Botanica

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EDITORIAL

Ars Botanica: The Botanical Art of Colonial India

Botanical art, a genre poised between the disparate realms of art and science, are detailed botanical illustrations of plants that were created for the purpose of naming and identifying them.

BOTANICAL art, a genre poised between the disparate realms of art (*Ars*) and science (*Botanica*), are detailed botanical illustrations of plants that embody a visual tension between naturalistic depiction of plant "specimens" serving the utilitarian purpose of naming, identifying and classifying them, and artistic stylization of floral "portraits" that indulge our senses in aesthetic pleasure. In the golden age of botanical illustration, from 1750 to 1850, this art form was valued by botanists of that age as the live or dried specimens of tropical plants from the newly opened overseas colonies seldom survived the perilous sea passages to safely reach the botanic gardens and herbaria in Europe.

In India, this botanical art was a sub-genre of the Company School of painting, or *Kampani kalam*, of the colonial period that includes a variety of hybrid, Indo-European style painting styles developed by Indian artists under the patronage of the East India Companies. These records of plant species and their folk lore collected across India by the colonial powers was for the profitable exploitation of these plant resources. Books on colonial flora in India had their own illustrations. Before the term itself was coined, the Colombian exchange had resulted in the 'globalization' of cultivated plants. A worldwide network of botanic gardens, including the 'Company gardens' in India, played a key role in this. Largely unacknowledged, recent studies have thrown light on the role of three such gardens across India in producing botanical literature with brilliant illustrations: the 17th century *Hortus Malabaricus* ("Garden of Malabar" in Latin) from Malabar, the 19th century *Plants from the Coast of Coromandel* and the *Icones Roxburghianae* ("Roxburgh Icones" in Latin) from Calcutta, and the 20th century *Ootacamund Flowers* and *Flora of South Indian Hills* from the Nilgiris. A copy of the drawings commissioned by William Roxburgh, a renowned Scottish surgeon-botanist from Calcutta, was sent to Kew (right fig.). These were far superior to the physical specimens and served as the 'iconotypes.' Published in the 19th century, *The Rhododendrons of Sikkim–Himalaya* by Joseph Dalton Hooker, famed English botanist and director of the Royal Botanic Garden, Kew, England, was illustrated by the English artist Walter Fitch (left fig.). Otherwise, the set formula was Company botanist—Indian artist. Unfairly enough, the focus was on the foreign botanist as the corporate sponsor, while the native artist who was the real creator of this art unnamed and ignored. However, a set of 19th century illustrations by Hugh Cleghorn, a famous Scottish physician-botanist working in Madras, is signed by some 'Govindoo,' an obscure Indian artist.

Botanical art has roots running both ways—beauty and utility. Their subjects, the plants as the world's first globalizers, were at the heart of the trade interests of colonial powers. These visual archives of floras of particular areas can be used to trace the dispersal of plant species in the recent past. The restoration, preservation and study of this rich botanical heritage seems more urgent than ever before.

Kuntal Narayan Chaudhuri
Assistant Professor & Editor
World Forest Day, March 21, 2020

DEPARTMENTAL NEWS

An Excursion to the Eastern Himalayas: Rishyap and Lava

THE department organised an excursion to Rishyap and Lava, Kalimpong, West Bengal, from November 15 to 21, 2018, with twenty nine Botany Honours second year students guided by Dr. Asis Kumar Pal and Dr. Ashutosh Mukherjee. The rich flora of the Eastern Himalayas was documented during the fieldwork including a trek from Rishyap to the hilltop of Tiffin Dara along the Neora Valley National Park (see figs.).

Kalimpong, a newly created district in the Darjeeling Himalayan Region bordering Bhutan, is situated in the south-western part of the Eastern Himalayas, in the hills of North Bengal. Rishyap (2,360 m) is a Lepcha hamlet nested on a forested slope of the Neora valley. Lava (2,138 m) is a hill station near the entry point to the Neora Valley National Park. The excursion team visited the Lava Research Station, a silviculture unit harbouring a rich collection of commercially- and medicinally-important plant species of this region. The temperate conifer forests in these mountains are dominated by *Cryptomeria japonica* (locally *dhupi*) trees along with bamboos, orchids, ferns, mosses, fungi and lichens.

--*Eds*

49th KS Rao Memorial Lecture and Photo Contest

ON November 29, 2019, the 49th KS Rao Memorial Lecture was jointly organized with the department of Zoology in the Vivekananda Sabhaghar of the college. Prof. Ruma Pal, Professor, Department of Botany, Calcutta University, was the Chief Guest on this occasion. She delivered the memorial lecture entitled: "Algae in Aquatic Ecosystem: Diversity and Biotechnology."

A photography exhibition-cum-contest themed "Treasures of Nature" was also organized on the sidelines of the memorial lecture. Prof. Sirsendu Gayen, Convenor, Photography Cell of the college, adjudicated the 1st position to Santanu Das (1st semester student, Arts General), 2nd position to Ahana Bera (3rd semester student, Zoology) and 3rd position to Adil Chowdhury (3rd year student, Zoology). The "honourable mention" list includes Shrutarshi Maiti (3rd semester student, Botany).

--*Eds*

DEPARTMENTAL NEWS

Another Excursion to the Eastern Himalayas: Darjeeling

THE department organised another excursion to the Darjeeling Hills, Darjeeling, West Bengal, from February 10 to 15, 2020, with twenty Botany Honours fourth semester students guided by Prof. Meenakshi Muphopadhyay and Dr. Asis Kumar Pal. The rich Eastern Himalayan flora was documented during the fieldwork in and around Darjeeling Town (see figs.).

The Darjeeling Himalayan Region, aptly been called the "Queen of the Hills," is located in the south-western edge of the Eastern Himalayas. With about 40% forest cover, the broad altitude range of 150 m to 3,600 m favours a wide array of climatic zones with luxuriant vegetation and diverse flora. Darjeeling town (2,042 m) is surrounded by tea plantations. The Lloyd Botanic Garden (established in 1878) is located in the heart of this hill station and houses a conservatory, herbarium and orchidarium. The team also visited the Lepcha hamlet of Chota Mangwa (1,768 m), nested atop a forested ridge overlooking the confluence of the rivers Teesta and Rangeet, as well as the Orchid Research Station of Takdah (1,602 m) harbouring an enviable collection of epiphytic and terrestrial orchid species of the Eastern Himalayas.

--*Eds*

Two Notable Achievements by Our Alumae

THESE are indeed a couple of silver linings in the middle of a global gloom. The members of the department feel proud of two noteworthy achievements by two of our alumnae, both from batch of 2006.

Ms. Urmi Chakraborty, Senior Research Associate at Pivot Bio, Berkeley, California, USA, has recently published a research article along with her co-investigators in the prestigious periodical *Nature*—the leading multidisciplinary science journal in the world. This research paper is entitled "Action of a minimal contractile bactericidal nano-machine."

Dr. Suvarthi Das (fig. below), Post-doctoral Fellow at Stanford University, California, USA, has become part of a large-scale immunity test against COVID-19. During this mammoth exercise, the first of its kind in America, this team of 300 scientists, doctors and health workers led by Prof. Eran Bendavid are testing 3,200 people in Santa Clara, California, to devise sustainable mitigation methods and policies.

--*Eds*

SHUTTERBUGS

PLANT MEETS ANIMAL

Bird among Blossoms
Manjira Yadav
Botany Hons. Sem. II

Under Leafy Parasols
Sayantan Mandal
Botany Hons. Sem IV

Basking on a Floral Stage
Sutapa Kumar (Rai)
Associate Professor

A Flaming Tree Roost
Kuntal Narayan Chaudhuri
Assistant Professor

Moment's Slumber on a Bed of Florets
Asis Kumar Pal
Assistant Professor

BIO-TOONS

A Living Fossil

Mita Bose
Graduate Laboratory Instructor

THE maidenhair tree, *Ginkgo biloba*, is a rare and interesting plant native to certain remote mountainous areas in China.

The tree is known as a 'living fossil' because apparently it has remained unchanged in the fossil record for the last 270 million years. The two-lobed, fan-shaped leaves are unique among seed plants. For many centuries it was known to science only as a fossil and was thought to be extinct, till its 'rediscovery' in China in the eighteenth century.

REFLECTION

Inbuilt Birth Certificate

Sutapa Kumar (Rai)
Associate Professor

WE humans need another person as an external authority to certify the date and time of our birth. Each newborn baby is the most helpless creature needing total parental care for perhaps the longest duration in the living world. They grow up only to change the person and place related to their dependency. The child goes to educational and other institutions with teachers, coaches and trainers. Every move is taken care of in the pursuit of knowledge and achievements in other fields. These are recorded in certificates by the competent authorities. This record of the growth curve is penned down in black and white by someone else to testify that they are a true copy of his or her career graph.

However in nature, the entire process of growth in trees is recorded over the years in the form of distinct patterns of the water conducting tissue in the wood, as annually formed pairs of rings called the annual growth rings—whose study is dendrochronology. The growth rate in a tree changes in a predictable pattern throughout the year in response to seasonal changes, resulting in these visible rings. Each pair of ring marks a complete cycle of seasons or a year in its life that could span tens, hundreds and even thousands of years. After the inactivity of winter, during the next spring, growth occurs at a fast rate and moisture is abundant the lumen of vessels which are large in diameter and have thin walls. The ring of tissue formed by these cells is lighter in colour and is called spring or early wood. The longer the growing season, the broader the ring. Towards the end of the summer this growth slows down due to insufficient moisture and the lumen of vessels are much smaller in diameter and have thicker walls. Therefore, they form a dark coloured ring of tissue called summer or late wood. Thus, the contrasting shades of one light-hued ring and one dark-hued ring together mark a year's growth of the tree. Thus, by simply counting these annual rings, the precise age of a tree could be ascertained—like an inbuilt birth certificate.

Growth rings also help in the study of climate and atmospheric conditions during the past, a specialized field—dendroclimatology. In temperate countries with sharp demarcation of seasons, these rings are clear, whereas in countries with an equable climate, the early and late wood are not remarkably different. In places exposed to high winds, off-centre rings are formed because growth in the side facing the wind is slower than the other side. Calamities like droughts, floods, disease, injury or air pollution affect growth and alter the nature of these rings. These inbuilt certificates of birth and growth patterns are especially of help for trees which are more recent in origin. Radiocarbon dating is not possible for these recently dead or still living giants on earth. Perhaps the plant world guessed that certificates indicating the time and place of birth might become very important documents to the incapable human race some day.

G.N. Ramachandran (1922-2001): A Luminary in Structural Molecular Biology

Meenakshi Mukhopadhyay
Associate Professor

Ramachandran has been among the global pioneers in the field of structural molecular biology. The coiled-coil structure of collagen proposed by him has stood the test of time. All modern-day investigations into the protein structure prediction and design, protein-protein interactions, protein-ligand interactions and the like have been founded on his theory.

GOPALASAMUDRAM Narayana Ramachandran, the eldest son of G.R Narayana Iyer and Laxmi Ammal, was born in 1922 in Ernakulam, Kerala and was brought up there. He was a mathematics wizard since his childhood. His father was a professor of Mathematics, and Ramachandran got his initial training at his home. After completing B.Sc. from St. Joseph's College, Tiruchi, he moved to the Indian Institute of Science (IISc), Bangalore, to begin his journey as a student of physics, a subject then overwhelmingly dominated by the presence of C.V. Raman. He then spent two years in the Cavendish Laboratory, Cambridge, from where he got his Ph.D. degree. He finally moved to Madras University to begin an extraordinary burst of scientific activity.

Ramachandran worked in a number of fields in physics, chemistry and biology. His first major research contribution was the discovery of the triple helical structure of collagen. It was criticized as “stereochemically unsatisfactory” by Francis H.C. Crick, who was involved in unravelling the double helical structure of DNA. Spurred by this criticism, using the simple hard sphere model for atoms and driven by the insight that each residue in a polypeptide chain is allowed only two degrees of torsional freedom, Ramachandran, together with his colleagues C. Ramakrishnan and V. Sasisekharan, laid the foundations for the conformational analysis of polypeptide chains. Their work was published in the Journal of Molecular Biology in 1963, titled “Stereochemistry of polypeptide chain configurations” introducing the two-dimensional ‘Ramachandran map’. This has almost immortalized him. He has also made seminal contributions to almost all other aspects of biomolecular conformation. Ramachandran illuminated the theoretical foundations of crystallography through his work. He brought together the diverse fields like x-ray crystallography, peptide synthesis, NMR and other optical studies along with physio-chemical experimentations under the common field of Molecular Biophysics. He founded the Molecular Biophysics unit in IISc, Bangalore in 1970, which later came to be known as the “Centre of Advanced Study in Biophysics and Crystallography.”

Ramachandran did all his work in India, following the footsteps of his illustrious mentor C.V. Raman. An excellent teacher and lecturer, he was widely honoured in India and abroad for his work and nominated for a record seven times for the Nobel Prize. G.N. Ramachandran’s death in Chennai, on 7th April, 2001, marked the end of one of the most remarkable chapters of modern science in India.

DO YOU KNOW?

The Forty Fruit Tree: A Living Sculpture

Jessica Upadhyay
Botany Honours (Sem. IV)

THE art of plant grafting reached its zenith with the "forty fruit tree" created by the New York artist Sam Van Aken using the bud grafting technique. Each tree produces forty types of stone fruit, of the genus *Prunus* (Rosaceae) including plums, peaches, apricots, cherries, that ripen sequentially from July to October. In August, the buds of the host tree are removed and replaced by the ones from other trees collected in February and stored in a freezer. Then wrapped in plastic bags to create a greenhouse effect, finally any remaining old bud near the grafts are also removed during the next spring. The idea is to trick the host tree into believing that these new buds are part of itself. After blossoming in different shades of pink, white and crimson, then, and quite magically, the tree displays a mix of fruit. Sixteen such trees have been installed in private and public gardens.

Moringa olifera: A Nutritional Powerhouse

Sirin Aslam
Botany Honours (Sem. IV)

THE drumstick tree or *Moringa oliefera* Lam. (Moringaceae), native to India, is called a miracle tree. Every part of this tree is nutritious, but its leaves are the ones most packed with nutrients such as proteins, minerals like calcium, potassium, iron, zinc, magnesium and copper, and vitamins like A, B complex, C, D and E, to name only a few. Gram for gram, these represent 9-times more protein than curd, 17-times more calcium than milk, 15-times more potassium than bananas, 25-times more iron than spinach, 10-times more vitamin A than carrots, and 7 times more vitamin C than oranges. These nutrients protect the body against free radicals and also promote the immune system. Therefore, the intake of these leaves has been recommended as a general precaution against COVID-19.

Carnivory: A Manifestation of Plant Intelligence?

Dipyaman Banerjee
Botany Honours (Sem. IV)

INTELLIGENCE—the first thing that comes to our minds are 'humans.' But what if the plants were more intelligent? The plant world is full of hidden treasures. They not only make their own food, but can also communicate, defend themselves, and even catch prey. The carnivorous nature and hunting skills of the North American cobra lily *Darlingtonia californica* Torr. (Sarraceniaceae) illustrates this lucidly. It has a remarkable strategy of catching preys. The leaves resembling a raring cobra has cell walls of different thicknesses that creates the illusion of 'false windows' to lure the prey. Once trapped inside, the tiny exit is then hidden by curling it underneath. The struggling prey, confused by these multiple false exits, finally dies and a proteolytic enzyme digests it. Thus, this complex trapping mechanism based on an ingenious leaf architecture can be considered as an intelligent behaviour.

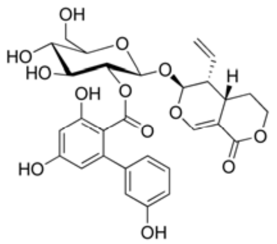
Swertia chirayita: The Bitter Elixir

Saradiya Mitra
Botany Honours (Year III)

CHIRATA, *Swertia chirayita* L. of the family Gentianaceae, is a critically endangered medicinal plant endemic to the temperate regions of the Himalayan of India (Kashmir to Meghalaya), Nepal, Bhutan and Tibet (China). It is an annual herb; stem is erect, robust and quadrangular; leaves are opposite, broad, lanceolate, and 5-nerved; flowers are greenish-yellow with purple tinge, borne on numerous, small, axillary, lax cymes, and appear from September to October. The plant is propagated by seeds and grows in the wild in open forests and on shady slopes. It is called *chirata* in Hindi and Nepali.

S. chirayita whole plant has a long history of use in the various Indian systems of medicine *viz.* Ayurveda, Unani, Siddha, for the treatment of a wide spectrum of diseases. Its medicinal usage is also well-documented in the British and the American pharmacopeias. It is traditionally used for the treatment of liver disorders, diabetes, inflammations, fevers, malaria, anaemia, asthma, hepatitis, gastritis, constipation, dyspepsia, skin diseases, ulcers, intestinal worms, epilepsy, hypertension and melancholia. Traditionally prepared decoctions have hepatoprotective, hypoglycemic, anti-malarial, antifungal, antibacterial, ant-helmintic, cardiostimulant, anti-inflammatory anti-diarrheal and even antiaging properties.

This indigenous medicinal herb has a well-known bitter taste caused by the presence of several bitter principles. These bioactive compounds include amarogentin (the most bitter compound isolated till date, see fig.), swertiamarin, mangiferin, swerchirin, sweroside, amaroswerin and gentiopicrin.



The anti-diabetic effects of *S. chirayita* are by far the most investigated mechanism of action of this traditional medicinal plant. Its hypoglycemic action is due to the release of insulin. Active principles such as swerchirin lower blood sugar levels due to the depletion of granules in the pancreatic beta cells of the islets of Langerhans.

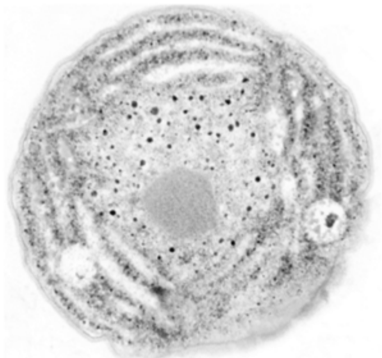
Chirata, due to over-harvesting to meet high demand in both the national and international markets, as well as habitat destruction, is facing drastic loss of its wild populations. Sustainable commercial use of this critically endangered medicinal is only possible by improved *in situ* conservation practices for a reliable supply of raw materials. Furthermore, exploring *ex situ* conservation and *in vitro* production of its active principles will require innovative biotechnological approached such as micropropagation, cryopreservation and the use of bioreactors.

HERBAL HEALER

Novel Bio-Oil Algae

Asis Kumar Pal
Assistant Professor

CYANOBACTERIA, formerly known as blue-green algae, have come up with their hidden talent to produce oil from water and carbon dioxide. So far only plants were known to do this. Recently published in the journal *Proceedings of the National Academy of Sciences*, Peter Dörmann and his team from the Institute of Molecular Physiology and Biotechnology of Plants (IMBIO), University of Bonn, Germany, working on an enzyme active in plant chloroplasts in catalyzing a step in oil synthesis, have identified a gene coding for a so-called acyltransferase in the cyanobacteria *Synechocysti* ssp. responsible for producing oil (see fig.). This pioneering endeavour supports the postulate that plant chloroplasts—regarded as the kitchens for generating energy-rich compounds—have originated from the cyanobacteria. This surprise discovery happened as these scientists were searching for a gene in cyanobacteria that was similar in its genetic make-up the one involved in oil synthesis in plants. This discovery opens up new avenues for the commercial production of biofuels, since unlike plants, no arable land is required for the growth of cyanobacteria. Although the quantity is low in terms of the requirement, the team is hopeful in bringing about biotechnological modifications in these cells to meet this demand.



Life Found a Way: Fungi Feeding on Radiation

Ashutosh Mukherjee
Assistant Professor

THE nuclear accident in Chernobyl, Russia, occurred on April 26, 1986. Several years later scientists had discovered some fungi inside the nuclear reactor. This discovery puzzled scientists about the ability of the fungi to survive in that extremely radiation-heavy environment. In 2007, Ekaterina Dadachova and her colleagues at the Albert Einstein College of Medicine, New York, USA, published a paper in the journal *PLoS One* showing that three fungi *Cladosporium sphaerospermum*, *Cryptococcus neoformans* and *Wangiella dermatitidis* had large amount of the pigment melanin which absorbs radiation, changes its electronic properties and enhances fungal growth. This process is called radiosynthesis, much like photosynthesis in plants. Melanin absorption is an interesting property that could be used to protect astronauts in space from radiation. Recently, in November, 2019, scientists from Johns Hopkins University, Baltimore, USA, have sent melanin from *C. neoformans* to the International Space Station to test its ability to protect astronauts against radiation in space. Scientists at NASA are looking into the possibility of extracting melanin from *C. neoformans* (see fig.) as a cost-effective way of producing a space-approved sunscreen.