity is likely to contain significant elements of media and consumer education, will give greater attention to the body as a site where nature is constructed (Payne 1999), will convey a questioning and reflexive attitude, and will enable students to perceive the structural origins of their subjectivities (Castells et al. 1999). It will accommodate diverse voices, from peoples and species variously located within ecological and social relations, and so develop the kind of communicative rationality that fosters ecological democracy and sustainability. Botanic garden educators can glimpse elements of such pedagogy in the work of Body Shop, AdBusters, Greenpeace, and such new attractions as the Earth Centre in Doncaster, U.K.

INDIAN HEMP, COMMUNITY GARDENING, WIDE EXPERIENCE AND PRACTICAL SKILLS

Indian hemp or cannabis has religious, recreational and medicinal uses in India. It provides a bridge to Exodus, a community living in Luton, thirty miles north of London, and to other community gardeners around the world. Exodus originated as a travelling sound system delivering free music to ravers and attracted the attention of the police at a time when Mrs

Thatcher's Conservative Government was seeking to outlaw outdoor rave parties and crack down on hard and soft drugs (McKay 1996; Saunders 1999). The largely unemployed and homeless members of Exodus squatted in derelict buildings and on land in Luton, establishing a housing action zone (HAZ Manor) and a city farm by 'do it ourselves' methods. At HAZ Manor they have a communal organic garden, a sustainable water system, and are saving for a renewable energy system. They have gradually found an accommodation with the police and Luton Council and have plans for The Ark, a community centre for others who are socially excluded on Luton's Marsh Farm estate. It will have a non-profit community shop, provided with organic fresh vegetables by the farm, a wind generator making energy for the whole estate, and cheap entertainment of all sorts for young people. In describing their approach to sustainable development Glen Jenkins of Exodus echoes Ayurvedic philosophy and that of critical EfS.

> This is regeneration by the people, for the people. We are taking responsibility for our environment, we want to make it liveable and sustainable. We can't leave it to people who think regeneration is about repainting a few doors and promising computers to schools. What people don't realise is that our philosophy addresses social, environmental and spiritual poverty, as well as problems with money.
> (Glen Jenkins quoted in Saunders 1999, p29)

The sort of initiative that Exodus has taken in establishing a community garden is found all around the world. Stocker and Barnett (1998) remind us that community managed gardens of various kinds, can act as change agents for sustainability by producing fresh, safe organic food (physical and ecological sustainability); creating community places for social and cultural interaction, encounter, negotiation, and embodied engagement with the land, other community members, and the wider society (sociocultural sustainability); and providing sites of research, development, design, demonstration and dissemination for community science, horticultural techniques, and innovative technologies (economic sustainability). They can fulfil important functions in the Local Agenda 21 process: acting as living examples of the praxis of sustainability; establishing embodied participatory democracies that acts as a political signpost to local government and the wider society; and employing a communicative rationality based on people's love of gardening that fosters reflection and action on wider sustainability issues. Of particular interest to educators is their significance as sites for action research that combines academic and local knowledge to create citizens' or community science.

Stocker and Barnett's case study of King William Park in Fremantle Australia has much in common with Irvine, Johnson and Peter's (1999) account of the Alex Wilson Community Garden in Toronto, Canada. The garden in Toronto, established in memory of the Canadian horticulturalist, author and community activist, demonstrates the principles of sustainable land use and community planning in ways that reveal the ecological and social relations between people, communities and landscape. It reconstructs the natural and cultural history of southern Ontario and its pedagogical significance lies in the ways in which it reflects Wilson's belief that '…we must build landscapes that heal and empower, that make intelligible our relations with each other and the natural world'. The garden

draws attention to the history that made community gardens possible and necessary and in Wilson's words, illustrates the theme of my keynote;

> The environmental movement has begun to undermine the social consensus for growth, development and the promotion of commodified relations with the land. It must now directly engage in social debate for the culture of nature – the ways we think, teach, talk about and construct the natural world – is as important a terrain for struggle as the land itself.
> (Wilson 1991, p87 quoted in Irvine, Johnson and Peters 1999, p45)

Botanic garden educators should be involved in community gardening. They should encourage their colleagues to share their expertise with community gardeners and open botanic gardens to the community. I realise that there has been much innovation and progress in this direction, but the community garden is the key site at which botanic garden educators can bring sustainability alive to ordinary people. I regret that I have focussed on three gardens in the North and neglected the wealth of knowledge and expertise amongst small farmers and gardeners in the South, but others at this conference will, I am sure, compensate for my neglect (Pushpangadan 1998). We should remind ourselves also that pathways to sustainability are only partly local. Community gardens and other initiatives for change from below can only grow if there is change from above.

TOWARDS SUSTAINABILITY

In his book *Nature's Keepers,* Stephen Budiansky (1995) recounts the experience of William Jordan at the University of Wisconsin Arboretum (U.S.A.). He found that a conventional environmentalism, based on modern ecology, that asks people to love and revere nature but never touch her, brought 'overuse' of the arboretum by passive consumers of nature. When he began to promote a radical environmentalism, based on postmodern ecology that asks people to reconstruct nature so that it better meets their interests and those of other species, a huge number volunteered for restoration projects in the Chicago area.

In reconstructing nature such volunteers, like community gardeners, bring '…the full scope of human attitudes to bear on the landscape, aesthetic, scientific, utilitarian, even moral. They know that what they are fashioning will reflect their creativity and wisdom, but they know in the end that their effort is a joint one' (Budiansky 1995, p250). My challenge to you as botanic garden educators is to consider the role you may play in the social construction of unsustainable natures and to engage with colleagues and communities seeking to reconstruct nature in more sustainable forms. I hope I have provided some insights into the kinds of knowledge, skills and visions that will help you in your constructional and presentational work.

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REVITALISING EDUCATIONAL ACTIVITIES IN THE OLDEST BOTANIC GARDEN OF RUSSIA

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The Botanic Garden of Moscow University is one of the oldest scientific and educational organisations in Russia. Founded by Peter the Great in 1706 almost 50 years before the Moscow University, now the garden attracts attention not only because of its interesting botanical collection, but also because of its historical significance. Subsequent recognition of the historical value of the site has resulted in it having the status and official designation as a Historical Monument.

The garden covers approximately 6.5 hectares and includes the arboretum, the pool with a wetland plants collection, the pond and several glasshouses. There are about 1300 species (both in the open grounds and under glass) in the garden; the content of the collections reflects the educational purpose of the establishment. The Subtropical House dates back to the 1870s and has a well preserved brickwork facade and some interesting interior features such as the cast iron pillars and water lily pools. There are collections of succulents, plants from the Mediterranean regions and tender coniferous plants displayed in the Subtropical House. In the Palm House one can see a wide range of tropical plants including some palms up to 17m high and 150 years old and a cycad (*Cycas circinalis* L.), probably one of the oldest potted plants in the world (more than 200 years old) is also housed here. In other glasshouses, there are special collections of orchids, bromeliads as well as ferns and other interesting groups of plants.

The garden was first founded as an Apothecaries Garden for raising medicinal plants and teaching plant science to future doctors. Thus, from the first years of its existence the garden has been an important centre of education. The garden originally belonged to the Moscow Hospital and subsequently to the Medical Academy. During this period, specialists invited from abroad furnished the garden. Among them were Traugot Gerber, doctor of medicine from Leipzig University, the first Director of the Garden, and Professor Friedrich Stephan. These scientists, contemporary leaders in medicine, plant science and horticulture, brought to Russia professional skills and also knowledge of the latest achievements of European botanical science and fashion in gardens.

When the Medical Academy moved to St. Petersburg in 1804, the garden was abandoned. In 1805, Moscow University, the most respected educational establishment in the country, purchased the site to be transformed into a proper botanic garden. Georg Franz Hoffman, from Göttingen University, Germany, was invited to become the first Director of the

Garden. Since then the garden has always served conventional botanic educational purposes and research based on its rich collection. Also from that time onwards, regular lectures and guided tours for the general public and those curious about plants were organised in the garden. Since then, the new stage in the development of education in the garden began: education for the general public.

Almost 300 years have passed since the foundation of the garden. The times have changed and every period of Russian and Moscow history has been followed by changes in the garden, not only in its appearance, but also in its aims and tasks, including education. However, in every period of the garden's history, education has remained the main part of its work and this too has determined the content of its collections.

The garden has known golden age periods and periods when it has fallen into decay. The golden age periods have taught us to be optimistic, because after every period of decay a new golden age has followed.

Currently the garden is facing such a positive period. Since 1995, the garden has been undergoing reconstruction, this programme aims to enhance the layout of the garden, restore and rebuild the glasshouses, improve the library and education facilities and generally maximise the potential of this important resource. Improvement of these components finally leads to the revitalising of educational activity, since education is one of the garden's main strategic directions.

Founded many years ago in the outskirts of Moscow, nowadays the garden is located in the centre of the modern megalopolis, surrounded by busy streets, including one of the city's principal roads, Prospect Mira. Because of this, it has appeared to be a hot spot of ecological problems. These new circumstances have defined a new role for the botanic garden as a unique place for environmental education; in fact one could not find a better place for it.

Taking into consideration the importance of the aims and tasks of contemporary botanic gardens, according to the *Botanic Gardens Conservation Strategy* (IUCN-BGCS and WWF 1989), the new educational programme is being developed in the Botanic Garden of Moscow University.

The direction that science is taking within the education programme involves the following topics: plant science, ecology, environment, geography and gardening. Structurally, the ecological programme can be divided into three levels of education:

1. information
2. general environmental education
3. scientific.

When the gardens education programme is fully functioning it will target several groups: the students of the University and other higher schools, primary and secondary school

children and teachers (fitting the national curricula as well as offering more beyond them), senior people, families and the general public.

The new educational activities in the garden combine methodical approaches to education; guided tours and lectures conventional for botanic gardens; together with modern ones such as training courses for teachers and experimental and practical work with children. These are as follows:

Guided tours for:
students of Moscow University
students of medical academies and colleges
school children
general public

Methodical courses for:
primary school teachers
secondary school teachers

Experimental and practical work with children for:
special groups (Young Ecologists club)
school children

Thus, a new trend in education associated with botanic gardens is emerging. The transition from passive forms of education to active ones is obvious.

As the gardens is still, and will remain, in the university's possession, provision of facilities for teaching of plant related sciences is one of the major tasks within the programme. Classes given by the scientific staff members in the garden are included in the curricula of several university departments. University students regularly come to the garden in groups to have lectures and demonstrations in the glasshouses.

The garden (with the temporary exception of the glasshouses) is open to the general public and no entrance fee applies. That means that we have to organise the educational space in the garden so that every visitor can learn more about the plants in the garden.

Labelling and interpretation are very important and we are now working on this with the help of BP, the sponsor of the garden's environmental education programme.

The environment education programme was set up with the aim of using the garden as a teaching resource for children living in the city. In the first stage of the development of this programme, the Young Ecologists Club (YEC) was established.

The Young Ecologists Club conducts after-school sessions for different age groups, giving children aged between 8 and 14 years an opportunity to learn more about the natural world through observation, experimentation and practical work in the garden.

The aim of the YEC is to:

- develop the interest of children in plants and their life;
- teach children to observe nature;
- teach some specific aspects and general perspectives on the complex relationships of man [*sic*] and the biosphere;
- study the relationships between plants and other components of ecosystems; and
- teach children practical skills to enable them to work with plants.

Through their own research experience under the scientific supervision of their tutors, the members of the club learn about modern environmental trends, methods and techniques, as well as classic ones such as the use of microscopes and other laboratory equipment, herbarium techniques, bird watching, and assessment of the condition of plants in the garden in particular with reference to the influence of various factors such as air pollution.

The main principles of teaching members of the YEC are to:

- give children the opportunity to develop knowledge via their own experience and practice; and
- first ask: 'why?' 'how?' and then observe and study; secondly: analyse and generalise; and thirdly: discuss, compare and intepret the results.

According to the children's interest, we give them the opportunity to develop some experimental or practical projects in the garden, which will be presented in ecological competitions and journals.

The second stage of developing of the educational programme has been the Teacher's Programme; the training course for teachers of primary and secondary schools was started in 1999.

The aim of the Teacher's Programme is to encourage a wide number of schools to visit the garden and to take advantage of the learning opportunities which the garden offers to pupils from the city. It enables teachers to learn how to:

- organise experimental work with school children in school yards and investigate the practical techniques that can be used; and
- use the resources of the botanic garden in environmental education.

The course includes themes that match the different levels of education. These are as follows:

<u>For primary school teachers:</u>

- Methods of nature observation with children, using special activity pack materials that look at:
    - seasons in plant life
    - plants and other components of ecosystems (e.g. soil, litter, insects, soil fauna, birds, mushrooms)
    - plant reproduction (e.g. flowers, fruits and seeds, dispersal agents, time)
    - phenological observations
    - identification of trees in summer and in winter (e.g. flowers, leaves, buds and habit).
- Collections of the garden's arboretum addressing:
    - trees and shrubs (local and introduced species)
    - wetland plants
    - early flowering bulbous plants and ephemeroids.

<u>For teachers of secondary schools</u>

- Undertaking plant state assessments in cities (trees and shrubs) – How does the tree 'feel'? and looking at:

    - influence of traffic related factors, including air pollution, on trees
    - soil experimental techniques
    - cycling in forest ecosystems
    - litter decomposition rates in different ecosystems
    - trees bioproductivity
    - time and rhythms in plant life (idea of spatial-time organisation in biosphere).

The course programme was devised after consultation with a wide range of environmental educators in Russia and the U.K. and encompasses some of the most recent approaches to environmental education. It focuses on active environmental education outdoors, using activity pack materials, which were developed by specialists within the garden.

To conclude, the revitalising of educational activities in the oldest botanic garden of Russia aims to develop both classical and traditional approaches, as well as the new ones in accordance with the Botanic Gardens Conservation Strategy (IUCN-BGCS and WWF 1989). These include:

- to make the education more active, than passive, using the modern forms and methods;
- to replenish the ecological programme with the new environmental content; and
- to widen the audience through attracting different target groups.

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BOTANICA: SIMULATION AS ONE MODEL FOR EDUCATION FOR SUSTAINABILITY IN BOTANIC GARDENS

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INTRODUCTION

Botanica is an exciting approach to using the botanic garden as a resource for learning in the widest sense. It involves creating a scenario within the garden and inviting participants to step into the minds of the people concerned; seeing life as *they* would see it, interacting with others from *their* perspective, tackling issues from *their* viewpoint.

Imagine this: in one area of the garden a group of eleven year olds is busy building a shanty town from cardboard boxes and old tarpaulins. An argument breaks out between two of them and a journalist from the Botanica Daily Record about the way the newspaper handled some recent interviews with members of their community concerning the government's resettlement plans for them. Meanwhile, over by the pond, a group of scientists from the Botanica Institute of Scientific Research is collecting species to identify and illustrate in the new edition of the Flora and Fauna of Botanica. Colleagues of theirs are in the seed store sorting seeds of rare plant species from Botanica to send to sister research institutes around the world.

At the other end of the garden a small group of traditional herbalists prepare herbal remedies to sell at market, while on the cut flower plantations (on land where locals used to have their own small subsistence farms) the workers are busy spraying the crops under the eagle eye of their supervisor. A deputation from World Wide Fund for Nature (WWF) arrives and is horrified to see the workers handling strong chemical pesticide with no protective clothing while their boss is fully kitted out. There is a heated exchange.

At 10.30 a queue of citizens forms outside the offices of Botanica State Security (BoSS) to ensure that their identity cards are stamped on time.

Botanicans going about their daily business…

At 12.00 Radio Botanica broadcasts an interview with the President about the country's bid to host the World Cup in 2010. It is a knotty issue: Should Botanica tender for the contract – or should it leave the World Cup well alone? Will being host country help to accelerate appropriate development in Botanica – or simply put money into the pockets of a few, at

vast social and environmental cost to the majority? The interview is broadcast live across the garden on a network of loudspeakers. FIFA representatives being entertained regally by the Ministry of Special Events, with the help of the Botanica Catering Corporation, lend a keen ear.

The next day at school the representative committee will meet to determine the people's verdict: whether to support their government's bid or vote against…

HOW BOTANICA STARTED

SEED (Support for Education in Environment and Development) is the education arm of the Leicester University Botanic Garden. Over the years, SEED has developed a number of core programmes (the Whole World Cake Treasure Hunt and the Global Christmas Pudding for instance) for pupils, teachers and parents as learners. The programmes provide the opportunity for fun through interactive learning experiences that challenge those who are new to the garden; young people and adults alike.

Our next step has been to design a programme for garden veterans; we wanted to build on their previous learning experiences at the garden, in a way that not only inspired the children and taught them more about environmental and development issues, but took them further and actively engaged them in grappling with the issues themselves. Simulation seemed a possible way of doing this. Not only does it provide a forum where participants are forced to consider issues from different perspectives, which may differ radically from their own, but it also enables them to practise, use and sometimes acquire the skills necessary for tackling similar issues in real life.

When SEED was approached by an education officer organising a day's event to develop the problem solving, decision making and team working skills of Year 10 participants, it was seen as the perfect opportunity to move this idea forward. One thing led to another and over the course of a year we devised and ran two major simulation exercises, Special Report and World Cup Twenty Ten, as well as a workshop for teachers and educators based in botanic gardens. These collectively have come to be referred to as the Botanica project.

THE BOTANICA PROJECT

Special Report was initially designed to support learning within the Leicester Vocational Framework for Key Stage 4 students at Fulhurst Community College. When it was piloted in September 1998, we invited a range of professionals and volunteers to become involved, including teachers, youth and community workers and gardeners, to work alongside the group of thirty two 14-15 year olds. Feedback from all participants strongly reinforced our belief in its potential as a rich and flexible educational experience and we sought new opportunities to develop it.

We approached the Year 6 teacher team at Folville Junior School, a school that used the Whole World Cake Treasure Hunt as an integral part of its curriculum for Year 3. Their

initial response was interest tinged with apprehension, especially as the school was awaiting notification of the date of their inspection and was also still finding ways to cope after the tragic death of their head teacher. However, their commitment to developing interesting ways of working with children and their previous positive experiences of the project enabled them to agree to be involved.

With World Cup Twenty Ten we sought to build on the lessons of our first attempt. It differed from Special Report in a number of ways including the greater involvement of teachers in the initial planning process. At each stage ideas were brain stormed and checked out at teacher meetings. Students involved in Special Report had said that it would have been better if they had been more prepared before the day itself and we felt we must incorporate a considerable preparation period for the children into the programme. We also wanted to give those Year 10 students who had expressed a wish to do a similar thing again a chance to be involved. This fitted in well with one of the aims of a participating teacher, which was to help prepare Year 6 children, most of whom would actually be moving on to Fulhurst in the Autumn, for transfer to secondary school. The other main aims of the programme were to:

- provide an opportunity for the whole of Year 6 to work together in developing a range of life skills, and to feed into a number of curriculum areas in particular the Key Stage 2 Geography curriculum (a locality study in a developing country); and
- develop the simulation approach to using the botanic garden as an educational resource in Leicester for a wide range of pupils and in collaboration with local community organisations/ agencies.

So World Cup Twenty Ten was devised and designed to bring together the entire Year 6 group of about 100 pupils from Folville with a variety of other participants, including volunteers from Year 10 in Fulhurst, in order to work through and resolve a complex development issue.

Because of the intentionally open ended nature of the approach, we expected there to be a wide range of outcomes for individuals and groups that we could not anticipate. Specifically, however, what we hoped the exercise could help to achieve was:

for PUPILS:

- an increased self-awareness, awareness of others and greater confidence;
- an understanding of the importance of process (how you do things as distinct from what you do) and improved process skills, including communication, team-working, organisation, decision making;
- a better understanding of development and environmental issues and aspects of global citizenship; and
- a renewed awareness and appreciation of the botanic garden.

for the SCHOOL:

- an enhancement of National Curriculum work on Place and Thematic Studies in Key Stage 2 geography;
- an exciting mechanism for delivering personal and social education; and
- better liaison with a local high school.

for SEED was:
- the development of a programme which could be offered to other groups; and
- an enhanced local profile and an extended network of voluntary and professional supporters.

EVALUATION

If our aim was to have an impact on the attitudes of learners as well as to contribute to the development of the skills and knowledge they need for global citizenship and environmental sustainability: How successful were we? What difference did we make?

We argue that it is impossible to be conclusive in pin pointing specific connections between the Botanica experience and long term learning except on an indicative, anecdotal or impressionistic level. Our belief is that the complexity of the learning process in the human brain puts building an empirical case beyond our capability. One person might conclude (as he did) I didn't learn anything but I had a good day, whilst the next asserts, of the same programme, I learned to be responsible, to be independent and to manage time sensibly.

Who is to say that two weeks, two months, twenty years down the line, the fun element of Botanica will not have provided a trigger for specific development; or even a platform for fundamental change, in the former; or that the latter goes on to lead a life in which dependence on others features significantly, in spite of perceived immediate learning? Yet Botanica in any of its forms represents a serious investment of time, energy and other resources and we also believe we need to be accountable for this. If we are unable to claim, with confidence, that indeed the experience does, or at least CAN, make a significant difference, our conclusion has to be: think again.

So, how did we resolve the dilemma? The key for us was to resist the call of a summative approach to evaluation and throw our lot in with a formative style that was integrated into our thinking and planning as well as our management of the exercise itself. The main thrust of Botanica is an attempt to help young people and others to become reflective, responsible global citizens. So what we did was to try to build and exploit a framework for thinking about learning into the process itself. We did this in a variety of ways, not always systematically. For example:

- We took care to clarify and agree what the exercise was about (its aim and intended outcomes) in advance, to communicate these appropriately to all involved and to use them as a point of reference for planning and reflection.

We knew we were only partially successful with this; the logistics of briefing all adult helpers, for example, meant that a good number came to their first contact session with little concept of what they had let themselves in for; and with both sets of pupils we were heavily dependent on teacher colleagues to interpret and reinforce the purpose and connectedness of the exercise following our initial briefings and we were unable to monitor the consistency or effectiveness of this process.

- We encouraged the children to reflect on key concepts and their own skills and personal qualities before their involvement in the exercise as well as after it was completed, and provided a simple framework for doing this in the shape of a Concept Map and Skills/Talent Audit.

  For example, Kirklun's conceptual expectation of Botancia as a developing country was to find that '…there will be fighting and unfairness, cruelty to people who live on the streets and a lot of arguing'. Her experience was that '…there was arguing, there was unfairness, there wasn't fighting and not as much cruelty as I thought'. In terms of skills, Tiffany, before the event thought she was '…not at all good' at asking questions to help or get information whereas after it she rated herself 'very good' at the skill. By contrast, with regard to looking after and spending other people's money, beforehand she thought she was 'quite good' but afterwards she rated herself as 'not very good'.

  Are these examples shallow or profound? Are they indicative of serious thought or simply trite responses to another worksheet? What do they mean? And do answers to these questions matter, or miss the point?

- Communicating with others about both actual life experience in Botanica and opinions about that life experience was built into the process at a number of levels, both within role and outside it, including:
  - small group presentations to the whole group as part of the initial briefing;
  - negotiating, selling, canvassing, interviewing, debating, report writing and other associated skills as essential elements in different roles;
  - consensus building within groups and the delegation of responsibility to a group representative to ensure the group view was properly taken forward;
  - the opportunity to vote on the outcome both in role but also out of role;
  - involvement in group reporting on the activity after completion.

  Of course individual access to, and take up of, such opportunities varied widely, according to motivation and ability; we cannot begin, nor would we presume, to quantify or gauge the extent of impact in these areas.

- We encouraged all helpers, and in particular the older students, to think about and articulate what they hoped younger pupils would gain from the experience as well as their own learning from it. Their aspirations for the young generation ranged from: 'respecting the environment around us' and 'learning about all aspects involved with

arranging a major event like the World Cup and how it affects people as well as the environment' to 'becoming more confident and learning to cooperate with others', 'learning a lot about themselves and about other people', 'communicating with others', 'enjoying working in a team', 'learning how to do good timekeeping and to organise themselves' and 'just enjoying it'.

In retrospect helpers were able to provide plentiful examples of all these things going on during the exercise. The extent to which the examples provide evidence of learning is much less clear however. Furthermore, many of the individual evaluative comments beg more questions than they answer. For example, take a statement like 'It could have been fun if there weren't so many rules about travelling' (e.g. not enough tickets or money). Does this mean that red tape got in the way of enjoyment? that there weren't sufficient resources to do the job? or that individuals or the group did not make best use of the resources available?

And once you have established the meaning: What is the range of learning that can be drawn out? that the importance of the rule itself is variable and questionable? that life can be unfair in terms of the distribution of resources? that 'doing the job' may need defining in relation to the resources available? What are the implications for further learning and teaching?

CONCLUSION

The other major strand of evaluation concerns our own learning based on the feedback of participants as observers as well as on our personal reflection. Although in general the feedback has been very positive from all those who have been involved, constructive criticism has focused on a number of aspects, only some of which we were able to address in planning the second major event. The most important of these concerns:

Planning: getting the balance between enough detail and too much detail is significant, even if it is hard to judge.

Implementation: the critical importance of clear briefing as well as of providing adequate space and support for induction into the experience. Too much information to assimilate at one go is off putting, especially if the approach itself is new to participants.

Resourcing: particularly in terms of the human resource, this is a very intensive approach. There needs to be a high level of commitment at school level combined with a vision of the event as integral to the school's curriculum rather than something discrete or additional to it.

Application: off the shelf versions will not work. There are many ways in which people interested in the approach can be saved time and energy by the experience and ideas of others. However, ultimately each event is a special event that needs customising according to the needs of the moment and the resources available at the time.

That said, we are greatly encouraged by the experience to date, summed up no better than in the words of one of our volunteer helpers:

> It was brought home to me that those children really are our future and they need to know what the real world is like. This exercise showed them in a kind way that things are not always what they seem, or for that matter, what we want. To make things better we have to work together.

As a result, our intention is to take the project forward in three ways:

1. by networking activity with others who have experience of the approach or who wish to develop it;
2. by piloting the approach further in a variety of ways; and
3. by writing it up in a generic handbook supported by case studies and actual material on a website for anyone interested to access or add to as appropriate.

EDUCATION BY STEALTH: THE SUBTLE ART OF EDUCATING PEOPLE WHO DIDN'T COME TO LEARN

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INTRODUCTION

The Royal Botanic Garden Edinburgh (RBGE) has an educational programme which encompasses three complementary areas: school's and teacher education, community education and events, and public exhibitions. The most important resource, which is at the basis of all aspects of the programme, is the living plant collection. Often in deciding whether or not to take on a new project we ask ourselves the question could this be done as well somewhere else? If the special resources of the RBGE, and in particular the living plants, would provide some unique or original aspect to the project it is much more likely to be taken further.

Although primarily a scientific organisation, the educational programme of the RBGE is not exclusively about the understanding of science. It is designed to appeal to a wide range of user groups and aims to encompass artistic, aesthetic, horticultural and practical aspects of plant and environmental studies. More importantly it seeks to communicate with people who are not intentionally involved in any kind of formal study programme, including garden visitors who did not come to learn. This is what is referred to in the title of this talk as 'education by stealth'.

When we analyse attendance figures for RBGE we find that schools' programmes reach about 10,000 pupils, and adult and community programme, including the Edinburgh International Science Festival at RBGE, another 14,000 people each year. Approximately 150,000 people, mostly families, visit exhibitions in the Exhibition Hall. These numbers, however, represent only a small proportion of the more than 700,000 visitors to the Edinburgh Garden each year. We have established that the majority of visitors do not come to our garden, or to most botanic gardens, with the specific aim of learning. Therefore, if we wish to impart some ideas or messages relevant to sustainability during a visit we will need to do this almost subliminally. The definition of site interpretation which I offer: '…the subtle art of educating people who didn't come to learn', tries to reflect this.

WHY DO PEOPLE COME TO BOTANIC GARDENS?

As a starting point it is worth considering why people do visit a botanic garden or arboretum. Many institutions have carried out visitor surveys but you will have your own

ideas and these are probably quite close to the true picture. A quick poll to see why people visit sites represented at the congress produced a long list, including:

- to find peace and tranquillity
- to eat
- to read a newspaper
- to relax
- for recreation
- to play games
- to be with their family
- to escape from their families.

There seemed to be a consensus that to study or learn about plants was generally less important for the majority of visitors than something more obviously linked to seeking pleasure or satisfaction of some kind.

The thirteenth century mystic St Thomas Aquinas said 'You change people by delight. You change people by pleasure'.

Aquinas understood that giving people a pleasant experience is more likely to put them in the mood for receiving some new ideas or information. This principle is well established in the advertising industry where companies compete to place their commercials between the most popular and entertaining television programmes. What is more we know from our surveys that people who have an enjoyable experience are the ones most likely to return. Repeat visits are important for the type of low level of interpretation I am proposing. Each exposure helps reinforce and strengthen even the most subtly delivered messages.

In asking for ideas for why people visit gardens no one specifically mentioned healing. However, I believe that public gardens can and do offer people a form of healing and although this may not necessarily be accepted by those who manage them, this may lie close to the root of their popular appeal among visitors.

We are all familiar with one aspect of the relationship between gardens and healing. Cultivating medicinal herbs, a central theme of this congress, has been a significant activity in both Western and Eastern cultures since the first gardens were planted. For millennia people have grown many plants used in herbal remedies as an alternative to collecting them from the wild. The European physic garden of the sixteenth and seventeenth century, styled on earlier monastery gardens, is just one example of horticultural activity devoted to the supply of medicines. An important supplementary role was the training of apprentice herbalists who in ignorance could as easily kill a patient as cure them if they made a mistake with their botanical identification!

In Europe there was, however, another incentive behind the creation of the first botanic gardens. Until the sixteenth century Christian theologians believed than the Garden of

Eden actually existed somewhere on earth. The first explorations of the Americas and in particular the discovery of tropical forests of 'perpetual summer' led to claims that Eden had eventually been found in the New World. However, when it was acknowledged that the Age of Discovery had not found the lost Garden of Eden, the search ceased and some wealthy and influential people set out to recreate paradise on earth. European botanic gardens of this period can also be viewed as an effort to assemble all the known plants of the world into Eden-like garden of earthly delights.

Consequently from the start European botanic gardens had a dual function. They were practical collections of useful plants but also places of divine beauty where humans could feel on intimate terms with their Creator - havens for the soul. Through the combination of these two roles gardens were important in the nurturing and healing of body, mind and spirit. Therefore, there is nothing particularly radical or innovative in suggesting that people feel better from the experience of visiting a garden. On one hand this idea receives wide acceptance while on the other we find it rarely acknowledged within mission statements, strategic plans or annual reports of the world's leading botanic gardens and arboreta.

THE SECRET GARDEN

In the nineteenth century children's classic *The Secret Garden* author Francis Hodgson Burnett recognised both the security aspect and the healing power of gardens. The story tells how three children discover a neglected walled garden and gently coax it back to life. As the momentum of an English Spring builds, they find themselves swept along in the current of renewal and rebirth and believe that what is happening to *their* garden is pure magic. The excitement and fulfilment that they all share in the garden becomes their most over-riding preoccupation. One of the children, a spoilt, hypochondriac boy of ten, who has spent his life confined to a wheelchair due to a mysterious and one suspects largely psychosomatic illness, learns to walk for the first time, gaining inspiration from watching the first faltering steps of a young deer fawn.

Wrapping sound moral education inside a sentimental story was a popular device among Victorian writers but the parable of *The Secret Garden* seems at least as relevant for today's screen-addicted children as it was when it was written. Many young people seldom have direct experience of animals beyond domestic pets and for many nature is confined to the virtual world of TV or computer simulations. In *The Secret Garden* adults are excluded and the children can pursue their natural instincts for play and discovery, using their imaginations without inhibition. Protected behind high stone walls from unknown dangers, characterised in the book by a wild and windswept Yorkshire moor, the trust between the children also grows and they become involved in their own magic.

The children do not seek to dominate the neglected garden but rather to coax from the earth the potential which they believe to be buried or sleeping. The result is an earthly paradise where wildness still has a place and the scent of colourful flowers is accompanied by the flight of butterflies and songs of wild birds. The other transformation, in the character and

health of the children themselves, occurs in parallel to the changes in the garden. The children's senses are revived as they become intoxicated with the scent of the roses and feel and smell the wet earth in their hands. It is ultimately through this direct contact with nature their young lives become rich and meaningful. Burnett clearly believes in the power of fresh air and healthy exercise in creating strong bodies but also acknowledges the increase in confidence which can be gained from taking care of something and the changes derived from focusing beyond the self to the wider world.

The Secret Garden, like so many children's stories, is a fantasy based on simple truth. In this case the underlying message is that gardens, through their remarkable ability to stimulate the complete range of human senses, are capable of helping people who have been deprived of sensory experience or allowed their perception of the natural world to deteriorate. Those of us that live in urban areas may be unconsciously forced to reduce our sensitivity to disagreeable or overpowering environmental stimuli. Out of sheer necessity we have to shut our ears to the noise of traffic, block off our noses to the smell of car exhaust fumes, screw up our eyes in the glare of headlamps and turn our heads from the ugliness of litter lying in the gutters. Only in the comparative safety of urban green spaces can we timidly explore the more rich scents, colours, reflections, calls and textures of nature.

Matthew Fox, the renegade Catholic priest who has become a kind of latter day St Francis of Assisi, describes how the urban dweller is surrounded by stories which are 'cleverly and expensively' told by the media (Fox 1993). He feels that advertising people are ever encouraging us to fill our lives with the 'goods and goodies of twentieth century Western society', things we don't need and that are damaging to our health or the environment, in order to fulfil a fantasy which rarely leaves one's mind content but is more likely to generate an even greater thirst. Fox argues that we need an 'alternative story' which fills the need and satisfies the human condition. Interpreters should be trying to discover and tell this alternative story. The challenge is to demonstrate gardens, with their rich and diverse array of sensory offerings are able to provide a stimulating 'high' which is more fulfilling and long-lasting than, say, a can of Coca-cola or a new compact disc.

Many people believe that human beings have an innate capacity to appreciate nature in an aesthetic rather than purely scientific ways - a phenomenon which Edward O. Wilson calls biophilia (Kellert and Wilson 1993). If we accept the biophilia hypothesis then it follows that gardening, which involves manipulating living things to enhance a landscape's aesthetic appeal, expresses the same basic human need to be in touch (sight, smell, taste and sound) with nature. Gardens act as a catalyst to enable people to discover this important part of their psyche and to be involved in a practical and immensely satisfying way with the environment. For many people gardening does offer an alternative and ultimately more rewarding experience than consumerism. In the U.K., although shopping is considered the most popular recreation, gardening is probably a close second. However, in the wake of increasing popularity gardening has also attracted its own form of consumerism as garden centres, glossy magazines and TV garden make-over programmes proliferate.

USING METAPHORS

At the 1998 BGCI Congress hosted by the National Botanical Institute Kirstenbosch (NBI), South Africa, Ally Ashwell of the NBI gave a presentation in which she asked us to consider our organisations as metaphors. Her examples were more to do with the corporate structure of an organisation than its functions but this set me thinking about some of the metaphors we use to describe the role of botanic gardens and their appropriateness as starting points for planning themed interpretation.

The design of gardens, from earliest times, involved the frequent use of metaphors and symbolism. Modern botanic gardens also have many metaphors. For example:

- Many gardens strive to cultivate rare plants which are in danger of extinction in the wild in *ex situ* conservation collections. An appropriate and frequently used metaphor for these gardens might be a *botanical ark.*
- The traditional educational value of botanic garden reference collections not only in teaching plant taxonomy and classification but for illustrating important botanical concepts, such as pollination or seed dispersal, has led to the description of botanic gardens as *living encyclopaedias* demonstrating in a unique way the diversity of plant life.
- A third metaphor might be a showcase for botanical diversity. By displaying to a wide public (over 150 million people a year worldwide) the greatest possible variety of plants, and providing interpretation on their value and usefulness, botanic gardens are an important *shop window* for science and horticulture.
- Another useful metaphor and one particularly appropriate for a main theme of this congress is the *medicine chest*. As described above botanic gardens from the earliest times have provided herbalists with a wide range of valuable plants and by supplying cultivated material have helped to conserve wild sources.

My favourite metaphor, however, is the *sanctuary*. Mediaeval engravings of gardens show a dark or mysterious forest beyond the protective walls, a place with wild animals and other untold dangers lurking suspiciously in the shadows. In modern times it is likely to be an urban landscape outside the garden and the environment in our cities becomes less habitable with each decade. Beyond safety of our carefully cultivated collections plants are under threat but so too is our own species. There is a real danger that we are fouling our nest to such an extent that we could make large areas of our planet unliveable in the future. The urban environment is becoming increasing less suitable for human existence and as already described our reaction has been to turn down our sensory perception to a low level in order to survive the onslaught.

Safe within the sanctuary of the garden we can see, feel and breathe naturally. Green spaces offer revitalisation and I am aware that for many people they provide restorative energy with which to carry on with their daily tasks. This is not a new discovery. My ancestors and traditional communities throughout the world experienced similar

empowerment within the greenness of their sacred groves. But, then again, this is a probably lesson that every generation must learn for themselves.

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Spreading the message about biodiversity conservation at the Museum National d'Histoire Naturelle of Paris

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THE START OF THE MUSEUM

The Royal Garden for Medicinal Plants was created by King Louis XIII in 1635 to complement the lectures given to the future apothecaries and doctors at the School of Medicine. Three disciplines were taught: plant chemistry, botany and human anatomy. The institution has a long standing educational tradition and an amphitheatre was built in 1788 to house 600 people; the lectures were open to the public free of charge.

In 1793, during the French Revolution, the garden became the Museum d'Histoire Naturelle and started out with 12 laboratories. Today the Museum National d'Histoire Naturelle (MNHN) is a scientific establishment managed by the Ministry of Education, Research and Universities. The organisation employs 1800 researchers, teachers, engineers, administrative, maintenance, and service personnel. Its 26 research laboratories are devoted to the study of natural sciences and its evolution and to the management of national natural history collections. The tradition of education continues and its public education mission concerns all parts of society.

CONSERVATION AT THE MNHN

Conservation has been added to the three original missions stated at the creation of the garden: research, preservation of collections and education. The year1955 saw the creation of a Laboratory of Ecology and Nature Preservation, followed by the Department of Natural Heritage and, in 1995, the Institute of Ecology and Biodiversity Management.

HOW IS THE MNHN IMPLICATED IN CONSERVATION AND EDUCATION FOR SUSTAINABILITY?

Sustainability is dependant on the wise management and rational use of natural resources. This necessarily implies a thorough knowledge of nature and all its components, its interactions and evolution through time. Since 1635, the Museum National d'Histoire Naturelle has been at the forefront of the study of biodiversity and is thus in a unique

position to evaluate the state of its degradation. Its scientific teams travel all over the world to explore, discover, list and describe the natural and human resources of our planet.

The 70 million objects in its collections; from meteorites to fossils, plants, and animals; as well as the expertise of its scientists, constitute invaluable sources of information. These collections and expertise serve not only for scientific research but are also used for education programmes and are of great help in decision making on environmental issues.

THE PUBLIC

For the visitors, the Museum National d'Histoire Naturelle is a complex place, with a range of public galleries, research laboratories, a botanic garden (the Jardin des Plantes) and a zoo.

Due to its location, in the immediate proximity of a main train station and several universities, people have a tendency to pass by without stopping to look at what is around them. It is therefore important to catch their attention. The public is diverse with different expectations: from strollers seeking peace in a garden environment, local residents with advanced education background, to visitors attracted by the atmosphere of the place in this dense urban area. The garden is a public space with no entrance fee or precise figures available on visitation. It is estimated that the different establishments which form the institution receive almost 2.5 million visitors annually. In 1998, 1.5 million visitors paid an entrance fee to one of the following buildings: glasshouses, Evolution, Mineralogy and Palaeontology Galleries, or the zoo.

Exhibits on conservation at the MNHN

An annual environment week was initiated by the Ministry of Environment to promote the understanding of plants and the need for conservation. For its participation to this national scheme, the institution organised a series of exhibitions on general themes. These exhibitions were informative, with a series of posters and debates led by scientists; however the general tone was rather austere and the content too scientific and specialised for the general public.

The Department for Scientific and Cultural Events was created to support the different laboratories in their communication and help them produce educational tools. In 1995, it launched the first Journées de la Conservation de la Nature, a 3-week programme held annually in June with exhibitions, conferences and guided tours in the Jardin des Plantes. Since 1998, living collections, animals and plants alike, have been used in this event and have largely contributed to its success and evolution.

THE *JOURNÉES NATURE*

A new less formal approach has been chosen to ensure that the annual meeting has a more convivial atmosphere than the previous exhibitions in an attempt to reach a broader range of people.

In 1998, IUCN's 50th anniversary was celebrated in Paris where it was first created. A very interesting debate brought together journalists with a special interest in environmental issues to look at the role of the media in conservation. Different events were organised around the theme of biodiversity conservation and included a promenade-exhibition, theatre events, oral presentations, guided tours of the zoo, alpine garden and systematic collection, a gardener's information desk, and children's workshops. Several associations were also invited to present their own programmes. There were a vast array of activities to choose from, appeal to, and satisfy, a diverse public.

The objective of the department was to make sure members of the public enjoy themselves while learning and 'hearing a different language' about nature and our responsibility to protect it. This year's promenade-exhibition was based on the following themes:

- a familiar theme – the montane flora and fauna one might encounter during holidays;
- a current theme - a protected insect stops a motorway project; and
- a scientific theme - the endangered tropical flora studied by the botanists of the Herbarium.

For this last theme, researchers were once again urged to participate. The Herbarium staff were consulted and asked to organise, in conjunction with the Plant Collections Department, a joint presentation on endangered tropical plants and habitats using posters and plants from the live collections. These were presented in a small, elegant glasshouse which was lent by a private company; it helped to catch people's interest by its unusual placement within the garden.

A series of theatre events for the younger public dealt with urban waste management, workshops were organised on the protection of montane species and a conference was presented on the Madagascan Flora. In addition, the popular Gardener's information desk was maintained.

THE FUTURE

The increasing success of the Journées Nature has shown us the importance of regular meetings with the public on environmental problems in order to strengthen long-term interest. The support from the institution staff, as well as regular visitors, helped spread the word.

New environmental issues presented to the general public using familiar themes such as The Plants from Your Holidays or The Management of Urban Waste are extremely successful. These are relayed by background scientific explanations.

Held in the central part of the Jardin des Plantes, the Journées Nature with its free exhibitions and varied activities, scientific as well as ludic, are attractive to the different garden visitors. Preparations for the year 2000 are underway and will follow a similar approach with the following themes: the fauna and flora of the seashores, scientific news, and nature conservation in Europe.

WORKING WITH SCIENCE, GAMES AND VALUES IN ENVIRONMENTAL EDUCATION

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INTRODUCTION

Naturens Hus (Nature's House) started its work in 1989 with the goal of developing people's knowledge about, and feelings towards, nature and to engage people in working for a sustainable future. We hope that people will develop a stronger interest, increased consciousness and maybe change the way they value nature. Our main target group is the younger generation and others working with them such as teachers and their families. An important part of our work is to develop methods in environmental education. Naturens Hus also links everyday life and the continuous environmental research undertaken at Stockholm University, and other universities in Sweden. The activities offered to schools include pupil programmes in the botanic garden and the surrounding natural areas, teacher training courses, and the production of material such as a newsletter with information from scientists working with environmental issues. We are not only developing experimental and interactive activities, but also games and exercises that enhance children's positive experiences with, and relation to, nature. Since 1997, Naturens Hus has formed part of the Bergius Botanic Garden in Stockholm at Stockholm University.

BERGIUS BOTANIC GARDEN

Bergius Botanic Garden dates back to the late sixteenth century. The two brothers, Peter Jonas Bergius and Bengt Bergius, wanted their garden to serve as a school for gardeners and horticultural experiments. Today, the Bergius Foundation still exists as a research institute and runs the Edvard Anderson Conservatory. There are over 9000 plant species from all over the world in the Bergius Botanic Garden, and as our pedagogic arena it enables us to offer the unique opportunity to help people study plants and understand their importance on earth: ecologically, systematically, and geographically. The garden contains a variety of trees and shrubs from northern Europe, Asia and America as well as flowerbeds with examples of Nordic flora. There are also Mediterranean perennials, rhododendrons, a Japanese garden, and the Victoria house with tropical plants, organic garden plots and a great deal more.

The Bergius Botanic Garden is situated on an inlet of the Baltic, and its undulating landscape provides attractive walks all year round. The garden lies in the heart of the

National City Park, a big green area conserved for the future. The National City Park, located only 3 km from the city of Stockholm, has unique cultural and natural values and is an important place for our natural and environmental studies. In 1990, the Swedish Government decided that the botanic gardens needed economic support to work with information concerning environmental research.

NATURENS HUS - PEDAGOGIC CENTRE FOR NATURAL SCIENCE AND ENVIRONMENTAL EDUCATION

Our goal is to develop people's knowledge about, and feelings towards, nature and engage people to work for a sustainable future. We believe that we have to focus on more than just knowledge. There are several other important steps that lead people to become engaged in environmental issues. Today environmental issues force people to make difficult choices and maybe change their way of living. It is therefore important to teach children about their own rights, and to ask critical questions. Working with values is also important, it makes people aware of themselves and what they do and think. It is difficult for people to care about nature if they don't have any positive nature experiences, therefore we are working to develop people's experiences by providing activities that involve simply walking and climbing as well as exercises and games.

Setting a good example is important and we try to have ongoing discussion about our role as adults. Learning by doing is a well-known theory and our students undertake practical environmental work including taking tests in the organic garden plots and investigating what their school consumes in energy consumption. We believe knowledge about biological processes such as decomposition, photosynthesis and pollination can make it easier for people to understand environmental problems and how they affect the earth. In our new project Experiment Garden, people can interact with these processes. We also think it is important for teachers and students to meet scientists working with environmental issues and we want to create a meeting place for the general public and experts.

Our Activities

Our education programme has many components:

Programmes for Children and Youth
We have different programmes and tours for pre-school to upper secondary school focusing on botany, environment, natural science etc.

Teacher Training Courses
In our teacher training courses we have teachers from pre-school to upper secondary school. Examples of courses include The Garden as a Pedagogic Arena; Environmental Issues; and Research and Knowledge about Natural Science. Every term we conduct two day 'environmental days', where teachers can meet scientists, get information about their research and receive educational tips.

Tours and Hikes
We have environmental tours in the garden where we demonstrate how we work with the environment. We also conduct hikes in and around the National City Park.

Newsletter
The newsletter is written for schools and contains current environmental research information, and educational tips for teachers that they can use in their classrooms.

Environmental Consultants
We provide support to schools and companies in their environmental work. We hold courses and develop special programmes as requested. We also coordinate a programme for schools who want to work with their own environment called Green-schools.

Ask Naturens Hus
We have a question box on the internet where we answer children's questions about nature and the environment. Our aim is to create curiosity for the scientific world and the scientific way of thinking.

Outdoor Exhibitions
In the Bergius Botanic Garden, Naturens Hus develops and cares for the organic garden plots, flowering road edges and the wildlife garden. Here people who walk by can learn about organic gardening and organic food. Our new project, the Experiment Garden, is a hands-on garden with living plants. The goal is to promote an interest and an understanding of biological processes like decomposition, photosynthesis and pollination. In the future we plan to do a study to see if girls and boys interact differently in the Experiment Garden.

Using Games

Using games in education can enhance the visitor's experience in nature and increase understanding. Games usually form part of our programmes. We work with two different kinds of games firstly sensitization games that try to bring the person closer to nature, stimulate observation, and add to their enjoyment of the place. Secondly there are knowledge games which also help to enhance observation skills but also lead the visitor to deduce and form opinions on issues. We have been cooperating with an education project in Argentina and some of the games we use originate from that project.

Life Net
This is a game that aims to increase comprehension about food chains; how plants, animals and humans are interconnected; and how all life depends on the sun's energy.

The group forms itself into a circle around the Leader, who has a ball of string in his/her hand. The Leader asks some questions to the group e.g. 'What provides life with energy?' Someone may answer 'The Sun', and that person takes the end of the string and represents

the Sun – the source of energy. The Leader asks the group 'Who uses the energy from the sun to make food?' A child that responds with a type of plant, for example, is given the ball of string by the Sun, a line of energy. The Leader then asks the group 'Who eats plants to gain energy?' A child that responds correctly is then passed energy from the 'plant' in the form of string. The string starts to unwind as it gets passed around the group when the others in the circle say they are different plants and animals. As more children become involved an intricate web of energy is formed. When all the children are connected by the string the Leader then introduces environmental issues for example 'What will happen if one of the plants or animals die?', 'Will the life net fall apart?', 'What would happen if a pesticide was sprayed into our ecosystem?'. Those that would be effected directly fall down and those that feel a tug on their energy line also fall down, as they too would be affected. The only person left standing is the Sun showing that everything is interdependent. Through this activity children begin to observe the interdependency of our ecosystem.

Life Pyramid

This game illustrates the different links in the food chain and their importance in the ecosystem. The participants are asked to be a plant or an animal, they then start to build a living pyramid using their own bodies. The 'producers' have to stand on their hands and knees, the 'consumers' on top of them and so on. When the participants decide upon which organism they will play there usually ends up being more carnivores. This means the pyramid can't be built so the group needs to start the activity again with more people choosing to be plants. This gives participants an understanding that there has to be more producers than consumers to have a balanced ecosystem.

Pablo´s Watergame

This game provokes thought about the world's natural resources. The participants divide themselves into small groups and the Leader places a bucket in the middle of the groups to symbolise water flowing from the tap. Each group has a bucket and something to transport water with.. There can also be a full bucket of water symbolising the world's water resources. The Leader asks one group to fetch water from the central source using cans, the other to fetch the water using straws and a third group using a broken can and so on. In a limited time the participants try to carry as much water as they can to their own buckets, trying not to spill any. At the end of the game the Leader poses some questions: 'Which group has more water?' 'How much water did the group waste on their way to their bucket?'; 'Did everybody have an equal chance of getting the water?' (This game was developed by Pablo Stefano, Fundación Proyecto Pereyra, Argentina).

The Photograph Game

This game develops participant's perception of nature's elements. Two people work together. One person closes his/her eyes and pretends to be the camera, the other person is the photographer. The photographer leads the camera to a motif in nature, for example a beautiful view, a tree, or a rock. The photographer takes the picture by carefully pulling the camera's ears, then the camera opens his/her eyes for a short time, saving that image in his/her memory. The photographer leads the camera away from the area where they took

the photo and then asks the camera to find the spot where they took the photo. There can be several variations to this activity, for example children who pretended to be the camera could draw the image that they took a photo of.

Working with Values

People's values make them aware of themselves and what they think about different issues. These exercises also make people aware of how they are influenced by society, school and parents.

The 'Hot' Chair
The aim of this exercise is to challenge people's values; it forces people to develop an opinion on difficult issues. There are some important points to communicate to participants: 'nothing is right or wrong', 'we don't value each other', 'don't think to long - act quickly'. The Leader presents some statements and the participants are asked to move when they hear something they agree with, and to sit down when they don't agree. 'I want to drive a car'; 'I want to travel around the world'; everyone starts moving. 'I want to stop eating meat'; most of the group stays still. 'I want to ban genetically modified food'; the group starts moving again. The Leader can finish the activity by facilitating a discussion on people's values.

Four Corners
This exercise makes people think about who in society has the responsibility for environmental problems and it can be conducted in a classroom. Each corner of the classroom is labelled as either industry, politicians, households or shops. The Leader asks the participants a series of questions, for example 'Who do you think has the responsibility for products in the store which can damage the environment?'. The participants decide on one of four possibilities: industry, politicians, households or shops. When they have decided they go to one of the corners that corresponds to their opinion. The Leader can finish the activity by facilitating a discussion on who has primary responsibility for certain environmental problems in society.

Working with science

Knowledge through experience is important in our work. We try to work like scientists; explorationally and experimentally. We try not to use too many complicated measuring instruments or expensive materials so that teachers can use our methods in their own classrooms, therefore we try to use things from everyday life. Below are examples of some of our different programmes.

The Closed Ecosystem
One of our activities is the Closed Ecosystem - Nature in a Jar. This activity involves taking a green plant with its roots and soil; putting it in a jar and closing the lid forever. This stimulates lots of questions: 'Where does the water come from?', 'Will the plants die from starvation?,' 'Will the oxygen run out?'. The children start to explore the water cycle,

how plants can absorb sun light etc, they do their own research to find the answers. We want the children to increase their understanding about the biological cycles in nature. After this activity they can continue to develop their understanding of how different toxic substances poison our earth and how the green house effect is affected.

From the Cradle to the Grave

The aim of this activity is to develop an understanding of which natural resources we use, if they are reusable or if they can be depleted and if we can put the resources back into the ecosystem again.

The pupils start the activity by looking at different products and trying to find out what they are made of, and from which natural resource they originate. They then consider what happens with the product after they have used it. The children also sort different garbage and assess its origin and they finish the activity by making their own art using some of the garbage and making paper and compost.

Food, Environment and Social Justice

This activity aims to enhance the participant's consciousness concerning the production of food. It involves distributing different types of food amongst the group, e.g. a packet of biscuits or a piece of fruit or a vegetable. Participants are then asked to think of where the food comes from and how was it produced - conventional verses organic. If the vegetables are grown conventionally, they are asked to consider whether it is socially justified that people should live in areas where they use a lot of pesticides. To end the activity the participants are taken to the Victoria House where they can see many of the tropical plants that provide us with food. Undertaking soil and water tests in our organic garden plots is also part of the programme.

NBRI BOTANIC GARDEN - A NATIONAL FACILITY: CENTRE FOR EDUCATION AND CONSERVATION

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EDUCATION IN BOTANIC GARDENS

The evolution and development of education through botanic gardens has seen tremendous changes and improvements over the last few decades, particularly in areas of conservation of nature, environmental awareness and bioaesthetics. Botanic gardens play an important role in training a large number of professionals and can act as a valuable source of information and enlightenment for researchers and scientists about the problems pertaining to the conservation of floristic wealth and upgrading the environment. A garden possessing ample representation of indigenous plant species serves as an invaluable educational tool through which the students at all levels are helped to learn and appreciate the diversity of plants in their neighbourhood and the relationship between plants and other organisms found in natural habitats. Considering the responsibilities and experience gained in botanic gardens in the field of research, education and display of varied plant species including their cultural requirements, they should further expand the public education programmes to promote knowledge about plant conservation and ethics for visitors; especially school children, local communities and regional authorities.

The role of botanic gardens has been transforming rapidly with the progression of botanical sciences and growing socio-economic demands of humankind since their existence during the last few centuries. Present day gardens are meant to have multifaceted aspects and be equipped to conserve plant resources and serve as a linkage between people and local and global problems. They are considered to be important centres and tools for the conservation of plant diversity and the education of the masses about its sustainable utilisation.

ABOUT NBRI BOTANIC GARDEN

The NBRI Botanic Garden was established around 1800 as a royal garden by Nawab Saadat Ali Khan; and later adopted by Nawab Wajid Ali Shah, the last king of Avadh region during the first half of the 19th century. Nawab Wajid Ali Shah attributed this garden its name Sikander Bagh after his favourite queen Sikander Mahal Begum. It was transferred to the Council of Scientific and Industrial Research by the state government during 1948 and became known as the National Botanic Garden. Presently spread over an area of 25 hectares, it is located in the heart of the city of Lucknow, the capital of Uttar

Pradesh, along the southern bank of the River Gomti. The garden has been disseminating knowledge and educating a cross section of society by organising various educational activities and programmes throughout the year to create awareness about plant conservation, environmental improvement and the sustainable utilisation of plant resources. Short education-cum-training programmes are conducted and focus on the cultivation of ornamentals, landscaping, garden layouts, bonsai culture and techniques in horticultural practices as well as imparting knowledge about the importance of different groups of plants and highlighting the need for their care and conservation.

RESEARCH & DEVELOPMENT ACTIVITIES

The research and development (R & D) activities of the botanic garden are highly versatile and consist of plant introduction, documentation, ex-situ conservation, propagation, evaluation, floriculture, plant protection, horto-taxonomy, bio-remediation, education and training programmes, annual flower shows and exhibitions, publications, seed and plant exchange, sale of plants and seeds, technical consultancy and societal interaction. Training and education programmes comprise an integral component under the charter of this botanic garden.

Germplasm Collection

This garden has been credited as a living repository to conserve the plant wealth of indigenous and exotic origin and offers immense opportunities to researchers, students, teachers, plant and garden lovers from India and abroad. It is reputed for its well identified and aesthetically displayed germplasm in a well designed landscape that captures a living nucleus of various plant species totalling nearly 7000 taxa for posterity. The collections in the botanic garden are being nurtured in the Arboretum, Conservatory, Philodendron and Bromeliad House, Cactus and Succulents House, Palm House, Bonsai Section, Fern House, House for Economic, Medicinal and Rare Plants Section, Green House with Mist Propagation Facility, Acclimatisation Chamber, Nursery, and in the Display and Commercial Plots.

Ex Situ Conservation

Ex-situ conservation and the multiplication of endangered and endemic taxa is of prime importance to the botanic garden. Such duplicate material is made available to other gardens, scientific organisations and university departments for R & D studies and the maintenance of their germplasm collection to save them from extinction and to inform and educate the masses about their importance in natural ecosystem. Some of the notable taxa are *Adhatoda beddomei, Cycas beddomei, C. pectinata, Frerea indica, Hoya wightii, Isonandra villosa, Phoenix rupicola, Sophora mollis, Trachycarpus takail* and *Vanilla walkerie*. The cycads comprise a very significant group of plants from an educational and evolutionary point of view. The germplasm of over 25 taxa of cycads representing the genera *Cycas, Dioon, Encephalartos, Microcycas, Macrozamia* and *Zamia* is being maintained and constantly enriched in the garden. *Welwitschia mirabilis*, a bizarre plant

also known as Tree Tumbo, has been introduced from the National Botanic Garden, Kirstenbosch in South Africa. Besides this, other prominent taxa of evolutionary significance are *Cyathea, Equisetum, Ginkgo, Helminthostachys, Nepenthes, Ophioglossum* and *Psilotum*.

National Collection of Nelumbo (Lotus)

The NBRI Botanic Garden is maintaining one of the largest germplasm collections of *Nelumbo* (Sacred Lotus) comprising 60 spp./races with 25 races of exotic origin (from 7 countries) and 35 races of indigenous origin (from 11 states in India) to serve as reference centre for research and development studies. The dissemination of information about the Lotus through publications, articles and planting material has been provided to over 120 organisations, progressive farmers and plant growers, as well as to educational institutions.

Domestication of Wild Plants

The indigenous floristic wealth in our country proclaims its own significance and is deeply involved in our culture, literature and socio-economic life. A large number of plants in the country are intricately associated with festivals, rituals, and religious ceremonies related to all walks of life. Such plant species are collected by organising plant collection tours, and then introduced, acclimatised, multiplied, accessed and released for sale/exchange to raise the awareness of students and the general public of the importance of the conservation of indigenous taxa and their habitats. Noteworthy species are *Butea superba, Cassia fistula* (White) and *Erythrina resupinata.*

Botanical Excursions

Excursions to the gardens are arranged throughout the year for trainees, students and teachers. Appropriate guidance is rendered to them in the formulation of their various types of project reports pertaining to special groups of plants and for the purpose of bio-aesthetics and bio-remediation. Students at all levels are also provided with plant material for the preparation of herbarium specimens and their identification as per the requirements of their curricula.

Tree Plantation Drive

For creating mass awareness about the significance of living plant resources and their ex-situ conservation, a tree plantation drive was launched during the monsoon season in 1999. This project involved the general public and its purpose was to conserve important rare, exquisite and endangered tree species on the botanic garden campus. The general public were provided with a one page handout about the species that they had transplanted in the garden. This programme has helped to educate them and inculcate a bio-aesthetic sense.

Floriculture

The institute has evolved and released approximately 200 new ornamental cultivars such as Bougainvillea, Chrysanthemum, Gladiolus and Tuberose with the aim of promoting the floriculture industry. Authentic planting material of ornamental crops is provided to the public, farmers, students and researchers for experimental studies and other purposes. Short educational-cum-training programmes at various levels are conducted focusing on topics such as the cultivation of ornamentals, landscaping, garden layouts, bonsai and the latest techniques in horticultural practices.

Gladiolus

Germplasm of more than 150 cultivars of Gladiolus has been developed. Agro-technology has been standardised for the commercial cultivation of gladiolus under sub-tropical conditions. Courses are organised to impart training skills for the commercial cultivation of gladiolus in North Indian plains for the benefit of rural people. A get-together of beneficiaries of agro-technology transferred by the garden was also arranged during May, 1999 on National Technology Day. The participants discussed their problems, new planting material and crop management with the scientists and technical staff.

Bougainvillea

The botanic garden is maintaining a large collection of Bougainvilleas with more than 250 cultivars and serving as a reference centre for further research, development work and nursery trade. It has evolved over 20 new cultivars in the floriculture trade.

Chrysanthemum

This crop is widely cultivated for the cut-flower trade and the germplasm of more than 350 cultivars is being maintained in the garden. Several new cultivars have also been evolved and released in trade. Training and education is imparted in floriculture for floral dehydration and dry flower arrangements to the public and entrepreneurs by conducting training courses from time to time.

Annual Flower Shows and Science Exhibitions

The garden organises two annual flower shows (the Chrysanthemum and Coleus Show and the Rose and Gladiolus Show) during December and January. These shows are held for aesthetic reasons as well as to develop awareness amongst the general public about keeping their dwellings and the environment clean, healthy, green and colourful, as well as to generate self employment. All sections of society, floriculturists, gardeners, and the general public including government and non-government organisations, are encouraged to participate. The winning entries are awarded running trophies and shields besides several other prizes. The garden also participates every year in the State Flower Show by having a stall highlighting and educating about the R & D work in the area of floriculture and conservation. These flower shows provide an opportunity for close interaction on the problems of mutual interest to the masses from all walks of life.

Two science exhibitions; namely Science Day and CSIR Foundation Day; are arranged during February and September every year and involve keeping the garden and plant houses open to the public, students and teachers. On such occasions the visitors are given free access to all facilities and guided tours are conducted so that they can learn and realise the vital importance of plant diversity. The garden has also participated in science exhibitions in rural areas highlighting work on some important floricultural crops that benefit farmers and rural people.

Landscaping and Consultancy

Technical advice is rendered to individuals, the private and public sectors, national institutions and government organisations on bio-aesthetic planning and bio-remediation. The organisations worth mentioning are Navodaya Vidyalaya Complexes, National Thermal Power Projects at Sonebhadra & Unchahar, Larson & Toubro in Lucknow and the Gas Authority of India, Aurayia. The botanic garden has provided consultancy in the form of a detailed project report and layout plans for the establishment of the Temperate Botanic Garden at Paritabba, Mussoorie; Indira Gandhi Memorial Botanic Garden at Raebareily (UP); and the College of Agriculture, Nagpur (Maharashtra).

Training Courses

The garden regularly organises training courses for students, farmers, entrepreneurs and floriculturists. Notable ones are:

- the two training courses on the commercial cultivation of Gladiolus in North Indian plains sponsored by SIDBI during 1996 and 1997; and
- an Ornamental Horticulture and Landscaping course that was organised during 1997 and 1998 for the students of M.Sc. Life Sciences, Lucknow University and addressed both theory and practical classes incorporating various aspects of ornamental horticulture and landscaping with the help of audiovisuals and living plants.

Training for Field Staff

The training of field staff in the management and cultural aspects of different groups of plants and ornamental crops is provided on request and at various levels for the gardeners, supervisors, and horticultural officers. The gardeners from this garden also actively participate in the contests organised for the identification of plants. Training in Bonsai culture has also been provided to the housewives of the Army Wives Welfare Association from Central Command.

Documentation

The documentation and labelling of plant species is very important for a botanic garden for educational purposes. At NBRI the germplasm collections are properly labelled and

documented including details on their binomials, author, family, common name, nativity and distribution, as well as with other salient features as per requirement for the benefit of visitors and students not familiar with their botanical names. The advice for labelling of trees, shrubs and annuals was rendered for the Cantonment area of Central Command, Bhartiya Vidhya Bhawan and City Montessori School at Lucknow to educate army personnel, school/college students and the public about plant diversity in their local surroundings.

Publications

Publications about plant wealth and the activities of the garden serve as an important device for educational purposes. Research papers and popular articles are regularly published in journals and popular magazines. A botanic garden brochure has been produced to give a bird's eye view of the garden. A booklet and a folder have also been published about the commercial cultivation of gladiolus to educate and benefit the public and progressive growers under the rural development programme. In addition one page handouts have been published and provided to students and trainees covering various groups of interesting taxa and books on house plants and Bougainvillea. Bulletins on annuals and tuberose have also been published recently this year. Wide publicity is made about the interesting plants in media through newspapers and television to educate the public about nature conservation.

Sale and Exchange of Plants / Seeds

A variety of wild and ornamental plants are propagated in the garden for sale and/or exchange to inculcate bioaesthetic sense among the general public and connoisseurs. For the sale of plants/seeds, a price list has been printed and freely distributed. The garden is maintaining exchange relations with over 250 botanic gardens and institutions from within and outside the country from isoclimatic regions so that plant genetic resources of diverse groups of plants can be constantly enriched, conserved and disseminated. An Index - Seminum is printed and updated regularly for this purpose; notable species recently introduced in the garden are *Adansonia za, Heliconia rostrata, Jacranda cuspidifolia, Nolina paryii, N. stricta, N. longifolia, Pachypodium lamerei, Senecio confusus* and *Sophora secundiflora.*

Sponsored Projects

Sponsored projects contribute significantly towards strengthening the ongoing activities, facilities, and capacity building in the garden and for creating new ones to ameliorate the variety of habitats to conserve the plant diversity and rare and interesting taxa. Projects presently in operation are on ex-situ conservation, upgrading, networking and agro-technology of *Euryale* (Makhana) sponsored by MOEnF & CSIR, New Delhi.

Future Programmes

The botanic garden has been under the process of modernisation to equip itself with better facilities in order to further enrich its plant wealth. A separate section for people with disabilities is being conceived and will take the form of a scented garden. A Cycad House will be developed for students and the general public to educate them about the flora of the Jurassic Period. An Ixora garden is also being planned for enriching germplasm of this genus.

CONCLUSION

Botanic gardens are now considered important centres for education and can play a very vital role in catering for, and educating people about, the vast and varied heritage of plant life in complete harmony with nature. Rich and diverse plant collections in a garden serve as an invaluable educational tool through which the communities are helped to learn and acknowledge their plant resources, its sustainable utilisation and environmental improvement.

Considering the responsibilities and experience gained through the expertise generated in botanic gardens in the field of education, research and plant resources, gardens should expand their public education programmes to promote knowledge and the conservation of plant diversity and ethics to visitors, school children, community involvement and regional authorities. Capacity building programmes should be initiated to strengthen education in the botanic gardens at local, national, regional and global levels to generate more experienced hands by way of organising regular and frequent exchange programmes to various botanic gardens, organisations and institutions within and outside the country. Mobilisation of adequate resources, skilled staff and identification of an appropriate nodal agency to formulate specific need based programmes and policies worldwide, will be the right approach in this direction to achieve the desired results for present and future generations.

THE ROLE OF LIVING COLLECTIONS IN GARDENS FOR A SUSTAINABLE FUTURE

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INTRODUCTION

Whilst maintaining their long historical tradition of accumulating and studying plant diversity, botanic gardens have carried out a wide range of services and activities. Their priorities and roles are varied, differing from one to another, and have changed over decades, in some cases centuries, in order to adapt to the changes in the world and the evolving needs of society (WWF, IUCN and BGCS 1989; Maunder 1994; Heywood 1996).

Do botanic gardens have an authentic and important role to play in today's world? If the answer is yes, what should their current priorities and roles be? In particular, do living plant collections, which must be one of the major characteristics that define these institutions, help to meet these priorities and roles?

Because of the increasing general awareness of the current environmental crisis and likely future loss of biodiversity, botanic gardens' responsibility for plant conservation has become widely debated (Rae 1995; Maunder 1997). Now recognised as centres of plant conservation, botanic gardens around the world are involved in some kinds of conservation activities (Heywood 1987). Almost 800 botanic gardens have recently been active in promoting and practising biodiversity conservation in some significant way (Wyse Jackson 1996). In particular since the Earth Summit, the United Nations Conference on Environment and Development (UNCED) held in Rio de Janeiro in 1992, a focus on biodiversity conservation and sustainable development has been increasingly stressed in their mission and policies.

LIVING COLLECTIONS IN THE GARDEN – PAST AND FUTURE

It has been a long tradition that botanic gardens have been judged, or have judged themselves, by the number of individual representatives of different species held in the garden (Maunder 1994). *Bigger is better* and *more is merrier* have been philosophies that have accelerated the expansion of living plant collections (Robertson 1996). Too often, '…it seems that the collections are built up first and then a justification for their existence is sorted out afterwards' (Rae 1995).

Even where original collection strategies were well defined, over time the purpose and meaning of many collections has become uncertain. As a result, living collections no longer play as useful and as meaningful a role as they could. That is why it has been stated by Heywood that the common perception of botanic gardens is that they have virtually no role in strategic plant genetic resource conservation, but instead grow a random and diverse range of rare or endangered plant species (Heywood cited in Rae 1995).

As one of the most costly facilities within the organisations, but becoming less and less important for research and conservation, the problems regarding living collections in botanic gardens are complex (Oikawa and Kendle, in press). However the living plant collections are above all the publicly accessible face of the botanic garden. At the end of the day the decisions about their future value will not be made by the staff but by the wider public and politicians. Maunder (1994) argues that botanical gardens will be judged by the number of viable species and habitats surviving as a result of their intervention, and by their contribution to economic and social development but not by the number of the species maintained as botanical living dead.

'The collections are a museum's 'soul' and raison d'être' (Alberch, 1993). Without this facility, most botanic gardens would not have existed (Figure1). The living collection's role as the main method for maintaining plant diversity has been largely superseded by the development of new technology such as seed banks. It is now possible to conceive that botanic gardens could fulfil at least their scientific mission with vastly reduced collections. If living collections, or gardens, are to continue to play a role it will be important to clarify their purpose as related to their own institution's mission. This will require a fundamental change in the concept and direction of many living collections.

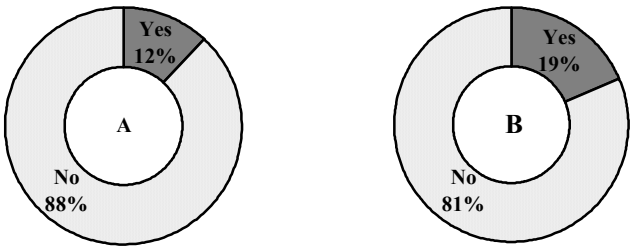

Figure 1. The results of two questions posed to botanic garden directors (n=75) as part of a survey in 1998.
A: Could your institute continue to meet its main goals without a living collection?
B: Could your institute exist without a living collection?

LIVING COLLECTIONS AS A CONSERVATION SHOWCASE

Although the recognition that living plant collections could be used for promoting conservation messages to a wider audience is not new (Ashton 1987), recent research carried out by Rae (1995) confirmed that conservation education was considered as the best way in which gardens in botanical institutions could support conservation. His results also showed that most frequently endangered and rare species were cultivated for the purpose of public education, while research staff rarely used the garden collections. The result of a survey of botanic garden directors in 1998 regarding both the main roles of the organisations and use of living collections (Figure 2) also supports the argument that the primary role and justification of living plant collections should be for public education.

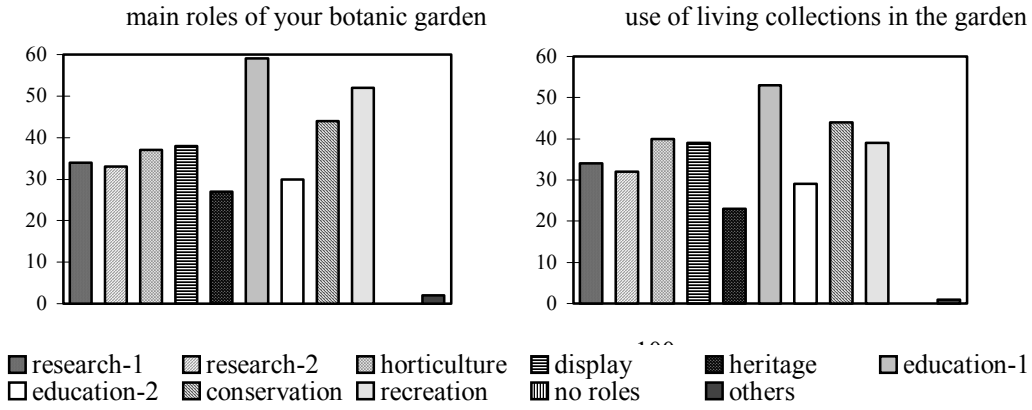

Figure 2 Main roles and actual use of living collections at botanic gardens (result from a survey of botanic garden directors, 1998, n=75). research-1: taxonomic research, research-2: other botanical research, education-1: public education, education-2: professional/ academic education.

Despite the importance of education, the education officers are rarely involved in plant selection and display design in the garden (Rae 1995; Oikawa 1999). The time and money commitments required to develop new collections and designs is not justified without consulting with key user groups, which are in the most case education staff. This approach requires an evolutionary change in the long tradition of living collection development if botanic gardens are to fulfil their own, and society's, requirements.

If more consideration is given to education opportunities when plants are chosen and laid out, the living collection in the garden could be much more effectively used, with clearer objectives. The conservation roles of the collection could in turn be more widely recognised and acknowledged. Most importantly, because the public experiences in the garden could become richer and more exciting, their perceptions and images of botanic gardens could also be expected to become more positive.

With the garden viewed as such a showcase, designed to awaken an interest in plant diversity for a wide range of public, the garden would interpret various themes and aspects.

These could include horticulture excellence and the possibilities of landscape design, the world of natural biodiversity and the conservation of plants and our environment, the principles of science and also the relationship of plants and people; culture, arts, religion and tradition. For example the concept of biodiversity, a common word for the professional communities in environmental conservation and natural sciences, is still not well understood by the general public (Bayon 1996) and could be well illustrated with the rich and unique resources in botanic gardens.

Furthermore, if botanic gardens wish to stress their contribution to sustainable development, then they have an obligation to address what sustainability means and how it could be achieved. For example there is a need to address holistic issues of plant-focused education, because:

> …education is critical for promoting sustainable development and improving the capacity of the people to address environment and development issues...It is critical for achieving environmental and ethical awareness, vales and attitudes, skills and behaviour consistent with sustainable development and for effective public participation in decision-making.
> (UNESCO 1992)

There is increasing debate about the agenda of development at one hand and the environment on the other. In the international forum a redefinition of the links between those concerns is being explored in the name of global sustainability and social justice. These concerns have been widely accepted as components of a new world ethic of sustainability (IUCN, UNEP and WWF 1991). If support for the move to sustainability is accepted in the mission of botanic gardens, educators within these teams need to investigate how education for sustainability is currently being conceived. Fien and Tilbury (1998) argue that environmental education in the past has too often concentrated on approaches which are either apolitical, naturalistic, scientific or aesthetic, and call for reorientation to focus more sharply on environmental quality, and socio-economic, political issues. How can such ideas be implemented in botanic gardens?

The unique strengths of botanic gardens lie in their land and plant collections and broader concepts of education should not become just classroom exercises. However there is no longer any need for the use of garden to be limited by the living collection as traditionally conceived i.e. a scientific genetic reserve of wild collected accessions. For example, if the living collection embraced cultivated as well as wild collected forms, this would allow exploration of our cultural dependence on plants to underline the link between nature and our survival.

Another important aspect is the importance of participatory techniques in environmental education. The gardens could provide a setting and opportunities for the public to learn approaches and skills for environmental citizenship. There are also opportunities to explore personal responsibilities and opportunities for change. One of the most straightforward examples could be a demonstration of recycling or composting. Participation in garden

maintenance and gardening, can also be recognised as a process that can nurture a sense of stewardship towards nature. If approached in the right way, participatory garden projects have also been shown to be powerful catalysts for the development of social responsibility (Lewis 1992).

The traditional living collection carries certain implicit messages about conservation. These include the idea that conservation is defensive (relying on a control of negative human action), carried out by scientists and specialists, does not involve personal responsibility or participation and is an issue that relates to rare and strictly wild species. Such perspectives are seen and now widely recognised as ineffective (IUCN, UNEP and WWF 1991), and the need for change was a primary motivating factor for the Earth Summit. In the future, conservation will be seen as participatory, a responsibility of everyone, active and creative (relying on positive human intervention) and an issue that emphasises the links between protecting wild nature and protecting our cultures, economies and societies. To be effective vehicles for education of such concepts, living collections need careful selection and design.

CHALLENGES FOR EDUCATION STAFF IN BOTANIC GARDENS

Education activities in botanic gardens have grown over the last ten years and will continue to grow. Botanic gardens themselves believe that education is now the best way that they could contribute to society (Figure 3). The roles and the responsibilities of the education officers are growing also. However from the perspective of Lucas's (1979) three strands of environmental education - education *about*, *in* and *for* the environment - it could be argued that current education efforts in botanic gardens are still too often focused on education *about* the environment (Figure 4).

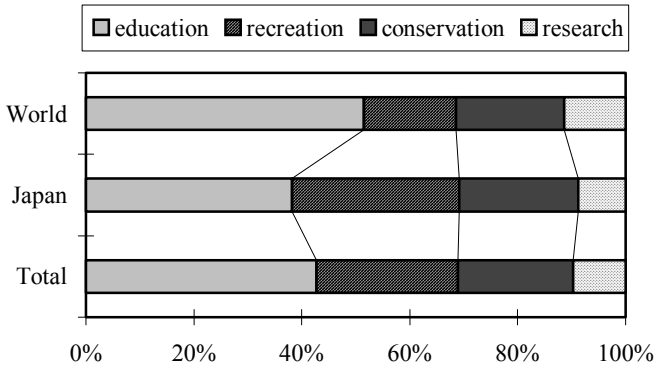

Figure 3. The opinions of botanic garden directors on factors that represent botanic gardens' most important contribution to society (result from a survey conducted in 1998).

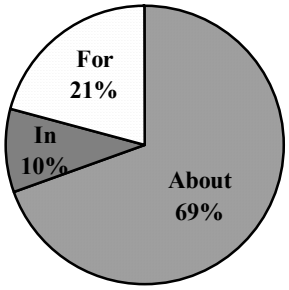

Figure 4. The goals of environmental education in botanic gardens classified by the three strands of environmental education; education *about* the environment, education *in* the environment, education *for* the environment (result from a survey of botanic garden education officers, 1998).

Education officers need to explore the implications of the whole concept of sustainable development and of the new perspectives on nature conservation. Without a fundamental understanding of these issues, composting will be seen as just another technique of horticulture, rather than an opportunity to explore issues of sustainable living. The imagination and creativity, and perhaps the philosophy, of education officers will be put to test to see how such holistic issues of sustainability could be represented.

'Education officers are so much more advanced [than us] in the debates of sustainability', according to one of the botanic garden directors participating at the BGCI Congress held in Cape Town, South Africa in 1998. If they can meet the new challenge, education officers should also be able to influence the agenda of the entire organisation. Perhaps most urgently, the living plant collections, which are becoming confused in terms of direction and role, would benefit from much greater commitment of, and communication with, education officers.

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DOES A VISIT TO THE SIR HAROLD HILLER GARDENS AND ARBORETUM SIGNIFICANTLY AFFECT SCHOOL CHILDREN'S ENVIRONMENTAL AWARENESS?

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THE CONTEXT

The Sir Harold Hillier Gardens and Arboretum (SHHGA), like many national and international sites, provides an educational service for schools. The importance of these sites as environmental educators is highlighted in the document *Caring for the Earth* (IUCN, UNEP and WWF 1991), which specifically cites some of the key institutions for spreading environmental information as:

> …museums, zoos, botanic gardens and national parks. These are especially effective because people choose to go there and expect to learn.

(IUCN, UNEP and WWF 1991)

Like the SHHGA, many will link their programme to various aspects of their national schools' curriculum, but direct assessment of any resultant influence on the children involved in a visit to a site seems to be limited or non-existent.

THE GARDEN SCHOOLS PROGRAMME

The garden provides a broad programme of topics all linked to the statutory requirements of the U.K. National Curriculum, and it is this link-up which appears to be the main reason for teachers' support of the programme. It operates a programme of tailor-made activities for every class i.e. all schools have their own individual day plan led and organised by the SHHGA education staff. The garden has a ‘no worksheets’ policy, believing these to be a hindrance rather than an aid to positive learning.

THE NEED FOR PROGRAMMES WITH IMPACT

Since the 1992 United Nations Commission on the Environment and Development (UNCED) summit, governments have continued to reiterate their commitment to environmental education, ostensibly seeing it as of paramount importance as the means towards a sustainable future.

> Clearly environmental education far transcends the boundaries of formal education. Work in the field as well as the classroom, bringing in local communities, is an essential part of the process from nursery and primary schools upward.
> (British Government Panel on Sustainable Development 1995)

> Education is a central means of furthering the Government's commitment to sustainable development. Education can give people that capacity to address environmental issues, which is vital to achieving a sustainable society.
> (Government Strategy for Environmental Education 1996)

A great deal of information and advice has been given to schools on the best methods to address environmental education. However, the greatest part of children's social learning will take place outside the school environment. A fact which has direct relevance for educators working in sites outside the school environment which are more likely to be linked with recreation and leisure. This places an even greater pressure upon environmental sites to maximise the effects of a school visit upon the participants.

Teachers are always quick to say how well their needs are fulfilled; but are these the real needs of the children? How much impact can just a few hours make? Has the environmental awareness of the class really been increased? How do you devise a suitable method to evaluate the immediate impact of a visit lasting just a few hours prior to later classroom intervention, by the teacher?

The possibility of devising a method for a simple assessment procedure which would not impinge upon the planned programme could be of value to educators at other sites, giving them a tool to assess their own programmes. This in no way would be a comparative measure between sites, but merely a comparison for each individual site and its own programme of topics.

Palmer and Suggate (1996) investigated early life experiences which produced a lasting effect and direct influence on environmental educators attitudes, subsequently affecting their career choice. Significant amongst these influences was the effect of outdoor experiences during childhood. The on-site environmental educator therefore, already has a good beginning.

> At a time when schooling is being restructured to make it better serve the economic and cultural needs of capital, teachers deserve a more realistic theory if they are to practise and defend education FOR the environment.
> (Huckle 1992)

More recent research (Palmer and Cooper, in press) recorded only 13% of respondents making reference to formal education as being the most important influence on their attitudes towards the environment. '…the influence of structured programmes is certainly not as prominent as perhaps it ought to or could be…experiences in other domains have had

far greater influence upon their [people's] relationship with the environment…' (Palmer 1997). Taking these factors into consideration, it would seem to be dangerous for any site to rely wholly on judging its effectiveness by the reactions of visiting teachers. Some means of evaluating their own methods and approach are imperative.

THE METHOD

One of the most commonly used activities in the SHHGA's EE programme is the Leaf Slide (Pearce 1990). Its versatility ensures its use in virtually all school's programmes. This offered the possibility to produce a breakdown of its use as a teaching tool. The Leaf Slide Activity uses a simple piece of equipment referred to by SHHGA personnel as either a Leaf Slide or a Leaf Window. The second term is used with younger children doing the activity.

Each child collects a leaf, or an assortment of leaves, according to various criteria e.g. shape or colour. Each leaf in turn, is placed between the two halves of the slide frame, covering the 'window'. Holding the two parts tightly together, so ensuring the leaf is flat, the slide is held up to the light. This has the effect of throwing the veins into sharp relief. In summer, using freshly picked green leaves, these are translucent due to the water content; autumn leaves collected from the ground, still demonstrate venation but appear as a darker network against a variety of autumn colours. This activity can be used in a number of contexts and programmes:

a) leaf shape and form	b) distribution patterns	c) discussion of a plant's water needs
d) photosynthesis	e) classification and keys (venation is used as a characteristic, including parallel veins for linear leaves)	f) colour comparisons (used in conjunction with maths)
g) listening	h) talking and describing	i) stimulation for imagination and creativity

Its great advantages are:

- simplicity, which means it can be used with a wide range of pupils ages and abilities; and
- its versatility, making it an integral part of many SHHGA topic programmes.

A portion of a large number of programmes contains the Leaf Slide activity. By examining a number of leaves it is hoped that the children's view of leaves and their significance within the environment will be expanded. Therefore, the children's concept of a leaf was decided on as the basis for measuring the development of their environmental awareness.

But what *is* understood by environmental awareness?

HOW IS ENVIRONMENTAL AWARENESS UNDERSTOOD?

Class teachers completing a questionnaire for SHHGA education service, all recorded environmental awareness as one of their main objectives for visiting the site. But what is the teachers' understanding of the term 'environmental awareness'?

There seems to be two equally valid interpretations of environmental awareness:

1. what may be termed the superficial consciousness of the immediate surroundings or environment; and
2. in-depth understanding and insight of the environment. This may be linked to an individual's relationship with the environment (Posch 1988 cited in Elliott 1991).

Are Children Aware of the Natural Environment?

Palmer, Suggate and Matthews (1996) recorded that pre-school children have already learned much, including misconceptions, about the environment. Their research showed that misconceptions could be maintained and reinforced during the first two years at school. Whether the knowledge is accurate or not, these findings indicate children's interest in the natural world.

American research examined children's reactions to vegetation and came to the conclusion that it suffered from invisibility (Harvey 1989; Moore 1986; Schneekloth 1989; Simmons 1994). Children could visit a forest, but see nothing. The plants there were not perceived as a living community of value in its own right.

During the second phase of research the emphasis moved away from language and questioning; instead they asked for drawings about the outdoor experience. Here the role of vegetation became much greater and more important for the participants. Plants now assumed an integral part of the environment and talking *about* the drawings brought many more experiences and observations to light. Similarly Moore (1986) remarks on the richness of children's drawings of their environment, compared with the paucity of their verbal expression.

So what features of plants *are* of importance to children? What *does* make them worthy of note?

Tunnicliffe (pers.comm 1998) has been examining children's perception of plants. Assessment of the feature most commonly used to identify the plants and the source of the children's knowledge was the flower and leaves. These were not readily considered means of identification for a plant, despite their predominance as a plant characteristic.

Taking into consideration the lack of interest shown by children for plants in general and leaves in particular, the value of a school visit to the SHHGA must be called into question.

Therefore, the following hypothesis was formed: A visit to the Sir Harold Hillier Gardens and Arboretum has no significant effect on the environmental awareness of schoolchildren.

Draw a leaf test

A way of testing this hypothesis was devised by drawing upon a number of sources. Some of these were from educational psychology testing methods, where subjects were given little time to consider what might be considered an appropriate response for a task; and the use of drawings or pictures in assessing individual children's attitudes was another technique used.

From Joicey's (1986) reference to children's stereotyped drawings of objects, it seemed reasonable to assume that in a short time allocation, children would be more likely to draw a stereotype object than an atypical example. Therefore, if that stereotype could be altered, through the Leaf Slide Activity and general observations, this could be an indication of improved environmental awareness.

The test procedure involved the site educator for each class asking its members to make a drawing of a leaf at the beginning of a visit and again, just prior to departure. The collection of data from the entire class took no longer than a maximum of five minutes each time. The children were all hurried along as quickly as possible, to give as immediate a reaction as possible. The pieces of paper used were all the same size and provided by the tester on both occasions. The drawings were assessed as stereotyped or not according to outline and approximate proportions. All drawings were produced anonymously to prevent the children feeling any pressure to draw a 'better' leaf or one different from their original effort.

A control series of tests was carried out using all the pupils at a local school to find out whether there were any measurable sensitising effects caused by the actual drawing itself. The classes were asked to draw a leaf at the beginning, and end, of a normal school day.

THE RESULTS

The study revealed that there was an increase in the percentage of atypical leaves in the second set of drawings for all classes. In contrast the control group showed no such variation at all. Thus it may be argued that the act of making a drawing at the beginning of the day does not significantly influence the children's drawings at the end of the day. Therefore any difference may be due to the visit to the SHHGA.

The results were analysed using the chi squared statistical method for significance for a divided sample. These results were used in two ways:

1. as the intended significance test
2. as a numerical comparison between different groups.

The chi-squared values were compared with a number of other factors:

- pupils' ages
- school location
- botanical content of the visit
- school grounds.

Statistical Analysis

The use of percentage values as a comparison between classes was considered to be an unsatisfactory technique since this would not involve comparing like and like; class size will have a considerable effect on the percentage values e.g. a difference of one will have a much greater statistical impact on a small class than a large one. The use of the chi-squared (X^2) divided sample test was considered more suitable. This test makes a direct comparison of changes which may be expected to occur due to probability and those observed. Extreme deviations can therefore be assessed for their significant variance from the expected, most probable deviation. Each class of children could then be assessed on this scale and direct comparisons between different classes and different schools, could be more accurately made.

A series of cells, based on the leaf drawing results, was established for each class.

	Leaves - morning	Leaves - afternoon	
Stereotyped leaves	A	C	A+C
Atypical leaves	B	D	B+D
Total	A+B	C+D	A+B+C+D

Day plans were graded according to their botanical content, on an increasing scale 1-5. Each school was asked about their own school grounds and the school's location. Four general descriptive areas were eventually used:

1. Inner City - centrally placed within an urban context, with little or no access to any natural or artificial environmental sites, including gardens at home.
2. Urban - placed within an urban area, but with opportunities to see something natural within the local landscape.
3. Suburban - situated as part of housing developments, either long established or relatively new, with gardens and recreation grounds relatively nearby.
4. Rural - village schools within local community, local environment of wood and farmland.

School grounds were crudely graded according to the presence or absence of five criteria: school field, pond, wildlife area, seats for children and children's gardens.

Using the results from the various observations and the chi-squared analysis a series of comparative graphs was produced (Figure 1). Examination of the graphs indicates the following trends:

Pupil's Ages
The age of the children visiting the garden is a key factor to the impact that the visit makes. Those apparently gaining the greatest benefit being within the age group 7-9 years. Comparing this with Palmer, Suggate and Matthew's (1996) findings, the inference has to be that at this age they have gained sufficient basic concepts to act as a comparison for new experiences and observations.

Similarly impact on the lower age groups (5-7 years) does not appear to be significant. It is suggested that this is due not to lack of impact entirely, but other considerations e.g. development of motor skills and/or basic concepts or mis-concepts. Although Palmer suggests that pre-school children already have a large body of knowledge about the environment, it may be the mis-concepts concepts she highlights, that are not yet firmly enough understood to act as a comparison for other experiences.

Social Factors
The location of the school and therefore, by inference, its sociological make-up appears to have had some effect on how much impact the visit to the SHHGA made on the children. Inner city and suburban children apparently gaining most from a visit.

Botanical Content
As might be expected, this was a contributory factor to the results of the Draw a Leaf Test i.e. groups with high botanical content producing more significant results, than those without. However, this was not true for all classes with high botanical content, indicating other factors may also have influenced the result. The most likely would appear to have been the activities undertaken by each class, with some classes participating in programmes with greater opportunities for direct contact with the vegetation.

School Grounds
The present survey also underlines others' work on the importance of school grounds in the development of children's environmental awareness. Its findings lead the author to suggest that school grounds may be of most value to the 5-7 years age group, providing them with freedom of access and repetitive activities to build confidence in the natural world. In this instance, vegetation would be the most accessible 'representative' of the natural world.

IMPLICATIONS FOR THE SHHGA SCHOOL'S PROGRAMME

These may be summarised briefly:

- To maintain the policy of no worksheets.

- To extend the variety of games and activities again. Although the garden already has an extensive repertoire of games and activities, more are still needed for the older age groups. To stimulate their interest they require more challenging and new environmental experiences, if a visit is to produce any significant impact on their environmental awareness.
- Positive action is needed to encourage inner city schools to visit SHHGA. Although such a policy does already exist, it needs to be followed up more aggressively than at present. It probably merits a high priority aim since these children seem to be amongst the group that benefit the most from a visit.
- There may be a need to reappraise the types of activities which are incorporated into some programmes, to ensure there is a high degree of plant interaction for all classes.
- A period of free investigation, discovery and interaction with the environment could be incorporated into future class programmes.

CONSIDERATIONS FOR OTHER ENVIRONMENTAL EDUCATION SITES

As noted in the previous section, there are some aspects of this survey's findings which may cause adjustments in the schools' programmes at the gardens. These also raise questions pertinent to other sites.

Although the garden's programme does not use worksheets, it does follow a structured, logical progression of reasoning and activities, throughout the day. Is there a danger that this structure is too obviously linked to schoolwork and the National Curriculum? Thus being perceived in the same light as formal classroom teaching, by the children? In the light of Palmer's (1997) research and Tunnicliffe's (pers.comm 1998) interim results highlighting that formal education has little effect on an individual's environmental awareness – is there a danger that this could be negating the positive aspects of the outdoor experience, shown by Palmer and Suggate (1996) to be so important in the development of environmental awareness? Is the knowledge that the visit will initiate more formal work at school a problem for older groups?

There seems to be a case for evolving a period of undirected activity during the day's programme. Posch (1988 cited in Elliot 1991) states that environmental awareness is a type of practical wisdom developed through personal experience. If this is so, then in line with Palmer's findings, it seems unlikely that closely directed activities will have any great impact on children's environmental awareness. Similarly Trainer (1990) and Munro (1995) point out that structured programmes of telling/teaching are useless; the light has to dawn in each child's eyes, they need to experience and to understand for themselves.

Perhaps environmental education site educators need to step aside from the needs of teachers and curricula, to remember and put the light back into their own eyes, if they really are to influence their many school visitors each year.

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Personal Communication

S. Tunnicliffe is undertaking research in 'Building a Model of the Environment: How do Children Perceive Plants?' and a draft research paper was provided to the author in 1998.

ECOLOGICAL EDUCATION POTENTIAL OF BOTANIC GARDENS – A CASE STUDY AMONG INDIAN SCHOOL CHILDREN

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INTRODUCTION

One of the most crucial challenges facing modern society is the environmental crisis, and there is wide spread international concern about the loss of our biodiversity and the serious consequences on our economic-ecological systems. As far as India is concerned, according to the findings of both the Botanical and Zoological Survey of India, over 1500 plant and more than 150 animal species are categorised as endangered. Therefore the problem of preserving our natural resources confronts us more than ever before, and we must find ways to protect our biological diversity for the future generation.

Agenda 21 (United Nations 1993) has emphasised that environmental education is one of the most important strategies for protecting our environment. It is being recognised that a better understanding of the environment can only come through environmental education. It aims to help us to learn about the environment in which we live; interact, grow and survive, to appreciate it; and also to make use of the nature and natural resources in a sustainable way. In addition, environmental education can also play an integrated and pivotal role in conserving biodiversity.

Therefore, the question arises how environmental education can be extended to the masses in a systematic framework? In addition, the following questions arise:

- Who are the target groups to be identified to receive this knowledge?
- At what level can we educate them so that they are more conscious of the importance of the environment and the human - nature relationship?
- Is our general education system adequately designed to accomplish this challenge and what institutions are going to participate in this programme?

We have to find answers to these questions before we can design a comprehensive environmental education programme at both formal and informal levels.

Palmer (Palmer and Neal 1994) conducted a study on the development of personal concern and individual commitment for the environment. She observed that the single most

important category of responses at all levels was outdoor experience, particularly at a young age. So it is now recognised that children are the most suitable target population to receive environmental education since they are more receptive and responsive to the environment as well as being the future guardians of the environment. This paper therefore explores the environmental ecological education potential of botanic gardens through a case study conducted with secondary school children. This work aimed to evolve experimental designs and methodologies for the effective implementation of environmental education, making use of botanical infrastructure in a botanic garden.

Increasingly it is now being realised that botanic gardens are superb and appropriate centres for environmental education and one can observe that botanic gardens have a long tradition and history in the field of education. Heywood (1985) observed that today, in accepting a major conservation role, it is the botanic gardens with rich flora that have a clearly defined role to play.

From the early 1990s botanic gardens all over the world have gradually focused and intensified their efforts and resources to educate the general public, especially school children; as children are the potential decision and policy makers of the future. For example the Royal Botanic Garden Kew (RBG Kew) in the U.K. became the cradle of environmental education instrumentalising it for performing an effective role in propagating ecological education especially among school children. RBG Kew has produced a teaching resource kit entitled Plants across the Curriculum to introduce children between 8 and 13 years to the world of plants and to make them understand the vital role it plays in our lives. So also do Australian botanic gardens which provide educational opportunities for people of all ages, abilities and backgrounds to learn about Australian flora and develop skills and interest in horticulture. In addition, North American public gardens place much emphasis on children's programme with preparatory or follow-up activities in the schools. In New York Botanic Garden, educational activities for the public are arranged at all levels involving the very simplest observation to formal courses for adults.

In India, the Indian Botanic Garden in Calcutta with its picturesque vistas, delightful lakes with marvellous lotus and water lilies and vast green areas, serve as a source of inspiration, recreation, education and research for thousands of visitors throughout the year. Special facilities for visitors are available in the form of guided botanical trips in the garden on Sundays and holidays. Other activities include extension services such as open week exhibitions, flower shows, film shows and the distribution of materials during Vanamahotsava. Notwithstanding these initiatives, so far no botanic gardens in India have taken serious steps to initiate environmental education except the Tropical Botanic Garden & Research Institute (TBGRI) in Thiruvananthapuram.

At TBGRI an incredible opportunity exists for imparting environmental education to students and general public. A visitor survey conducted in 1997 revealed that 75% of the visitors were students from various colleges and schools. TBGRI is now engaged in structuring, developing and implementing an environmental education programme for

students to observe, understand and appreciate the plant wealth so as to use these resources judiciously for sustainable development.

This paper presents the results from one of the environmental education experiments conducted at TBGRI involving secondary school children between 1995 and 1997.

MAJOR OBJECTIVES OF THE EXPERIMENT

1. To understand the general observational ability of the students in identifying different types of plants (categorising them according to their use and economic importance in a pre-demonstration scenario).

2. To identify the demonstration effect and ecological awareness and effectiveness of botanic gardens among school children in a post-demonstration scenario i.e. a situation in which students are already exposed and are acquainted with different plant systems and their utility.

3. To understand the ability of students to identify different medicinal plants including spices in pre and post demonstration scenarios.

In general, the aim of the study were to find out how botanic gardens can be made into an institutional establishment that makes school children identify and understand the different types of plants which are commonly grown in our villages and/or countryside.

METHODOLOGY

This study was conducted in two phases; in the first phase about 50 common plants consisting of medicinal plants, spices and fruit plants (which were usually growing in the students surroundings and seen by them every day) were selected and exhibited. The students were asked to identify the plant by writing the respective local name on a sheet of paper. After identification, a questionnaire was given to students and they had to identify the medicinal plants, spices and the plants that were common in their neighbourhood.

In the second phase, about 100 live plants were selected, demonstrated and the economic importance and the therapeutic value of the medicinal plants was explained. The students showed much interest and they were given enough time to acquaint themselves with these plants. On the second day, from this selection, about 50 plants consisting of medicinal plants, food plants, and spices were exhibited for identification. Here also the formal assessment of the experiment was done using a questionnaire.

In the first phase, as it happened to be a spontaneous and inadvertent exposure and identification, common plants that were found more in the immediate environment of the students such as home premises, school compound and waysides were selected. A small proportion (10%) of the plants were from forest areas and most common plants were selected for the experiment in order to help the students to learn about the environment in

which they live, to assist them in appreciating it and to educate them on using the surroundings without damaging it.

In the second phase, 70% of the plants were rare; rare in the sense that they were not seen by the students in their immediate vicinity. This was to enable us to discover whether the students were able to identify common plants without a demonstration; and more rare plants after having an effective demonstration and acquaintance with the help of botanical infrastructure. A target group consisting of 40 students was used. This group were new to both the experiments so that each group had an equal demonstration experimental opportunity and therefore the accumulated demonstration effect of the exposure to botanic gardens (botanic infrastructure) was not accumulated in the second test.

RESULTS AND DISCUSSIONS

In the pre-demonstration scenario a maximum score was 80% and the minimum was 30%; half of the students could identify 60% and above. While 70% of them were able to identify up to 50% of plants (Table 1), nearly one third (30%) of the students could not identify half of the plants. When the questionnaire was analysed it was found that this was not because of their familiarity with these plants; many of the plants were familiar but the students had not heard about, or thought about, their names.

Table 1: General ability of the students to identify different types of plants (pre-demonstration)

% of Score	**% of Students**	**Cumulative % of Students**
70 -80	25	25
60 – 70	25	50
50 – 60	20	70
40 – 50	17	87
30 - 40	13	100

For example *Scoparia dulcis*, a medicinal plant that is used for the treatment of kidney stones, was familiar to almost all the students; but the local name was not known to most of them. The same was experienced when considering the general public who had visited the garden; they were very eager to see this plant but when they saw it they exclaimed that this occurred everywhere. From this simple example it is interesting to note that the botanic infrastructure available in a botanic garden is able to play a very effective or a catalytic, role in providing botanical knowledge and information to students as well as the general public. However, in the case of *Acacia auriculiformis*, the opposite was found; none of the students revealed that this plant was seen in their immediate surroundings but 70% of them correctly identified it. This may be because of the social forestry activities that were effectively implemented by the government in public land whereby the major species selected was Acacia.

When the seeds of *Adenanthera pavonia* and *Abrus precatorius* were exhibited, the majority of the students were able to identify these plants. This observation indicates that any ecosystem element that is involved in an entertainment interaction phenomenon, especially in a magic religious framework, makes more of an imprint on students. It is interesting to note that all the fruit trees were identified correctly by almost all the students.

We saw a significant difference in the identification of medicinal plants (Table 2). 70% of the plants were medicinal but only 3% of the students were able to identify 70% of them and 6% of the students correctly identified 50% and more. *Phyllanthus amaras*, *Eclipta alba*, *Elephantopus scaber*, and *Moringa olefera* were identified as medicinal by most of the students. *Rauvolfia serpentina*, even though they had to study this plant in Std. IX, only 5% of the students identified it correctly. This result indicates poor knowledge by the students about our traditional medicinal plants. In the general plant identification exercise, more students were able to identify the plant by its name, but its economic utility was not clearly understood because they were using and depending on allopathic medicine for their ailments.

Table 2: General ability of the students to identify medicinal plants (Pre-demonstration)

% of score	**% of students**	**Cumulative % of students**
60 – 70	3	3
50 – 60	3	6
40 – 50	7	13
30 – 40	14	27
20 – 30	23	50
10 – 20	23	73
0 - 10	27	100

Although we included only 4% in the category of spices, less than 25% of the students could identify these plants correctly. They mistook some other plants like *Eucalypt* sp. and *Thotteo siliquosa* as spices. Even though this concept is included in the curriculum, 75% of the students couldn't distinguish spices from the other plants. This shows the lacunae in formal teaching as it is slightly divorced from the environment. A programme in the botanic garden will help the students to learn more about the local plants and this will develop their interest in identifying more plants and learning more about their uses and economic importance.

POST DEMONSTRATION

Analysis of the results (Table 3) shows that the maximum score was 90% and the minimum 40%. Non-availability of most of these plants in their surroundings made the identification process a little bit difficult for students; even then, 75% of the students correctly identified 50% of the plants. It is interesting to note that no one scored below 40%.

Table 3: General ability of the students to identify different types of plants (Post-demonstration)

% of score	% of students	Cumulative % of students
80 – 90	7	7
70 – 80	23	30
60 – 70	15	45
50 – 60	30	75
40 - 50	25	100

In this experiment the success of recalling the names mostly depended upon memory and the general academic performance of the students because most of these names were new to them. The power of retention varied according to the difference in the individual ability and general academic performance. Some students retain information much better than others do. According to Ebbinghaus' experiment (1913), 66% of information can be forgotten with the lapse of one day. However, in this experiment all the students were able to remember more than 40%. Learning is the primary condition for remembering and if learning experiences are active and interesting they may create mental images for recalling when needs arise. The demonstration of these plants was much more meaningful because learning depended upon active observation, creative interest and greater attention. Here it is appropriate to quote the relevance of the famous educational dictum 'We see, we remember…'.

In the identification of medicinal plants (Table 4) a quarter (25%) of the students identified 80%, and 65% of the students identified 50% of the plants. This contrasted with 6% who identified 50% of the plants in pre-demonstration activities.

Table 4: General ability of the students to identify medicinal plants (Post-demonstration)

% of score	% of students	Cumulative % of students
90 – 100	7	7
80 – 90	18	25
70 – 80	15	40
60 – 70	15	55
50 – 60	10	65
40 – 50	21	86
30 - 40	7	93
20 - 30	7	100

Some of the rare medicinal plants and their frequency of identification are outlined in Table 5.

Table 5: Rare medicinal plants and their percentage of identification (Post demonstration)

Name of Plant	% of identification
Trichopus zeylanicus	95
Acorus calamus	85
Gymnema sylvestris	80
Rauvolfia serpentina	75
Pseudarthria viscidia	75
Desmodium gangeticum	75

In the activity focusing on the identification of spices all the students identified more than 50%. More than a third (37%) of the students scored 83%, and two thirds (66%) of the plants were identified by 33% of the students and 30% of students identified half (50%) of the spices.

These results show that information, awareness and knowledge obtained by the students through demonstration with the help of a botanic infrastructure was exceptionally effective even beyond the scope of Ebbinghaus' experiment.

The above comparative analysis reveals that even though there was no significant variation in performance in the general plant identification where an awareness and training was provided, as far as application of medicinal plants and spices was concerned, demonstration very effectively increased the knowledge and understanding of the students.

The first and second experiments were heterogeneous both in the case of the plants, as well as the participating students. This was to prove the efficacy of demonstration in the sense that how a particular group of students reflect back on their performance in an independent situation. So comparing the results has its own limitations because the post-demonstration intelligence and memory of the students also played an important role.

CONCLUSION

As explained earlier, this pioneering experiment shows the botanic garden itself is an effective tool in the formal and informal environmental education process. From this experiment, it is understood that children can acquire knowledge in an incidental and informal way and should be able to retain it if the collection of plants are well presented and interpreted. The results of this experiment reflect the children's experiences in their home, school and community environment and it is hoped that these activities will get the children pondering about every day habits and occurrences in an environmental dimension.

It is hoped that the students will develop an understanding that they are a natural component of the total ecosystem. This also supports the aim that children will understand what natural resources are, how natural resources affect humans and how humans affect natural resources and thereby imbibe and inculcate in them a symbiotic interaction between humans and natural systems.

This type of experiment can make learning about the environment practical, meaningful and potentially have long term impacts on children's attitude towards the environment in their future life. Another benefit is that children can develop many desirable attitudes and also observational skills and a scientific approach.

Botanic garden biodiversity collections can be a considerable ecological asset to enhance public understanding and appreciation of the biodiversity of their own region including inculcating a positive attitude towards the protection and conservation of biodiversity. Whether the people come informally to walk around the garden or more formally to participate in an educational activity, this opportunity must be utilised to promote the conservation activities. From the youngest pupils in school groups, to the oldest in the continuing education programme, they can all carry the message about the global ecological crisis and the need for conservation of biodiversity to a wider audience. Therefore the results obtained through the investigation help to establish, to a greater extent, that botanic gardens could be instrumentalised as a living technological system that have significant potential to impart science and environmental education focussing towards an integrated sustainable developing education.

The interaction with young minds during this programme has given us many thoughts and insights for future work. The young students have shown greater interest in fieldwork and have expressed their desire to do something practical to improve the quality of environment and protection of biodiversity.

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Development Education and Environmental Ethics

THE ROLE OF ETHICS IN ENVIRONMENTALLY SUSTAINABLE DEVELOPMENT EDUCATION

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I cannot help feeling a sense of inevitability of events, as I see the emerging behaviour of the human race towards the planet upon which we live and the planet that provides us with all of our life-support systems; including the splendid botanical edifices which ornament our earth. In simple terms, it seems we are distancing ourselves from the earth's innate manifestation, its personality and the extinguished fragile fabric of nature, which requires us not only to take from it, but also to give it our protection and affection.

As I circle this planet and meet my fellow human beings, I see these distances growing more and more. Amidst all this, thankfully, the human race has conceived a concept called the Botanic Garden. These gardens are the result not only of a divine inheritance, but one that the human race has further evolved as its scientific achievement, an orchestra of God's nicest creations, both inherited by humankind from this planet, but also designed and devised by him through his own knowledge and effort.

However, more and more, these great botanic gardens are becoming critical vital links between humankind and their roots of culture, grace and equity and last but not least, bulwarks of sustainability of human's life on earth.

Let me now turn to the other gardens of the world, the forests. I have always considered a forest not as a chaotic cluster of trees, shrubs and flowers. The chaos that exists in a forest is only the manifestation of our own ignorance. We do not see in the design of a tree; or the formation of a forest; or the flow of a brook in a jungle; the divine design. Our ignorance of this makes us think of this as chaotic.

I have often stood in front of a magnificent tree. Its branches taking shape and form as its roots and its genes ordain it. The soil upon which it grows, the air that caresses it and the raindrops that nourish it, become the only external players that participate in this design, and thus we have in our midst, a tree. Humans have had no participation in the design or structure of this tree, be it a tree in a forest, or a tree in our garden.

Thus, I have thought of forest as another garden, a garden that has been designed, not by humans, but by nature. It is, in a sense, a Mother Garden.

Drawing from this immortal mother, humans over the centuries have attempted to take from her and re-design and re-culture what they now call botanic gardens, and indeed they have in this process made some great contributions, all over the world, by creating masterpieces.

The major concern today among all those involved is the future wellbeing of our planet, i.e. sustainable development. Let me re-define this term; we are concerned with environmentally sound sustainable development. While this sounds like a tall order, it is not. It is a means of evolving sensible development for the sake of our future and ourselves. Here, I have learnt to walk with care; as a member of the Planning Team for the United Nations Conference on Environment and Development in Rio de Janeiro in 1992, my mandate as a representative of IUCN (the World Conservation Union) was to draft Chapter 36 of Agenda 21. We were a small team working on this, travelling to the four corners of this plant (Asia, Africa, Canada, Australia, South America, Europe, Russia and China) to gather data and advice.

In many parts of the world, I began to hear people suggesting that we should evolve Environmental and Developmental Education as Chapter 36 of Agenda 21. They advised that I combine the two. The more I heard from people around the world, the more I was concerned. If we mixed environmental education with developmental education, we would surely confuse and diffuse the issue. I realised that developmental education is a different concept; it brings with it issues of productivity, increased product and profit.

We are being taught that we must produce more, better and faster; make more profit, and use more profit. Environmental education is another culture; it asks that we understand the environment, learn how to protect it, how to preserve precious natural resource and use them where necessary in a sustainable manner. I therefore argued that we should not speak of development education in the same breath as environmental education. But how should we harmonise the two? It is here that we researched into the whole issue and came up with the concept of environmentally sound sustainable development. Within the framework of environmental soundness, we introduced the concepts of ethics and equity.

Botanic gardens are not only manifestations of botany but also manifestations of art, culture, aesthetics and the environment. There is the great Moghul Gardens of India; the gardens in Kyoto, Japan, symbolising dignity and quiet grace; the resplendent explosion of an orchestra of trees, flowers, bodies of water, and mounds of emerald grass in the Queen Elizabeth Park at Vancouver, British Columbia; the Royal Botanic Gardens Kew in London U.K., or the magnificent botanic garden of Rio de Janeiro, Brazil. In addition, the spectacular botanical treasure houses of Proteas in Cape Town, South Africa. Each flower looking unlikely, the way in which its petals are placed one over the other in colours and forms that make some of these Proteas look like plastic objects glued together. There is also the heavenly valley of Saffron flowers in our own immortal Himalayas; each of these botanic gardens, to name but a few, represents not only a botanical treasure house, but also a celebration of people's finest sense of aesthetics, culture and, last but not least, a sense of ethics.

In my long service to the environmental cause on this planet, I have found that, increasingly, the ethical dimension of environmental protection has often been set aside. This is indeed a most painful, dangerous trend. People's concern for humanity is one of the fundamental requirements of sustainable life on Earth if they want, and deserve, to be called human. The human race owes to today's humankind, as well as to Mother Earth, a sense of ethics and equity in everything it does. By overlooking or ignoring ethics and equity in the way in which we live, we are not only offending Mother Earth, but also insulting ourselves, and damaging the life and well being of future generations.

We need to come back to our own instinctive culture; the culture of the human being, which sets it apart from animals in the wild.

Let me hasten at this point to say, that I am not ready to accept that animals in the wild are any less, in terms of the ethical way in which they behave. Often, the behaviour of wild animals in a forest appears to be vastly superior to that of human beings, especially humans in our cities, and more especially in countries that call themselves developed. There is a sense of justice and a sense of equity among wild animals and birds. Life and death are part of a larger orchestra of nature. Wild animals do not manipulate and divide themselves into classes or castes; they do not have national boundaries; there is no politics in wildlife; there are no boundary wars. Plants have been known to migrate without hindrance from south to north; from continent to continent.

It is only the human race that has needed to evolve methodologies of war and antidotes to war, out of a sense of despair. The League of Nations, which evolved into the United Nations, has today needed to carry on unrelenting fire-fighting operations, only because some parts of the human race seem to have set fire to another. Wild animals do not set fire to each other's lives. They perform with dignity, discipline and decorum as ordained by nature; they perform with a sense of ethics.

This important conference is addressing, among other things, the role that ethnobotany can play in environmental conservation through the proper protection, propagation and greater facilitation of botanic gardens. I do not claim to be a botanist, but I have the privilege of having been educated in the earth sciences. When I first perceived the concept of ethnobotany, I did not look at a dictionary. Instead, I said to myself: 'I understand ethnicity and I understand botany; the combination of these two should imply ethnobotany'. What is Ethnobotany?

First my mind proceeded to the ethnics of the world. Indeed, the ethnic history of this world has not been something that it can be proud of. The 20th century has witnessed perhaps the most unfortunate catastrophes relating to what I call ethnic ethics. Who would have imagined that this great Earth, which produced great apostles such as Buddha, Gandhi, Christ, Mohammed, and a galaxy of immortal beings, not to speak of mythological beings, would degenerate itself into a thing called ethnic cleansing? Ethnic cleansing is not something we are witnessing in recent times; it has always been there. The history of many nations in the world has been tarnished by vulgar attempts towards ethnic cleansing in one

form or another. One would only hope that the value of ethnicity and the need to honour, protect and preserve it, comes back to this planet as we enter the 21st century.

The word ethnic is described as a '…reference to races or peoples, with special reference to distinct ancestral, cultural, religious or linguistic characteristics'. Alas, this very definition has been its own enemy, since it has revealed how fragile ethnicity is! The Greek word 'ethnos' meant nation; what happened? Almost every nation on earth seems to have developed races, or peoples with their own distinct ancestral, cultural, religious or linguistic shells and barriers. As the world grew, so grew the walls among them; not only that but assertions of these boundaries rather than the unity among them. Fortunately, one such wall was beaten in Berlin and the 10th anniversary of that event took place yesterday.

Thank God ethnobotany does not have any racial barriers or ethnic cleansing. Ethnobotany, which forms part of what I consider the root-structure of botanical gardens, symbolises a unifying force. It also, for me, implies an ethical presence; it symbolises an act of living and letting live and harmonious life among the species that are found in these beautiful botanic gardens. It offers to the human race an example and a sanctuary of peace and harmony.

Permit me now to express one of the concerns that I have had, over the last several decades, as a student of earth sciences and a person who has also been deeply involved in international conservation, as well as international environmental education and communication; which I consider an important component of effective conservation efforts. I have found that science has been playing a prominent, if not dominant, role not only in conservation, but also in development. In fact, science and technology appear to have become a leading force, driving all life on earth. As a scientist, who explored with great pleasure the emerging vistas of science and technology, I have often felt that they have a habit of occupying my mind and several of my faculties in a way in which I run the risk of losing myself in them. It is my view that science and technology, while one cannot but admit, have been important and useful tools that have contributed to humanity's improvement of their life on earth, they have also often demanded a great price for this benefit. It is here that I feel that, in the pursuit of science and technology that is often a headlong pursuit, we should guard ourselves from being servants or blind worshippers.

Science and technology often represent a cage or a prison. The bed, which is offered to humanity, often disguises the bars of this prison. Even when we enter this prison, we are not aware that we are in fact imprisoned. This prison gives us a bed, a comfortable bed, faster and faster food, great artificial weather, and everything else. What it does not give us is the fresh air of a free mind (which can explore beyond the limitations of the formulae and the assertions of the science and technology) and the directions which science and technology often insist upon.

Very often, tragically, ethics is among the victims as humankind speeds headlong towards surrendering to science and technology.

There is a biblical statement concerning common salt. Common salt is supposed to be added to enrich food. Salt is also considered to be an essential element among all living beings. At the same time, if the salt is applied to the eyes, the eyes run the risk of being extinguished. If salt is overused, it becomes poison. Do we therefore do without salt? certainly not. By the same token, I am not advocating that we reject science and technology. I am pleading for human good sense and ethics, and a recognition of the need for human beings to be concerned about humanity and nature; and use the God-given freedom to think and act beyond the constraints of a society enveloped by a science and technology obsession.

Fortunately, the role that botanic gardens around us are playing as a scientific presence providing aesthetics, tranquillity, environmental education and education towards ethical behaviour among humanity, has gained richly deserved importance. Even though we have just witnessed the ugly manifestations of ethnic cleansing, among other misfortunes in humanity's recent life on this planet.

Permit me to speak for a moment on another educational, if not enlightening event in my life.

I was once walking in a forest in Africa. Suddenly, my guide and friend, a tall Masai tribesman came upon an Impala (a deer) and her new born baby. The mother was panicking, for, not far away, was a leopard with her cubs. The leopard began to move towards the Impala. My friend the Masai whispered to me to be silent and watch. The leopard needed food for her cubs. As she approached, the mother Impala ran away, leaving her little baby, who stood there, not knowing what was happening. The mother leopard approached, and I held my breath, knowing that a cruel event was about to happen. As the leopard came to the baby Impala, the baby, mistaking it for its own mother, began to search for its milk. The leopard stood still for several moments. Then, in an incredible gesture, she licked the face of the baby Impala a few times and walked back to her cubs.

This was among the most unforgettable moments of my life. I like to think that the human race, which is indeed designed to be an improvement on what is called the wild animal, with faculties and capacities superior to all wild animals, would be an improvement also in terms of ethics and compassion where it concerns fellow humans. And yet, as we go into the 21st century, I do not see too many signs of it. It is against this background that I feel that botanic gardens which have all the manifestations of an extraordinary presence, complimenting the best of human endeavour, exuding the finest of colour, grace, tranquillity, peace, spraying around them the perfume of ethics and equity, should become centres of enlightenment to all human life on earth.

INTEGRATING ENVIRONMENTAL AND DEVELOPMENT EDUCATION INTO BOTANIC GARDENS

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INTRODUCTION

Education in botanic gardens worldwide must prepare individuals for the challenges of the next decade by radically reviewing global development practices that affect life-supporting systems. Agenda 21 (UNESCO 1992) argues that the only way to assure ourselves of a softer, more prosperous future is to deal with environment and development issues together in a balanced manner. This can be effectively done in botanic gardens by integrating environmental education and development education.

To ensure that there is widespread environmental and development literacy, botanic gardens should address all the core issues as identified by the Brundtland Report (World Commission on Environment and Development 1987). These are population and development, species and ecosystems, energy, industry and the urban challenge. Despite the rising interest in integrating environmental and development education, good practice especially in many of the African botanic gardens is not widespread. Much needs to be done to foster professional development opportunities so as to enhance the integration of the two fields of education into botanic gardens.

It will be helpful at this stage to look at definitions of environmental education and development education so as to uncover their links. According to Huckle (1990):

> Education for the environment should be a shared speculation with learners on those forms of technology and social organisation which can enable people to live in harmony with one another and with the natural environment.

On the other hand, according to Hicks and Townley (1982):

> Development education is concerned with issues of human rights, dignity, self-reliance and social justice in both developed and developing countries. It is concerned with the causes of underdevelopment and the promotion of an understanding of what is involved in development.

Looking at these two definitions, it is very difficult to think of environmental education and development education as being distinct fields. A broad understanding of environmental education inevitably leads to questions of development.

Since environmental and development education have a common content, similar approaches and both involve education for the future, they should be integrated to provide the core of education in botanic gardens. A framework of such core education is briefly discussed in this presentation. The current efforts being made by Botanic Gardens Conservation International (BGCI) to develop guidelines on education for sustainability is a move in the right direction. These guidelines will bring together the educational concerns of the development and environmental worlds.

A FRAMEWORK FOR EDUCATION IN BOTANIC GARDENS

It is important to convert every opportunity in botanic gardens into an educational experience. Such an educational experience must integrate knowledge, skills, values, attitudes and actions. This is the basis of bringing together environmental and development education.

Teaching Environmental Ethics

The teaching of values for sustainability must be emphasised in botanic gardens education. Environmental ethics that have sustainable living at their core should be taught to promote the transformation and construction of society. This can be done by developing in learners, values of social responsibility, concern for all life forms and commitment to work with others.

Encouraging Issue-Based Learning

Learners in botanic gardens should be involved in the issues surrounding the environmental and development problems. The use of issue investigation as a context for the exploration of moral, social and political values, required for the development of environmental ethics, must be encouraged in botanic gardens as much as possible.

Adopting a Holistic Curriculum Approach

Education in botanic gardens should treat environmental and development issues holistically through all areas of understanding and experience. Such an approach will no doubt immensely contribute to the education of the whole person.

Making Education Relevant

Learners should be encouraged to explore links between their personal lives and wider environmental and development concerns. Education should help learners to develop an

understanding of themselves and the world around them. In this way, education will be made relevant to the needs of learners and society.

Adopting a Socially Critical Orientation

Education in botanic gardens should prepare learners to be socially critical. Critical thinking skills, critical reflective knowledge, democratic skills and experience of the processes of environmental politics need to be developed in learners in order to improve their capacity to address environment and development issues.

Incorporating a Futures Perspective

Incorporating a futures perspective entails examining probable futures that occur as a result of existing environmental relationships, and of possible alternative environmental futures. In this respect, learning should involve looking to the future as well as the present and the past.

Making Learning Action-Oriented

Education programmes in botanic gardens need to involve learners in real and simulated environmental action through active learning strategies. There is a need to provide knowledge and experience in a variety of environmental actions e.g. ecomanagement, legal action, political action, consumerism, negotiation and persuasion.

THE GLOBAL CRISIS OF ENVIRONMENT AND DEVELOPMENT

Issues of environment, development and social justice pose important questions for the future of human society. Many countries suffer both from the shadow of inappropriate development practices and increasing poverty amongst those pushed aside in the wake of industrialisation. Human environment in countries with developing economies is characterised by rapid population growth, rising numbers of people in absolute poverty, increasing ill health, mounting foreign debts and high levels of unemployment. There is no one big solution to these human environment issues. Many diverse ways of responding to them are required; this will be discussed later.

Environmental crisis has been linked to the modern way of living and our modern world views. In the so-called developing countries, development is considered only possible by emulating the ways of developed nations; their aspirations, values, culture and even technology. However, this approach has obstructed the evolution of indigenous alternatives for societal self-expression and authentic progress. It is also important to note the role that colonisation played in alienating people from their environment. Colonisation promoted intellectual impoverishment of local indigenous knowledge and vital information that is important to sustain local social systems. These local social systems are very crucial in sustaining the environment. Such destruction, which is even continuing to this very day, took place through education and religion.

There is no doubt that the pursuance of the social and cultural evolution of the industrialised countries has produced disastrous results in our developing economies. It is therefore imperative to create development awareness that direct transfer of knowledge from the West is often counterproductive and that the implication of high economic growth has been the environmental crisis. In the industrialised countries there is a rising awareness of the environmental effects and the wasteful use of resources with their own style of development. This is not true for the countries of developing economies.

EMERGING RESPONSES TO THE CRISIS

We educators in botanic gardens must join others in finding and promoting ways of addressing the global crisis of environment and development. This is because botanic gardens can effectively be used to raise concern about problems associated with global inequalities, regional conflicts and imbalances in consumption of resources. They are also well placed to analyse the relationship between education and the processes of the world economy.

There have been historical shifts in finding solutions to the global crisis of environment and development; from preservation to conservation through resource management and sustainable development to sustainable living. The following is an outline of some of the emerging responses to the crisis and how they can be incorporated into botanic gardens.

International Conventions

With increased recognition that environmental and development issues are not confined within borders of one or more countries or regions, intergovernmental meetings have established agreements to limit environmental degradation. To this end, governments have ratified these agreements and have committed themselves to develop regional and national strategies to address global issues. Some of the conventions that have been established include the Convention on Biological Diversity (CBD), Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and Convention to Combat Desertification. Botanic gardens are in a good position to promote these conventions among their staff and audience.

Sustainable Development

This is a term currently used to refer to the challenge facing contemporary human society of reconciling development with the protection of the environment. It is a global response to environmental crisis that entails improving the quality of life for all within the carrying capacity of supporting ecosystems. Various options and solutions have been introduced towards this end. These include:

Community-Based Natural Resource Management

In this response, selected development activities are planned and implemented by the people of a community. This is primarily a response to rural poverty ascribed to a lack of access to a natural resource base.

Through community outreach programmes, botanic gardens can support development activities that utilise plant resources. Community outreach educational processes should seek to broaden the range of development possibilities of rural communities.

Competencies of learners in this context should be developed to act locally within a global perspective. More important, community outreach programmes must aim to encourage the participation of local communities in development activities. Such participation will require a critical awareness of local, national and international development processes.

Ecotourism

Through community partnerships with areas of unique flora, botanic gardens can promote ecotourism as a means of alleviating poverty while protecting the environment. Tourists visiting botanic gardens with such community partnerships can easily receive information on areas to visit.

Sustainable Agriculture

Education in botanic gardens can easily promote sustainable forms of gardening as a response to food insecurity. Through compost education programmes, botanic gardens are well suited to show the need to minimise the dependency on external inputs such as fertilisers and pesticides.

Creating Partnerships with Industry and Local Government

In developing nations, urbanisation is occurring independently from industrialisation. This has led to high levels of unemployment and poor living standards. The trend in these countries has been to emphasise industrialisation without considering its effects on the environment.

Challenges of Urbanisation

Most of the world's botanic gardens are found within urban settings. Through partnerships with local governments within cities where they are found, botanic gardens can provide programmes that address urban poverty and the environmental challenge. Such programmes should empower the urban poor to take control of their own development so as to achieve levels of urban development.

Changes in Business Concepts and Management

Increased pressure on industry to clean up its act has led to wide ranging responses to environmental issues and risks in this sector. There has been changes in business concepts and management in the industrial sector. New concepts such as eco-efficiency, life cycle

analysis and accounting for the environment have emerged. Botanic gardens should create partnerships with the industrial and commercial sectors with a view of encouraging these sectors to embrace and practice these new concepts.

Capacity Building Programmes

Chapter 36 of Agenda 21 (UNESCO 1992) calls for expanding education, public awareness and training. Many botanic gardens worldwide are already offering a wide range of activities and courses to the public as outlined in Roots 18 (BGCI 1999). Making environmental information widely available is thus strengthening the capacity of people in addressing environmental and development concerns. This is being effectively achieved by botanic gardens working in a broad series of partnerships with business, non-governmental organisations, local and national governments, universities and other botanic gardens.

Integrated Environmental Management

It should be appreciated that a modernistic framework of development is the root cause of many environmental issues. Botanic gardens must work towards changing this prevailing model of development and the belief that economic growth is the only solution to the global crisis of environment and development. Approaches that recognise that diverse processes ranging from technical and scientific solutions to public participation are all required in trying to resolve the crisis, should be adopted by botanic gardens. Tools such as environmental audits, participation action research and environmental impact assessments, all designed to implement integrated environment processes in different settings, should be made understood through education in botanic gardens.

CONCLUSION

It is disheartening to note that it took such a long time for the environment to reach a prominent position within the development debate. We cannot have a healthy society in a world with so much poverty and environmental degradation. Economic development cannot stop, but it must change course to become less ecologically destructive. Botanic gardens globally have a major role to play in changing this course.

Nevertheless, it is individuals who hold the key to sustainable resource using practices. They ultimately decide how resources are to be used. However, it is only when individuals have security for meeting their basic needs that they will be able to take a long-term view of environment and development.

Integration of environmental and development education that culminates into education for sustainability is destined to become a dominant focus for education in botanic gardens. This new focus will however require a great deal of creativity. Educators in botanic gardens will need new ways of looking at old problems and new challenges will no doubt appear on the agenda. These challenges should be put into action through the guidelines for education for sustainability that will soon be published by BGCI. We should all work

towards increasing public sensitivity to environmental and development problems by teaching *for* development and *for* the environment.

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PRACTICAL APPROACHES TO THE TEACHING OF SUSTAINABILITY AND DEVELOPMENT EDUCATION

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WAKING UP

When we get out of bed every morning, wash, dress, eat breakfast and brush our teeth, we are entering a relationship with plants from around the world. The project that will be described has taken a few every day items and investigated issues of sustainability for some of their plant material ingredients, such as aloe vera and palm oil.

THE PROCESS

The Study Centre at Birmingham Botanical Gardens and Glasshouses has successfully worked in partnership with Birmingham Development Education Centre (DEC) on many projects over a number of years. By working collaboratively and sharing resources and skills, much can be achieved to explore ways of teaching about sustainability. Development education is all about:

- the major global, social, economic, environmental and political issues which affect us all;
- making these issues accessible and exploring the challenges they raise;
- exploring attitudes and assumptions;
- seeing knowledge in context; and
- developing the skills necessary for effective participation in the world.

Having planned an outline of the project with the DEC, the concept was advertised to local schools and interested teachers through an initial meeting. From this, a group was formed, with each school committing themselves to the project by agreeing to a contract. This was useful because it ensured that everyone was clear as to what was expected of them.

A series of meetings during the day and after school took place during which a series of activities were carried out in order to develop a common understanding of sustainability in the context of the project. This provided a springboard for creative curriculum work. From our experience, we have found that groups of teachers appreciate the opportunity of working with other schools in order to share ideas and experiences.

Each teacher then worked with their pupils back at school with the initial emphasis on teachers and pupils as researchers; writing letters to companies, applying book based skills and using information technology. In addition, each school brought groups to Birmingham Botanical Gardens and Glasshouses to look at the source plants and make connections with the places that they are grown. The key challenge was to use this information to ask natural, social, economic and political questions which were global (i.e. where the plants are grown), local (i.e. where the plants are sold) and about trade between the two. Throughout this stage, it was important to teachers that links were being made to aspects of the curriculum they were required to cover, including literacy, geography, science, information technology and citizenship.

OUTCOMES

The group has been working on a collation of their ideas, activities and experiences, which is to be published shortly by the DEC.

The main findings from the project were that the children:

- found it difficult to gather current information about the plants and their products;
- discovered they had to look at the information provided with critical awareness;
- were able to consider that there was more than one point of view and value the opinions of others;
- became more proficient at articulating their opinions;
- began to understand cause and effect and were able to see that a decision they made now could affect the lives of others for better or for worse in years to come; and
- are now aware that there are no easy one way routes to sustainability.

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They can produce further details of teacher produced resources.

BOTANIC GARDENS: A TRIBUTE TO THE ROLE OF BEAUTY IN CONSERVATION OF OUR PLANT HERITAGE

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A theory of gardening was expressed by Joseph Addison in 1712 'I look upon the Pleasure which we take in a Garden, as one of the most innocent Delights in humane Life' (cited in Dixon Hunt and Willis 1997).

The instinct to cultivate is strong and independent of simple material necessity. Gardens and gardening are activities that, although associated with necessity, have given humanity centuries of pleasure. Botanic gardens, although mainly devoted to the acquisition and diffusion of knowledge, have a strong aesthetic element without which they wouldn't attract the wider public.

UTILITY AND BEAUTY

Interaction between humans and plants cannot be reduced to mere economic expediency. Yet a more recent tendency to look for quantifiable use has reversed the ancient numinous look at life. An inhibition is caused by the sentiment of guilt, that if there's no use for something there cannot be any justification for wanting it. We have not taken into account an important human element; the human perception of, and response to, the natural environment.

We are rightly reminded that plant preservation is necessary for the survival of our species. Still, the debate on sustainability risks degenerating into a new form of instrumentalism, whereby the value of nature is assessed on the basis of producing something else; a material commodity. If it doesn't deliver the goods, its survival is doubtful. The issue of gene manipulation in agriculture brought about by the ever expanding need for food, already points to a substantial change in our perception of the function of nature and questions the importance of biodiversity.

While I leave the scientific side of it to the many experts at this congress, I am deeply troubled by the implications. If we could invent a means to be independent from nature, if we could really master it to the point of creating another nature more convenient and more pliable, what will then happen to what is called biodiversity, the richness of the plant kingdom and the stability of the biosphere?

By chance, the name Flora was the name of the ancient Greek Goddess of fertility and the functions of giving birth and growing suggested wealth and abundance. The principle of

variety and contrast has been a recognised feature of the mind's delight in change, mirrored in the bounty of nature.

> Here order in variety we see,
> Where all things differ, yet where all agree
>
> William Gilpin an eighteenth century English writer (cited in Prest 1981).

It is also the recognition that this diversity of life has an aesthetic appeal.

Two new documents give me some reason to hope for recognition of such a truth. One explains that there's a '…progressive diminishing of global and local biological diversity and of economic, scientific, educational, cultural, recreational and aesthetic values due to unsustainable human activities' (Convention on Biological Diversity 1992), which states the importance of beauty as an element of biological diversity.

A second document recognises the necessity of a shared vision of basic values, '…which are the preservation of the Earth's vitality, diversity and beauty' (Earth Council and Green Cross International 1999).

One thing should worry us; the loss of this beauty which is an assessment of environmental quality and health, and the perception of the balance, harmony and diversity, which are also indicators of good human development. The loss of beauty accompanies the loss of biodiversity, replaced by a few useful man-made [*sic*] plants.

Lately the image of environmentalism is too often linked to news-making issues, which are usually bad news and give a sense of powerlessness in the face of global disasters. The message is often pessimistic and moralistic, neglecting the fact that nature is there to be enjoyed and that its defence should be a pleasurable task, not a sacrifice. The emotional effects are somehow counterproductive, because these big issues detract from the tasks that each of us, with personal action, can undertake in the defence of nature, within our own place in the world.

Biological diversity is one of these tasks. It can be protected through the interest and love for the humble and ignored flora of our regions. These plants which have for so long nourished and cured us, are our sisters in the ecosystem and will continue to accompany us along the path of our existence, if we allow them to prosper. This idea of preservation conjugates pleasure with an ecological life-style. After all, any small garden can give us an endless source of stimulation, delight and gratification, which is the form of aesthetic experience, not merely practical.

THE IMPORTANCE OF AESTHETIC PERCEPTION

I remember walking on a little tropical island of the Micronesian Archipelago and seeing to my surprise a clearing in the woods, where, by a tin-roofed shack, stood a glorious cultivated garden full of flowers, as if to prove that the longing for beauty is an irresistible force which

fulfils some ancestral emotional need. In fact, the aesthetic perception of nature is not a frivolous subject; it is imprinted in our biological nature.

> The force of appearance has naturally attracted all ancient cultures because it has a survival value. The senses are our most democratic attributes, equally shared by rich and poor , black and white, male and female, and they represent the organism's emotional response to the environment, and the basis for our thought process. The world enters our mind through chemical, mechanical and luminous sensorial receptors. According to Dewey, the aesthetic experience is grounded in the most primitive relationship between organism and its environment.
> (Bourassa 1991)

This cultural arsenal can vary individually or according to groups, but there's a basic common heritage of direct, pre-rational, non-mediated apprehension.

Apart from food and shelter, the next preoccupation of humans is the finding of a mate, but this instinct is so bound with the notion of beauty, as to become a powerful means of selection. Beauty becomes an important factor of recognition. Its erotic function is of absolute importance for the species, it is genetically inscribed. From it derives the urge to decorate and beautify the body, home, surroundings, and tools. The practical scope sublimates itself in ennobling gestures. Religions adorn temples and offer gifts to the gods. The monuments erected by different civilisations testify to the need for the artistic expression that conveys ideas of serenity and transcendence.

An exquisite example is the Taj Mahal, suspended in a seemingly immaterial space, which gives it the impression of permanence. Significantly, one of the masterpieces of gardens in the world is its Mogul Garden, which elevated a complex system of engineering to the task of enhancing its sacred geometry. Artisans have produced early masterpieces everywhere such as Celtic mirrors, Maori paddles, and American Indian pottery. Visual satisfaction is a powerful element that connects north and south, east and west.

Aesthetic perception has contributed to the expansion of the human mental and physical world. Many of the scientific writings of naturalists, in their apparent objective presentation, have the quality of lyrical descriptions and obvious delight. Scientists, far from being neutral or aloof in this department of the mind, have succumbed to the fascination of nature. To study nature and plants one had to love them. Listen:

> Words cannot express the joy that the sun brings to all living things…Yes, love comes even to the plants. The actual petals of a flower contributes nothing to generation, serving only as the bridal bed which the great Creator has so gloriously prepared, adorned with such precious bed-curtains and perfumed with so many sweet scents in order that the bridegroom and bride may therein celebrate their nuptials with the greater solemnity…

These are not the words of a poet, but of the great botanist Linnaeus who devised the current system of nomenclature based on the sexual apparatus of the plants (cited in Mawbey 1997).

And another scientist wrote:

> Nothing within the compass of the whole wide world yields a richer pleasure not only to the mind but also to the body, than the rich store of plants life and the copious and various produce of things growing in the earth…I know of no occupation which is more worthy or more delightful…than to contemplate the beauteous works of nature…
> (Laurembergius cited in Mawbey 1997)

ENVIRONMENTALISM AND THE ROLE OF AESTHETICS

The issue of plant conservation is an environmental issue. It is not the first time that environmental concern has been identified with aesthetic concern. Certain historic indicators show that the birth of Western environmentalism coincided with aesthetic interest, in the form of the discovery, appreciation and defence of the beauty of nature, in the face of the growing alienation due to industrialisation.

A Sand Country Almanac was first of all a celebration of wilderness aesthetics, the real humus on which to grow a land ethic. The Forestry Commission (1919), the Council for the Preservation of Rural England (1926), First Town and Country Planning Act (1932), the Ramblers Association (1935), the creation of Areas of Outstanding Natural Beauty in England, and of National Scenic Areas in Scotland were institutions first and foremost aesthetically motivated.

Surveys of people's opinions and feelings towards nature suggest strong aesthetic considerations, including outdoor pleasures and health concern, together with moral, social and economic reasons. They have also proven that aesthetic appreciation is at the top of the list of advantages provided by national parks. As the art critic Kenneth Clark (1976) observed, nothing, except the pleasure of love, can accommodate every kind of person as does the pleasure of a beautiful landscape.

> Nature is not only a source of immediate physical beauty, but also a treasure trove of symbols and values on which we all rely…its manifestation stands for life itself, as well as growth, change, continuity, purity, freedom, mystery and the transcendent.
> (Winifred Gallagher 1994)

We can conclude that without these aesthetic impulses, the environmental movement would not have been so successful, and bereft of much of its creative impulse.

All of you gathered here are probably too professional to notice the motivation of a less informed public which visit botanic gardens that are a promise of a sensuous experience, more

than by the opportunity for scientific enlightenment. So why not , after environmental ethics, shouldn't we recognise the existence of an environmental or eco-aesthetic? We could admit that one of the educative values of botanic gardens consists, among other things, in the celebration of their seductive appeal.

THE MICROCOSM OF GARDENS

The aesthetic subject is so fascinating because it collates the physical and psychological sources of our knowledge with religious overtones, it is similar to the mystical experience, with which it can be assimilated. In The City of God St Augustin describes lyrically the beauty of the world, a living demonstration of the magnificence and power of God, and asks what is the main point of the creation: usefulness or beauty?

There's no doubt that the origins of gardens have been religious, as most human activities had originally some religious meaning and associations. In the past, even the activity of cultivation was sanctified by paying attention to the divinities that controlled the seasons. In Mediterranean religions that share the same cosmological story, a garden had been the prime setting of human history, and Adam, the first man was a gardener. The Garden of Eden, which serves as the model for the good life, gave priority to the beautiful over the merely useful. In Genesis, God says that trees should be '…pleasant to the sight and good for food'.

In the study of gardens we are offered a panorama of human cultures encompassing virtually the entire history of the species. We can divine their philosophies, their political, social, economic and artistic universe by looking at their gardens; and changes in the design, conception and cultivation of gardens reflect the changes of the dominant ideology. They are an admirable collaboration between art and nature, offering a complete experience that engages all our senses.

Gardens are a celebration of nature in the vegetable kingdom and their beauty uplifts the spirit of humanity. From immemorial times, the power of plants and flowers to inspire the imagination of artisans, artists and poets, has been a sort of leit-motif which criss-crossed humanity's diverse cultures. The invariant innate instinct explains the development of common features in places and cultures that had no known connection. Floral decorations have been frequently used all over the world. The appeal of the flower is in its perpetual fragile beauty that speaks of the recurrent drama of death and rebirth in nature. With the rapid disappearance of the diversity of the world of plants, the inspiration not only for high art and poetry, but also of the more anonymous expression of popular art, departs.

BOTANIC GARDENS

Gardens and botanic gardens bear the same origins in an ideological framework, which includes moral, social, aesthetic and economic considerations of the time in which they were created. Lately, reflecting the current ethos, botanic gardens have undergone some changes, becoming part of a bigger design for nature conservation.

The first impulse for the creation of botanic gardens was the re-creation of the Garden of Eden**,** where all the abundance of the flora created by God for the pleasure and uses of man could be found in one enclosed place, which was to be beautifully laid out to resemble the original model; symmetrical and harmonious, like the Order of the cosmos. The idea was to bring the scattered pieces of creation together into a garden.

The medieval monastic gardens initiated the scientific interest with the cultivation of therapeutic properties of herbs (the Simples) in the humble *hortus conclusus* of Benedictine monks where religion, magic and knowledge met. Beauty was all-important, because was as an emanation of God, the monastic garden was also called *dulcedo et suavitas visionis divinae,* the vision of divine goodness and loveliness.

A quote from the Life of St.Francis of Assisi of Bonaventura shows us that already in the 12th century, and in a subsistence garden, the saint offers praise of weeds and a case for biodiversity:

> He orders to the gardener to leave a strip of fallow on all sides of the garden, in order that at the right time green wild herbs and beautiful flowers could praise the beautiful Father of all things, and in the garden he wants to leave aside a little area for sweet-scented herbs and flowers, which recall to the onlooker the eternal fragrance.

Certainly more advanced than some of our modern gardeners!

To delimit space is a sacral act and there is an intimate relationship between the beauty of the garden, the opulence of nature and the enclosure that protects it. This closed universe brings to memory the archetypal Persian Paradise as a separation from the world. European cultural exchange with the east enriched this vision and emphasised the elements of inviolability, health, bird songs, water and symmetry. Moreover, the old concept of the Sacred Grove dedicated to a divinity was transformed in the Temple of Knowledge, the botanic garden, as it is the ancient idea of a place where to study and conduct philosophical discourse (the Greek Gardens of Epicure or the Chinese Gardens that provided a retreat for meditation adorned with philosophical or poetic features). It is a place of perfection where all the distasteful or dangerous elements have been neutralised and where the scope is enjoyment in enlightenment.

EDUCATION

Inspired by such past examples, the educational possibility of botanic gardens is expanding, offering an integrated and multidimensional approach. They can take the lead from the imaginative world of gardens of the past, which served many functions and were theatres of popular entertainment, an aesthetic experience, teaching devices, places for mystical meditation and contemplation, with their universe of smells, sounds, colours and forms, enhanced and tailored for many needs. Leonardo da Vinci, in the Italian Renaissance, introduced hydraulic wonders*, song et lumiére*, and animal life. Maybe the scientific approach has been too strict and has stunted the imagination and the insight of what the general people

are really interested in, in order to attract them to the world of plants and subsequently to impart knowledge.

Fortunately, in many botanic gardens today, the educational staff are getting the message and have a more adventurous and experimental attitude and offer, especially to children**,** the opportunity to smell, touch the exhibits, handle them, and get sensually involved by role playing and through theatrical performances. The physical involvement will excite the natural curiosity, as the poet Robinson Jeffers says 'Your love will follow your eyes' (cited in Williams 1990).

In a modern world so concerned with speed aided by technological prostheses, the natural rhythm is being forgotten. It is wise to put aside time to feel, absorb and contemplate the beauty of the world, learning from the wisdom of cultures of our past. But a cultural change is again in the air and it is shaping our idea of gardens and green spaces. The environmental movement is creating a new more sympathetic aesthetic. After the aseptic formality of the English lawn (which destroys biological diversity, aided by pesticides, selected grass, herbicides etc.) and the modern tendency towards maximal means of intrusive technology which destroys the sense of place, we are entering a period which is more ready to accept nature's own rules. We cherish a return to more natural gardening, under the influence of ecological concern, which involves the owner in the double role of aesthete and scientist.

We cannot of course pretend to save rare botanical species in a limited environment, but we can symbolise the beauty of threatened nature and raise awareness of its fragility.

CONCLUSION

As it is true that nature has no life of its own for us, except as defined by our needs and purposes, it follows that it can be preserved by cultivating those human inclinations and purposes which are in harmony with its authenticity and integrity. After all, only humans of all mammals, dedicate their life and efforts to the search, creation and preservation of beauty.
According to this thesis, botanic gardens today should address even more the value of aesthetic appreciation and imbue it with conservation concern. The historic gardens of the past were all designed with this in mind. The very design could be an educational experience and occasion. We recommend that today areas for contemplation and silence, arbours for love, grottoes, play areas for children, sounds of birds, religious shrines, and the creation of new ecologically inspired spaces should be incorporated within the design of botanic gardens in order to attract the uninstructed into them before you can begin to raise a consciousness of plant conservation.

To conclude; I believe that plant conservation would benefit from a return to aesthetic values and that a pluralistic model is needed; one that includes the sense of beauty as our best guide for the management of nature.

> …what seems right also looks good and arouses those pleasurable feelings which comprises our sense of beauty.
> (Lovelock 1987)

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THE GIFT SHOP AS A SITE FOR EDUCATION FOR SUSTAINABILITY

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In societies of high consumption, objects, replicas and images of nature are being packaged and sold as never before. Consumerism increasingly draws upon and promotes particular cultures of nature and serves a contradictory function in relation to the transition to sustainability. It enlarges the ecological footprint of such societies but can encourage reflexivity and support for a more radical environmental politics.

John's workshop developed the theme of his keynote address (the social production or construction of nature) by suggesting to participants that the botanic garden gift shop could be a site of education for sustainability if there was careful attention to the origins and presentation of the goods on sale. Gift shops were more likely to be a problem than a solution, but attention to relevant critical theory could help shop and education staff reconstruct them in more sustainable and educational forms.

In the first part of the workshop participants were invited to arrange five postcards showing landscapes or environments in order from most natural to least natural. After comparing results and discussing the criteria used, some of the multiple meanings of nature and natural were brainstormed and listed. The concepts of first, second and third nature were introduced or revised as were those of external and universal nature.

Next explanations for the rise of retail chains such as the Discovery Store, the Nature Store, The Body Shop, and Nature & Decouvertes, were discussed. The appeal of objects, replicas and images of nature was linked to the alienation of people from nature in modern societies and such associated concepts of commodity fetishism and denaturalised consumption were introduced. Quotes from Wolfgang Sachs and Scott Lash and John Urry pointed to the increased significance of consumerism in post-modern societies and to consumerism's role in helping to promote current debates on sustainability.

The main part of the workshop invited participants to evaluate a number of products on offer in the catalogues of private companies and non-government organisations. This involved examining use and exchange values; the buyer's likely knowledge and motives; the way in which the product was linked to signs of nature; what the buyer was or was not told about the product's production; and whether or not its production and consumption was likely to promote one or more or the five dimensions of sustainability. Participants

were asked to recommend a product from the list or from other sources, for sale in a botanic garden gift shop and suggest how it should be presented and promoted.

The final part of the workshop looked to a sustainable society beyond consumerism by means of a utopia describing John's hometown of Bedford in the U.K. in 2045. Participants were asked to annotate this with references to sustainability values and indicators and to suggest why and how this community had moved towards sustainability. Changed time budgets are a key element of such eco-socialist restructuring that allows a new balance between immanence and transcendence in people's relations to the rest of nature. Routes to sustainability are becoming clearer but what products could be sold in the gift shop to prompt visitors to reflect and act on such alternative futures?

EDUCATION ON CONSERVATION IN THE CONSERVATOIRE BOTANIQUE NATIONAL DE BREST

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The Conservatoire Botanique National de Brest, the first of its kind, owes its creation to its current curator, Jean-Yves Lesouëf. Working on the basic idea of cultivating the rarest plant species to avoid their complete extinction; in 1975 Jean-Yves Lesouëf brought together the Brest Urban Community Council, Brest Nature Conservancy Council and the French Ministry of the Environment to establish our garden.

Other identical bodies soon appeared across France. In 1988, the Ministry of the Environment decided to set up a national network of Conservatoires Botaniques and to formalise the role of these gardens. There are currently 8 such national gardens assigned the task of recording French flora, preserving in situ and ex situ threatened wild species and educating the public on conservation issues.

The National Conservatoire Botanique de Brest is situated in a narrow 2 km long valley, close to the sea and a town of 250 000 inhabitants. Threatened species, which are hardy in the Atlantic climate, are grown in the 22 hectare garden alongside indigenous and ornamental plants. Greenhouses enable us to cultivate and propagate threatened plants originating from different exotic locations. A small laboratory provides facilities for the processing and cold storage of seeds from species close to extinction.

With around 1500 threatened species under cultivation, Brest manages and maintains one of the biggest collections in the world of plants close to extinction. For almost twenty five years, the Conservatoire Botanique has taken part in, and led several operations to rescue plants from the brink of extinction, reintroduce plant species and manage threatened species in their natural habitat.

In the case of local species, we pursue a specific in situ conservation programme. On a national and international level, our garden, in partnership with other bodies, ensures the ex situ conservation of native species of the French Atlantic seaboard, Europe and the oceanic islands throughout the world, which also involves the cultivation of species from French overseas territories.

Alongside its in situ and ex situ conservation activities, the Conservatoire Botanique aims to raise public awareness of the need to protect our botanical heritage. Our organisation's

collections, and its experience in the field of conservation, offer a wealth of material to draw upon for assessing the importance of protecting plant diversity.

Permanent educational coordinators were first employed in 1990, with an additional member of staff joining at the end of 1998. Our educational task involves a range of activities concerned with communication (liaising with the media, participation in conferences and the organisation of events within the garden), and teaching (conducting guided tours, devising educational tools, hosting touring exhibitions and taking part in educational projects with students).

Around 250 000 people come to our visitor centre every year to view our touring exhibitions which are concerned with aspects of the environment. As part of these exhibitions, we organise activities and events for students from the urban area on topics such as the recycling of waste and discovering the world of plants and animals. A small part of our programme therefore includes environmental education activities.

Our main task, however, is to raise public awareness of conservation issues through guided tours organised in the greenhouses and the garden and through educational materials that we produce.

In 1998, we organised events involving 7200 people, 4500 of whom enjoyed guided tours through the greenhouses. The majority (60%) of participants were pupils and students from nursery through to university level and the remaining 40% were adults who were both beginners and specialists.

We decided that, on these guided tours, we would always focus on the same topic, namely the conservation of threatened species, and that we would adapt the level of our presentation as required.

The guided tour of the greenhouses centres around the following four main themes:

1. the comparison of the natural and artificial rhythms of plant species extinction
2. the importance of protecting threatened species
3. methods of ex situ conservation
4. in situ conservation of endangered species.

In the course of the tour, we introduce endangered plants whose history provides a concrete illustration of each of these themes. We sometimes deliberately choose species which are not spectacular, but which are on the brink of extinction, in order to demonstrate that our selection of plants is above all carried out on the basis of rarity and not mainly for utilitarian or aesthetic reasons.

During the presentation, our aim is to make the public realise what is at stake in the protection of plant diversity and to put across a global message about species preservation. In addition, we try to make visitors receptive to our message by establishing a dialogue

with them. People are encouraged to feel free to ask questions and to put forward their own views on the importance of the work conservation bodies are able to undertake.

This method is particularly effective with students and pupils as its helps us gauge the group's level of knowledge and adapt our presentation accordingly. This programme of activities is of particular use to biology teachers because it fits perfectly within the context of studying plant reproduction, species adaptation and evolution, human's influence on the environment and the preservation and sustainable management of biodiversity. At the end of the tour, we hand out educational literature to the teacher to enable him or her to explore these topics further with the pupils.

As an introduction to our greenhouse tour, we regularly devote part of the time to detailing our task of protecting indigenous flora and to dealing with the legal aspects of plant species protection in France. By introducing visitors in the greenhouses to exotic species on the very brink of extinction, we enable them to understand better why, in our own country, we must preserve and protect threatened plants.

Therefore, we also receive groups made up of local councillors, decision-makers, administrators and members of nature conservancy bodies who turn to us for a global account of plant heritage preservation.

We are also called upon by educational establishments to partner their educational projects. Thus, we have entrusted pupils with the care of endangered species with potentially healing properties, which they grow in their medicinal plant garden at school; on behalf of the Conservatoire Botanique. In addition, the pupils following a specialist course have taken part in recording the stations of a protected plant on a Breton island and others are twinned with a school in the Seychelles and exchange information about threatened plants from the Indian Ocean which we cultivate in our greenhouses.

We are also involved in the production of teaching tools which are used as support materials for our conservation education programmes.

In 1995, we laid out an interpretative trail in the greenhouses based on the conservation of threatened species, which has been used by over 30 000 visitors. We have an exhibition on the protected plants of Brittany, which we regularly put on display in our visitors' centre. In the garden, a circular walk enables our visitors to discover the endangered plants that we grow. Lastly, we collaborate on the writing of articles which detail the work of the Conservatoire Botanique and the programmes we run about species close to extinction.

As the Conservatoire Botanique exists in principle to preserve endangered species, the educators are not the only staff responsible for raising public awareness of conservation issues. In particular, the scientific and administrative personnel, in the course of their work, are also involved in raising awareness amongst specific groups of people.

Botanists estimate that one plant species in four in the world is threatened with extinction. Whilst it is a matter of urgency that conservatoires and botanic gardens work together to try to save some of these through cultivation, it is absolutely crucial that they combine their efforts to raise public awareness of conservation issues, if we are to ensure the sustainable existence of these species within their natural environment. Conservation education is therefore central to the global strategy adopted by the National Conservatoire Botanique de Brest aimed at successfully safeguarding plant diversity.

TEACHER CAPACITY BUILDING: SKILLS DEVELOPMENT THROUGH ENVIRONMENTAL EDUCATION

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BACKGROUND

In its new education policy introduced in 1997, South Africa has adopted an outcomes based education approach. 'This is directly linked to democratisation and the resulting effort to address the political injustices of South Africa's past through the transformation of the national system of education and training' (Department of Environment Affairs and Tourism 1998). Environmental understanding and skills are, for the first time, prescribed as key outcomes in all eight learning areas of the South African school curriculum.

South Africa's most recent Government White Paper on Education and Training states that environmental education, '…involving an interdisciplinary, integrated and active approach to learning, must be a vital element of all levels and programmes of the education and training system, in order to create environmentally literate and active citizens to ensure that all South Africans, present and future, enjoy a decent quality of life through the sustainable use of resources' (Department of Education 1995).

In addition to the above, teacher education has been described by UNESCO as '…the priority of priorities…' in environmental education (UNESCO 1990). Despite the emphasis on environmental education, many provincial education departments do not have the expertise or funds to run development programmes to support teachers with environmental education.

The National Botanical Institute (NBI) is one of many parastatal and non-governmental organisations with an interest in environmental education to provide resources for teachers and learners. Our Teacher Capacity Building: Skills Development through Environmental Education Workshops are one such initiative. This is a two-year project administered and facilitated by the NBI and funded by the South African National Commission for UNESCO.

SCOPE OF THE PROJECT

The project caters for teachers (210 primary and high school) over a two-year period. The schools participating in the first year were selected with the assistance of the provincial

education department and came mostly from under-resourced schools in township areas close to the NBI's Pretoria and Witwatersrand National Botanical Gardens. Teachers selected to join the project were requested to sign an agreement committing themselves to three workshops, a weekend field trip and a number of tasks and assignments. The principal of each school was asked to sign the same document as a pledge of support.

AIMS AND OBJECTIVES

The aims and expected outcomes of the project were identified jointly by the teachers, the education department officials and the NBI staff at the first workshop. These were to:

- encourage and support the development of environmental education at schools;
- demonstrate the practical links between outcomes-based education and environmental education;
- introduce a process enabling teachers to identify and analyse local/school/community environmental issues and to develop learning programmes around these issues; and
- provide the opportunity to implement activities that promote active learning.

AN ISSUES-BASED APPROACH

In our workshops we tried to move away from the traditionally held view that environmental education refers purely to the physical environment, to a view that links social, political and economic processes to natural systems. We initiated an issues-based approach in an attempt to deal with issues identified as important in the daily lives of the learners and also to encourage teachers to look beyond the confines of the classroom for teaching and learning resources and experiences.

Examples of some of the issues identified in the schools:

- poor state of school yard and garden
- poverty
- dumping and littering
- inability to establish a vegetable garden
- vandalism
- drug abuse
- unhealthy sanitation at school
- water wastage.

WORKSHOPPING THE ISSUES

After the teachers had identified and submitted their issues, resource materials were collected from as many sources as possible. For issues such as vandalism and drug abuse, where we lacked expertise, we entered into partnerships with organisations or individuals that provided relevant literature and facilitated small working group sessions with the

teachers. The teachers had the opportunity to discuss and workshop their issues and were introduced to many different types of resources. A list of addresses and service providers that produce inexpensive resource material suitable for future use in the classroom was drawn up.

LESSON PLANS AND ACTIVITIES

The lesson planning phase was complicated by the fact that only a small number of teachers attending the workshops had received prior training in outcomes-based education. To build teacher confidence, we embarked on a step-by-step approach to lesson planning in the outcomes-based way, using the issues identified as the unifying theme.

At least 50% of the teachers successfully developed and trialled lessons based on their issues. Most of them reported that their lessons had been successful while some came back for advice on aspects such as assessment and the facilitation of group work.

In a number of schools, the teachers and learners initiated long-term actions or projects that have not only improved the quality of life of the learners at the school but have also impacted positively on the community surrounding the school.

Phatudi Primary School, for example, was concerned about the unhygienic conditions created by poor sanitation at the school. In Maths the learners determined the ratio of toilets to users and the cost of maintenance of blocked toilets. In Life Skills they looked at personal hygiene and contagious diseases. In Language classes they wrote letters to the education authorities using the data collected to motivate for renovations to the toilet block. In Art they made posters to create an awareness of health issues. The school has raised funds and obtained the necessary support from the education authorities to have the toilet blocks extended and renovated while the learners monitor the state of hygiene and cleanliness.

LIMITING FACTORS

1. Outcomes-based Education Training

We understood from the outset that although our focus was environmental education, the vehicle would of necessity be outcomes-based education. However, we did not anticipate that teachers would have had no previous experience or training in outcomes-based education. The result was that we spent a great deal of time introducing teachers to outcomes-based education before we could embark on our core business.

We intend overcoming this problem in the new year by targeting only Grade 7 teachers as they would all have undergone training in outcomes-based education. We believe that in this way we will have more time to focus on environmental issues and the development of learning programmes around them.

2. Drop Out Rate

Although we were disappointed at losing half our teachers along the way, we have learnt that other organisations have had the same experience. This situation was exacerbated by difficulties experienced with public transport in certain areas. Disagreements between minibus taxi operators resulted in violence in some areas and made the use of public transport to and from workshops unsafe. The threat of country-wide teacher strikes created uncertainty and resulted in workshops being repeatedly postponed.

BANARENG PRIMARY SCHOOL - A CASE STUDY

Banareng Primary School serves the informal settlement in the Attridgeville township about 30 km from the Pretoria National Botanical Garden. At the start of the workshop series, Banareng identified the lack of a vegetable garden at their school as their environmental problem. They pointed out that the chief causes were a lack of water and funds coupled with community indifference and inactivity. Their learners were hungry and unable to concentrate sufficiently to benefit from the education offered.

The first workshop introduced Banareng to an approach which enabled them to analyse their issue, break it down into manageable parts and start looking for solutions to the problems. The Food Gardens Foundation was approached for assistance and training and a committee of teachers, learners, community organisations and parents was formed. The principal of the school, Paulina Sithole, was so inspired by the training received from the Food Gardens Foundation that she was able to motivate her staff, the learners and their parents to start a vegetable garden. The garden now provides 520 children with a midday meal, prepared, cooked and served by women from the community.

As the principal, Mrs Sithole, says proudly: 'We are feeding the child that is hungry, the community that is hungry and thereby feeding the nation. The nation shall never be hungry again, we empower people by teaching them sustainable food gardening to overcome malnutrition and hunger.'

The learners benefit directly from the project in that an attempt is being made to address the negative effects of malnutrition on their concentration and academic progress. It is also anticipated that absenteeism will be reduced as learners begin to feel the effect of a healthier diet.

The project has brought a number of additional benefits to the school and strengthened the relationship between the school and the community in the following ways:

- Establishing a committee consisting of teachers, learners, parents, community members and organisations to oversee the project has fostered a sense of ownership and involvement.
- Neighbours deposit all garden and organic waste in designated areas in the school yard and compost is made from it.

- Glass, cans and plastic are deposited at the school for recycling and the proceeds used by the school.
- Each household contributes their grey water which the children carry to school in two litre bottles each day. This initiative has significantly reduced the water bill at the school.
- Surplus plants and vegetables are sold to the community.
- Banareng has won a number of awards and garden competitions during the year. This has provided them with additional funding for their school.
- Competing at a regional and national level has generated much interest in the project which has resulted in additional sponsorships.
- The school has also been identified as a training venue for other schools and courses are sponsored by various organisations.
- Vandalism and burglaries at the school are less frequent as the community members are quick to report suspicious behaviour to the police.
- The school is able to employ regular gardeners from the community with the income that is generated.
- Environmental awareness and action have been initiated in the community.

As part of the NBI/UNESCO workshop process, the teachers have developed integrated natural science and mathematics lessons using the garden as a teaching and learning resource. Further collaboration between NBI education staff and the teachers is planned to extend the scope of the existing activities and to facilitate activities covering other learning areas.

IN CONCLUSION

In South Africa, the integration of environment into all learning areas in the formal school curriculum provides a unique opportunity for environmental practitioners and teachers to form partnerships that explore environmental education within the context of human influences.

During our workshops the above process was facilitated by adopting an issues-based approach. This provided the opportunity to examine political structures, culture and social equality as well as natural processes and systems in an integrated, practical and useful way.

In addition to the above, the workshop process created the opportunity for capacity building, empowerment and participation, which are important stepping stones in helping to reorientate teachers towards a sustainable and just view of the environment.

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Beyond the Limits
Rural and Community Outreach

THE GENESIS OF THE MEDICINAL PLANTS CONSERVATION NETWORK (MPCN)

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A LIVING TRADITION

Although India's medical heritage is many centuries old, it is an evolving and living tradition. Today, millions of people in villages, towns and cities across the country, depend upon the traditional medical systems. Around 8000 species of medicinal plants are used in our health traditions, across the length and breadth of the country.

Unfortunately, these rich medical traditions have become marginalised in recent times. This is so because of various social, economic and political factors and not because the traditions in themselves are medically inefficient.

THE URGENCY TO CONSERVE

Due to the rapid degradation and loss of natural habitats, juxtaposed with the over harvesting of some species, much of the biological wealth that is so intrinsically important to traditional systems of medicine has been destroyed or become endangered.

Today, there is an urgency to conserve India's medicinal plants. Although the point is not sufficiently understood, it is important to note that it is only a sound conservation strategy that can promote a backbone to a robust cultivation program. The latest global Red-list of plants brought out by The World Conservation Union (IUCN) presents a shocking picture: nearly 34 000 species or 12.5% of the world’s flora is facing extinction. Based on these figures, it is reasonable to estimate that around 1000 of India's 8000 medicinal plant species are also threatened. Threat Assessment studies carried out in recent years have placed about 200 species on the Red-list. If urgent conservation action is not taken immediately, we stand in danger of irretrievably losing our priceless heritage.

THE GENESIS OF THE MEDICINAL PLANTS CONSERVATION NETWORK (MPCN)

Since 1993, a major medicinal plant conservation project in southern India has been underway with the State Forest Departments of Karnataka, Kerala and Tamil Nadu, Research Institutes and leading NGOs as the key players. Over 50 medicinal plant

conservation sites have been established in the three states, across different agro- climatic regions, so that the entire diversity of medicinal plants of the region is conserved. This initiative of conserving wild medicinal plant genetic resources is the first of its kind in India. It is being coordinated by the Foundation for Revitalisation of Local Health Traditions (FRLHT), Bangalore.

The Medicinal Plants Conservation Network (MPCN) was created out of the need to formalise this pioneering conservation effort, and to link the conservation programmes initiated five years ago to the needs of users. The collective efforts of FRLHT, the State Forest Departments, Research Institutes and NGOs, can provide enormous mutual benefits, as well as services to both non-commercial and commercial end-users of medicinal plants.

MPCN Aims

- To facilitate sharing of resources and experiences amongst its members who may be NGOs, government departments, trusts, co-operatives, companies, research institutes and others who are actively involved in the conservation, cultivation and sustainable utilisation of medicinal plants.

- To facilitate links between the medicinal plant conservation organisations, who are its primary members and medicinal plant user groups, who are its associate members. These links may result in mutually beneficial projects and public support for the multi-faceted conservation activities of the network.

- To undertake advocacy with governments and other bodies on policy matters related to medicinal plant conservation and their sustainable utilisation.

- An essential feature of the work of MPCN members is the involvement of local communities in their work and its conviction that there is a need for benefit sharing with these communities so that they also gain from the growth of the medicinal plant sector. This community-oriented policy of the MPCN members is based on the understanding that rural communities, women and tribals are among the key custodians and conservators of medicinal plants and indigenous knowledge.

MPCN Conservation Sites

Medicinal Plant Conservation Areas (MPCAs)

Thirty Medicinal Plants Conservation Areas (MPCAS) have been established across different ecological regions of southern India by the State Forest Departments of Karnataka, Kerala and Tamil Nadu; two more MPCAs are being established. MPCAs represent the in situ component of the conservation programme. These sites have an average area of 200 hectares with wide topographical and altitudinal variations (19 m to 2150 m). They cover 10 out of the 11 major forest types of southern India and harbour

populations of most of the medicinal plant diversity of the region, including red-listed species. The MPCAs act as live field gene banks of the medicinal plants of southern India.

Medicinal Plant Development Areas (MPDAS) and NTFP sites

MPDAs are small areas in NTFP circles and on degraded forests which are being developed for production of medicinal plants by planting the locally available indigenous species of medicinal plants and trees at these sites. The local communities and the Forest Department share the returns through sustainable harvesting of plants from jointly managed conservation areas, under the Joint Forest Management Scheme and/or Tamil Nadu Afforestation Programme. Seven MPDAs have been established; six more are being established. These sites are to become sources of supply of high quality raw materials, which are sustainably collected from natural habitats.

Medicinal Plant Conservation Parks (MPCPS)

MPCPs are meant to conserve the region's medicinal plants diversity in ex situ conditions. Sixteen such parks have been established by non-governmental organisations and research institutes; two more MPCPs are being established. These ethno-botanical gardens also help in revitalisation of local health traditions. They currently grow more than 800 medicinal plant species known to local ethnic communities, and provide planting material via their nurseries to the public. Some of these parks also include herbariums and seed and raw drug centres. They engage in training, local enterprise development, education and community outreach programmes they have the potential to develop into centres of reliable supply of planting materials and organically grown raw materials.

MPCN'S COMMITMENT TO THE CONVENTION ON BIOLOGICAL DIVERSITY (CBD) AND THE INDIAN BIODIVERSITY ACT

The Draft Bio-diversity Act of India based on CBD guidelines regulates access to native plant genetic material and traditional knowledge of plants for certain commercial purposes without the consent of the notified authorities specified in the act, and suitable benefit sharing arrangements with local communities. In this context, MPCN will encourage its members to implement the provisions of the Indian Bio-diversity Act.

CONSERVATION ACTION

MPCN members have made considerable progress in the conservation of medicinal plants, via community participation activities. The in situ conservation programme initiated by the network is reported to be the most cost-effective way of conserving
inter and intra specific diversity of medicinal plants. Around 1500 species of medicinal plants, including 76 Red-listed species, are being conserved in and outside their natural habitats. The medicinal plants conservation efforts are being initiated in Maharashtra and Andhra Pradesh.

COMMUNITY OUTREACH

In India, 90% of common ailments are reported to have local solutions based on local health traditions that use locally available medicinal plants. With the difficulty of resource mobilisation encountered by the providers of organised Public Health Control (PHC) services based on western medicine, the PHC has not been able to deliver 'health for all' in the country. It is also reported that these organised PHC services have been able to effectively cover only 30% of population.

In the light of above, the programme of conservation of medicinal plants and revitalisation of local health traditions has launched a Green Health Campaign. This is a strategy to promote the use of self-help methods through training programmes for local community members based on local health traditions that could lead to sustainable health care in PHC.

Green Health Campaign's slogan, Medicinal Plants in Every Backyard - Primary Health Care in Every Home is intended to promote the use of local plants and local knowledge for primary health care, through training on the use of medicinal plants by self-help methods. The household herbal gardens, community herbal gardens, farm herbal gardens and sacred herbal gardens are promoted as individual and collective initiatives by the local communities to grow the medicinal plants that could be utilised to meet their PHC requirements, as and when required.

MPCN's members have established 23 nurseries, which are today multiplying about 550 species to meet the requirements of local communities.

CONSERVATION RESEARCH

A research team engaged in the following areas of work supports the conservation programme:

- Floristic surveys
- Medicinal Plants Database
- Ayurveda Database
- Siddha Database
- Trade Database
- Propagation Database
- Seed Storage Database
- Herbarium
- Raw Drug Collection.

EDUCATIONAL MATERIALS AND ACTIVITIES

The communication strategy for engendering local community support for the conservation programme involves the use of a wide range of media that the local communities are familiar with, and which have the power to communicate the messages to the target groups. These are:

- illustrated signs
- thematic posters
- books on growing and using medicinal plants for PHC
- conventions of folk health practitioners
- exhibitions
- nature camps for students and teachers
- folk media such as puppetry, folk plays, etc.

CURRENT ACTIVITIES OF THE MPCN

The MPCN Secretariat brings out a quarterly newsletter GeneNET for its members. A biannual conference of the network is organised to share and exchange experiences amongst members. On this occasion, an exhibition is also organised by MPCN members to inform the wider public of the activities of the network, including a display of MPCN members' products and publications. MPCN has a policy of inviting representatives of conservation organisations and others interested in MPCN to this meeting. MPCN also promotes state-level conferences of Nattu Vaidyas (folk healers) and women's green health organisations and medicinal plant exhibitions.

The Medicinal Plants Conservation Network has a Steering Committee, representing its members, which meets once a year to give direction to its activities. The Steering Committee decides on policies, services, budgets, programmes and projects that should be promoted via the MPCN Secretariat and MPCN members, so that individual member organisations and the network as a whole can become socially useful.

<u>Information available to the public via the MPCN network</u>

- GeneNET newsletter
- information about plants in MPCN Nursery network
- names and addresses of primary members of MPCN.

<u>Membership of the Network</u>

All the organisations involved in the southern India medicinal plant conservation project, initiated since 1993, are founding members of the MPCN. These include the research institutes and NGOs who have established Medicinal Plant Conservation Parks (MPCPs), and Forest Departments who have established Medicinal Plant Conservation Areas

(MPCAs) and Medicinal Plant Development Areas (MPDAs) in Karnataka, Kerala and Tamil Nadu.

Primary Members of the MPCN are those organisations that are actually engaged in community based activities related to conservation and sustainable utilisation of medicinal plants.

Associate Members of the MPCN are the individuals, groups and organisations who are interested in medicinal plant conservation. Associate members include all potential medicinal plant user groups like urban and rural households, women's organisations, government departments, ISM physicians and their associations, research institutes, industry, NGOs, development aid agencies and schools and colleges.

SCHOOL IN THE FOREST – EDUCATING THE TOUNG AT THE GURUKULA BOTANICAL SANCTUARY

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ATTRACTING PEOPLE WITH MANY INTERESTS

Every year around 2000 people walk up the 3 km of dirt road, in rain and sun, to visit the gardens at the Sanctuary. Around 80% of these are local and regional folks namely families on an outing, schools, youth groups, nature clubs, botany students, seminarians, tribes people, farmers, women's groups and so on. All are given a tour by one of the Sanctuary staff or residents. They are taken around the main garden areas which host an attractive and comprehensive collection of native and exotic plants, arranged in taxonomic order and also landscaped under the natural forest canopy. For these casual visitors it is a chance to satisfy their curiosity and see something quite different. It is also an occasion to learn a little about plants, the importance of conservation and regional efforts to maintain and protect biodiversity. Most are quite surprised and delighted, and many fall under the spell of a colourful and bounteous tropical world, full of unusual and fascinating beings. Often these casual passers-by return with other friends, colleagues or associates for a more detailed and slow exploration of the tropical microcosm that is the Sanctuary.

There are the individuals and groups that come out of more specific concerns or interests. They want to learn horticultural techniques, study the botany and taxonomy of the various groups of plants, see ecology in action, do bird watching, explore possibilities in restoration, conservation, and integrated land use. Some of them come several times over the years and become friends. They are from all over the south; scientists, environmentalists, educators and students. They bring with them wisdom, knowledge, techniques and insights and their visits are a chance for us to explore issues of common concern with a very wide network of individuals.

WORKSHOPS FOCUSING ON CONSERVATION AND SUSTAINABILITY

Yet another category of day visitors come as part of a workshop, where a range of activities, tours and discussions are woven around the central theme of conservation and sustainable living. We provide tea and biscuits, they bring a picnic lunch and there is a lot of intense exchange. There are increasing numbers of organic farmers and groups working with farmers who visit us as farming and self sufficiency are among the primary concerns at the Sanctuary. We try to farm the natural systems way where the forest is the model and

our lessons from forest ecology and plant biology are applied to food crops. The goal is to maximise diversity and productivity using successional and seasonal dynamics. Such workshops are very practical and involve detailed discussions on farming, agro-ecology, plant diseases and the economics of it all.

There are workshop type engagements with large school groups as well. A number of NGOs are working regionally with environmental science for school kids. We collaborate with them and use the land, plants and animals to demonstrate and explore questions in ecology with the very young.

Most of these children would have grown up in a similar landscape and have intuitive and experiential knowledge of different crop plants, soils, wildlife and the climate. However, for a large number it is still a first time contact with the primary ecosystem of the place. Our local kids are very comfortable with the outdoor environment and yet their eyes are conditioned to lemon grass hills, tea plantations, and increasingly few traditional home farms. Their familiarity with local regional environmental issues brings a kind of schizophrenic element; they know very well the problems of soil erosion and water loss, the dangers of chemical intensive farming, the heating up of the environment, and on the other hand they are vulnerable to the burgeoning mindset that values the so called benefits of modern development and cash economies, which are intolerant of native cultures and ecosystems. To these children the forest looks messy, wild and dense, and full of dangerous animals like leeches and elephants! (something you could nicely replace with orderly tea slopes and areca nut plantations).

Thus a great deal of time, during local schools' visits, is spent in looking at and discussing the forest world and exploring the feelings and impressions it arouses in their minds. And this is done through a playful exploration of plants, an excited and eager rediscovery of their native landscape and wild community. Common themes that come up include: beauty, gardening with nature, uses of plants, and the role of wildlife.

WORKING IN PARTNERSHIPS WITH NEIGHBOURS

The Sanctuary's intertwined relationship with the neighbourhood allows for an exchange or flow at many levels constantly (labour, services and support). Virtually all the older people in the neighbourhood have at some point or the other worked at the Sanctuary over the last twenty years and this makes the work very locally rooted. Most significantly, the main garden staff for over ten years have been directed and trained by two remarkable young women who have themselves grown into inspired conservationists and highly competent gardeners. They are from the very immediate locality and are part of the core team that shares responsibility for the place. In addition we hold annual festivities which involve the whole neighbourhood. These ritually honour the forest, the earth and the elements followed by a feast for all which is a kind of a remembrance and thank you to powers and forces that have sustained the human community.

RESIDENTIAL PROGRAMMES WITH REGIONAL SCHOOLS

I will now focus upon our residential programmes with regional schools, significantly one or two schools with whom we have jointly developed the whole concept of School in the Forest. This term is in part derived from the title Gurukula and is very much the original inspiration under which the place was founded, as a forest retreat and a place of learning.

In ancient India students went to live in the homes of their teachers which were usually in remote quiet places, perhaps in the woods. In this quiet and conducive natural setting, significant disciplines were explored through the act of living and learning together. In our case the Gurukula, or the House of the Teacher, includes the forest, the garden with its colourful assemblage of plants and animals, the river, the monsoon climate and also the community of humans in which children and adults can live, participate and share responsibilities for varying lengths of time. Thus, community life at the Sanctuary involves the daily care of other living beings and a consistent and playful enquiry about the wild natural community of which people are a part. Children have come to the Sanctuary and made the place their home and a very critical aspect of all this is that they learn to listen and look and take great interest in the various creatures they share their daily space with.

The main intent of The School in the Forest programmes is to provide a diverse and challenging exposure to a way of life that is intimate with nature and natural processes. The stay at the Sanctuary involves a number of different and complementary aspects. Attention is given to the quality of the whole day, from dawn to dusk, rhythms of other living beings, chores and jobs around the garden and kitchen, quiet contemplative moments, health and physical activity (swimming, tree climbing, outdoor forest games etc), investigation and discussion. Usually, children join in with little or no resistance, especially on their second or third visits by which time they have overcome their initial inhibitions with nature and also established a rapport with the residents and the place itself.

One reason why we have welcomed these residential programmes is that working, functioning and living in nature demand an alertness of the senses and the ability to look continually and afresh at what is going on around one. We feel it is of critical importance for youngsters to develop a different relationship with the natural world and this process requires time. Nature moves in unpredictable ways, never static, always new, revealing deeper patterns and principles. To engage fully with this invites looking and listening, an agile body and a quiet, non-judgemental and yet intensely alert mind. This takes time to develop and most kids, whatever their background, come upon this slowly if given time, some playful guidance and space. All of this is of value, wherever one is; in manual work, play, academic study, human relationship or travel. Our thesis is this; that the loss of such qualities is part of the severance of the connection between humanity and wild nature.

CREATING A SPACE FOR LEARNING AND DISCOVERY

We have been wondering if it is possible to draw out young people's inherent sensitivity and readiness to look and learn through observation of, and participation in, nature. Awakening the most primary mode of learning (i.e. direct experience and first hand awareness) is too often ignored in education, especially as the child grows older. Contact with the primary gets progressively shaded out as abstract learning takes over, too early in our opinion and often with detrimental results. This may be one factor leading to disconnected, disoriented uprooted youngsters with no sympathy for their immediate environment or for things and people. We thus attempt to create a space for learning that allows for the discovery of something new and afresh, of spontaneous perception, engagement and enquiry as can indeed happen when immersed in nature and natural processes, even for short periods of time. We don't begin by giving them lots of knowledge and information, rather we take them out first and then let perception and understanding blossom into compassion, action and applicable knowledge.

This back to nature form of learning has a second component that is of great relevance too. Making sense of the world around, communication, raising questions and articulating one's observations and concerns are all critical aspects of learning. Seeing connections and reflecting upon them, expanding the capacity of the brain by allowing its very different intelligences to flower all help to generate a connection to the earth. There are so many fascinating dimensions to explore with the children as their own windows open: heightened awareness, body-kinaesthetic abilities, interpersonal skills, linguistic and intellectual abilities, as well as aesthetic and artistic sensibilities.

If direct experience is woven together with sharing and reflecting and enquiry it brings about good science. This is really to do with being very close to your subject (be it the river habitat, or the bird community, or the plant), so close that you suspend your own judgement and watch, free of pre-conceived ideas, the subject until it tells you its story. This becomes extraordinarily intimate, if given time and space, and this intimacy with creation in its vaster aspects or its more minute details has the possibility to bring about a truer and more active compassion.

If you add to this the incentive that children feel when they are active participants in research, (they are assisting and enabling the work of the Sanctuary to continue by bringing in their observations and questions), then the zest for nature study doubles. They are not to be underestimated in their acuity of perception or in their abilities. So, if you want to undertake a study of ants or birds for example, just invite a whole bunch of kids to help you widen and deepen the pool of knowledge of local natural history. The kids become your extended eyes and ears, assistants and junior scientists in a joint exploration and discovery of the natural world.

Thus, the understanding of nature needs a direct involvement, in whatever way, and it can happen in city parks, with a home garden, or trips out to the wilderness. But what is

essential is the building up of care, involvement, curiosity, activity and responsibility over time, which begins with a slow tuning in to the cycles and rhythms of the natural world.

Does observation really bring about learning? People differ in their opinions about this, especially about the usefulness of such learning and especially in a world that is dominated by the intellect and where individuals, even in rural areas, are subject to bits of information that trickle down to them third hand and bear no relevance to their immediate world. We believe we have not even touched upon the potential of direct observation, which we suspect is vast, especially for the very young. The trend is to fill them up with colourful books and hi-tech films on nature very quickly and the electronic, virtual or printed media becomes the only gateway to the vital, dynamic, rich and beautiful world. Rather, can the young mind be awakened to the muse of the forest, the incredible complexity of tropical life, the fragility of this ancient ecosystem and the fact that there is no separation between humans and nature? And, once initiated can this connection be sustained?

By observation so far I have been including the action and involvement of all the senses. The senses are a fundamental component to our earth bound existence and to us as physical beings. It is through the senses that we relate to the world at large. Looking, listening, touching, tasting, smelling by bringing these together through games, activities, explorations it opens the doorway into a different and more integrated mode of functioning. This seems to give children a degree of self confidence, self awareness and also a boost to their natural liveliness and spontaneity.

Our main focus has always been on the local outreach programmes and so our residential programmes grew quite organically - slowly, bit by bit, over time. We never had the idea that it could build into anything significant as most schools are ready to send their kids away on trips for a few days at the most, and at best so far as we have seen this turns out to be an enjoyable experience.

TAKING THE INITIATIVE

Because a few of the teachers were very struck by the beauty of the forest and the possibility that children could develop a more caring relationship with the environment, one school took the initiative in 1993 to send 10 students to the Sanctuary for three weeks. The 13 year old students came along with books, teachers and homework, so that they wouldn't miss out on their regular curriculum and we essentially provided a kind of a physical support structure and took them on walks and gave small garden projects to the interested ones. At first we had to deal with quite a lot of reluctance and fear; the leeches, the immersion in wildness, the lack of physical conveniences (we have no electricity or television) and the sheer overpowering effect of it all. Still it went reasonably well, so they came again the next year.

This time all their old inhibitions were gone and they were much more active around the place. They started taking responsibility, becoming easily involved in kitchen and garden chores. The third time round, we decided to run a pilot project with them. This focussed on sense-based learning and the students took to it well. Each had a specific topic they wished to study: one chap followed a colony of red ants, another looked at purple sunbirds, a third looked at one tree and all the animals and birds that came around to the tree, a fourth compared different spots in the river and a fifth investigated rhythms of activity in the main garden area, and so on. They were out looking and watching for several hours a day. From the programme some lovely documents were developed: log books, stories, caricatures, tables, and illustrations. These were very different representations of natural phenomena, but all valid and rooted in the perceived and perceptual field.

This was so exciting that the school sent its 11 years olds the following year for a one month stay and we studied the bird life of the Sanctuary. The same process ensued. On another visit fifteen year olds came and looked at ants. We took their work into the entomology laboratory of Centre for Ecological Sciences in Bangalore and were told that this was excellent science and that all observations were valid and relevant. The only thing we had to ensure was that we didn't mix up species, which is quite difficult to do with ants! This led to further projects on insects in general: the different orders, their peculiar life habits and cycles, habitats, movements and so on.

Finally the oldest students at the school were sent for a three month immersion in simple living. They built their own thatch hut, managed and took care of a piece of land, did lots of natural history observations and some craft work (as they made their own mats and tools and ladles). Into this physical land-based natural context, were woven daily lessons in ecology, globalisation, environmental and personal health, questions in careers and sustainable livelihood, the relationship between self and society, energy issues and farming.

THE COMMITMENT SPREADS

Lest you assume that all this is happening with only one school, I'd like to add that although it took one school to develop the whole programme of nature education to such a comprehensive and sustained depth, the relevance of it has been picked up by other schools who are now ready to send their children on similar programmes. In the last year, four other schools so far have participated in our residential School in the Forest programmes. This year a school for children with disabilities has asked to come, as well as an NGO working with village youth and a rural school. Being small we can handle only certain numbers. In addition as the programmes are so intensive they can only really be conducted with a maximum of 10-15 kids at a time. However, it is very encouraging that increasingly, schools in south India are seeing the relevance of this kind of learning, particularly as they are able to use it back home in different ways; especially schools that are really serious about the environmental crisis. The relevance they see is that in such a learning situation conservation is not an abstract idea, but rather a daily living reality through the care and

interaction with other life forms and that this brings about a dynamic involvement with the environment.

Working with all these different individuals and groups (local, regional, young, old, on day visits or longer stays) through all these years has brought about an enthusiastic and creative spirit of learning, care and common ownership of the Sanctuary. Children turn up on holidays with parents and friends in tow and introduce them to environmental issues. There is a slow but definite multiplier effect. Young gardeners and budding ecologists, teachers, farmers and travellers, not only take away with them this sense of a marvellous, beautiful and vital world needing care and responsible participation from its human members, but they also bring with them a joy and enthusiasm that nourishes the place itself. In a world that is otherwise directed by the intellect and subject to unnatural and unsustainable pressures of being, there are few opportunities to explore a more basic and spontaneous mode of living. This tragically and inexorably leads to separation from other people, the environment, society and even oneself. It is this fragmentation and separation that we seek to address through the work with nature and young people at the Gurukula Botanical Sanctuary.

Empowering Rural People for Primary Health Care – A case study

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Introduction

The role of botanical gardens in p[popularisation of science is well recognised. Botanical gardens' new roles in educating people on environmental, conservation, sustainable management and utilisation of local biodiversity elements are nowadays getting more important. In a developing country like India, rural people are concerned more on health problems and livelihood. During the past few years TBGRI has developed a programme called 'health for all and herb for all' as a part of its outreach programmes. This programme was designed to develop the productive potential of the rural people using the under utilised floristic wealth for income generation and primary health care.

Background

India has perhaps one of the richest ethno botanical traditions in the world. A study conducted by the Al India Co-ordinated Research Project on Ethnobiology reveals that different communities use more than 7000 species of plants across the country for an unbroken 5000 year old living legacy. This system is working in India through two main streams; well codified indigenous systems like Ayurveda, Sidha, Unani, Amchi and immensely rich and diverse fold practices. A good portion of modern plant based drugs were developed as a result of scientific study of plants used in traditional systems. Unfortunately, these traditions have largely been eroded due to lack of support and recognition as well as due to the rapid destruction of forest wealth which has resulted in the shortage of medicinal plants. In this context, a combined approach of conserving both the traditional knowledge as well as the medicinal plants ahs turned out to be the only option for protecting the country's age-old medical heritage. A healthy population is the real wealth of a nation and it is the collective responsibility of individuals, families and governments to ensure the community's health security, for which food security is the basic requirement. The TBGRI outreach programme addresses this core theme and has launched various activities aimed at eh conservation and sustainable utilization of biodiversity.

Steps Involved

Over the past few years TBGRI scientists have been carrying out certain community participatory activities especially with medicinal plants in certain rural villages. Some of these villages were selected for the present programme. To start with, background information on the socio economic and resource profile of the villages was obtained as a base document for properly planning the programme. The data collected included information on the bio-resources of the region and their utilization pattern. Social organizations of the villages, socio-economic and techno-economic capabilities of the villages, health profile of the villagers and the status of health management in the villages were also recorded.

After the assessment of the above data, four rural villages in Thiruvananthapurum District were selected for implementation of the programme; Njaraneeli, Bharathanoor, Pampuchathamannu and Panangode. The villages are situated within a distance of 20km from TBGRI and the majority (80%) of the people belong to farming communities owning small pieces of land (0.1 – 0.5 ha) cultivating rubber, paddy, pepper and tapioca. The villagers are mostly Christians, Muslims and Hindis and the majority are literate.

A team of TBGRI scientists visited the villages and interacted with several influential people and discussed the proposed action plan. Encourages by their positive responses, a series of seminars and exhibitions were organized in the villages. During seminars an action plan was introduced before the village people and their co-operation was sought for the programme. Ten people form each village were selected based on their ability to write, read, and speak before a group of people. These 'core group member' were brought o TBGRI for a three day residential training.

ON the first day of the programme , scientists gave lectures on agrobiodiverity , wild bio-resources, conservation, sustainable and productive use of bio-resources and value addition , ecologically sound and economically sustainable utilization strategies, importance of traditional diets, qualitative superiority of local fruits and vegetables, issues involved with the disappearance of home gardens , harmful effects and problems associated with monoculture.

On the second and third days, the importance of primary health care and the need for sustainable utilization of bio-resources were discussed. The uses of thirty single plants which can be used for common ailments and the preparation of 10 combination drugs were clearly demonstrated, so that they can prepare them without the help of the experts in their villages.

After this residential training the core group members were asked to go back to their respective villages and to organise village level family meetings of 20 people each at an interval of 15 days. All these meetings were organized conveniently during evening hours under the supervision of TBGRI scientists. In the meetings the core group members took the lead role and taught uses of some common plants for treating common ailments. They

then recorded some of the traditional knowledge of the villagers who were willing to share it for further evaluation and use. In every meeting they used to prepare one compound herbal drug in sufficient quantities for their own use and shared equally between them under the guidance of core group members and TBGRI scientists. The training programme emphasised the need for self-reliance and aimed to empower the villagers in primary health care. The participating families collectively mobilised funds and herbs for preparing the drugs. This programme continued for a period of 5 months and during this period a full package utilizing locally available bio-resources for primary health care was prepared.

Exposure Visits

During the course of the programme the participants could not gather some of the ingredients of the combination drugs form their areas. Scientists realized that this was not due to the non-availability of the plants but their inability to identify the plants. The TBGRI scientists took the participants to neighbouring forest wild areas and showed them the diversity of plants including the required herbs. Later these groups came to TBGRI and were taken around the medicinal plants demonstration areas. This exercise enabled them to develop skill to identify locally available medical plants especially for preparing the remedies.

Seedlings of medicinal plants, lesser known wild fruits and local vegetables were supplied to them for developing homestead gardens according to their demands, form TBGRI. The cultivation techniques of the plants were also made available to them.

Evaluation

The success of this programme depends on the effective dissemination of information and materials throughout the community and the committed involvement of the people. Active participation of the rural women was the other major factor. This programme was evaluated in two ways, on economical aspects and on conservation aspects. On the economic side the villagers could prepare al the combination drugs at much cheaper rates compared to their market price. As drugs prepared by them had ingredients readily available, they could avoid travelling to distant hospitals for ht treatment of common ailments.

As the programme progressed, the participants were found observing plants of medicinal use and protecting those in their surroundings. They even started their cultivation along with other plants as they could find some use for them. This change in attitude was very encouraging.

The Story of Success

Encouraged by the success of the trial programmes (1994 – 1996) TBGRI received several requests from adjourning villages for extension for the programmes to their areas. After preliminary analysis of the socio-economic data of the villages, four more rural villages were adopted during 1996-98 by which 800 new villages received the benefit.

During the course of this programme TBGRI produced several brochures, fliers and books in local language for the benefit of the trainers and trainees. The topics selected include primary health care, commonly cultivated medicinal and aromatic plants, wild edible fruits and vegetables etc. The programme was highly regarded by several international bodies, like the World bank, which appointed a team to record the entire programme to be used in other developing countries as a model.

Acknowledgment

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Teaching our Traditions Medicinal Plants and Ethnobotany

TRADITIONS AND MEDICINAL PLANTS: A VALUABLE FIELD OF KNOWLEDGE AND A GREAT CHALLENGE FOR SCIENCE

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INTRODUCTION

In a country like Mexico, city-life is markedly different than country-life. The accelerated urban tempo has influenced the loss of oral traditions; children prefer to watch television rather than listen to their grandparents' stories. In contrast, life in the country promotes family gatherings and traditions as well as intimate contact with nature from which one constantly learns. Today, in many rural areas, the children still join their parents on trips to the field and assist in the cultivation practices. While they accompany and help their elders, they exchange knowledge and ideas about the plants and animals that surround them.

Mexico is a pluricultural country and, in general, its traditional relationship with nature includes the respect and wise use of the natural resources. The deities associated with natural resoures mark strict cultural patterns equivalent to laws in other social environments. One example are the prayers that proceed the gathering of medicinal plants in Santa Catarina del Monte (a state of Mexico), as well as the ritual incantations that are sung upon cutting the maguey plant as part of making pulque, a fermented beverage based upon the plants' sweet juices. In general, these rituals request permission from Mother Nature to use the resource and promise to only take what is necessary and appropriate (Figure.1).

THE PRESENT DAY SITUATION

To complement the medicinal plant research project (International Cooperative Biodiversity Group), we had the opportunity to develop a workshop on the conservation of dry tropical forests in a rural school in Batopilas, Chihuahua, México. The objective was to motivate the children to care for nature and we designed a series of games, including a memory game of characteristic plants and animals, as part of the workshop. A prototype was developed at the IB-UNAM's Chamela Biological Station in Jalisco where similar vegetation occurred. Afterwards, the participating students were asked to draw the important plants and animals of their community. Among the findings were:

- Children from the third through to sixth grade (9 to12 years of age) who accompanied their parents into the forest knew the wild plants and animals whereas the younger children did not.

- In contrast, the children from first and second grade (7 to 8 years of age) knew the domestic plants and animals that were normally present in the corrals and home gardens.
- In general, the children paid more attention to the animals than to the plants.
- Of the plants mentioned, the edible species were more frequently mentioned and were followed by medicinal plants.

Based upon the experience in Batopilas, medicinal plants were found to be one of the elements of traditional knowledge that is maintained. Perhaps the daily use of herbal remedies has reinforced the importance of these plants in many areas of Mexico where permanent medical attention is not available or where their use complements institutional medicine. Nonetheless, our studies carried out in different parts of Mexico indicated that the knowledge of grandparents' was being lost and many of the younger generation were not interested in carrying on the traditions because they regarded them as old-fashioned.

Based upon these considerations, various Mexican botanical gardens have developed programmes to recover ethnobotanical knowledge including aspects of edible plants, plants used in construction, vegetable dyes and, above all, medicinal plants. This type of research has enriched educational programmes within the botanical gardens at the local level as well on a national scale. These experiences have supported other programmes that have gone beyond the limits of the botanical gardens and even have been applied to communities where the original investigation was initiated. Countries which have ratified the Convention on Biological Diversity must assure that such studies are approved by the community and share with them the benefits derived from such knowledge including publications and commercial products.

ACTIONS CARRIED OUT AT THE BOTANICAL GARDEN IB-UNAM

Over the last 20 years staff from the botanical garden have been documenting the use of medicinal plants in Mexico, especially in markets (Bye and Linares 1983, 1987, 1990; Linares and Bye 1987). These investigations have enriched our living plant collections as well as our educational program inside and outside the botanical garden.

The medicinal plant section within the botanical garden exhibits plants obtained from the field and also these donated by collaborators. The plants are labelled with ceramic plaques that summarise botanical and ethnobotanical information. Selected medicinal herbs from central Mexico are included on a CD-ROM with the text in Spanish and English, photographs and videos clips. Based upon this electronic medium, a bilingual book was produced in order to accompany the disk as well as make the information available to wider audience (Linares, Bye and Flores 1999). This book has been well received by the public, including traditional healers as well as pharmaceutical researchers looking for active

principles. By having the text in English, we hope that appreciation of our traditional knowledge will transcend political boundaries.

For the botanic gardens staff, the area of medicinal plants represents a multidimensional educational field which can support such disciplines ranging from history and geography to biology and civics.

Normally, medicinal plant workshops attract a wide range of people from housewives and teachers to professionals in the medical fields. A recent course targeted spouses of ambassadors from around the world who currently reside in Mexico. The Botanical Garden in collaboration with the Mexican Secretary of Exterior Affairs developed the program not only using the university facilities but also the major medicinal plant market. This course was a new experience for us in that each participant representing a distinct culture not only learned more about Mexican culture but also placed the plants and their uses in the context of each person's cultural background as well as his/her accumulated worldly experience. Such interaction demonstrated the potential power of plants as a universal medium of communication. For educators in botanical gardens, medicinal plants represent a powerful tool for providing precise, clear and attractive information that promotes the message of the importance of plants in our daily lives.

In Mexico, medicinal plant markets are a laboratory that allows us to know more about the Mexican flora. The Sonora Market in Mexico City sells over 400 species daily. It is one of the most important commercial centres of vegetal remedies that promotes the exchange of knowledge between sellers and buyers. Our research in such a dynamic environment generated ethnobotanical information that enriched our botanical garden's educational programmes.

PROGRAMMES ORIENTED TOWARDS TEACHERS

An important aspect of our programmes is oriented towards the formation of botanical information multiplicators such as school teachers. Our botanical garden has developed a special training program for high school teachers. This program focuses on the relationships between plants and people based upon historical references, field work, contemporary literature and recent scientific discoveries. In addition, class exercises with plants in the botanical garden are carried out in order to motivate the teachers to return and incorporate the living collections as part of a living laboratory. In this manner, the teachers are prepared to supervise their own class activities with familiar material and to awaken the interest for plants in their students who are invited to return to the botanical garden (Table 1). As a requirement for completing this course, each teacher designs a class exercise on one of the course's theme of his/her choice so that it can be implemented when his class visits the garden.

CONCLUSIONS

The knowledge of traditional plant use is a valuable tool for developing the different public sectors' awareness of the importance of plants in their lives as well as the impact that plants have made in human history. The first step to appreciate plants is the development of knowledge and subsequent sustainable use of vegetal resources. In this manner, we can promote the conservation of the natural resources, especially medicinal plants. If we can motivate people in this way, their increasing knowledge will activate positive attitudes, customs and changes in our lives in a permanent and lasting fashion. In order that our efforts yield products at a larger scale, it is fundamental to stimulate individuals who can act as multiplicators of the importance of plants in our lives.

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*Table 1: Know and Use the Botanical Garden as a Teaching Resource - A course carried out at the IB-UNAM Botanical Garden**

Themes included:
Century-plants and their use
Trees of the botanical garden
Cacti and their propagation
Orchids and their maintenance
Useful plants and domestication
Titles of some class exercises developed by the teachers:
The importance of the study of biological diversity in the plant kingdom
Visit to the Botanical Garden
Describe and observe the cycads in the greenhouse
Guess who I am, where I live, and what I am good for
The botanical garden in support of the study of medicinal plants
Cultivate and propagate cactus seeds
Know the trees of the botanical garden
Adaptations of plants in arid zones
Shall I introduce you to some beauties?... the orchids
Developing a dichotomous identification key
Diversity and ecology in the botanical garden
Ecological walkway in the botanical garden
Rally in the botanical garden

*this course was coordinated in collaboration with Carmen Cecilia Hernández

Figure 1. Sebastiana Clavijo (from Santa Catarina del Monte, State of México, México) has dedicated the maguey plant in preparation for the extraction of its sap, which is fermented and drunk as a traditional beverage called pulque. Before she sacrifices the *Agave* she asked permission to the spirits of the forest to utilize this necessary plant.

TOYS: AN AMUSING USE OF PLANTS

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Among the vast uses of plants, there is one that is especially attractive, not only for children, but for adults as well. Toys can provide enjoyment for the young and the old. The aims of this workshop were to:

1. learn about toys made from plants or plant structures from different regions of Mexico;
2. relate the variety of toys to the biodiversity of the country; and
3. analyse these aspects in terms of how useful this kind of activity can be in raising awareness, particularly in children, of the importance of plant conservation.

This workshop included ludic, historical, cultural, botanical and ecological issues. Delegates considered what toys were and their importance.

Toys are an essential element in the formation of a child's character. By playing with toys, children start to learn about adult life and in addition parents use them to educate children.

Contemporary Mexican culture has developed from a mixture of pre-Hispanic and Spanish cultures resulting in a culture that is unique and rich.

There is archaeological evidence that in pre-Hispanic Mexican culture, artisans made different types of toys. Nevertheless, it wasn't until the 18th and 19th centuries that elaborate toys started being made such as trains, dolls, tea sets, doll houses, soldiers, marionettes etc. Many of these were made from plants or plant structures.

Although there are toys made with fruits, seeds, vines, palm leaves, cotton and aquatic plants among others, most are made from wood. When conducting workshops at CICY with the public we question and analyse what wood is, how trees produce it, mentioning as well some of its botanical and ecological characteristics, and how the diverse type of toys are directly related to plant diversity.

The practical part of this workshop with congress delegates involved building toys. Using the templates toys can be made from soft and thin wood.

Materials

- paints in a range of bright colours
- paint brushes
- sand paper
- copper wire
- pliers.

Instructions

1. Place the templates on the soft thin wood and cut out the shapes.
2. Sand the edges of the wood pieces using sandpaper.
3. Paint each of the pieces and let them dry.
4. Attach the pieces as shown in the diagrams and ensure that the arms and legs hang loosely so that they can move forwards and backwards.

Bellota comes from the Nahuatl communities from the state of Puebla in Mexico. The original toys were made with the *Quercus* sp. seed. You can either use a large seed or use a small piece of wood. When you pull the string it turns.

Equilibrista comes from the state of Michoacan in Mexico. This area has large pine and pine-oak forests. This toy is in the shape of a monkey.

Chinete originates from the state of Guerrero in Mexico. Staff from CICY have made a chameleon and a rabbit – but many other animals could be made.

COCONUTS IN INDIA

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The Coconut Palm (*Cocos nucifera* Linn.) is supposed to be one of the five legendary Devavrikshas and is eulogised as Kalpavriksha - the all giving tree - in Indian classics. All parts of the palm are used in someway or another in the daily life of the people of the west coast; the traditional coconut growing area. Its fruit is called Lakshmi Phai and is used in social and religious functions in India irrespective of whether palm is locally grown or not.

Coconut is grown in more than 86 countries worldwide, with a total production of 54 billion nuts per annum. India occupies the premier position in the world with an annual production of 13 billion nuts, overtaking Indonesia and the Philippines, the other two prominent coconut-growing countries.

The coconut palm is a versatile tree crop; no other tree crop grown can match coconut palm in its versatility. It provides nutritious food and a refreshing drink, oil for edible and non-edible uses, fibre of commercial value, shell for fuel and industrial uses, thatch, an alcoholic beverage, timber and a variety of miscellaneous products for use as domestic fuel. The palm is amenable to both plantation and homestead management and it can be either a major crop or a minor one in a homestead garden of mixed crops. While responding favourably to scientific management, the palm also tolerates negligent farming to a certain extent. Thus, it can adapt to the divergent farming situations and management practices that are prevalent in the different agro-climatic regions.

The coconut palm exerts a profound influence on the rural economy of the many states where it is grown extensively and it provides sustenance to more than 10 million people. The export earnings derived by India from coconut are around Rs.3000 million, mainly through the export trade in coir and coir goods. The processing and related activities centred on the crop generate employment opportunities for over two million people in India. The contribution of coconut oil to the national edible oil pool is 6 %. In addition, the crop contributes Rs.7000 crores annually to the Gross Domestic Product (GDP). It is no wonder coconut culture is spreading even to non-traditional belts that were, until recently, considered unsuitable for the purpose.

In India, coconut is cultivated mainly in the coastal tracts of Kerala, Tamil Nadu, Karnataka, Andhra Pradesh, Orissa, West Bengal, Pondicherry, and Maharashtra and in the islands of Lakshadweep, Andaman and Nicobar. Of late, coconut cultivation has been introduced to suitable locations in non-traditional states including Assam, Gujarat, Madhya

Pradesh, Rajasthan, Bihar, Tripura, Manipur, and Arunachai Pradesh and in the hinterland regions of the coconut growing states.

Kerala is the main coconut growing state with an area of 10.20 lakh hectares and production of 5911 million nuts, followed by Tamil Nadu (3.20 lakh hectares and 3716 million nuts), Karnataka (2.87 lakh hectares and 1493 million nuts) and Andhra Pradesh (0.95 lakh hectares and 780 million nuts). These four southern states together account for 90 % of the total production in the country.

In productivity too, India ranks number one among other coconut growing countries in the world. The average productivity of coconut in the country is 6898 nuts per ha. Among the four major coconut growing states, Tamil Nadu has the highest productivity (11 620 nuts/ha), Andhra Pradesh has a productivity of 8296 nuts/ha, followed by Kerala (5793 nuts/ha) and Karnataka (5204 nuts/ha).

There are mainly two varieties of coconut: tall and dwarf. In addition, hybrids of various combinations have also evolved. The tall cultivar is extensively grown throughout India, while the dwarf is grown mainly for parent material in hybrid seed production and for tender coconuts. The tall cultivar generally grown along the west coast is called West Coast Tall, and the cultivar grown along the east coast is called East Coast Tall.

Benaulim is the tall variety grown in Goa and coastal Maharashtra. Laccadive Ordinary, Laccadive Micro, Tiptur Tall, Kappadam, Komadan and Andartian Ordinary are some of the tall varieties grown in the country and Chowghat Dwarf Orange, Chowghat Dwarf Green, Malayan Yellow Dwarf and Malayan Orange Dwarf are some of the dwarf cultivars grown in India. Gangabondam is a dwarf type grown in certain tracts of Andhra Pradesh. Many hybrid combinations of tall and dwarf cultivars that have evolved are also grown in the country.

Coconut possesses the unique characteristic of allowing any crop combination in the inter-spaces. A well-spaced coconut garden provides adequate inter-spaces where it is possible to grow a variety of crops, both seasonal and perennial. When annuals or seasonal crops are grown in coconut holdings it is designated as inter-cropping; when perennials are grown it is called mix cropping. A combination of inter-crops and mixed crops raised together are referred to as a multi-storeyed cropping system.

In widely spaced gardens the shade from the coconut palms is not intense enough to prevent the growth of other crops. During the pre-bearing period, especially up to three years after planting, the entire area could be made use of because of the negligible shade effect. As the palms grow there is a progressive increase in the shade coverage produced by the crown for up to 20 years. Depending on the age of the palms and canopy coverage suitable crops, or a combination of crops, could be selected for growing in the gardens. The common inter-crops that could be grown during the pre-bearing or the early stages of the growth of the palms are pineapple, banana, groundnut, chillies, tapioca, sweat potato

and other root crops. In addition, cocoa, pepper, cashew, fruit trees could be grown as mix crops.

Coconut crops are susceptible to various diseases and pest attack. The major pests to coconut in India are rhinoceros beetle, red palm weevil, leaf-eating caterpillar and rats and the major diseases are root wilt, thanjavur wilt/ganoderma, tatipaka, bud rot, leaf rot, stem bleeding and crown chocking. Of these, root wilt, prevalent in Kerala, is a century old disease. Effective control measures are yet to be developed for root wilt disease in Kerala; thanjavur wilt/ganodarma disease in Tamil Nadu and Karnataka; and tatipaka disease in Andhra Pradesh. However, the diseases can be kept under control by adopting the recommended package of practices.

Of the total production of coconuts, about 5 % is consumed in the tender form for drinking purposes. The rest is utilised as mature nuts for household and religious purposes and for the production of edible copra, milling copra and desiccated coconut. Coconut oil production in the country is nearly 4.5 lakh tonnes. Of this 40 % is consumed for edible purposes, 46 % for toiletry uses and 14 % for industrial uses.

The emphasis given by the Coconut Development Board to evolving technologies for the development of new value added products has yielded results and this product diversification and by-product utilisation has recently gained momentum. Various research programmes, sponsored by the board through the existing research institutions in the country, have led to the development of new technologies for the manufacture of coconut cream, spray dried coconut milk powder, preserved and packed tender coconut water and coconut water based vinegar. Commercial production units have started in various parts of the country with the technologies developed so far.

The research on coconut in India is being carried out by the institutions under the Indian Council of Agricultural Research and the State Agricultural Universities located in different coconut growing states. Research on post harvest processing of coconut is also undertaken by the institutions under the CSIR. The board has a programme to sponsor research on post harvest processing of coconut through such research institutes. The institutes under the Coir Board mainly undertake the coir research.

Coconut development programmes in India are mainly carried out by The Coconut Development Board, which was established in 1981. The board's schemes are either implemented directly or through the Department of Agriculture/Horticulture of the states and union territories. The state governments also implements their own programmes to suit the local needs. The board functions under the administrative control of the Ministry of Agriculture, Government of India with the Chairman as the chief executive. The Coconut Development Board Headquarters is in Kochi in the state of Kerala and in order to implement and monitor various developmental projects, the board has established field offices in various parts of the country.

To conclude, coconut is a crop with unique features. Owing to its versatile uses, the demand for coconut and its products has been on the increase. The crop is spreading fast even to the interior tracts and the north and northeastern parts of the country gaining national acceptance. Having already attained the premier position in the world, India's thrust now shall be to exploit the wealth potential of the crop in all respects. Moreover coconut is an ecofriendly crop which permits coexistence of multi-species plants. It enriches soil fertility in association with other crops and is quite amenable to organic farming if appropriate intercrops are grown in the inter-spaces. Due to multifarious uses, the future of the crop is very bright irrespective of the locations where it is grown in the world.

THE TEACHING OF INDIAN TRADITIONAL MEDICINE

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THE TEACHING OF INDIAN TRADITIONAL MEDICINE

Indian Traditional Medicine functions through two social streams:

1. The Classical Health Traditions (CHT) like Ayurveda and Siddha are highly organised, classified, and codified and have a sophisticated conceptual and theoretical foundation and philosophical explanations.

2. The other stream, Oral Health Traditions (OHT), is very rich and diverse, but is not organised or codified. It is a distilled knowledge from people's experience and is prevalent in rural and tribal areas of India. This oral folk tradition is mainly based on plants and it holds a respectable position today, especially in developing countries where modern health care is limited. Safe, effective and inexpensive indigenous remedies are gaining popularity among the urban and rural populations especially in India and China.

The sources of Classical Health Traditions and Oral Health Traditions are outlined in Table 1.

Table 1: The Sources of Indian Traditional Medicine Functions

Classic Health Tradition (Ayurveda, Siddha and Amchi)	**Oral Health Tradition (Folk and Tribal)**
• Classic health traditions have developed from Vedic/classical texts and treatises like Rigveda, Yajurveda, Samaveda and Atharvaveda, Charaka Samhita (text on ancient Indian medicine), Susruta Samhita (text on ancient Indian surgery), Ashtanga Samgraha, Ashtanga Hridaya (text on ancient Indian medicine and surgery), Kashyapa Samhita (text on	Oral health traditions have developed from: • Traditionally trained folk healers/village physicians. • Folk healers/village physicians who are not traditionally trained but experienced in certain health practices (e.g. Dai, bone setters, specialists in treating poisons, jaundice, mental disorders.

gynaecology and child health), and other numerous related text books in both Sanskrit and regional languages.	• Old individual or different ethnic communities including women treating the patients based on the knowledge acquired from their predecessors. • Individuals belonging to different professions (educated group) who acquired certain knowledge from their predecessors • Ancient copper plate/palm leaf writings. • Old and recent publications in regional language. • Traditional groups of tribes. • Organised groups of tribal communities/tribal physicians/old individuals. • Tribal physicians among the migrated groups of tribe settled in the plains.

AYURVEDA

Ayurveda is not merely a system of medicine, in a broader sense it is the science of life of the universe; hence it is universally applicable. The word originates from Sanskrit; 'Ayu' meaning life and 'Veda' meaning knowledge/science pertaining to human beings thereby forming the word Ayurveda, or in the case of knowledge pertaining to plants or animals the words Vrikshayurveda and Mrugayurveda are used respectively.

Ayurveda teaches us the science of life from a micro to a macro level. Therefore Ayurveda, conceptualised with concrete fundamental theories, begins with the theory of evolution of the universe (Brahmanda) with the entire life forms (Pindanda) prevailing in it (including human beings, plants, animals and microbes etc.), supported with non living components like soil, water, minerals and metals. According to Ayurveda, all the living and non-living things are made up of the five elementary principles (Panchamahabhutas) which are derived from the three effective principles/energies of nature (Prakruti):

1. Satwa - responsible for conscious manifestation
2. Rajas - responsible for the existence of energy in matter
3. Tamas - responsible for resistance and stability.

> The actions, interactions and transformations of the five elementary principles, 'Apancheekrita panchabhuta and Pancheekrita panchabhuta' which have evolved from the pre-particle state to the molecular state (Panchatanmatras) leads to their different states of equilibrium.
> (Rajasekharan 1995)

The objective of the science of life is to maintain the equilibrium state of the body's elements. In short, when an imbalance takes place in the Panchabhautika character of the body and mind due to various etiological factors, the balancing state of doshas will be affected and this will be reflected on Saptadhatus and Malas. This in turn aggravates or depletes the balancing equilibrium of dosha, dhatu and mala of the body and mind and produces different kinds of disorders. The ultimate objective of treatment is to bring a person back to a balanced state. This process is termed in Ayurveda as Dhatusamyakriya. This balancing technique helps the doshas to achieve an equilibrium, therefore the selection of a drug should be based on the bhuta character of the drug. For example, if the disorder is due to Prithvi bhuta depletion, the drug prescribed must be Prithvi bhuta predominant.

DIVISIONS OF AYURVEDA

There are two divisions of Ayurveda: Swasthavritta and Athuravritta. Swasthavritta mainly deals with Swasthasya Swasrhya Rakshanam i.e. how to maintain the health of a healthy person in a positive way through prevention, promotion and correction (Table 2). Athuravritta deals with disease management and treatment through prevention, promotion, correction and curation. Athuravritta can involve medicine and/or surgery.

Within Ayurveda there are eight specialities:

1. Kayachikitsa - internal medicine
2. Kaumarabhritya - paediatrics and gynaecology
3. Shalyatantra - surgery
4. Shalakyatantra - ophthalmology and otorihnolaryngyology
5. Grihachikitsa - psychiatry
6. Agatatantra - toxicology
7. Rasayanatantra - geriatrics / rejuvenation therapy
8. Vajeekaranatantra - sexology / virilification

Table 2: How to maintain the mental and physical health of a healthy person through Swasthavritta

Sadvritha (Mental) **Ethical Conduct**	**Sadvritha (Physical)** **Health Conduct**
• Natural urges (urine, faeces, semen, sneezing, yawning, hunger, thirst, sleep, tears and taking deep breaths after exertion) are important and should not be suppressed or induced. • Nithya Rasayanas, the ethical principles which rejuvenate the mental	• Daily routine (Dinacharya) • Seasonal regimens (Ritucharya) • Exercise, yoga and meditation are important. • Wholesome food, seasonal food and ethnic food are important and should be taken.

faculty should be followed.	• Healthy sexual behaviour and sound sleep. • Panchakarma (techniques adopted for servicing/conditioning the physical faculty/mental faculty) should be applied. • Rasayana* should be applied in Vajeekarana.

*The aim of applying Rasayana at the right time and age is to bleach out the toxins accumulated in the cellular level so as to condition and/or service the whole body and mind. Further it accelerates the process of RASA + AYANA which is a enriching/nourishing mechanism which helps to control ageing and enhances strength and vitality.

PLANTS IN AYURVEDA

The study of plant species can be traced from the age of Vedas. Plants are considered as divine in origin and were worshipped as Mother (Goddess). In the aushadi sooktha of Rigveda it is said 'Oh! Divine plants! Always be kind to us! Pour happiness over us, you are having great power like the horse, you are the greatest destroyer of fatal diseases, you are the guardian of mankind, save and protect us from all kinds of illness'.

There are a number of plants which have been mentioned in the three main treatises of Ayurveda:

1. Charaka Samhita: 1100 plant names
2. Susruta Samhita: 1270 plant names
3. Astanga Hridaya: 1150 plant names

The total number of plants mentioned in the above three samhitas has been estimated to be 1900, out of which 670 are common to all three texts and about 240, 370 and 240 respectively have been exclusively mentioned in the three texts.

INDIAN ETHNOBOTANY

Different ethnic groups of ancient lineage and the occurrence of rich biodiversity make India one of the richest countries in the world in the field of ethnobotanical knowledge. Over 53 million tribal people belonging to over 550 tribal communities coming under 227 linguistic groups inhabit the Indian subcontinent. They inhabit varied geographic climatic zones throughout the country.

Ethno-medico-botanical investigation has led to the documentation of a large number of wild plants used by tribal people for meeting their multifarious requirements. The

application of most of the plants recorded are either lesser known or hitherto unknown to the outside world.

Wild Plants for Food, Medicine, Fibre, Fodder and Other Purposes

Over 9500 wild species used by tribal groups for meeting their varied requirements have been recorded so far. Out of 7500 wild plant species used by these groups for medicinal purposes, about 950 have not been previously recorded and are worthy of scientific scrutiny. Of the 3900 or more wild plant species used for edible purposes (as subsidiary food/vegetables) by tribal groups, about 800 have provided new information and at least 250 of them are worthy of attention because of their potential to be developed as alternative food sources food to meet future world needs.

Similarly, out of over 525 wild plant species used by tribal groups for making fibre and cordage, 50 have potential for commercial exploitation. Out of 400 plant species used as fodder, 100 are worth recommending for wider use and out of the 300 wild plant species used as pesticides, at least 175 show promise as safe biopesticides. Due to the revived interest worldwide, almost all the plants used as gum, resin, dye, incense and perfumes are worth investigating.

INDIAN ETHNOMEDICINE

Ethnomedicine denotes plants, animal products and minerals used by tribal communities of a particular region or country for medicinal purposes other than those mentioned in classical streams of the respective cultures.

Ethnomedicinal information/data is playing an important role for developing new scientifically validated and standardised drugs (both herbal and modern). In India, uses of more than 7500 plant species by different ethnic communities have been recorded so far.

An intensive ethnomedical survey conducted by the author and his team from 1987-1992 in the southern most state of India (Kerala), has provided rich and varied ethnomedical data recorded from the different tribal communities including Kani, Malapandaram, and Cholanaykan. During this study, the author documented medicinal uses of over 300 single plant species and 100 formulations. Much of the information is new and hitherto unknown to the outside world and has not been mentioned in other classical systems of medicine for the scientific validation of these data.

Arogyappacha and Benefit Sharing with the Kani Tribal People

Based on the ethnomedical data collected from the Kani tribal people, the author and his team selected Arogyappacha (*Trichopus zeylanicus* subsp. *travancoricus*) for detailed ethnopharmacological investigations. In 1987, Mr. Mallan Kani and Mr. Kuttimathan Kani of Chonampara provided the clue that '…the tender fruits of the plant are having anti-fatigue property'.

The Kanis

The Kanis inhabit the forests of the Thiruvananthapuram district of Kerala in southwestern India. According to the census of India from 1991, their population is 16 181, which is approximately 1.8 percent of the total population of the district. The Kanis are traditionally a nomadic community. The traditional occupation of the Kanis, which they continue to follow to some extent, includes handicrafts such as basket making, mat making and cane works. They are also engaged in the seasonal collection of minor forest produce such as honey, bee wax and medicinal plants.

Based on the Kanis information on Arogyappacha scientists of TBGRI developed a scientifically validated and standardised herbal drug called Jeevani. It is a formulation consisting of four ingredients. The drug was designed by the Ethnomedicine and Ethnopharmacology Division of TBGRI in which Arogyappacha is one of the constituents. Therapeutic efficacy of this formulation has been proved by conducting research studies at various levels. Jeevani has been found to have good anti-fatigue and immuno-enhancing properties and it has also shown good hepato-protective and anti-stress properties.

In 1995, the technology for the production of Jeevani has been transferred to an Ayurvedic drug manufacturing company (Coimbatore Arya Vaidya Pharmacy Ltd.) for a period of 7 years after obtaining a licence fee of Rs 10Lakhs (one million rupees; approximately $ 25 000US) and 2% royalty on the ex-factory sales price from the company.

Subsequently TBGRI decided to share 50% of the licence fee as well as the royalty with the Kani people to encourage an equitable sharing of the benefits arising from the utilisation of such knowledge, innovations and practices as stated in the mandate of Article 8(j) of the Convention on Biological Diversity (CBD). This is considered to be one of the first models for benefit sharing in the world, which is popularly known as the TBGRI Model for Benefit Sharing. The Government of India has presented this case study to the Secretariat of CBD.

The 50% share promised to the Kani people was handed over to them in March 1999 and remitted in the account of the trust, constituted by the Kani people known as Kerala Kani Samudaya Kshema Trust.

PRIMARY HEALTH CARE THROUGH BOTANIC GARDENS - HERBS FOR ALL AND HEALTH FOR ALL

The security of a nation is directly related to the food and health security of its people. A biodiversity rich nation like India can achieve a reasonably high level of food and health security, if the people are encouraged to make the best use of the local biodiversity resources with appropriate science and technology intervention.

Herbs for All and Health for All is a model, experimented by the scientists of TBGRI, with a view to empower the people to take care of their primary health care needs by making best use of the locally available medicinal plant resources. It is essentially a participatory, action-oriented programme. It has been designed to equip the rural villages of Kerala State, India, to conserve and utilise plant biodiversity in a sustainable manner.

In this programme training was given especially to the women folk on public health and hygiene, (based on both traditional and modern medical systems), biodiversity conservation, cultivation and sustainable utilisation of plants including medicinal plants and lesser known fruits and vegetables. The programme emphasised the nutritive, preventive, promotive, corrective and curative properties of plants with a view to combat common ailments through the administration of home remedies.

There were several key steps in the approach used for the Herbs for All and Health for project. These steps included:

1. Undertaking an awareness campaign in the village on conservation, cultivation and the sustainable utilisation of local biodiversity.
2. Selecting a core group of 10 members from each village.
3. Developing and conducting a Trainers Training Programme where training is imparted to the core group members in:

    - general awareness on public health and hygiene
    - conservation of biodiversity
    - cultivation and propagation of medicinal plants
    - cultivation and propagation of lesser known wild edible fruits and vegetables
    - the sustainable utilisation of medicinal and edible plants
    - practical training in the preparation of home remedies for primary health care.
4. Each trainer then in turn trained 20 families in their own village, therefore 20x10 = 200 families per village were trained.
5. Evaluation of the project.

In conclusion, it is the collective responsibility of individuals, families and governments to ensure the health security of members of the community. The staff at TBGRI have recognised the importance of continuing, and supporting, the teaching of traditional Indian medicine to ensure the health and well being of their local communities and the maintenance of biodiversity. The Herbs for All and Health for All project provides a excellent model for botanic gardens so that they can play an important role in educating people about the sustainable utilisation of the local biodiversity for health care and income generation.

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THE USE OF STORYTELLING IN COMMUNICATING THE VALUE OF MEDICINAL PLANTS

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Aim

The workshop aimed to provide an opportunity to share ideas on the use of traditional storytelling in botanic garden interpretation programmes.

Objectives

- to focus on stories relating to medicinal plants
- to give delegates an opportunity to share stories
- to discuss how best to use these stories in the delegates own programmes.

Introduction

Why Use Storytelling as Part of an Interpretation Programme?

For the purposes of this workshop the definition of storytelling used is:

> …the art or craft of narration of stories in prose and/or verse, as performed or led by one person before a live audience; the stories narrated may be spoken, chanted, or sung, with or without musical, pictorial, and/or other accompaniment, and may be learned from oral, printed or mechanically recorded sources; one of its purposes must be that of entertainment…
> (Pellowski 1977, p15)

The stories I prefer to use are traditional myths, legends and fairy tales.

The nature of traditional folktales from many cultures lend themselves well to introducing discussion on the value of plants in our everyday lives. This is particularly relevant when communicating the value of medicinal plants.

Stories have always been a part of our lives. Early examples of tales transmitted via an oral tradition show that story has been used to:

- spread and reinforce belief

- educate
- make work move more swiftly
- entertain
- satisfy our need to explain the surrounding physical world.

Astonishing continuity of medicinal plant usage is evident throughout the world. Transmission of information on the use of medicinal plants has been an important part of the oral tradition. Shamans, witch doctors and medicine men have been and, in some cultures still are, living repositories of this medical knowledge (Griggs 1997). The nature of this information could be seen as magical, sensitive and secretive. There is huge variety in the ways that this information was/is passed on. Story can certainly be seen as part of this process.

I come from a culture which today places little value on its oral tradition. Where this survives it is mostly in the printed collections of folktales which are still read to children. Even from this culture there is evidence of plant motives in stories which would have originated from this early need to explain our world and pass on this information.

The use of storytelling in botanic gardens is particularly relevant today. As Dr Pushpangadan highlighted in his keynote address during this congress the enforcement of international legal instruments such as Trade Related Intellectual Property Rights places responsibility with botanic gardens to ensure their observance. It is becoming increasingly important that traditional, oral knowledge is documented and inventoried. Recording the oral tradition in this way changes the way in which it is transmitted. I believe that we must be careful not to lose the human context in which this knowledge has survived up to now. Continuing to use this form of oral transmission is the perfect way to inform and entertain.

Mr G. Hariramamurthi pointed out in his congress presentation that 70% of the population of India rely on folk medicine in their daily lives and yet the continuity of even this tradition is being lost with very few people under 40 involved in the process of passing on such important knowledge.

This workshop provided an opportunity to explore this process and see how we can make use of an ancient tradition as we move into the new millennium.

A Story

Three Snake Leaves

A version of the Three Snake Leaves (after Grimm and Grimm, ed. Luke 1982) was told to illustrate how the plant motive survives within this story from the European tradition. It was proposed that the snake leaves may refer to yarrow. Yarrow (*Achillea millefollium)* is also known as the adder's tongue in many parts of Scotland. Its traditional application in the healing of wounds, in the treatment of flu and other fevers and to staunch bleeding is

evident from this story. Yarrow has had relatively little research attention given the wide variety of traditional applications (Griggs 1997).

THE USE OF STORYTELLING AT RBG KEW – CURRENT PRACTICE, FUTURE POSSIBILITIES

The Schools Education Programme routinely use storytelling techniques as part of their teaching practise but for the purposes of this workshop the focus was on how storytelling has been used with family audiences at a series of special events. The aim of these events was mostly to increase visitor numbers and revenue, however an element of Education by Stealth, as recommended by Dr Ian Darwin Edwards in his workshop, was possible at these events.

During the 1999 Orchid Festival, weekend entertainment aimed at families was provided to compliment displays in one of the conservatories. Developing the festival theme Orchids, Plants of Myth and Mystery a series of vampire inspired stories were told in an area which also featured a photographic display of the *Dracula* genus of Orchids. Very simple links were made through these stories to the herbarium and work of past scientists on this genus. The activities were popular and on many occasions over subscribed.

Over the first May bank holiday in 1999 a new event called Bluebells and Broomsticks was extremely popular. This celebration of woodland crafts in an area which was resplendent with bluebells in flower created the perfect environment for family entertainment and storytelling. This time the simple themes woven into the stories were the value of rural crafts and the importance of plant conservation. At times the aircraft traffic reduced sufficiently to allow us to hold these sessions outdoors meaning that we reached high numbers of visitors.

On a similar theme the format to the annual Woodland Skills Day at Wakehurst Place (a satellite garden of the RBG Kew) was changed slightly in 1999. We were able to include two storytellers who themed stories to the crafts displayed by visiting exhibitors and linked these to plants to be found at Wakehurst Place. Again the outside setting allowed for quite large audiences.

In addition to this, there have been some collaborative projects with the Friends of RBG Kew. In this instance storytelling has been used to provide an additional benefit to members who participate in summer children's activities. The educational emphasis was very understated in this case as the aim of these activities was to have fun.

Future possibilities for the use of storytelling as part of events and the interpretive programme looks promising as RBG Kew starts to develop a series of seasonally themed events. These will have the main aim of increasing visitor numbers but the themes will be strongly linked to the scientific work and collections of the organisation. Particularly exciting is the possibility of a Planthunters event.

HOW DO/COULD DELEGATES USE STORYTELLING IN THEIR PROGRAMMES?

The final part of the workshop enabled delegates to discuss how they use story in their own programmes. The following ideas for future activities were put forward:

- a collection of anecdotes from the local community of how they use medicinal plants;
- participatory exercises such as personification i.e. speaking for the trees;
- stories which relate to selected plants;
- reviving rituals, customs and festivals which relate to plants;
- a storyteller situated in a strategic position telling tales to anyone who was passing;
- creating new/contemporary stories which relate to plants using traditional frame stories; and
- presentations of epic tales.

There was a great deal of story sharing and some of the favourite tales which came out were:

- Popeye and his love for spinach
- Queen Hatshepshut's plant collecting expedition
- Zeus' tears
- Amaranth – the food of the gods
- Fly agaric and its use by the Vikings
- Frankincense and myrrh
- Vishnu's two wives
- Hanuman and the mountain.

Recommendations

Storytelling is a very appropriate technique to include in the interpretive programmes of botanic gardens. By keeping oral traditions alive and providing information in an entertaining and human context we make plants and their science more accessible to our visitors.

As always when faced with a room of storytellers links were made and tales woven, if we strayed from our emphasis on medicinal plants it was only to become wrapped up in the pleasure of talking about plants in general. If those who are delivering programmes are able to get absorbed in the material and gain pleasure from it themselves the experience for our visitors is likely to be more effective.

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USEFUL STORYTELLING RESOURCES

Internet Resources

Allan Davies is currently working on an Internet project called the Plant Storybank Project. He can be contacted on storybank@story.freeserve.co.uk

www.wolfenet.com/~allison/
The Healing Heart Project is an American initiative with advice for novice storytellers, some tales (though none are currently plant focussed) and an opportunity to contribute to the project.

Useful Books

These are really just a few favourites:
Chevallier, Andrew (1996) *The Encyclopedia of Medicinal Plants.* Dorling and Kindersley, London. ISBN 0 7513 0314 3
Evert Hopman, Ellen (1992) *Tree Medicine, Tree Magic*. Phoenix Publishing Inc., Washington, USA. ISBN 0 919345 55 7
Griggs, Barbara (1997) *New Green Pharmacy.* Vermillion, Random House, London. ISBN 0 0918 1461 8
Grimm, Jacob and Wilhelm, trans. David Luke (1982 edition) *Selected Tales.* Penguin Classics, London. ISBN 0 14 044401 7
Howkins, Chris (1995) *Daisy Chains – Plants of Childhood*. Chris Howkins, Addlestone, England. ISBN 0 9519348 8 0
Jarvie, Gordon (1997) (ed) *Scottish Folk and Fairy Tales*. Penguin Popular Classics, London. ISBN 014 062206 3
Mabey, Richard (1996) *Flora Britannica*. Sinclair Stevenson, London. ISBN 1 85619 377 2
Pellowski, Anne (1977) *The World of Storytelling*. R. D. Bowker Company, New York & London. ISBN 0 8352 1024 3
Vickery, Roy (1995) *A Dictionary of Plant Lore*. Oxford University Press. ISBN 0 19 866183 5

Useful Organisations in the UK

The Society for Storytelling
PO Box 2344, Reading, RG6 7FG, U.K.
Tel. +44 (O)118 935 1381

The Folklore Society
University College London, Gower St, London, WC1E, U.K.
Tel. +44 (0) 20 7 387 5894

Emerson College
Forest Row, E. Sussex, RH18 5JX, U.K.
Tel. +44 (0)1342 822 238
Fax. +44 (0)1342 826 238
Email: mail@emerson.org.uk
Website: www.emerson.org.uk

New Trends in Science Education

CHALLENGING AND CHANGING WAYS OF KNOWING IN SCIENCE AND SCIENCE EDUCATION

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A radical change in the way we view science and science education is needed if we are to meet the social, environmental and educational challenges of the 21st century.

Modern science has long viewed nature as an object to be dominated and controlled. Science itself was seen as a set of objective knowledge existing independently of people. Our teaching of science has reflected this philosophy by seeking to transmit to students an accepted body of information established previously by others.

A new ecological science has emerged which recognises the dynamic and subjective nature of science. This holistic view, which sees all things as interconnected, is congruent with changing approaches in science education. These approaches are inquiry based, encourage students to take responsibility for their own learning, and describe knowledge as being constructed when students form their own interpretations of evidence presented to them.

THE NATURE OF MODERNIST SCIENCE

The role of science in shaping the modern world view has been substantial. By looking at the historical development of modernist science we can begin to understand its role in shaping our unsustainable industrial world view.

Modernist science arose from the work of 16-17th century scholars such as Bacon, Descartes and Newton. These natural philosophers believed in a logical and ordered universe that could be controlled rationally by people. Plato had influenced their ideas of universal truths and they believed that only scientific knowledge represented truth. Others, such as Laplace in the 18th century, later reinforced their ideas of a mechanical world controlled by men. In the late 19th century, the belief that science was neutral and objective was at its height and further contributed to the status of modernist science.

The basis of this modern scientific world view is that the universe was seen as a machine governed by universal and unchanging laws, which function in a stable and orderly way that can only be comprehended by scientific intelligence. This machine theory developed along with the rise of the factory civilisation where science, technology and mathematics

were celebrated as vehicles of progress. Becoming the new foundation of knowledge and value they replaced God as the key to unlocking the mysteries of the universe.
The modernist scientific way of knowing is characterised by:

- Reductionism - seeing things only in terms of their mechanistic parts;
- Objectivism - claiming science and scientists are objective, neutral and unbiased;
- Determinism - asserting that time is reversible and thus all future events can be accurately predicted; and
- Dualism's of mind/body, subject/object, humans/nature.

Scientific development was, and largely still is, seen in terms of technological progress with little regard for the social and environmental consequences of this so-called advancement. Peoples who did not subscribe to this movement were seen as primitive, inferior and uneducated and were ignored, marginalised and colonised. Traditional knowledge such as herbal medicine and indigenous land management practices were considered questionable and inefficient. The knowledge of many cultural groups and indigenous peoples were dismissed as unreliable and unscientific despite the fact they had been proven to be socially and environmentally sustainable over thousands of years.

The criteria for establishing the objectivity and rationality of science, however, are being challenged by scholars of science, philosophy, mathematics, sociology, cultural anthropology, and literary and critical theory (Duschl and Hamilton 1998; Taylor 1998). Under attack is the extent to which science can lay claim to being an objective and rational way of knowing about the natural world and the idea that science is an activity that leads to an accumulation of truth by following the scientific method (Duschl and Hamilton 1998).

Modernist science is also under siege in the public sphere. People are becoming disenchanted with science and beginning to perceive technology as its evil twin (Stinner and Williams 1998). People are returning to alternative and traditional medicine, buying organic food, questioning the safety of scientific advancements and demanding information and controls on developments such as gene technology. They have seen the negative results of scientific advancements in their polluted and degraded cities, farms, oceans, rivers and forests. According to Stinner and Williams (1998), another cause of people's disenchantment with science is the perception of science as being arrogant, all knowing and beyond the comprehension of the average person.

THE NATURE OF NEW SCIENCE

The nature of the new science or post-modern science is such that it rejects modernism, seeing its expression in science as inherently repressive. Breaking from the mechanistic, objectivistic and deterministic world view of modern science, new science has been defined as an ecological science, viewing nature, people and their relationships in a holistic manner (Prigogine and Stengers 1984).

This move towards holism, now being attempted in western traditions, is being assisted by the new dialogue between post-modern science and social theory, not to mention renewed interest in and value given to eastern philosophies and indigenous wisdoms. Proponents of holistic education view this movement '... from the mechanistic industrial age to a global, ecological age...as part of a larger transformation of science in western civilisation' (Gang 1990). Many argue that this transformation is vital (Tofler cited in Prigogine and Stengers 1984, Shiva 1989, Gang 1990 and Griffin cited in Best 1991). As Shiva says, 'A science that does not respect nature's needs and a development that does not respect people's needs inevitably threatens survival' (1989).

Although shaped by many scientific and social influences, a new science has emerged largely as the result of three major developments in the field of physics. These developments in thermodynamics, quantum mechanics and chaos theory have systematically discredited the basis upon which the modern scientific world view was built. Not only are Descartes and Newton unfashionable, but some of their theories which have shaped and dominated our industrial world view have been proven to be false, by the very science that embraced their ideas - physics. A very brief historical overview of these developments demonstrates that these changes have been a long time in coming.

In 1811 Fourier advanced what later became known as the first law of thermodynamics, which stated that energy cannot be created or destroyed but moves from available to unavailable states. His research, which won him acclaim at the time, rejected two long held Newtonian concepts. These developments were augmented 41 years later by Thompson whose research supported Fourier's findings and went on to suggest that energy was increasingly being lost from systems. This notion of energy loss became known as the second law of thermodynamics, although it is also referred to the law of entropy (Best 1991).

The next development which cast doubt on Newtonian physics was the rise of quantum mechanics, which proved that some of Newton's theories do not work at all in the microscopic world. Perhaps quantum mechanics' greatest contribution to the debunking of modern science is its rejection of objectivity and so called scientific detachment.

Whereas quantum mechanics exerts its influence in the microscopic world, chaos theory, the third component of the new science extends into the microscopic world and to physical processes in general. Emerging in the 1970s, chaos theory itself has three concepts that together form the basis of new science's most recent and popular treatise. These are Lorenz's strange attractors, Mandelbrot's fractals and Prigogine and Stengers' concept of dissipative structures. Each of these chaotic concepts proposes that reality is dynamic, complex, random and unpredictable.

New science has disproved many of the precepts of modern science and so it is reasonable to assume that new science could assist in shaping a new world view. Beliefs emerging from post-modern science advocate making fundamental changes in the modern value base,

which includes transforming prevailing concepts and replacing inappropriate processes. For example, new science asserts that:

- things should be viewed holistically
- diversity is desirable
- resources are finite
- energy is running down
- time is irreversible
- the world is dynamic
- science is subjective rather than objective
- science does not have all the answers.

THE NATURE OF MODERNIST SCIENCE EDUCATION

According to Taylor (1998) education has been governed largely by a modernist view with educational reformers attributing many of the ills of education to the legacy of modernist science. Science teaching itself is often characterised by a reductionistic approach (Allchin 1998) and teachers are seen as trainers rather than educators, reinforcing a deterministic culture of social reproduction and conformity (Taylor 1998).

Teacher dominated classrooms that rob students of their agency as learners persist. Teachers present scientific knowledge through lecture, text and demonstration. They maintain responsibility, authority and control. Competition is supported and working alone is often advocated and modelled.

The modernist science curricula trivialises students' beliefs and experiences and focuses on the acquisition of scientific facts and information which are tested at the end of the unit or chapter. When practical activities are included in these science classrooms, their purpose is to confirm rather than stimulate inquiry.

CHALLENGES TO MODERNIST SCIENCE EDUCATION

Science education requires new perspectives and a new way of viewing science itself. Fortunately a widespread acceptance of alternatives to objectivism has been developing (Tobin 1993). These alternative ways of knowing include constructivist, critical and feminist perspectives.

According to Fensham (1992) the most conspicuous psychological influence on curriculum thinking in science since 1980 has been the constructivist view of learning. Constructivism

has developed many forms and become so popular that many in the education community have not only incorporated it into teaching method, learning theory and curriculum development, but they also have adopted a constructivist epistemology or way of knowing and a constructivist account of the nature of science (Matthews 1998).

A constructivist perspective views students as active constructors of knowledge and recognises the problematic role of students' prior knowledge in this process. It recognises the importance of students expressing their ideas and negotiating solutions to problems and investigations (Taylor 1998). Importantly constructivism also recognises that the final responsibility for learning lies with students. Their learning outcomes depend on the knowledge, purpose and motivation they bring to the classroom.

However while constructivism can provide teachers with a powerful perspective for taking account of students' own ways of making sense of their experiences of the natural world it can be relativistic. Some educators view this as a weakness and argue for an ethical grounding. Allchin (1998) suggests that the teaching of ethics and values is congruent with constructivism because it is not centred on teaching specific content, but rather on engaging the students in exploring values and demonstrating a process for discussing them collectively. He suggests that learning the questions in scientific inquiry might be more important than learning specific answers.

Taylor (1998) on the other hand argues that constructivism should be tempered with critical perspectives that promote '…culturally transformative teaching practices based on emancipatory principles of intellectual autonomy and social justice'. By linking constructivist theory to the critical theory of Habermas, Taylor proposes a critical constructivism which '…offers an ethical basis for regulating the discursive practices of knowledge construction'. He goes on to suggest that more than cold reason is needed and that feminist perspectives with concern for ensuring the quality of educational opportunities are necessary in order to adopt what he calls an 'ethic of care'.

DEVELOPING A COMMUNITY OF INQUIRY IN THE SCIENCE CLASSROOM

Many educators have developed practical strategies based on constructivist and critical pedagogies. In these approaches active inquiry is predominant while cooperative learning and metacognition are valued and practised. Integration across science disciplines and with disciplines outside science (such as history and philosophy) is also valued. Students have more responsibility for their learning, negotiating shared control over the planning, conduct and assessment of classroom learning activities. Opportunities for scientific discussion and debate are provided in a classroom community based on cooperation, shared responsibility and respect.

Active inquiry emphasises process as well as product, moving away from the acquisition of facts to the development of understandings about concepts and generalisations. This approach develops students' investigative and thinking skills and contributes to their ability

to participate effectively in society. It can also contribute to enhancing self-esteem by encouraging students to take responsibility for their own learning.

Learning is viewed, as active construction of meaning and teaching as the act of guiding and facilitating learning. This approach doesn't exclude direct teaching, which is particularly important for the development of skills both within and outside an inquiry. It does however challenge teachers to learn alongside students, handing as much control as possible over to them. Making the inquiry models used in the classroom explicit to students assists them to exercise control over their investigations and make choices about their directions.

This approach is successful because it recognises that '…in the final analysis meanings must be constructed for oneself' (Splitter 1989). This process of constructing meaning requires dialogue and it is dialogue that is at the very heart of the community of inquiry; a genuine, structured and mutual dialogue that demonstrates respect for one another. According to Lawrence Splitter, a key figure in the Philosophy for Children movement, a community of inquiry:

…describes any number of persons who are engaging in the complex business of building on each other's ideas, taking intellectual risks, encouraging self-correction, accepting responsibility for their own beliefs, values and actions, exploring the "hard" questions in ways which are both open-ended and well-structured, and throughout adhering to the PRP [principle of respect for persons].

(Splitter 1989)

A major feature of the community of inquiry is that the students identify the issues to be explored and that the role of the teacher is to facilitate. Of course the teacher needs to guide the students in the ways of inquiry. As Cam (1995) says, 'If the children are to learn how to run their inquiry, they need to be taught...Knowing how and when to 'pass the reins' or to take them back is every bit as important as knowing your way around in inquiry'. Developing a community of inquiry takes time and patience especially if students are not used to taking responsibility for their learning. However as De Hann, MacColl and McCutcheon (1995) explain, it is '…time and patience well invested'.

There are a number of skills that can enable students to participate successfully in the inquiry process. Two of these, that are very important but often overlooked, are asking questions and discussing. Using narrative to engage learners is also an under utilised strategy in science classrooms.

Asking questions

Central to inquiry learning is knowing how to ask and answer questions. If it is true that the questions we ask often determine the answers we get; then we need to know how to ask good questions. To be effective questioners, students need to be aware of the types of questions they ask. Making the purpose of different types of questions explicit helps students to frame their questions appropriately.

Even very young children can be aware of and ask different types of questions. But whether students are very young or much older, two things will assist them to frame appropriate questions. Firstly, teachers need to regularly model the framing of different types of questions in classroom. Secondly, teachers need to provide appropriate contexts for students before inviting them to ask particular types of questions. When students are engaged with a subject, it will be easier for them ask questions about it. The stimulus could be derived from an actual or fictional event, person, story or phenomena. In the classroom context students are used to having to answer questions posed by the teacher rather than asking questions themselves, so it may take awhile for some students to get used to the idea.

Discussion

Many teaching and learning materials have activities that direct teachers and students to discuss a question, issue or topic in pairs, small groups or as a whole class. Whilst classroom discussions can contribute significantly to the inquiry process, by developing thinking skills, values and conceptual understandings they can also be very frustrating for both student and teacher. This frustration often leads to abandonment of the discussion process. There is a qualitative difference between talking and discussing. Effective discussion, for example, requires active listening which is not necessarily present when people are talking to each other. The discussion process includes skills that need to be taught in much the same way reading is taught to young learners. Patience is necessary, for just as a young child doesn't learn to read in a day, a twelve old who hasn't learnt the skill of active listening will need time and practice to master the skill.

Attention to three things will greatly enhance discussions in the classroom; these are:

1. setting ground rules for group discussion;
2. knowing how to ask questions in a discussion; and
3. being aware of group dynamics during a discussion.

Conflicting ideas about how a discussion should operate can cause frustration in a group. It is important therefore to negotiate a set of rules that everyone can agree to in principle and try to uphold in practice. Teachers can ask students to list the behaviours that contribute to a good discussion or provide a list and invite students to modify it (Figure 1). Following the guidelines will be more difficult for some students

1. We sit in a circle so everyone can see and hear each other.
2. Everyone's contributions are equally respected.
3. We listen to each other.
4. We speak in turn.
5. We cooperate with each other.
6. We encourage others to participate.
7. We can agree to disagree.
8. We build on each other's ideas.

Figure 1: Sample ground rules for group discussion

than others but practice and encouragement from teachers will hasten co-operation. Inviting students to assess their own and the group's discussion behaviour can also be productive.

Students may often not know how to create and sustain dialogue in a discussion. Instead, they jump from one idea to another in a disconnected way without really exploring the ideas offered. The questions below (Figure 2) come from the tradition of philosophical inquiry. They encourage active listening, rigorous reasoning and building on each other's ideas.

Focus
What is it that puzzles you?
What did you find interesting?

Clarification
I didn't quite understand you.
Could you explain it to me?

Reasons
Why did you say that?

Connections
Is that like what X said?
It sounds like you agree/disagree with X.
Is that right?

Distinctions
How is that different from what X said?

Implications
What can we work out from that?

Assumptions
What have you based that on?

Testing
How could you work out if that was true?

Information gathering
What do we know about that?

Examples
Can anyone give me an example of that?

Counter-examples
When wouldn't that happen?

Consistency
Does that agree with what was said earlier?

Speculation
Can anyone think of how that might have happened?

Relevance
How does that help us?

Alternatives
How else could we think about that?
What if someone said...?

Summarising
Where have we got to?
What have we found out?

Listening strategies
Am I right that you said....?
Tell me if I'm wrong, but I think you said...
Is that right?

Participation
What do you think about this?
What do others think?
Who agree? Who disagrees? Why?

I'm not the expert here
I'm not sure.
I don't know. What do you think?

Source: De Hann, MacColl, and McCutcheon 1995

Figure 2: Questions that promote dialogue

Asking questions such as these is a skill that requires practice. However, students will adopt this language of dialogue with encouragement from, and modelling by, their teachers. Reproducing these sample questions on charts enabling ready reference during discussions may also be helpful.

If unhelpful group behaviour persists during discussions it can be useful to bring students' attention to the behaviour through an activity other than a lecture. There are many activities that can assist students to identify and practice positive discussion styles. Reflecting on the discussion process, either as a class or individually, is a useful process in itself. It enables students to congratulate themselves on their productive behaviour and remind them of areas that require improvement.

Using narrative

Stinner and Williams (1998) propose that science education must be comprehensible and meaningful to most students, reflective of the nature of science and based on sound scientific principles of teaching and learning. They advocate the use of narrative to engage students in the inquiry. They are not alone advocating this approach. The Philosophy for Children movement use narrative because of its ability to engage the affective domain of students. Splitter and Sharp (1995) maintain that, '…how one feels about a topic or problem is no more and no less important than how one thinks about it'. Cam (1995) says, 'Narrative is a very powerful stimulus. It engages with children's emotions, attitudes and values, and appeals to their imaginations'. Stinner and Williams, working with students and student teachers, have developed science stories with historical contexts. These narratives they argue can be used to build bridges between science and the humanities, by '…bringing to life real people engaged in real science and in the context of their times'.

Developing a community of inquiry in the classroom has many benefits including improved thinking and discussion skills. Students come to value one another as individuals, challenge ideas through discussion and accept responsibility for their own views. MacColl (1992) notes that students engaging in a community of inquiry, '…improve in reading comprehension, conceptual understanding, articulating questions, giving reasons, making logical connections, drawing inferences, considering other views and making judgements'. Importantly a number of writers and practitioners also report that self esteem can also be enhanced in this process. Wilks (1993) says, 'Because the exploration and reflection occurs within an encouraging atmosphere, the self-esteem of many members of the class is improved'. Splitter and Sharp (1995) talk about the ultimate benefit of using philosophy for children and the community of inquiry in our schools:

> We remain convinced that when it comes to protecting our children from harm and instilling in them a sense of hope and concern for the future, our best prospect lies in providing for them opportunities to think and talk about important issues in an environment of trust, care and respect, such as provided by the community of inquiry.

RESISTANCE TO CHANGE

Changing science education practices are likely to be met with resistance from both teachers and students. For change to take place educators need to reflect critically on their own teaching and learning experiences and consider the impact of any changes they make on students who may be very comfortable being passive learners.

Encouraging students to take more responsibility for their learning is problematic for some teachers and students. Some teachers resist handing over control and some students resist accepting it. Clearly, students require a great deal of explanation, skill development and modelling at first. This scaffolding can be reduced as students develop expertise. But as Brophy and Alleman (1998) suggest, '…students cannot learn self-regulation if the teacher continuously cues and directs their learning activities'. They go on to say that if '…developing self-regulation is taken seriously as a goal, students must be taught the cognitive and metacognitive skills needed to function as autonomous learners'.

An abrupt transition to critical self-reflective thinking can result in confusion, despair or at times hostility towards seemingly counter-productive teaching methods (Taylor 1998). Instead a gradual change in a supportive environment where experimentation and reflection is encouraged is more sustainable. Exposure to resources and learning opportunities broadens teachers' awareness of the possibilities for change and evidence of new methods working in classrooms builds confidence as does working in a team.

When some comfort is achieved with new strategies, teachers might try reorienting a familiar unit of work. The inquiry could be wholly teacher directed giving` the teacher an opportunity to become familiar with the process. Students will also benefit from being aware of the structure of the inquiry. Later when teachers and students are more familiar and comfortable with the process, the teacher can facilitate more, increasingly handing control of the inquiry over to students. For the teacher (and student) deciding to learn and try something new, however small the first step, can be a positive and sustainable choice.

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STRATEGIC IMPORTANCE OF SCIENCIFIC EDUCATION FOR THE BOTANIC GARDEN OF THE CITY OF PARIS

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INTRODUCTION

In 1995, the Green Spaces Department of the City of Paris decided to create a botanical garden using four sites which were traditional public gardens: the Garden and the Greenhouses of Auteuil, the Park of Bagatelle, and the Floral Park and the School of Horticulture of Du Breuil. The global strategy that has been followed was explained at the Botanic Gardens Conservation International Conservation Congress in South Africa in 1998. To summarise, the first step was to analyse the pre-existing assets and to compare them to some other famous botanic gardens; benchmarking. After this, objectives were determined as well as means to fulfil them identified. Throughout this process the charter of the French Speaking Botanical Gardens Association was used as a guideline. The purpose of this presentation is to illustrate the importance of scientific education in the Botanical Garden of the City of Paris and highlight what has been achieved in this field.

The characteristics of this botanical garden will first be explained and its strategy will be presented in relation to the charter of the French Speaking Botanical Gardens Association. Following, the positive and negative aspects of scientific education, as they existed in 1994, will be presented. Human resources were a prerequisite for good educational activities and achievements since 1994 will be highlighted. Lastly, the education strategy will be outlined and illustrated using examples and the conclusions will address future propositions.

THE BOTANICAL GARDEN OF THE CITY OF PARIS

The botanical garden is made up of four sites:

1. to the west of Paris is the 6.5 hectare Garden and Greenhouses of Auteuil which was built in 1898 and has 4060 accessions;

2. the Park of Bagatelle with 2730 accessions was built in 1777 on 24 hectares;
3. to the east of Paris, the Floral Park with 5960 accessions was built in 1969 on 31 hectares; and
4. the School of Horticulture of Du Breuil and its arboretum, with 2220 accessions and numerous educational plant collections, was built in 1936 at its new location on 22 hectares.

The botanical garden is a horizontal structure inside the Green Spaces Department of the City of Paris. A specific software has been developed for the botanical garden which works on a local network (an intranet) and which complements the second version of International Transfer Format (ITF). Since 1995, a seed bank, herbarium and a fruit and seeds collection have also been created. The botanical garden was recognised by the French Speaking Botanical Gardens Association in 1998.

The French Speaking Botanical Gardens Association[1]

The French speaking botanical gardens association states that a botanical garden must undertake education, scientific activities and conservation projects. To summarise, the overall goal is to combine these three areas and take into account the botanical garden's historical tradition in horticulture and its limited budget.

ANALYSIS OF THE PRE-EXISTING SITUATION

Positive Aspects in Education

The first step for the Botanical Garden of the City of Paris was to analyse the pre-existing situation. From an educational perspective there were two main assets: firstly the school of horticulture, whose quality of courses is well recognised, and which also has a library with more than 11 500 references; and secondly the education service of Paris-Nature catering for children between 5-12 years old. Paris-Nature was created in 1983 and aims to:

- communicate to Parisians of all ages and to teach them about fauna, flora, water, air, soil and their environment; and
- teach the community to observe, love and protect their environment; these successive stages in the educational process are necessary to respect nature and bring about a responsible attitude.

To fulfil these objectives, numerous activities have been proposed to bring a dynamism, which leads to a growing public awareness of the environment. Twelve places, each having a specific Parisian theme on nature, are connected to the parent house, placed in the Parc

[1] Association des jardins botaniques de France et des pays francophones, Place du Maréchal Leclerc, F-25000 Besançon.

Floral. The equipment is situated in different parts of the city such as the Maison de l'Air which is perched at the top of a hill (Parc de Belleville – 20th district) and the Ferme George-Ville displaying breeding and crops on five hectares (Bois de Vincennes – 12th district).

In addition, posters and brochures are developed and distributed and booklets outline details of walks in all the districts of the city. Protection actions for fauna and flora have been installed in the city such as ornithological reserves, nests for tits and owls, and plant conservatories as wild and natural gardens. Finally, exhibitions on different environmental themes contribute to sensitising the public. Ninety pedagogues conduct educational activities, led by Paris-Nature. Their priority is to target youth from kindergarten to middle school.

In all the nature houses, there are workshops with different activities adapted to each age category. For example, the House of Five Senses (13th district) caters for 5-8 year old children who discover nature by using their five senses. For the 8-12 year olds, a video-bus and a laboratory-bus aid them in exploring gardens and woods. The activities are complementary, for example in the wild garden (18th district) the children can discover natural characteristics of the city, in the gardening house (12th district) they learn how to cultivate plants, whereas in the gardening workshops (16th district) they create miniature gardens. This year, in 1999, 40 000 school children between 5-12 years old have visited the different houses and it is predicted that these houses will answer an ever growing demand.

Weak Aspects in Education

Though there are some positive key-assets, some weak aspects in education were also identified:

- human resources were not adequate for scientific education;
- there was no project for conservation and/or scientific education;
- there was no existing link with universities; and
- budgets were limited (but it is a limitation common to all of us).

All the solutions we developed in response to these points since 1994 are going to be presented.

RESPONSES TO THE WEAKNESSES IN SCIENCE EDUCATION

Human Resources

Objectives

Concerning human resources, our objective was to increase our credibility and efficiency in scientific activities, to improve our links with universities, and to produce scientific publications.

Solutions
The solution was to employ a PhD student in Plant Biology (in 1994) with field experience in plant conservation, an engineer in agronomy (in 1996), and a Professor of Horticulture with 20 years experience in education (in 1998).

Results
The main results were:

- a collaboration with universities which increases each year;
- publications in plant systematic;
- the creation of courses in botany and horticulture; and
- the development of research activities in seed physiology and in plant physiology as an adaptation to biotopes.

The botany courses created only two years ago are now overbooked. They consist of a basic level of six courses and an advanced level of six courses. There are two sessions during summer and autumn and the general public of all ages attend these courses. The main objectives of the basic level courses are to give definitions of the mains parts of plants and to enable people to develop skills in the identification of wild plants of France by using floral keys.

Strategy in Science Education

Objective
A strategy was also created in science education and conservation. The objectives were to:

- have low cost research and to undertake applied research and leave fundamental research to the university; and
- have a scientific strategy correlated with other activities of the botanical garden and with conservation (to reduce the costs of research activities).

Elaboration of a Strategy and Materials
Therefore, the scientific strategy involved the following:

- priority was given to seed physiology inside the botanical garden because it had a strong correlation with seed bank activities; and
- developing joint projects with universities for other research activities.

To fulfil this strategy, numerous other botanical gardens were visited before the creation of the seed bank, to determine on which plant species we had to focus and on which methodology was to be used for collecting, seed testing and seed conservation. Minimum equipment was bought, including three incubators and an infrared desiccator. These three incubators allowed us to conduct sound germination tests, but were also used, because of lack of room, for storing seeds. While taking into account previously published results, the

infrared desiccators allowed us to determine, with a very small quantity of plant material, the category of the seeds (i.e. orthodox seeds that are kept at 5°C with silica gel; and recalcitrant seeds that are kept at 15°C without silica gel).

EXAMPLES OF SOME RESULTS

Scientific Education Inside The Garden

Seed Tests on *Cladrastis lutea*

The first species on which studies were conducted was from the family *Fabaceae* because seeds belonging to this family only have tegument inhibition and are therefore easier to work with and could be used as a start point. On *Cladratis lutea*, the effects of temperature (5°C, 15°C, 25°C and 32°C) and sulphuric acid (5 min and 10 min-bath) were studied. At 32 °C, lethality was so high that no seed survived after 15 days. The optimal germination was obtained at 25°C after a 10 min bath in sulphuric acid.

Seed Tests on *Crambre maritima* and *Dianthus superbus*

After this first species which was quite easy to work on, other studies included the breaking of dormancy by cold treatment or hormonal applications. Research is currently being conducted in the botanical garden to determine the conditions for optimal germination of *Crambe maritima* and *Dianthus superbus*. These two species are protected under French national laws and very interesting results were obtained concerning conservation and regeneration of their seeds, even after long term storage of 10 years.

Scientific Education in Collaboration with Universities

Other studies interested the universities but had few links with the seed bank, therefore joint projects were created with these institutions. The botanical garden donated plant material, and offered expertise in botany and plant physiology. Studies, which did not concern seed physiology during the last three years, were as follows:

- water translocation in *Dionaea muscipula* in relation to leaf movements;
- hydatherous cells of *Crassula argentea* for water absorption; and
- nectar secretion in *Pseudobombax ellipticum*.

Leaf Movements in *Dionaea muscipula*

A team of undergraduate students supervised by Patrick Thommen studied the mechanisms of the closing of leaves of *Dionaea muscipula*. The different phases can be summarised by the following sequence: induction of closing after contact with the sensitive specialised epidermis cells, a fast closing after induction and a long re-opening phase.

It is well known that leaf movement is linked to a potential of action. The depolarisation phase is very fast and corresponds to the leaf closing ; the depolarisation is much longer and corresponds to the re-opening of the leaf.

Osmotic pressure also plays a role in the closing of the leaf. The number of leaves closed or opened has been correlated with the concentration of saccharose. The lower the osmotic pressure, the higher the number of closed leaves there are. The entrance of water in the leaf (lowest concentrations of saccharose) is therefore correlated with the leaf closing.

In a closed leaf, it was shown that the abaxial epidermis cells were smaller than the adaxial ones that had a greater vacuole. The hypothesis was made that closing mechanisms are due to the turgescence of cells and differential water translocation, between adaxial and abaxial epidermis cells.

Hydathodes of *Crassula argentea*

Crassula argentea is a South African plant and its natural habitat is in the desert of Karoo. The crassulescent leaves are very rich in hydatherous cells that constitute a specialised structure represented by red spots above the succulent leaf.

Cytological studies show that this structure is in a shallow crypt and that three histological zones can be described. First a stomatiferous epidermis, then hydathiferous cells for water absorption, which are contiguous, finally tracheids beneath to conduct the water to the vessels. Cells rich in mucilage surround the hydathode.

This structure is very similar to the hydathode of *Ficus diversifolia*, but the first one is used for water excretion and the second for water absorption. Both of them are specialised structures of adaptation to the natural habitats.

Extra Foliar Nectar Secretion in *Pseudobombax ellipticum*

Pseudobombax ellipticum that grows in our arid climate greenhouse was used for the study of nectar secretion in this species. Extra floral nectaries are located in two places; the first is on the leaf mid-vein and has a circular form; the second is situated on the petiole, produces a great amount of nectar and looks like a knife cut.

Histological studies show that the petiolar nectary is composed of trichomes, secreting cells beneath, and a base of mucilaginous cells and cells with oxalate of calcium crystals. There are two layers of trichome cells upon a stalk composed of two cells. Secreting cells are characterised by their opacity to electrons and by numerous organelles such as mitochondria's and amyloplasts. Secreting cells are also characterised by a well developed endoplasmic reticulum.

OTHER FACTORS CONCERNING SCIENTIFIC EDUCATION

Another weak point in scientific education was the limited contacts we had with universities. We increased them by having partnership projects as previously discussed but also by having trainees in the botanical garden. During the last three years, students have spent 48 months training. We are also participating in the updating of the systematic courses of the University of Orsay and a joint publication has been produced.

Some other publications were also written on the new ordinal classification of flowering plants according to the angiosperm phylogeny group. In these publications, the results of this group were applied to the West European flora.

To increase the links with universities, we also participate in student excursions during their course to help them discover the wild flora around Paris and we donate plant material for DNA sequencing.

CONCLUSION

During the last four years, a benchmarking process has been used to transform a traditional city garden into a botanical garden with the help of the guidelines defined in the charter of French-speaking Botanical Gardens Association. This process has been particularly successful in science education and many realisations have been achieved: courses in botany, research and science activities, increased links with universities, joint projects with universities, and scientific publications. In the future, our objective is to focus on scientific publications and on conservation projects especially in developing countries.

THE FRAMEWORK FOR CHANGE: LOBBYING FOR CURRICULUM RECOGNITION

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This workshop was developed to explore the potential for improving the integration of Education for Sustainability (EfS) issues into national science curricula for schools. Using current curriculum documentation available in the United States (US) and in Britain as case studies, the extent to which inclusion of EfS was explicit, or even implicit, was presented to participants. In Britain, the geography curriculum offers some opportunities for teachers to develop EfS themes. Here, however, as in many other countries, geography is not seen as a core subject and is not compulsory for children over the age of 14 years. The key core subjects are mathematics, english and science and are likely to remain so for the foreseeable future, nevertheless issues relating to sustainable development and environmental management within the core science curriculum are negligible.

The situation in the US is little better; although there is a Presidential Task Force developed to encourage environmental and sustainability education, the National Science Education Standards, which teachers work closely to, make little reference to sustainable development as a curriculum topic. This lack of coherent policy, coupled with strong propaganda on the part of industrial groups to promote technocentric values, has resulted in a cultural resistance to the adoption of sustainable practices. When members of the Science Faculty in Kent University, Ohio were questioned on the importance of biodiversity education and EfS, comments ranged from '…that's politics not science.' to '…you can't get money for doing that', '…our graduates won't be able to get a job in biodiversity' and '…it has no relevance to our curriculum'!

Assuming that science and technology will remain as key core components in schools education, it would make sense to engage the scientific teaching fraternity and ensure that EfS is seen as an integral element within the science curriculum. Science has much to offer for the furtherance of EfS e.g. skills for accurate observation and data collection and an understanding of both biophysical concepts and scientific processes. These elements could, along with the development of a more holistic approach to scientific understanding, help produce students who can engage in informed scientific debate. This would sit particularly well in England with the new Science 2000 group, whereby a number of science advisors are seeking to develop the science curriculum so that it will enable all pupils to be scientifically literate.

WORKSHOP FORMAT

To assist this process, workshop participants were asked to discuss and list:

- key biophysical concepts that lend themselves to the integration of EfS teaching; and
- scientific processes for EfS teaching to interconnect with.

WORKSHOP OUTCOMES

Ultimately it was hoped to develop a series of key points, statements or case studies that could be used as part of a lobbying document to science curriculum development agencies.

Following discussion, groups within the workshop adopted three different approaches:

1. Lobbying from the bottom up

One group were firmly in favour of using data gathered by the botanic garden about pupil/teacher enthusiasm and increasing numbers of students/visitors wishing to participate in sustainable living programme activities. This data could be utilised to prove the need for a more integrated approach to EfS within the curriculum.

2. Lobbying the curriculum developers

A second group listed biophysical concepts e.g. effect of environmental degradation on ecosystem services , and went on to explore both scientific processes and scientific teaching methodologies. They recorded the importance of utilising the new iterative approach to science and the importance of exploring the philosophy of science and integrating ethics and values.

The statements offered as points to integrate into the science curriculum documentation were:

'We should include EfS in science education because:

- EfS is relevant to the lives of everybody; and can engage young people actively in their schools and communities' (NB a side note here added 'read increased enrolment in science education').

- 'The world is facing environmental crises and science education has a vital role in supporting progress towards sustainable futures'.

The group suggested case studies to support these statements could be based on 'Recognition of indigenous knowledge and wisdom of people who live their lives sustainably e.g. traditional medicine and agriculture supported through partnerships between local communities and botanic gardens'.

3. Lobbying from the top down

The third group felt that it would only be worth lobbying from the top down; they felt that this was the only way one would get any significant change. To engage politicians and decision makers, they recommended that the following tactics would enable successful lobbying:

- remind people of their national and international obligations e.g. sign up to Agenda 21 and CBD;
- use the fact that the electorate is increasingly aware of the severity of the crisis;
- sell EfS as an opportunity i.e. for new technologies;
- remind them that EfS is not incompatible with educating for job opportunities and economic success;
- use the fact that the electorate is becoming 'greener'; and
- offer EfS as an integrating focus for the science curriculum.

WORKING TOWARDS A MUTUALLY BENEFICIAL BOTANIC GARDEN / UNIVERSITY RELATIONSHIP

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WORKSHOP AIM

To identify practical means of achieving a mutually beneficial relationship between undergraduate university groups and botanic gardens.

WORKSHOP FINDINGS

Rationale for Establishing a Botanic Garden/Undergraduate Relationship

There are many incentives for establishing a botanic garden/university relationship and many ways in which a coordinated undergraduate programme can be mutually beneficial:

- From the university's point of view undergraduate groups can benefit from first hand experience of living plants gained in a botanic garden. Concepts taught in the lecture room can become a reality providing an enriched learning experience. A botanic garden can provide field experience for students and access to a valuable resource and expertise.

- As botanic garden educators, visiting undergraduate groups provide us with an opportunity to promote the botanic garden's mission to future scientists, botanic garden staff and decision makers. An undergraduate programme can enable greater use of a botanic garden's resources and is further justification of the garden's existence in a broad sense. It can also increase potential numbers of visitors to the gardens, both directly and indirectly.

- A botanic garden's responsibilities under the Convention on Biological Diversity includes the transfer of information (Articles 12 and 13) to as wide an audience as possible.

- Establishing a botanic garden/university relationship can be the start of bringing a greater research element into the garden's work. It can also provide some botanic garden staff with a new dimension to their work and therefore contribute to staff development.

- A developed relationship between university undergraduate groups and botanic gardens can bring kudos to both partners.

- There may be good practical reasons for a university to visit a botanic garden such as proximity and value for money!

What Academic Subject Areas Can Botanic Gardens Contribute at Undergraduate Level?

As well as the many branches of the biological sciences and horticulture botanic gardens can provide an environment for the teaching of other subjects such as biodiversity conservation, geography, forestry agriculture, and landscaping. Also related technologies such as furniture making, food technologies, medicine as well as maths and other sciences such as chemistry and physics can all find relevance in a botanic garden.

Other less obvious subject areas include: architecture, art, design, history, anthropology, sociology, town and country planning, engineering, social work/community studies, marketing, business management and music.

Setting up an Undergraduate Programme

Establishing the undergraduate audience

In setting up a programme for undergraduates it is important for a botanic garden to define needs and undertake some form of market research to assess potential services that can be offered to universities. This type of market research will enable appropriate activities to be identified and a 'strategic fit' to be arrived at. From this an outline programme can be devised. Market research could include:

- devising a brochure of garden programme/events to show their possibilities to universities;
- developing task forces with invited representatives of potentially interested universities to meet with botanic garden staff and discuss requirements;
- hosting general open days for university academic staff;
- marketing the programme to potential sponsors and emphasising that programme participants are the next generation of decision makers and scientists; and
- publicising through existing professional organisations and networks to save time and resources.

Delivering an Undergraduate Programme
Steps include:

- conducting outreach – academic liaison (curriculum) and lectures and talks by botanic garden staff at the university to help establish the links;
- piloting the programme followed by monitoring and evaluation before devising the final programme;
- undertaking joint initiatives e.g. an internet site, community project research;
- providing academic credits or placements;
- conducting initial training days for university staff in how the botanic garden could be used (this is an ideal way of reaching the undergraduate audience without putting additional long-term demand on botanic garden staff e.g. the time and effort involved in putting on one session for 10 tutors could mean the possibility of 10 university groups coming for years to come);
- conducting activities in garden e.g. lectures, guided tours, study materials, practical activities and demonstrations;
- using other media e.g. interpretation boards/labels, museum type exhibits, information leaflets, signs, written programmes, CD Rom, leaflets, pamphlets, videos and sheets/handbook (photocopiable resources plus others that require adaptation by lecturers themselves);
- developing and conducting short term specialised training for students according to their requirements; and
- developing and conducting refresher courses once the programme has been established.

Organisational issues to consider
There are several organisational issues to consider:

- the impact on botanic garden staff;
- timing is critical: what is the availability of tutors to attend in term time? outside term time?
- consider running courses in the long vacation (India: April – May);
- networking with other botanic gardens using existing regional networks and BGCI and other organisations (e.g. museums) to pool resources and integrate programmes; and
- finance issues need to consider: whether to charge the universities or not; when universities in the region set their budgets; if finances permit, consider sub-contracting guide-lecturing to outside lecturing staff (who are perhaps retired and/or freelance); investigate sponsorship possibilities.

Evaluation
As with all education programmes, evaluation is an essential part of effective delivery. Some possibilities include:

- recording how many students/groups are coming;
- implementing an evaluation questionnaire;
- monitoring follow-up queries and repeat visits;
- setting up a data base of annual figures and reviewing it annually i.e. number of visits, tutors trained, etc; and
- monitoring the number of visits to the web site.

CONCLUSION

There is much scope for maximising undergraduate use of botanic gardens (of all sizes) to benefit both the garden and university. This need not overburden existing botanic garden staff. Although there may be a fair amount of work in setting up a programme, once a system has been established there can be significant mutual benefit with an end result of 'more for less'.

NOURISHING DECIDUOUS BIODIVERSITY

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Our common indigenous wild trees possess flamboyant foliage and handsome flowers, yet they are not given priority in parks, gardens, avenues, urban streets, human habitations and industrial estates. Greedy people from the urban environment have invaded our deciduous forests and plundered our biodiversity. Humankind has often missed the opportunity to behold the beauty of nature.

With a view to encouraging appreciation of the wealth of the last remnants of our deciduous floristic elements, now is the time to nourish deciduous biodiversity in vast areas of the Indian subcontinent. Some other tree species with a very wide geographical range may not be indigenous, but they have nicely adapted to Indian conditions and are rated as naturalised.

This presentation is an attempt to typify harmonious relationship between people and nature. We are committed to the Convention on Biodiversity (1992) and have an obligation to conserve our biodiversity.

We wish to highlight some of the most conspicuous flowering plant species observed in our field studies in the Panchmahals (western India), during different months over a period of three years (Pandya and Oza 1998). Inculcating biodiversity events of the year (a flowering calendar), in our lifestyle, we shall serve the cause of Indian philosophy and culture, and thereby promote the protection of the disappearing deciduous trees. Such trees in our environment shall signify monumental sanctuaries attracting a great diversity of birds to lend music and colour at our doorstep. Hence, the authors appeal to the legion of nature lovers to bestow utmost priority in afforestation endeavours, both in the wild and urban environments, to the following species:

January
Ailanthes excelsa (India) Moto arduso; *Buchanania lanzan* (India) Charoli*; Ehretia laevis* (As. and Aus. trop.) Tamburiyo; *Phoenix sylvestris* (India) Khajuri; *Streblus asper* (As. trop.) Harero, Kharoti.

February
Alangium salvifolium (As. trop.) Ankol; *Boswellia serrata* (India) Gugal; *Butea monosperma* (Indo malaysia) Khakhro, Khakhar; *Cochlospermum religiosum* (India) Ganyari; *Firmiana colorata* (India) Kodar, Paroli; *Garuga pinnata* (India) Sota kankadio; *Holoptelea integrifolia* (India) Oro, Charal; *Lannea coromandelica* (India, Burma) Moino; *Spondias pinnata* (As. trop.) Khatimbo, Khatumbdo.
March
Artocarpus gomezianus (India) Khatumbi; *Bauhinia racemosa* (Malay,
China) Asatri, Asitro; *Bombax ceiba* (Am. Aus.) Shimdo; *Borassus flabellifer* (India) Taad; *Emblica officinalis* (As. trop.) Aamri, Amala; *Erythrina suberosa* (India) Karvinchlo; *Gmelina arborea* (India, Malaya) Shivan, Shevan; *Madhuca longifolia* (India) Mahudo; *Schleichera oleosa* (India, Malaya) Kosimb; *Sterculia urens* (India) Kadai, Kadayo; *Tecomella undulata* (India) Ragat rohido; *Wrightia tinctoria* (India) Kado.

April
Aegle marmelos (India) Bili; *Cassia fistula* (As. trop.) Garmalo; *Crataeva nurvala* (Trop.) Vayvarno, Doyali; *Dillenia pentagyna* (India) Gadh saag; *Dolichandrone falcata var. lawii* (India) Netarshindi; *Holarrhena antidysenterica* (As. trop.) Indrajav; *Miliusa tomentosa* (India); *Soymida fabrifuga* (India) Rohido; *Syzygium cumini* (India) Jambu.

May
Albizia odorratissima (India) Sarasdi, Chicholio; *Anogeissus latifolia* (India) Dhaodo; *Dalbergia latifolia (*India) Shisham; *Diospyros melanoxylon* (India) Timbru, Timbervo; *Ficus benghalensis* (India) Vad; *Ficus racemosa* (India) Umbar, Gular; *Ficus religiosa* (India) Pipdo; *Lagerstroemia parviflora* (India) Kankadio, Bondaro; *Morinda tomentosa* (India, Malaya) Aledi; *Pongamia pinnata* (As. trop., Aus., Ins. Pac.) Karanj, Kanaji; *Schrebera swietenioides* (India, Burma) Mokho; *Terminalia bellirica* (India, Malaya) Behedo.

June
Haldinia cordifolia (India) Kalam, Haldarvo; *Mitragyna parvifolia* (Reg.
Himal.) Karmi, Karam; *Pterocarpus marsuptium* (India) Biyo; *Zizyphus mauritiana* (India, Malaya) Bor.

July
Acacia chundra (India) Khair; *Albizia lebbeck* (Geront. trop.) Siris, Siras; *Ehretia laevis* (As. and Aus. trop.) Tamburiyo; *Hymenodictyon orixense* (India, Malaya) Dundro, Bhamarchhal; *Oroxylum indicum* (As. trop) Tetu.

August
Bridelia squamosa (India) Akalkanto; *Kirganelia reticulata* (Geront. trop.) Kamboi; *Kydia calycina* (India) Warang; *Nyctanthes arbor-tristis* (India) Parijat, Chhari; *Tectona grandis* (India, Burma) Saag.

September
Careya arborea (India) Kumbi; *Zizyphus oenoplia* (India, Malaya) Bor.

October
Gardenia resinifera (India, Burma) Dikamali, Jangli Champo; *Mallotus phillippensis* (As. and Aus. trop.) Kampilo, Kankur Oro; *Trema orientalis* (Geront. trop.) Ghol, Vanjhli.

November
Delonia elata (Afr. trop.) Sandesro; *Grewia tiliaefolia* (As. and Aus. trop.) Dhaman; *Manilkara hexandra* (India) Rayan; *Ougeinia oojeinensis* (India) Tanach.

December
Azadirachta indica (India) Kadvo limbdo; *Mangifera indica* (India; Malaya) Ambo.

Original homes of the plant species are given in parenthesis, followed by local names in Gujarati.

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ETHNOBOTANY - THE SCIENTIFIC VEHICLE IN EDUCATION FOR CONSERVATION AND SUSTAINABLE DEVELOPMENT: AN EXAMPLE FROM PARAGUAY

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BACKGROUND

Applied floristics is a new science dedicated to the application of botany and taxonomy for sustainable development in the North and in the South. About ten years ago, Geneva's Botanical Institute started a new challenge working on applied floristic projects in Europe (mediterranean and alpine areas), and in particular in the tropics (Ivory Coast, Madagascar and Paraguay). A cooperative process was developed with the local population (including pickers, sellers, users, teachers, healers, students, farmers, and health promoters) and environmental education became one of the best tools to convey the Conservatoire et Jardin Botaniques de la Ville de Genève (CJB) messages on conservation and sustainable development.

THE PROJECT

This congress provides a good opportunity to present one of CJB's projects, Etnobotanica Paraguaya, an integrated ethnobotanical scientific project on the medicinal plants sold in the markets of Asuncion (Paraguay). For us, it is a case study in restitution using environmental education.

Etnobotanica Paraguaya is a small project financed by the the City of Geneva Fund for Development Assistance. It focuses on the registration, taxonomical formalisation and restitution of ethnobotanical data on traditional knowledge related to the medicinal plants sold in Asuncion's markets (Paraguay). Thematical environmental education is the principal vehicle of this restitution process.

In order to understand the circumstances in Paraguay and the strong cultural connection with medicinal plants it is necessary to know that:

- Supposedly, every Paraguayan consumes medicinal plants daily, either for the taste or to sweeten the bitterness of the maté (infusion of leaves from *Ilex paraguariensis*, the paraguayan holly) or téréré (cold maceration of ground leaves from the same plant,

drunk with cold water), the national beverage, of which a Paraguayan can drink up to 4 litres a day.

- Approximately one quarter of the surface area of the market is dedicated to the selling of fresh, dried or conditioned medicinal plants; sales of produce in the streets are generalised.
- More than 500 different medicinal species (approximately 10% of the flora of Paraguay) have been collected by undertaking more than 40 investigations in the markets of Asuncion.
- 15% of all these plants are not native to Paraguay and can be considered as exotics, many of them originating from Europe during the colonial period.
- The collection and sales of medicinal plants in the wild often makes a vital economic contribution to the small farmers or the people living in the suburban areas of Asuncion.
- The knowledge concerning the picking and uses of the medicinals is very ancient in Paraguay, in particular among the poorer classes of the population who only have restricted access to the allopathic northern medicine due to the lack of economical means.

This data makes Paraguay unique; a country or a geographical entity which uses plants with medicinal powers, in a preventative way, on the largest possible scale i.e. daily.

The likely epidemiological and preventive values due to the regular consumption of these plants, and the socio-economic power generated by their commercialisation, pushed us to make traditional ethnobotanical investigations, in particular in the markets of Asuncion. Our informers are the Yuyeras, the sellers of medicinal plants (from the root yuyos, medicinals), but we have also made enquiries with Curanderos, the traditional healers, with pickers from the field and with private laboratories which transform and condition the plants (there are more than 60 laboratories in Asuncion).

An ethnobotanical herbarium and a living plant reference collection have been established and are maintained in the Botanical Garden of Asuncion. For determination and taxonomical research, part of the herbarium is in Geneva. Composed of more than 750 specimens, duplicates will be returned to Asuncion in the near future when appropriate conservation conditions are established.

These two phases are of primary importance but it is the restitution process, the third step of the project, which interests us more in this presentation, because it involves the educational aspect. Our approach needs to involve thematic environmental education, and this will be used as a vehicle for achieving restitution.

Our restitutional action is based on two main principles:

1. the informers decide on the educational techniques to achieve restitution (such as training courses, posters, publications, school materials, etc.); and
2. the data collected will always be used in an ethical way.

This restitution process has three principal components:
Short term environmental education work, focusing on medicinal plants, is occurring in the Botanical Garden of Asuncion, through the CEAM (Centro de Education Ambiental de la Municipalidad) and the Centre of Environmental Education of the City of Asuncion. It consists of courses and workshops on medicinal knowledge of living plants, toxicity and measurings, the problems of misuse and self-medication, family planning etc. These courses are primarily aimed at sellers of medicinals, teachers, and healthcare and environmental promoters from the different districts of the capital city. There is potential to decentralise the educational activities by developing a small, mobile interactive exhibition presented in a bus.

A middle term project of public healthcare training has been organised within the city and also in the countryside with the small farmers. Seminars, courses, publications, and posters based on the taxonomic knowledge of medicinal plants, their toxicity and the importance of measuring when applied, are conducted. A great part of the programme also includes the ethnobotanical valorization of traditional heritage, represented by the popular medicine that strengthens local communities, inside and outside the cities. The topics addressed are very diverse: toxicity and measuring, family planning and uses of abortive plants, complementarity between traditional and allopathic medicines.

The long term project of applied floristics for sustainable agronomic development has several aims to:

- bring to the forefront species endangered by overpicking;
- multiply, select and domesticate some of these species with a market in view; and
- propose alternative cultivations of these new crops for the small farmers in cooperation with the relevant bodies (NGOs, Farmer's organisation, Swiss Red Cross).

Our project is not revolutionary, it applies thorough ethnobotanical techniques, using the same methodology previously used in the Alps (European mountains) i.e.

1. evaluation of the traditional knowledge through ethnobotanical investigations;
2. scientific and taxonomic formalisation;
3. restitution through targeted training and education.

Its originality comes from the educational component in relation to public healthcare and agronomy. This pedagogical dimension is very important because it gives meaning to the scientific research work (taxonomy and ethnobotany) by permitting its application in a sustainable development process.

THE GREEN PLANT BLUES: ENGAGING STUDENTS IN SCIENCE INQUIRY WHILE ENCOURAGING A CONSERVATION ETHIC IN GEORGIA, U.S.A.

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'Wow! I wonder ...

- how long can an insect stay alive inside a pitcherplant?
- why there are holes in the sides of this pitcherplant?
- if more insects crawl into the pitchers at different times of the day?'

These are all questions that young scientists pose as they observe endangered pitcherplants grown in bogs on their school sites. These 'I wonder' questions quickly become fascinating science experiments for students as they formulate hypotheses such as:

'I think that:

- an insect can stay alive for three days in a pitcherplant
- some insects lay eggs in the pitchers and the larvae chew their way out
- more insects visit the pitcherplants in early morning than at any other time of day'.

Students at schools across Georgia, U.S.A. are learning about bog and other endangered plant species thanks to an exciting collaboration between three botanical gardens. Working under the umbrella of the Georgia Plant Conservation Alliance (GPCA), the Atlanta Botanical Garden, Callaway Gardens, and The State Botanical Garden of Georgia initiated a student endangered plant network in 1996.

The importance of protecting habitats and the concept of plants as foundations of healthy habitats are not always well understood by children. Georgia students are gaining personal experience with endangered plants through their work with the Georgia Endangered Plant Stewardship Network (GEPSN).

Zack Williams, a 7 year old student at Colham Ferry Elementary School, Oconee County, Georgia, is one of many children who has actually held and planted endangered species. He states: 'Wow, this plant is endangered just like the whales and sea turtles. It might become extinct if we don't help.' Zack and hundreds of other children in Georgia are caring for endangered plants right on their school site. As the children plant, hold and care

for these endangered plants, they begin to care about the larger environment and the seeds of environmental stewardship are nurtured.

THE GEORGIA ENDANGERED PLANT STEWARDSHIP NETWORK

Working with the Georgia Endangered Plant Stewardship Network (GEPSN), students endeavour to reverse trends that threaten the environment by growing plants and raising awareness of the rare flora and habitats in their local environment. Students between 7 and 15 years become stewards for the environment by propagating rare and endangered plants from seeds and establishing these plants on their school sites or returning them to the wild. They collect data including germination, bloom time, pollinators, and seed counts and report their findings to GEPSN Headquarters.

To participate in this network, teachers attend a 20 hour training workshop to learn about Georgia's endangered species and habitats, propagation, and related science inquiry activities. Workshops also provide an opportunity for teachers to meet and learn directly from plant scientists. Dr. Jim Affolter, Director of Research at The State Botanical Garden of Georgia, conducts sessions describing how scientists study endangered plants both in situ and ex situ. Ron Determann, Conservatory Superintendent at the Atlanta Botanical Garden, provides technical expertise to develop and manage pitcherplant bogs on school sites.

Eight GEPSN workshops have been held to date with approximately 190 teachers trained. Anne Shenk, Director of Education, and Jennifer Ceska, Conservation Coordinator, both with The State Botanical Garden of Georgia, developed the Green Plant Blues workshop and teacher notebook. During the workshops, teachers are introduced to acclaimed science education projects including Wisconsin Fast Plants, Bottle Biology and Grow Lab Life Science.

Classes embark on this project by conducting a plant species count on their school site. Through this process they collect baseline data about the number and diversity of plant species on site. Then, through the GEPSN project, students work to increase the number of plants on their school grounds by adding common and endangered species native to Georgia. At the beginning of the school year, GEPSN teachers are sent a list of available wildflower and endangered plant seeds. During the school year, students grow these plants under lights in their classroom to add them to designated plots on their school sites. As the number of species increase, species diversity and the importance of biodiversity start to become meaningful concepts.

Prior to receiving seeds, teachers and their students must apply for a permit to grow endangered plant species on their site. The Georgia Natural Heritage Program, a governmental organisation within the Georgia Department of Natural Resources, is an important project collaborator. As the official state permitting agency for endangered plants, this office provides special permits for participating classes. The permitting process

provides a meaningful lesson to students on legal issues related to endangered plants and on the importance of taking special care of the rare plants they are being permitted to grow.

SCIENCE INQUIRY

The GEPSN project offers many opportunities for student involvement in science inquiry. Many elementary teachers (grades K-5) who attend the training workshops are not science specialists and may be intimidated by the science content. To make teachers comfortable teaching inquiry science, we introduce them to techniques that scientists use to study plants such as pollinator counts, cross-pollination techniques, sampling methods, and soil tests. At the workshops we provide teachers with skills to involve their students in processes of science.

Teachers spend time observing native plants and learning answers to 'I wonder' questions such as:

- How does this plant reproduce?
- Which part is the seed?
- How does this carnivorous plant actually get nutrients from insects?
- Can it grow in a different habitat?
- What are its habitat needs?
- Which soils have the most organic matter?
- What insects eat plants, and which insects do the carnivorous plants eat?
- Who pollinates this flower?

Teachers quickly discover there are a multitude of inquiry possibilities to interest and challenge their students.

Next, teachers work in teams conducting guided inquiry experiments. Broad topics for experimentation include pollination, seed dispersal, soil comparison, insect/plant relationships, pollution, and climate. After teachers complete guided inquiries, they identify the science process skills embedded in each inquiry experiment. Teachers discover they have actually conducted science process skills (classifying, comparing, measuring, asking questions, predicting, and hypothesising), and thus science is demystified. By performing the experiments and then analysing the activities, teachers become familiar with techniques scientists use to study plants (science process skills). They gain the confidence to guide their students in inquiry sessions.

Back in the classroom, teachers take their students through the same process, conducting GEPSN science inquiry investigations then identifying the science process skills used within each investigation. Next teachers lead their students into open inquiries where children design experiments to answer questions and nurture their evolving curiosity about plants.

Teachers can borrow GEPSN Science Kits from the participating botanical gardens. Kits contain inquiry activity descriptions, student worksheets, and supplies to conduct the science inquiry investigations. As student interest and concern for endangered plants grows, so do their skills as science investigators.

ENDANGERED PLANTS ON THE SCHOOL SITE

In the autumn, seeds are collected from plants grown on school sites. Some seeds are saved for propagation at the school; extra seeds are sent back to GEPSN Headquarters, packaged and shared with other schools. Seeds are also collected from plants grown at participating botanical gardens. With permission from the Georgia Natural Heritage Program, additional seeds are sometimes collected by GEPSN educators and scientists in the wild.

Endangered plant seeds provided to schools include both sun and shade species. Protected plants include tree species such as the Atlantic white-cedar (*Chamaecyparis thyoides*), a tree threatened by over-harvesting for telephone poles and wooden barrels, and herbaceous species such as Mohr's Barbara buttons (*Marshallia mohrii*) threatened by loss of wet meadow habitats.

Teachers are trained to prepare raised beds and amend the soil in preparation for planting. They involve their students in designing the outdoor classroom, calculating the costs and amount of supplies needed, developing a plan for implementing the design, planting the collection, and caring for the plants. Students have overcome unattractive obstacles such as air-conditioning units and forbidding fences by planting vines to soften the landscape and attract pollinators.

Building pitcherplant bogs has been particularly appealing to participating classes. The bogs are 3m x 3m made with a plastic liner (which mimics the effect of a shallow sub-surface rock layer in wild bogs) and filled with milled sphagnum moss and sand. Watering is done with a soaker hose laid on top of the bog; the bog is built on a slight slope so fresh water will flush though the site.

Several classes have developed elaborate planting schemes. Colham Ferry Elementary School developed a butterfly-shaped garden where the abdomen of the butterfly was a pitcherplant bog and the wings were native plants that attract butterflies. We suspect the students found it interesting to observe the carnivorous bog plants eating their butterflies!

Pitcherplants are particularly interesting to young children because of their carnivorous habit. Children are surprised to learn how the pitcherplants 'eat' bugs (and occasionally small frogs). Most people think of plants as passive organisms photosynthesising quietly in the garden. Pitcherplants (the genus *Sarracenia*) are carnivorous plants found in eastern North America, mostly in the southeast United States. They capture prey with modified leaves through passive means (as opposed to active capture like the grasping 'hands' of

Venus Flytrap). Nectar glands line the opening of the pitcher, luring insects within the lip. Once inside, stiff downward pointing hairs force the insect deeper and deeper within. The more the insect struggles, the further it descends. The inside surface is glaucous (smooth and slippery). At the bottom of the pitcher, a pool of digestive enzymes waits to digest the prey.

Carol McDonald, a teacher at Jackson County Elementary School in Danielsville, Georgia, taught her GEPSN students about the physiology of pitcherplants, drawing the modified leaves on the chalkboard. She said the students could not understand how the insects could be trapped within the open tube. They repeated the question, 'Why don't they just fly out?' Once the students dissected a pitcherplant leaf from their bog garden and felt the stiff hairs and smooth interior, they understood. McDonald said the dissections were much more effective than standard classroom teaching.

In one of the science inquiry investigations entitled Insect Autopsy students count and categorise the insects caught within a single pitcher. They make comparisons between different species of pitcherplants analysing what kinds of insects different pitcherplant species trap (i.e., the flat parrot pitcherplant (*S. psittacina*), with a tiny opening in the pitcher, catches ants and beetles while the white-top pitcherplant (*S. leucophylla*), with tall wide open pitchers captures moths, butterflies, and wasps). One young student found three live moths in a pitcherplant leaf during a dissection.

All pitcherplant species in Georgia are state protected because the plants have been collected from the wild by unscrupulous nurserymen and gardeners, and the pitchers are over-harvested for the floral industry. Digging pitcherplants from the wild is inexcusable, because they can be propagated easily from seed.

STORYTELLING AND PUPPET KITS

Plant storytelling is another effective tool used in the GEPSN project to sensitise children to the plight of plants. Stories serve as a hook to draw young students into the objectives for a lesson. Children meet plant personalities such as Richard Pitcher Plant and his friends who sing the Green Plant Blues and describe their exciting lives as well as their problems. Grandpa Cedar (an endangered Atlantic white cedar) speaks of his relatives who were cut down for use as telephone poles. The Trillium Triplets (a woodland genus that has lost much of its habitat in the southeastern U.S.) tells a scary story about the day that Sucks, (Japanese honeysuckle - an invasive, introduced species in the southern U.S.) invaded their habitat and stole their home.

As problems are presented in stories, the door is opened to content learning and problem solving needed to help the characters. Some plants are admirable characters that provide humour and innocence. Donna Rosa, a pink ladyslipper orchid, is portrayed as a well known beauty queen who tells visiting reporters, 'Have you come to admire me? You can look but do not touch!' She encourages people not to pick her since overcollecting is a

major threat to her species. The children identify with the plant characters and their emotions and concern are engaged. They want to help these plants who might otherwise seem like obscure weeds.

Plant heroines convince children that they can make a difference through their work. Richard Pitcher Plant speaks lovingly of the kind human who rescued him from the tyranny of a bulldozer in a plant rescue and carried him to his present home in a botanical garden. Donna Rosa, the pink ladyslipper, complements student reporters who have decided to start a campaign to 'Give Plants a Voice'. Torrey, a Florida yew whose species is in imminent danger of extinction due to a pathogen, sends a warning and a message of hope. Torrey states: 'As my species is disappearing – take warning and safeguard your habitat - your earth home - so my fate does not become yours.'

Because awareness and caring have been established, the learner identifies with the characters and is eager to find out more. Ann Blum, a writer and retired education specialist has worked with Shenk on a book of stories and activities that bring these characters and others to life.

GEPSN Science Kits include puppets and scripts for teachers to instruct and entertain young students. Teachers perform the endangered plant puppet shows for or with their children. High school classes and upper elementary students carry puppet shows to classes of young students and pass on their concern and knowledge for endangered plants to these children. Puppet and story characters can help young children become stewards of our plant communities.

PROJECT SUPPORT

Ongoing teacher support is an important project component. GEPSN has a webpage (http://www.uga.edu/BotGarden/GEPSN/) and newsletter (The Green Plant Blues News). Both support GEPSN teachers with a current seed list, notices about upcoming workshops, background on protected plants in Georgia, and booking information for the GEPSN Endangered Plant Science Kits. In summer 1998 funding was secured to hire an intern to help coordinate support services to teachers including a GEPSN plant Hotline.

Jim Affolter, Chair, Georgia Plant Conservation Alliance, and Director of Research, State Botanical Garden of Georgia, states:

> The GEPSN project makes learning about endangered plants fun and stimulating, for both teachers and students. Because there are so many facets to the programme - teacher training sessions, fieldwork and gardening projects on the school sites, puppet shows and study kits - everyone has a chance to participate. Coupled with the programme's well conceived teaching philosophy and strong follow-up support, this approach provides a recipe for success that could be repeated in many communities,

wherever teachers are searching for ways to engage young students in issues and methods of plant conservation.

The project has been supported with funds from the Eisenhower Plan for Math and Science Education, the Georgia Initiative in Math and Science, the Turner Foundation and The Garden Club of Georgia.

THE SEARCH FOR FUNDING – STRATEGIES FOR SUCCESS

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INTRODUCTION

Botanic gardens need to plan carefully if their fund-raising efforts are to be successful. The search for funding is not an easy task; it requires determination, persistence, imagination and good humour. Botanic gardens need to decide what they want to achieve in the short, medium and long term and develop a clear strategy for fund-raising (Wyse Jackson 1998). There are several key steps that those responsible for fund-raising should follow:

- check the fund-raising strategy with others;
- assess the strategy and ensure that it is realistic;
- document the strategy; and
- decide on the level of support being sought i.e. if you are looking for general support or special project support (remember general support comes from governing bodies i.e. government, local government, endorsements etc.).

REVENUE SOURCES

Self Generated Income

Botanic gardens can generate income from various sources:

- admissions
- sales of plants and income from shop
- special consultancies (e.g. landscaping contracts)
- supplying a line of tropical plants for offices
- fees for courses, educational services
- special events
- fees from photo shoots, weddings
- friends' membership, subscriptions
- supplying facilities.

Unrestricted Income **(not regular revenue)**

Unrestricted income can be obtained from sponsors and donors. This type of funding can be hard to source but it is extremely beneficial to have, several examples include:

- wills
- annual or regular - solicited donations campaigns
- corporate membership schemes
- benefits in kind:
  - legal advice
  - volunteer services (cost it out)
  - accountancy services
  - marketing expertise
  - designers
  - use of equipment
  - prizes
  - food and drink.

Special Events

Botanic gardens can play host to special events such as gala dinners, exhibitions, auctions and concerts.

Support Groups

There is the potential for support groups to make a significant contribution to the botanic garden budget through fund-raising and using their contacts. Consider if there is the potential for your botanic garden to have a sub committee with a special remit of raising money. Also consider getting people involved such as Trustees, Friends and Volunteers and building up a portfolio of donors; make sure you keep them informed.

Project Funding

Projects are an ideal way to get new activities funded. Grants can be obtained from individuals, foundations, government, commercial organisations etc. Consider the following:

- you can package ongoing activities as projects if they have a clear beginning, middle and end;
- create a mini business plan for your project and include it in the project proposal; and
- who will fund your project?

STRATEGIES FOR REVENUE GENERATION

There are several strategies for revenue generation:

- create visitor attractions in your garden to enhance revenue sources;
- consider what visitors enjoy most and like best e.g.
  - floral displays
  - natural features
  - spectacular glasshouse
  - giant tree
  - spectacular shop
  - exhibitions; and
- know your strengths and market them.

Planning

Planning is an important part of fund-raising. A strategic approach is very important and botanic gardens should develop an institutional strategic plan that is linked to a business plan. This plan needs to clearly outline:

- priorities for the future
- the targets that you hope to achieve
- how much it will cost
- how it will be paid for.

FUND RAISING DATABASE

Setting up a computer database can be a very effective way of managing fund-raising information. The data recorded might include names and addresses of actual and potential donors, information on applications made and the result and solicitations.

The database can also be used for developing mailing lists, special appeals, membership management and sending invitations to events.

HOW TO FIND A DONOR

Many donors are willing to support projects that have a clear beginning and end, rather than supporting the ongoing general operation of the botanic garden.

National foundations give international support and can be located through:

- lists - national
- credits in other reports
- the Internet
- asking colleagues and partnership organisations.

Governmental sectors also support projects and many opportunities of support from governmental ministries such as:
- agriculture
- overseas aid and development
- education
- science and technology
- environment.

International aid agencies provide support to developing countries:

Bilateral aid agencies
- Department for International Development (DFID)
- US AID
- AUSAID
- Swiss Aid
- Davida (Danish)
- Irish Aid, etc.

Multi-lateral aid agencies
- United Nations Agencies e.g. Food and Agriculture Organization of the United Nations (FAO), United Nations Environment Programme (UNEP), United Nations Development Programme (UNDP), United Nations Educational, Scientific and Cultural Organization (UNESCO)
- European Union
- Global Environment Fund (GEF).

International

There are also a range of other international organisations that support conservation work:

- World Wide Fund for Nature (WWF) - National bodies and WWF International
- MacArthur Foundation, etc.

Corporations
Many corporations and commercial concerns have a policy to give funds to community projects. The first step is to compile a list of major commercial companies in your region and undertake research to see if they will donate to good causes. Following this, find the

names of key people; a personal contact is the best way to build a relationship with a company.

Many donors provide forms for applicants to complete. Good project proposals:

1. are clear, well presented and concise;
2. use limited jargon (include technical aspects in appendices);
3. are interesting and innovative (what makes it special?);
4. are well argued;
5. consider what the project will achieve, as opposed to what they will do;
6. include letters of support and collaborations;
7. meet the support categories e.g. registered charity;
8. benefit the sponsor/donor;
9. include an exit strategy;
10. include the institutions track record;
11. include the projects officer's curriculum vitae's, a brief background, appendices;
12. include a transparent budget.

Well prepared Project Officers:

13. submit proposals that are based on discussions about what the donor and recipient are interested in;
14. follow guidelines and do their research and consult information available e.g. the worldwide web;
15. meet reporting requirements;
16. try to arrange meetings before preparing the submission;
17. talk to others who have received support for guidance;
18. are flexible and creative;
19. are professional in approach - on time, deadlines, dress, conduct, make friends;
20. keep donors informed but do not bombard them;
21. consider the position of the donors;
22. prepare a convincing project;
23. consider whether they would support the project if someone was coming to them for support.

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Olin, P. (1995) Funding Botanic Gardens and Arboreta in the 21st century. BGCNews Volume 2 (5) Botanic Gardens Conservation International, Richmond Surrey U.K. pp46-49.

Key points from the 4th International Congress on Education in Botanic Gardens

Education for sustainability

- Botanic gardens should become experts in the implementation of the Convention on Biological Diversity and integrate concerns with biodiversity conservation into environmental education programmes to spread the message to the general public.

- Botanic Gardens should be developed as resource centres appropriate to their climate, culture and community needs.

- Botanic gardens should base their environmental education programmes on innovative education methods that encourage sensory discovery, emphasise imagination and contemplation, and encourage people to learn through emphasising values and critical questions, inquiry and communication.

- As centres of knowledge and its documentation, botanic gardens should protect intellectual property rights of those who hold knowledge, i.e. rural community.

- Botanic gardens should determine their role in precipitating social change required for achieving environmental sustainability.

- Botanic gardens should know their target audience and use a variety of techniques, settings and approaches (i.e. community gardens festivals, clubs, flower shows, empirical studies) to bring sustainability to the public.

- Botanic gardens should promote the sustainable use of plants for local communities.

- A range of botanic garden staff should be involved with the environmental programmes, thereby providing a diverse range of educational services by using the range of skills and knowledge within the organisation.

- Botanic gardens should carefully evaluate the gardens' use and the impact of their environmental education programmes on participants.

- Botanic gardens have a role in providing support to and building the capacity of, national and regional education departments in the integration of 'environment' across the formal school curriculum to provide opportunities for an issues and outcomes based learning approach which links social, political and economic processes to natural systems.

Teaching our traditions – medicinal plants and ethnobotany

- Botanic gardens should value the experience and knowledge of local people's traditional use of plants.

- Using oral tradition, i.e. story telling and role-play, botanic gardens should help disseminate traditional knowledge to their diverse audience.

- Botanic gardens should assist in the enhancement of local people's skills and knowledge in teaching traditions.

Development education and environmental ethics

- Botanic gardens should play a role in greening cities and reconnecting people with nature and the environment by conducting outreach activities in education for sustainability and city greening.

- Education in botanic gardens should prepare individuals for the challenges of the next decade by radically reviewing global development practices that affect the environment.

- Botanic gardens' education programmes should give visitors a view of a sustainable future beyond productionism and consumerism through their activities and day to day operations.

- Environmental education programmes should be based on current accurate information.

- Botanic gardens should ensure activities and programmes 'involve' participants and aim to develop their knowledge at a grass roots level to enhance the quality of their lives.

- Through developing appropriate partnerships botanic gardens should address population and development issues by providing an educational experience that integrates knowledge, skills, values, attitudes and actions

Beyond the Limits – Rural and Community Outreach

- Botanic gardens should conduct education programmes that provide sustained contact with nature and focus on the whole individual in a human and natural

context to counteract the increasing fragmentation of individuals and communities from the natural environment.

- Botanic gardens have an important role in creating community gardens that ensure primary healthcare in every home and implement a long-term strategy for the sustainable use and maintenance of the cultural heritage and use of plant species.

- Botanic gardens can nourish deciduous biodiversity through providing programmes that increase awareness of the need to develop practical tree planting measures that provide seasonal flowering and a sustainable food source for wildlife throughout the year.

- Botanic gardens should form alliances with organisations to provide practical accessible training that empowers the community and engenders their support.

New Trends in Science Education

- Botanic gardens should build the capacity of teachers and provide them with the skills with which they challenge and change ways of learning in science and science education; aiming to transform science education from teacher-centred transmission of knowledge to student-centred active construction of meaning.

- Botanic gardens should work with science educators to integrate education for sustainability into national science curricula and guidelines and ensure an interdisciplinary approach and involvement of the whole scientific community.

- Botanic gardens should audit their education assets (physical, budgetary and human resources) and compare with the charter of the botanic garden – the educational services should focus on the aims and strengths of the organisation and offer programmes addressing areas that are not offered elsewhere.

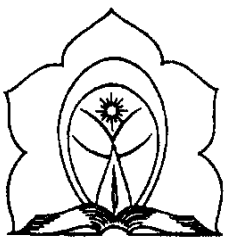
- Botanic gardens should develop partnerships and alliances to train teachers, involve children and foster an ethic of environmental stewardship that increases understanding of why young people need to engage in science.

- Botanic gardens should develop partnerships and alliances that are mutually beneficial and develop opportunities of collaborative research.

BOTANIC GARDEN EDUCATION NETWORK

Botanic Gardens
Conservation International

Tropical Botanic Garden and
Research Institute



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