1989 (4)

Hornbill

BOMBAY NATURAL HISTORY SOCIETY

COVER PICTURE

Blue Pansies (*Precis orithya*), by Isaac Kehimkar

This pair of courting Blue Pansies was photographed in the Great Indian Bustard Sanctuary at Solapur. Courtship is a complex ritual involving the exchange of visual, chemical and tactile signals. The male is attracted by the colour, size and movement of the female, and locates her either by waiting at a likely spot or by active, persistent search. Males of some species sometimes fly after a falling leaf, or even a small bird, mistaking it for a potential mate.

The colours of a butterfly's wings are not due to pigmentation alone. Minute overlapping scales on the wings, by causing reflection and refraction of incident light, produce what is known as structural coloration. Iridescence, and most blue and green shades in butterflies, are caused by structural coloration rather than pigmentation. Structural colours depend on the angle at which light strikes the scale; when the Blue Pansy shifts position, the shade of blue changes.

Acknowledgement

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DESIGN
Amar Shekdar

Editorial

Folklore:

I believe that folklore is perhaps the foundation for all baseline information on animals resulting from man's interaction with an animal or grounded on his observations, however clouded they may be with fear and superstition. Some of the stories become esoteric and some attain a fairy tale-like quality. It is time we made a collection of these tales arising out of man's initial contact with animals before science takes the magic out of them. One of the tales I heard in my childhood may be worth recounting.

The story is woven around the obstreperous screaming calls of the Common Hawk Cuckoo, heralding the hot weather. The story goes that there were once two brothers, makers of such exquisite flower garlands that they were patronised by all the nobles of the kingdom. Naturally then, the king commanded them to make the wedding garlands for his daughter. The elder brother, the maestro, braided the garland of the finest flowers in the kingdom, and handed it over, to weave the strands of fibre for the final knot of the garland, to his younger brother — the child whom he had sheltered and showered with love since the death of their parents.

Delighted at the beauty of the garland, the king selected it for the customary exchange of garlands between bride and groom at the nuptials. But alas, when the bride placed the garland around the neck of the groom, the knot slipped and the garland fell to the floor.

Aghast at the mishap and angered at the ill-luck that such a calamity would bring to his daughter, the angry king, immediately and for ever, banished the garland maker from his kingdom. Rushing back to his shop in anguish, the master garland maker, enraged by his brother's carelessness, slapped the boy so hard that he fell down and died on the spot.

Appalled at the sudden loss of all that he held dear, the garland maker wailed and screamed, calling out his brother's name, beseeching him to come back to help weave garlands again. The gods, taking pity on his suffering, transformed him into a bird — the Hawk-Cuckoo or the Brain-fever bird. That is why at the height of the Indian wedding season in the summer, the Hawk-Cuckoo, the weaver of garlands, frantically calls to his brother to come alive and help him to make wedding garlands. Hence the name **Thambi kuruvi** (= younger brother bird) in some parts of Tamil Nadu.

Chitrak

A New Family Of Insectivorous Plants

TEXT AND PHOTOGRAPHS BY M.R. ALMEIDA

चित्रकोऽनलनामाचपाठीव्यालस्तथोषण: ।
—चित्रक, अनलनामा, पाठी, व्याल, ऊषण
अस्य गुणा: ।
चित्रक:कटुक:पाकेवह्निकृत्पाचनोलघु: ।
रुक्षोष्णोग्रहणीकुष्ठशोफार्श:कृमिकासनुत् ॥
वातश्लेष्महरोग्राहीवातार्श:श्लेष्मपित्तहत् । (भावप्रकाश)

"Chitrak is bitter in taste , a heat generator - meaning an appetiser - easy to digest and non-oily in nature . It increases digestive power of the large intestine and supresses dysentry, leprosy, obesity, piles, intestinal worms, cough, acidity and counteracts ill-effects of excessive bile".
This is how 'Chitrak' has been described by Bhavprakash in ancient Indian Ayurvedic literature.

In a study camp for ayurvedic practitioners held in Gujarat some years ago, a practising vaidya told me that, according to his information, the properties described by Bhavprakash for Chitrak match closely with those of species of *Drosera* Recently, while looking through the literature for the botanical equivalent and correct identity of the Sanskrit name *Chitrak* , my search revealed that the name 'Chitra' or 'Chitramula' or 'Chitrak' is associated with various species of two genera of flowering plants belonging to different families, namely *Plumbago* Linn. (Plumbaginaceae — 3 species in India) and *Drosera* Linn. (Droseraceae — 3 species in India) which, phylogenetically, are placed far apart.

All species of *Plumbago* found in India are generally equated with 'Chitra', and their detailed medicinal properties are mentioned in numerous books. However, there is also a rare mention of species of *Drosera* under the name 'Chitra'.

I have been trying to understand why the word 'Chitra' is used for these two totally unrelated species; to find points of similarity or a common

Coming to a sticky end...

✽ Calyx surface showing stalked and sessile glands as well as fine hair-like structures.

✪ Glands on calices start secretion of sticky substance when insect comes in contact.

✪ Fore and hind legs of an insect firmly trapped by glandular secretion.

❀ Calyx showing sessile glands skeletal remains of dead insect.

Plumbago zeylanica Linn. Inflorescence showing glandular, hairy calyx.

character which places them close to each other. To date, I have not found a satisfactory answer. However, phytochemical literature has definitely shown a very important character common to these two genera. Both *Plumbago* Linn. and *Drosera* Linn. contain a common chemical, 5 hydroxy-2-methyl-1, 4-naphthalenedione, commonly known as plumbagin. Biological and pharmacological studies undertaken by various investigators throughout the world indicate that the therapeutic properties attributed to *Plumbago* species as well as to the *Drosera* species are in fact due to the presence of an anthraquinone, plumbagin, which is isolated as a common constituent from these plants. This observation has also been independently confirmed by using pure plumbagin.

In a study of the phytochemical literature on the plumbagin yielding plants it was observed that very few plant families have so far been reported as showing the presence of this chemical. During this study it was also noticed that a substantial number of species reported to contain this principal belonged to those classified as insectivorous plants.

This striking observation led me to believe that the species of *Plumbago* may perhaps also be insectivorous in nature. In fact, all *Plumbago* species have glandular hairs on the outer surface of the calyx, which closely resemble the hairs present in the species belonging to the genus Drosera. I have examined the glandular hairs of *Plumbago* species, and found dead insects attached to the hairs. However, no earlier literature is available to substantiate this fact.

Although there is strong reason to believe that the species of *Plumbago* may be insectivorous, I have made additional observations that plumbagin is also isolated from members of families belonging to Ebenaceae and Iridaceae, which so far have no proven connection with insectivorous habits. I therefore presume that the mere presence of plumbagin is not a clear indicator of the insectivorous nature of a particular species. Further studies and additional evidence are necessary to prove the exact role of plumbagin in insectivorous plants ■

SEASHORE LORE

IV - Octopus - Odious or Octracized?

BEEFSEA

With the approach of winter, the seawater near our shore gets cooler. This signals the arrival of octopi; first, the juveniles by mid-October, followed by the adults a few weeks later.

What the film Jaws has done to man's (mis)conception of sharks, Victor Hugo's novel, Les Travailleuses de la Mer (= The Toilers of the Sea) did for the octopus in 1866. It narrates a fight to the death, in a Channel Island seacave, between the hero and a "devilfish". (The very name that Hugo gives to the octopus sends shivers down one's spine.) But very few octopi are in fact dangerous. Unlike the venomous Australian Hapalochlaena maculosa, whose bite has caused death within two hours, our octopi are harmless. For nearly four decades, I have played with them, allowing them to glide up my arm and then peeling them off. Only once have I been bitten — just a smart nip which felt like a pinprick and drew a drop of blood.

Compared to the European octopus, whose body is the size of a football, with each arm 1.5 m long, our local octopi are puny, with their body the size of one's fist and arms 45 cm long. The largest octopi live in the Pacific Ocean. They have a body of 45 cm, arms some 485 cm long, and weigh 45 kg.

Surprisingly, octopi are related to the lethargic snails and clams, but, along with their cousins the cuttlefish and squid, they are marine. The terms used to describe their body parts are sometimes a little confusing. What looks like the head, since it bears a pair of eyes, is actually the body, inside which are all the organs. Around the mouth

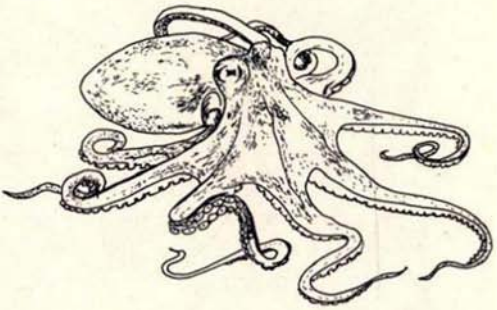
are eight 'arms' bearing rows of round suckers. The arms are used for walking (why not call them feet?) and are united at their base by a membranous web. On the lower side of the body is the funnel or siphon, from which the octopus can expel water forcibly to swim backwards. It is Mother Nature's earliest version of jet propulsion.

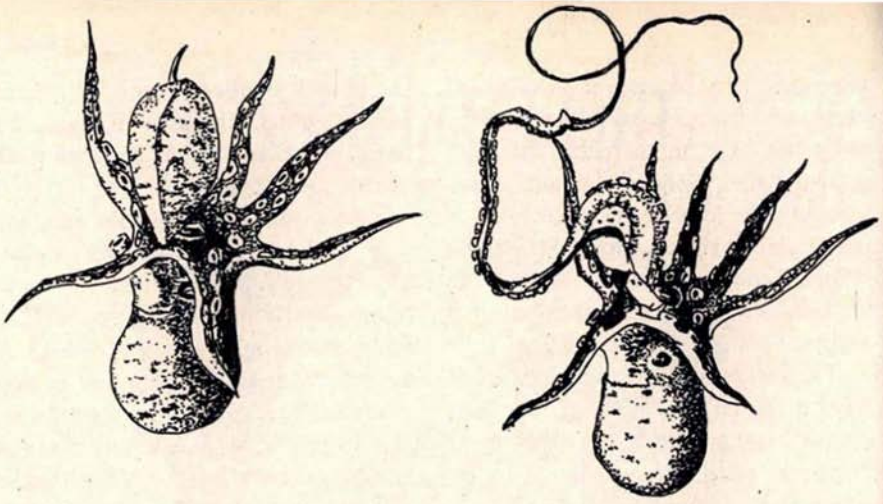
The suckers on an octopus' arms can form a partial vacuum. Its nervous control is so good that, at one moment hundreds of suckers will attach themselves to an object, and at the next, all will release the suction and clamp down somewhere else. The suckers feel like hundreds of tiny, wet, clammy hands pulling at one's skin.

Like the tiger, the octopus is not a sociable creature. Except when mating, it lives by itself in a lair made by collecting a pile of stones, or in a hollow under a boulder which it has excavated by blowing out the sand. The lair can be easily detected by the debris of recent meals cluttered about its entrance. To catch an octopus in a tide pool, an easy method is to squirt a concentrated salt solution into the lair and wait patiently. If the octopus is inside, it will violently expel water through its funnel, sending a cloud of bubbles to the water surface. Soon the octopus will send out an exploratory arm. If it finds nothing suspicious, and as the salt starts to suffocate it, the octopus will emerge. (Tobacco, vinegar, slaked lime and copper sulphate have been used to flush out an octopus, but are highly polluting.)

When hungry, the octopus stalks its prey (crabs, lobsters, shellfish and sometimes smaller octopi). If a crab passes by, the octopus will send out a neatly coiled arm which unwinds itself gently towards the crab. The victim is flicked with the tip of the arm, and then pulled into the octopus' mouth. Sometimes it hunts a crab by swimming over it with arms outstretched like an open umbrella and descending on the prey to engulf it. Its saliva is poisonous. The crab quickly succumbs; its claws open wide, then slowly close; its body quivers, and the crab is dead within 45 seconds.

The octopus' beak now comes into play. It is remarkably like that of a parrot, except that the lower beak is longer than the upper. The octopus opens the crab at the junction between its carapace and abdomen (the place from which the crab's soft body emerges when it moults). It pulls off the back, eats the body organs first, and then, one by one, pulls off the legs, cleans out the flesh with its armtips and eats them, and then drops the empty shell





Left: Sac (above the body) before bursting...Right:.. and after, with hectocotylus unwound

outside its lair. (In captivity, it relishes boiled eggs.) An octopus is prone to autophagy, i.e. it often eats its own arms. This is supposedly done during times of stress and is frequently a preliminary to death.

In speed and variety of colour change, the octopus surpasses even the chameleon. It has a multitude of small pigment spots: brown, black, red, yellow, orange-red. At rest and undisturbed, its body is a purplish brown, often with irregular honeycomb patches. When frightened, it turns ashy grey. It is enthralling to see, even in a dead octopus, waves of dark and light tints passing over the body.

Even octopi have enemies — sharks, moray eels, whales and seals. When approached by an enemy (even a scuba diver), the octopus remains still, relying on its camouflage. If the enemy persists in coming closer, the octopus throws out a cloud of purplish 'ink' from its funnel, which diffuses in the water to form a smoke-screen. By the time the water has cleared sufficiently for the enemy to see, the octopus has slunk away. The ink seems to serve another purpose. The sense of smell of a moray eel which has swum into the ink cloud is lost for up to an hour. When a moray attacks, the octopus wraps its arms around the moray's head. To dislodge it, the moray forms a loop with its tail and slips its head backwards through this loop, thus forcing the octopus' arms to slide along the moray's slippery body and release their hold. In open water, a moray which has grabbed an octopus' arm will stretch its own body full length and then spin round and round with giddy rapidity until the arm is torn off the octopus' body with a violent wrench. The octopus might escape with the loss of an arm and be satisfied with the bargain; it can regenerate a new arm within six weeks.

As an escape artiste, the octopus is more than a match for Houdini. Except for its horny beak, its body is soft,

allowing it to flatten its body and squeeze through unbelievably small openings. For the local octopus, with its fist-sized body, squeezing through half-inch wire mesh is child's play. I once had an embarrassing experience of this proclivity to escape. After collecting octopi at Madh Island, just outside Bombay, I was travelling home by bus. Since fish and live animals are not allowed inside a bus, I had hidden the octopi in an aluminium milk can. So that they should not suffocate, I had left the lid of the can slightly ajar, but not enough (or so I thought) for the octopi to crawl out. Scarcely a kilometre later, there was a commotion at the rear of the bus. Some octopi had squeezed out of the can, and were merrily crawling over the bus floor. A rather shamefaced me was evicted by the conductor!

When a man decides on matrimony, he asks for the girl's hand in marriage. A male octopus with similar intentions, in contrast, offers his own — literally. The male's third right arm is modified to form what is known as a hectocotylus. While mating, this is inserted into the female's body and is used to plant sperm sacs into her oviduct. In some octopi, the worm-like end of the arm breaks, and remains inside the female's body. In the argonaut, a distant cousin of the octopus, the hectocotylus breaks off from the body of the male, swims independently like a wriggling worm until it reaches a female , and fixes itself by means of its suckers onto the female's mantle cavity. The body of the female, which secretes a pearly white, fluted shell, may be 15 cm in size. The adult male is a tiny 6mm. Its third left arm looks like a sac almost as big as its body. When the sac bursts, the hectocotylus unwinds to a gigantic 22 cm and breaks free to swim away.

The eggs of an octopus, which are as large as a grain of cooked rice, are laid at night, in 7 cm long clusters, each containing 25-50 opalescent white eggs. There are up to 30 such clusters, attached to stones or seaweed. Aquariums often provide cement pipes for octopi to shelter in, and the egg cluseters are stuck inside the pipes, hanging down like curtains.

Fishermen hunting the octopus make use of its fondness for secluded crannies. In the Palk Straits of South India, shells of the five-fingered conch are used to catch them. The apex and fingers of the shell are broken off, and 700 to 900 shells are strung along a long line. The line is set in two metres of water at the sea bottom and lifted each morning. The haul is usually 200 to 300 octopi. In Japan and the Mediterranean Sea, earthenware pots are used.

Strange to say, you can hypnotize an octopus. Hold the octopus in one hand with the mouth upward, and with the arms and body hanging downwards. The trick lies in preventing the octopus' arms from touching yours, as this will break the hypnotic spell. If you can prevent such contact, and can hold the octopus in this manner long enough, its arms will hang limply, with no trace of movement. When an arm is lifted and let go, it will seem as lifeless as a length of rope. The octopus can even be passed from hand to hand. To awaken it, pinch hard ■

News, notes & comments

Ivory trade banned

The African Elephant *Loxodanta africana* is now officially an endangered species. At the CITES Convention in Lausanne, Switzerland, in October 1989, the 103 member nations voted to shift the elephant from Appendix II (threatened) to Appendix I (endangered) on the CITES list. This automatically makes all ivory trading illegal. The ban comes into effect from 18 January 1990.

The resolution continues to be a subject of controversy. Eight African countries expressed opposition to the Appendix I listing, and Zimbabwe has already entered a reservation (a legal device that will permit it to continue to export ivory, the decision notwithstanding).

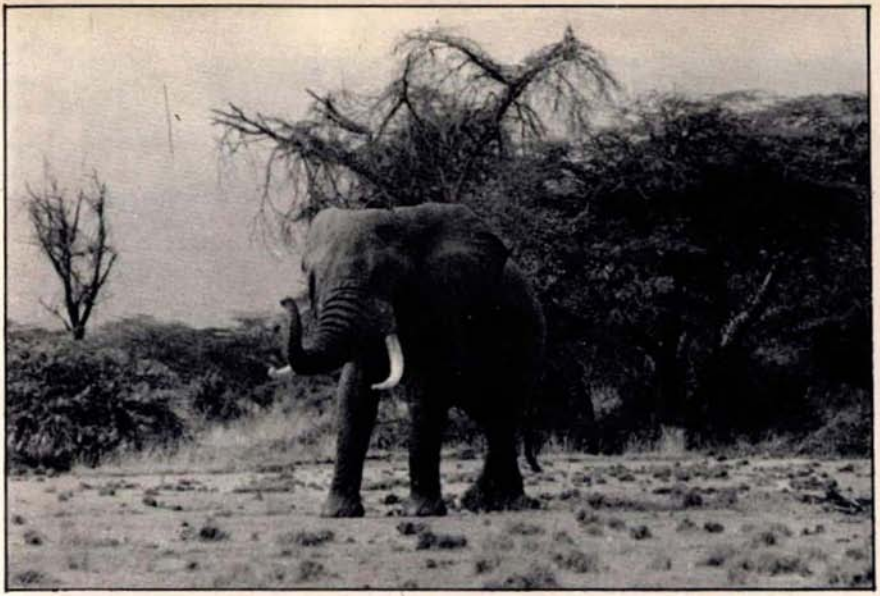
The transfer to Appendix I is subject to the adoption of a special process by which healthy, well-managed populations could be transferred back to Appendix II, provided there are trade controls in ivory and hides. Such future Appendix II listing would mean that some trade will be allowed.

More than 50% of Africa's once vast herds have been wiped out in the last decade, mainly by ivory poachers; Uganda and Kenya have lost 85% of their elephant populations. In the wake of a campaign by conservationists and some African governments led by Tanzania, several countries including Hong Kong, Japan and the USA banned imports earlier this year, thus cutting demand by an estimated 90%. The CITES ban was a logical, and essential, follow-up in the campaign to save the elephant.

The ban will not end ivory poaching. Export permits, which certify that a consignment of ivory is legal, and can be exported or imported (stocks acquired before February 1976 are exempt from the ban), will continue to be forged. But there is now at least a solution in sight, and with the cooperation of enforcement agencies, and funding from the developed countries (Japan is expected to contribute), the herds could still be built up to somewhat healthy levels.

Crocodile conservation

Fifty years ago, crocodiles and gharials were plentiful in the lakes and swamps of the Indus valley in the province of Sind, Pakistan. The construction of dams and barrages for agriculture has dried out many of these, drastically reducing the reptiles' habitat. Illegal trading in skins has exacerbated the problem, until the species is now endangered in Pakistan. The government of Sind has now announced measures to build up populations. A 50,000 acre sanctuary, containing about 30 lakes and swamps, has been proposed, as also a captive breeding programme for crocodiles and gharials. The reptiles would subsequently be released into the wild, to repopulate the areas they once occupied.



E. P. GEE

The government of India has offfered to help, by exporting 200 young crocodiles to Pakistan to help stock sanctuaries and breeding centres there. India's own breeding programmes for both the Marsh Crocodile (in several states) and the Saltwater Crocodile (at the Bhitarkanika Sanctuary in Orissa) have been successful. One hopes that the Pakistani programmes too will bear fruit.

Nature education scheme

Two major programmes were arranged in recent months under the Nature Education Scheme. An orientation course for teachers was organised in September '89, dealing with marine life and coastal conservation problems. 43 teachers from 26 schools participated. The course included lectures on botany, on ecology and conservation of coastal wetlands, classification of specimens, and a demonstration on setting up of freshwater aquariums. A productive collection trip was made to Manori beach outside Bombay. A manual was prepared and distributed, in order to help teachers make seashore excursions more interesting and educative to students. A nature camp for students from Municipal schools was arranged in December at the Sanjay Gandhi National Park, Borivli. 60 students and 7 teachers from 12 schools were introduced to birdwatching and taught to identify common trees and insects. A study of pond life was also included, in which the students learnt how to prepare and study slides under a microsope.

Ethnobotany

The Society of Ethnobotanists will conduct a one week training course in ethnobotany at Lucknow in March 1990. The course fee, including boarding and lodging, will be Rs 800/ (US $ 200/). For details, contact the course director, Dr SK Jain, at the National Botanical Research Institute, Lucknow 226 001.

Whitewinged Wood Duck

T. HULME / WILDFOWL & WETLANDS TRUST

Whitewinged Wood Duck

The 634 sq. km Dibru-Soikhowa Wildlife Sanctuary in Assam is believed to contain breeding sites of the highly endangered Whitewinged Wood Duck. It also attracts large concentrations of migratory waterfowl, notably Barheaded and Greylag Geese.

According to a local newspaper, a portion of the sanctuary's core area, which includes a *beel* where the duck is thought to breed, has been handed over to a fishery cooperative. The local Divisional Forest Officer denied permission for fishing operations within the sanctuary, but was overruled by ministerial fiat. Such a situation is certainly worthy of editorial comment, but the matter is sub-judice. A public interest petition against the transfer was filed in mid December in the Guwahati High Court, with the state Forests Minister and the secretary to the state government as respondents.

Conservation award

The Oriental Bird Club, UK, and the manufacturers of Leica cameras jointly sponsor an annual award for conservation-based studies of Oriental bird species or habitats. The 1989 winner is Dr Rene Dekker of the Institute of Taxonomic Zoology, University of Amsterdam, who will study the Nicobar Scrubfowl *Megapodius freycinet nicobariensis*, found in the Andaman and Nicobar islands. The two-month project will also involve the training of Indian biologists in study, conservation, and management techniques applicable to the species.

The Indian government has offered both cooperation and unprecedented access to this restricted area. Ministry of Environment officials have already begun mapping nest sites on Great Nicobar island prior to Dr Dekker's arrival ■

CROPS AND THEIR WILD RELATIVES

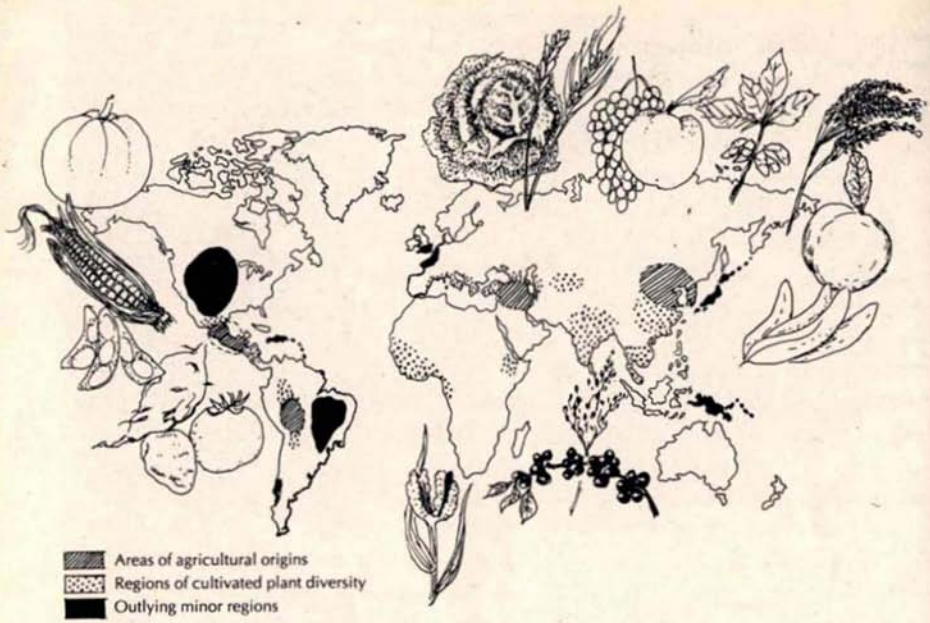
ERICH HOYT

AGRICULTURE began between seven and ten thousand years ago, when the first farmers gathered the seeds of wild plants and began sowing them to grow food. In the area now known as southwest Asia, the seeds were of wild grasses that would become barley and wheat; in Mexico, of wild corn (maize), squashes, peppers and beans; in Peru, of wild potatoes. When men were hunters and gatherers, far before agriculture emerged, many of them must surely have been planting seeds in convenient places. But by choosing to cultivate a favoured kind of plant, they imposed an artifical selection: for example by selecting plants where the seeds were retained rather than being dispersed as soon as they were ripe, as is more customary in nature. But although this selection operated over several millenia, crop plants remained relatively unmodified from their wild relatives, mainly because of a significant extent of interbreeding.

In the late 19th century, however, plant breeders made a systematic effort to improve yields, and a series of more advanced cultivars (cultivated varieties of plants) emerged. These gradually replaced the land races (the local crop varieties developed in primitive agriculture systems) that had coexisted and crossbred with their wild relatives. These new strains in many cases were highly successful. India's green revolution, for example, was due largely to new varieties of rice and wheat. The undoubted benefits from the new cultivars must, however, be balanced against the problems likely to spring from such large-scale displacement of land races and their wild relatives. The new varieties often require large quantities of pesticides, and their use killed off many of the natural predators of plant pests; the use of herbicides in particular killed many of the wild rlatives that grew nearby.

The new cultivars emerging from crop research laboratories were largely uniform in genetic characteristics and few in number, compared with the great diversity found in the land races. And as the new strains replaced the old ones, the

Extracted from "Conserving the Wild Relatives of Crops", published by IBPGR/IVCN/WWF.



valuable gene flow by crossbreeding diminished. The resulting genetic uniformity generally made for more reliable yields — but also increased vulnerability of the crop to epidemics. In 1845, potato blight struck in Ireland, where the degree of genetic uniformity was high because the entire crop was descended from a small number of introductions. The crop was wiped out, and over the next few years an estimated 1 million people starved to death, and another 1.5 million fled the country. In 1943, it was India's turn. Brown spot disease, aggravated by a typhoon, destroyed the rice crop and started the great Bengal famine. More modern cultivars, though usually bred for hardiness, are not always proof against such epidemics.In 1970, southern leaf blight fungus raced across American cornfields at an incredible 80 km per day, cutting the harvest by 15%.

Nature does not produce individual plants resistant to all pests, diseases and environmental stresses, and neither can the plant breeder. But natural genetic diversity, in which many individuals, each somewhat different genetically, thrive together, allows a population as a whole to better withstand challenges to its survival. New strains are constantly being developed with greater resistance to a broader range of diseases, but there is a catch. The more widely a cultivar is grown — as it will be if it proves resistant — the more likely it is that strains of its pests and diseases will evolve somewhere to break down the resistance carefully bred into the crop by plant breeders. Farmers in Thailand now use a combination of the old and the new. They plant high yielding cultivars during the dry season to take advantage of the productivity of irrigated modern strains

In the wet season, when pest outbreaks are more common, they stick to land races.

The ideal crop plant is one which gives high yields, needs little attention and is resistant to pests and diseases. Not all these qualities can be bred in simultaneously, but with judicious crossbreeding, researchers can work wonders. Genes from many sources have helped breeders adapt crops to a variety of growing conditions. The tomato, for instance, has a wild relative from the Galapagos Islands that has given modern strains so much tolerance to salt water that plants can be irrigated by one third sea water. A wild relative of the soyabean has provided genes to help the crop adapt to the short growing seasons in Siberia. Perhaps the most important use to which a wild relative has been put is in the development of modern cultivars for rice — the world's number one food. The brown planthopper is a pest that not only sucks the rice plant's sap but also transmits a viral disease called grassy stunt. For several years in the late 60s and early 70s, it ravaged the rice fields of Asia. It was finally overcome by the development of the cultivar IR 36 by the International Rice Research Institute. Thousands of breeding lines and other germplasm holdings were screened for resistance, but not a single likely candidate emerged. The researchers then turned to the wild relatives of rice. A population of Oryza nivara in Uttar Pradesh was examined. Three of the thirty plants proved resistant. From these three came a gene that was bred into IR 36, and is still found today in every high yielding rice cultivar grown in tropical Asia.

For all their demonstrated value and potential, wild relatives are usually considered by breeders to be a last resort, and are little used. One reason is that breeders in general are unfamiliar with wild material and the special techniques sometimes required to use it. When crossing a wild relative to a crop to transfer a specific characteristic, unwanted traits — low yields, poor quality, or fruits that shatter and spread the seeds, for instance — are invariably introduced into the progeny. Backcrossing is used to solve this problem. A disease resistant wild tomato relative, for example, is crossed with modern breeding stock. The resulting plants with the highest disease resistance and the fewest unwanted traits are then crossed with the modern cultivar. The process is repeated several times, testing each generation for resistance to the disease. This step-by-step process is long and tedious; a further problem is that the desired genes are sometimes linked with unwanted ones, and breeders may spend years trying to separate them.

To make wild relatives more accessible and easier to use, germplasm enhancement programmes have been started, in which wild relatives and land races are 'pre-bred'. The aim is to remove some of the unwanted traits before crossing them with the crop. Through backcrossing with modern breeding stock, prebreeding transfers useful genes from the wild relatives into a genetic environment in which they may be more easily used by breeders everywhere. Prebreeding has already

shown promise in several crops.

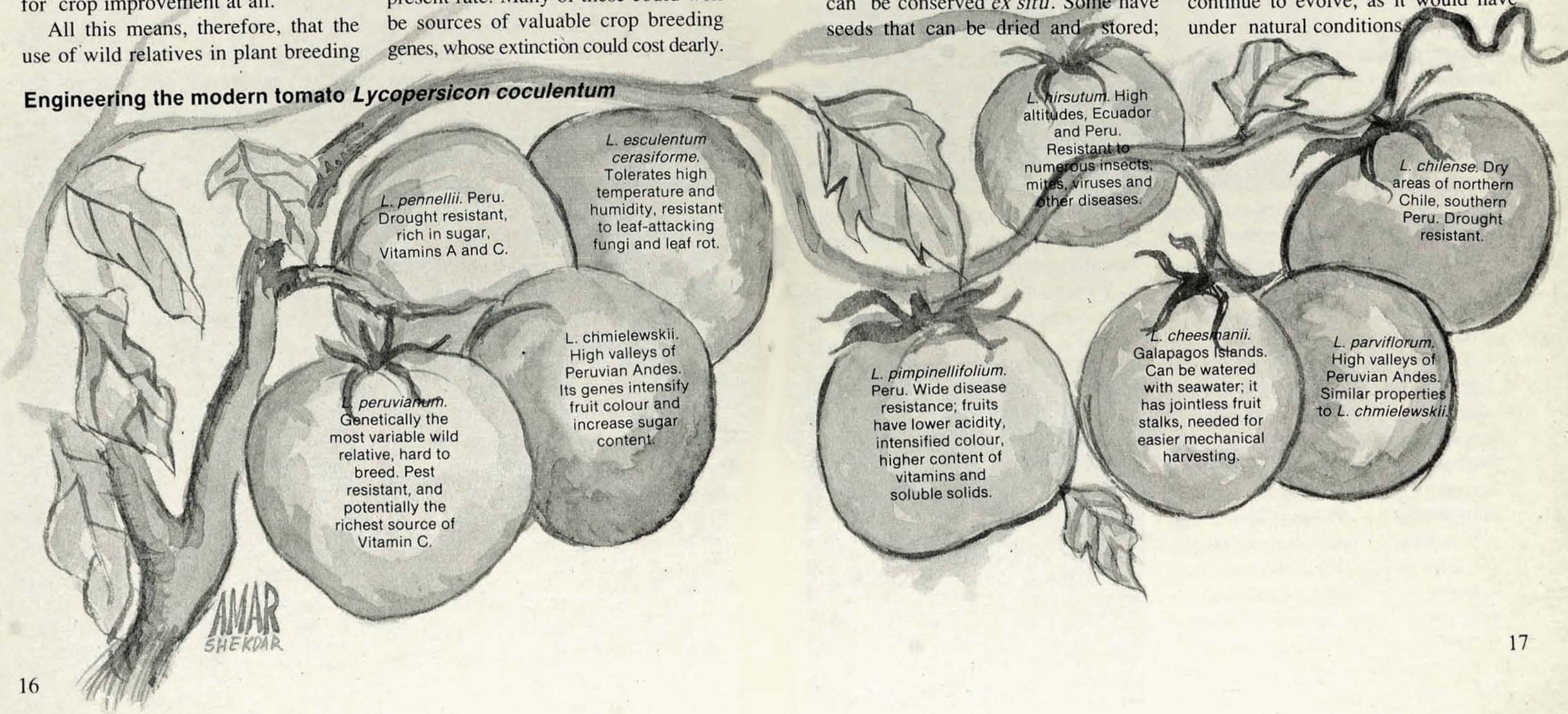
The rapid development of recombinant DNA techniques offers a new approach to the genetic improvement of plants. Transfers of a single gene from one plant to another will have a great impact on plant breeding in the '90s. Plant breeders are already working closely with genetic engineers to develop new cultivars, and we may shortly expect to see progressively more complex gene transfers without the lengthy backcrossing of conventional techniques. Such techniques could be used to introduce genes from more distant relatives that cannot at present be used for crop improvement at all.

All this means, therefore, that the use of wild relatives in plant breeding will increase sharply in the near future. But for this to happen, there must be available an adequate stock of these wild relatives.This is no longer guaranteed, given the massive and worldwide destruction of habitats. Land is being cleared for farms, houses and industry. Over 7 million hectares of tropical forests are being felled and burnt each year; and, especially in dry areas, grasslands are being ravaged by overgrazing. The IUCN estimates that 60,000 species of plants — one fourth of the world total — will become extinct or near-extinct in the next fifty years if the destruction continues at its present rate. Many of these could well be sources of valuable crop breeding genes, whose extinction could cost dearly.

Ideally, wild relatives should be conserved *in situ*., with the areas where they are found in sufficient numbers being declared protected. Sanctuaries and biosphere reserves sometimes contain useful populations of wild relatives — but not always. Reserves specifically designated for wild relatives would be more useful. India has set up its first 'gene sanctuary' in the Garo Hills in Assam for wild relatives of citrus. More such reserves are being planned for banana, coffee, rice, sugarcane and mango.

But setting aside large tracts of land for the purpose may not always be possible. Fortunately, many crop plants can be conserved *ex situ*. Some have seeds that can be dried and stored; under proper conditions, the seeds can remain viable for several decades. Alternatively, growing plants can be transplanted , or even grown in vitro in tubes of nutrient agar. This method is well suited to the mass cloning of a single species or cultivar, and is the only option for plants which do not form seeds, such as those propogated from bulbs or rhizomes. *Ex situ* methods can keep germplasm safe when plants are destroyed in their natural habitat, and have the advantage, to the user, of making material from widely scattered places available at one place, ready for immediate use. On the other hand, such methods do not allow a species to continue to evolve, as it would have under natural conditions.

Engineering the modern tomato *Lycopersicon coculentum*



SASHIREKHA IYER

Right :
Cocoa beans. Developed from wild plants, cocoa is now a major industry.

Below :
Momordica dioica, or Kantoli. A nutritious vegetable in its wild form, but not widely cultivated.

A judicious combination of *in* and *ex situ* methods is perhaps the only answer. Certain wild relatives with a narrow range may require immediate protection, and a small reserve may be sufficient. Those whose diversity extends across whole continents may require a system of reserves for the more concentrated areas of their diversity, and ex situ conservation for the remaining populations. This approach may also be the best for those wild relatives (grapes, yams, onions) whose diversity is not yet well understood.

Some wild relatives are threatened as species, but many more are threatened with genetic erosion, which, though less dramatic, is a serious danger too. Such genetic erosion, or loss in genetic diversity, is caused by the loss of individuals or populations. Even local populations of plants can be highly variable, and so their loss means a reduction in the diversity of the available gene pool. When the habitat where a species is found is reduced or degraded, outlying populations are lost — and it is these outlying populations that are sometimes the most valuable, because they often contain special characteristics, such as adaptation to a more extreme environment than the rest of the population, or resistance to a local disease. Genetic erosion is difficult to measure species by species, but the loss of forests, grasslands and other natural habitats around the world leaves no doubt that it is happening virtually everywhere.

Wild relatives of only a few crops such as wheat, potato and tomato have

M. R. ALMEIDA

Sorghum (Jawar) — an important staple food in Asia and Africa; widely used as animal feed in U.S.A. and Europe. It is part of a large group of wild grasses, most of which have not been adequately studied for crop breeding.

ISAAC KEHIMKAR

been widely collected and preserved in seed banks. For example, an estimated 70% of wild species of rice still remain to be collected. In most cases, wild germplasm represents less than 2% of the seedbank holdings for each crop. With human populations and the demand for food burgeoning, and land getting increasingly scarce, food producers and plant breeders will have to develop a much wider range of crops than is now available, in particular those adapted for local situations and for marginal lands. This would require the effective conservation of wild relatives, retaining as much of their diversity as possible. No one can predict which variants will be needed in future. The more variation is conserved, the greater the chances that breeders will find the characteristics they seek .

What is the future for wild relatives? We have come a long way in understanding their unique properties, seeing how useful some of them are, and glimpsing how useful many others might have been. Lately, we have begun to conserve them, but there is still much to be done, and not much time in which to do it. One thing, however, is clear: part of ensuring a future for the world and its growing human population will be safeguarding the future of the wild relatives of crops ■

BINOCULARS and you

J. S. SERRAO

Birdwatchers frequently write to the BNHS, seeking advice on what type of binoculars would be best for the pursuit of their hobby. This note has been written with such enquiries in mind. The most convenient and suitable binoculars for birdwatching have the specifications 6x30, 7x35 or 8x40. The first figure indicates the magnification, and the second the diameter of the objective lens in millimetres. Magnification in binoculars is the number of times the object viewed is apparently brought nearer to the observer. The diameter of the objective lens governs the amount of light admitted into the instrument. Considering that sunlight is bright in India for most of the year, the above objective lens diameters are ideally suited. Indeed, 8x40 binoculars are used in the colder climate of Europe, where haze hangs in the air for the greater part of the day or year. 7x50 glasses are also commonly used by birdwatchers in India. Such a pair comes in handy for stargazing too. But we do not value it much for birdwatching, because the admission of too much light causes a diffusion of the image.

The ratio of the diameter of the objective lens to the magnification is known as the exit pupil. For best results, the exit pupil should be as close as possible to the normal diameter of the pupil of the eye. The exit pupil in the specifications recommended above is 5mm, which is also the approximate diameter of the pupil of the human eye under normal light conditions. Such binoculars would therefore be ideal for adults with normal eyesight. For children, and in advanced old age, binoculars with a smaller exit pupil, such as 6x25, are handy.

A wide-angle binoculars is always preferable to others, and the angle is invariably marked on the piece (7.5 degrees etc). The larger the angle, the wider the range of view, and the better the piece. Where no angle is marked, an indication of the angle is given by the marks such as 584 ft. in 1,000 yards. It means that when you look through the binoculars, you command a view of an area 584 feet across and 1,000 yards away. Calculating the angle is then a simple matter of high-school trigonometry (see diagram).

Now check the piece for fungus or mould. Hold the eyepiece to the light and look through the object glass for the presence of any webby material or stains. Fungused instruments are not worth having. (Fungus can also develop later, during storage — your binoculars are therefore best stored in an airtight container along with a small quantity of hygroscopic material such as silica gel.)

Having found a pair of binoculars that meets these specifications, don't take them home yet. Make sure you are satisfied with the adjustment of the piece and the definition of what you view, and that the piece is corrected for colour correlation. Take the binoculars outside the shop (of course, with the vendor's permission). Focus them on an object standing against a clear sky about 400 to 500 metres away. Faulty adjustment would give you a double image. Focussing the glasses as you have done, move slowly from side to side. If the glasses have not been corrected for definition, the change of view you get as you move is abrupt and disjointed. This indicates poor definition. In a good piece the loss of definition is slight or negligible, and *not abrupt*. As you view, make sure there is no coloured border to the image you see. If there is, the piece suffers from the defect of astigmatism, and is worthless.

Another point to remember while checking for adjustment is to test for parallax error. Rest the binoculars on a steady surface such as a stool or table. Close one eye, and focus on three or four objects about 500 metres away. Now close the eye through which you were looking, and peer through the binoculars with the other, and make sure that the objects remain in the same part of the field as before, and are not displaced.

Now all that remains is to pay for them, and then off to look for your feathered friends. Happy birding■

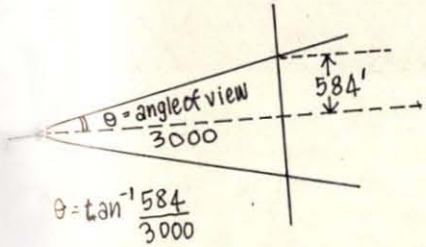


PHOTO ISAAC KEHIMKAR

BUTTERFLIES

Early stages in the life cycle

NARESH CHATURVEDI AND ISAAC KEHIMKAR

Alarmed Red Helen caterpillar, with osmaterium erected.

Hindu mythology tells us that the caterpillar was a resident of Lord Brahma's celestial garden. It was a voracious feeder, and wrought havoc among the exotics that adorned the garden. An irritated Brahma cursed the caterpillar. It became lethargic, lost interest in grubbing on the greens, and finally petrified into a dead lump. Despite the trouble it caused, the caterpillar fascinated the lesser gods. They interceded with Brahma on its behalf, and apparently pleaded their case well. Brahma relented, and from the petrified lump emerged a beautiful winged jewel — the butterfly.

Butterflies develop to maturity in four stages—egg, caterpillar, pupa and finally the winged adult — and their appearance during each stage is strikingly different. Many other insects too pass through such metamorphoses, but in none of them are the stages as distinct as in the butterfly. Grasshoppers and cockroaches, for example, exhibit only three stages, and newly hatched nymphs of the grasshopper look almost identical to the adult, except for wings and ovipositor.

A butterfly's life starts in the fertilized egg that is usually laid on the caterpillar's foodplant. The female butterfly first 'surveys' the area where these plants are likely to occur, and probably senses their presence through her antennae and palpi. She then examines the leaves and shoots by drumming on them with her short forefeet, which contain taste sensors. Once the plant is found suitable, the eggs are laid, singly or in batches depending on the species.

When fully developed, the caterpillar eats a hole in the eggshell and crawls out. In most species the newly hatched caterpillar's first meal is the empty eggshell, whose consumption, it appears, is vital for the caterpillar's initial growth. From then on it begins to feed on the leaves, flowers or developing seeds of the preferred foodplants.

Though caterpillars of different species appear quite different from each other, they have a common basic structure. The caterpillar's segmented, worm-like body consists of the head and thirteen segments. The first three segments following the head form the thorax. Each segment has a pair of true, or thoracic, legs which are used mainly for holding the leaf while feeding. The remaining ten segments form the abdomen, which has five pairs of fleshy, non-jointed legs on five of the ten segments. These are the prolegs or false legs. Prolegs, which form the main means of locomotion, are equipped with small hooks, and the centre of each foot acts as a tiny suction cup. The last pair of prolegs is known as the anal clasper.

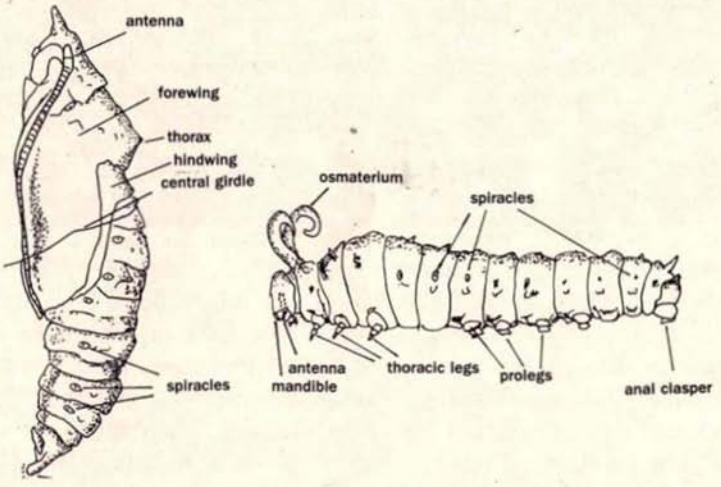
Caterpillars have evolved an array of adaptations to survive the onslaught of a host of enemies—insectivorous birts, mice, shrews, lizards, frogs, spiders, ants, bugs, and beetles. Then there are specialized parasitic wasps and tachinid flies

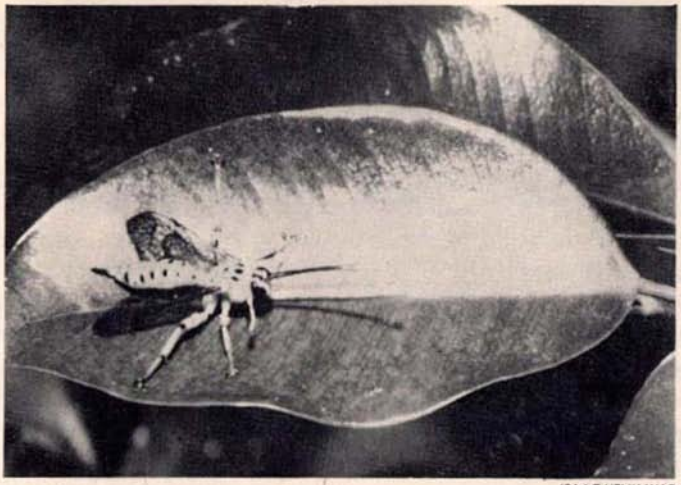
which lay their eggs on, or even inside, the caterpillar's skin. Young parasites on hatching begin to eat the innards of the caterpillar without harming its vital organs, so that the caterpillar lives on till the grubs emerge to pupate, leaving their hollowed-out host to die. Mason wasps carry an anaesthetised caterpillars to their mud cells as food for their grubs. Nematode worms, bacteria, viruses and fungi leave blackened, liquified caterpillars.

Camouflage is usually an effective means of defence. Most caterpillars come in shades of green and brown, with lines or colour patterns that render them almost invisible among the foliage. Others, in contrast, call attention to themselves by their bright warning colours. They feed on poisonous plants, and are therefore distasteful to predators. It would naturally be advantageous to advertise this fact.

There are other tricks in the bag too. Some caterpillars, like the Skippers, roll leaves around themselves with silk bands, while caterpillars of the Red Pierrot live within the fleshy leaves of *Bryophyllum* species. The Silverline lays its eggs on plants that are host to certain species of ants, which protect the caterpillar in return for a sweet honeydew the caterpillar excretes. Caterpillars of some Nymphalids are protected by an armour of spines. The Swallowtail caterpillar has a gland called the osmaterium situated at the base of its head, which, when the insect is alarmed, protrudes like a pair of orange horns and gives off a disagreeable smell.

Butterfly caterpillars may have some sparse hair, fleshy spines or filaments, but none are sharp or cause irritation. (Some moth caterpillars, in contrast, can cause pain or irritation or both.) When the





ISAAC KEHIMKAR

Blackspotted Yellow Ichneumon *Pimpla punctator*. This wasp is a specialised predator on caterpillar bodies.

caterpillar grows, its skin, being the external skeleton, does not. The skin thus becomes tighter, until the caterpillar stops feeding and comes to rest for a day or two. A new skin is formed beneath the old one; the old skin splits behind the head, and is forced down by the emerging caterpillar. The tough skin of the head falls off separately. The caterpillar then rests till the new skin hardens. The stage between such moultings is known as an instar. The number of instars varies from species to species, but there are usually five instars before the caterpillar pupates. Often the appearance of the caterpillar changes considerably from the first instar to the last.

When fully grown the caterpillar stops eating and becomes sluggish for a while. But soon it starts moving restlessly up and down the branches, often wandering off to another plant in search of of a suitable place to pupate. Having found one, it anchors itself to the branch with its anal claspers and spins a pad to hold itself in position. Some species, in addition, spin a silken girdle, which is looped around the thorax and the branch or leaf. About 10 hours later the immobile caterpillar starts wriggling rhythmically while remaining firmly attached to the branch. The skin splits from the top of its head and is worked backwards and held firmly between the last two segments of the pupa. The cremaster, which bears tail hooks, is withdrawn from inside the skin and is quickly fastened to the pad of silk.

As the skin is shed the soft, wet, pale pupa is revealed. The chitin soon hardens and in the process the shape of the pupa changes slightly. The front part of the pupa, consisting of the head, antennae, wings and legs, is immobile. The segmented abdomen is mobile in most species. The pupa appears lifeless, but dramatic changes have begun to take place

within. Cells that had remained dormant begin to develop. Some of the vital organs get reconstructed to suit the needs of a nectar-feeding, flying insect. The colours and wing patterns develop, and about 8 to 10 hours before the butterfly emerges, the colours begin to show through the pupal case.

The pupa cannot move; protection from enemies is therefore even more critical during this stage. Pupae of vitually all species are well camou flaged. Most resemble green or dry leaves, some have silvery markings that look like raindrops or dewdrops, and some resemble thorns or twigs. Some, however, sport bright colour patterns to warn predators of distasteful consequences. Pupae of the Skippers, are enclosed in cells made of leaves.

When the butterfly is ready to emerge, the skin of the pupa splits behind the head. The slit widens, allowing the butterfly to climb out. It either hangs onto the pupal case or the underside of a leaf or branch. The newly-emerged butterfly is soft, and its abdomen swollen with its body fluid. The wings are at first limp and shrivelled. Gradually, the fluid is pumped from the abdomen into the veins of the wings. The abdomen shrinks, and the wings open out and expand to full size; and a few minutes later, the butterfly is ready to take to the air ■

ATTRACTING BUTTERFLIES to your garden, or even to the potted plants on your balcony or window sill, is not difficult, provided you have the right plants. Surprisingly roses, gladioli, dahlias, chrysanthemums, begonias, hydrangeas and lilies fail to attract butterflies. They would rather settle on a yellow lantana or a pink cockscomb growing wild along roads. Marigold, cosmos, candytuffs, periwinkle or *sadaphuli (Vinca rosea),* Mexican sunflower (*Tithonia* sp.) and verbena, which can all be grown from seeds, are great favourites. So are yellow and purple lantana, *Nirgudi (Vitex negundo)* and Christmas flower *(Poinsettia pulcherrima).* These can be easily propagated from cuttings. Butterflies in general prefer purple, yellow and pink flowers.

Curry-leaf or *kadipatta* plant brings the Common Mormon to lay eggs, and a lemon plant invariably attracts the Common Mormon as well as the Common Lime. Common Emigrant prefers to lay eggs on the Siamese Cassia and *amaltas* or Indian Laburnum. These are medium-sized trees, but remain small in pots. *Sitaphal* or the Custard Apple and *asupalav (Polyalthia* sp.) saplings attract fast flying Tailed Jay for laying. The pretty little Red Pierrot appears from nowhere to land on a thriving, fleshy-leaved *Kalanchoe* or *Bryophyllum.* In the monsoon, the Grass Demon Skipper will find its way to *sugandhi (Hedychium* sp.). The Common Crow lays on the *banyan, peepal,* or any other fig-related sapling. Even the Oleander *(Nerium* sp.) is included in its larval food. These few plants are good enough to start a butterfly attracting garden. Later, wild plants like *aak* or *rui (Calotropis* sp.) could be added to seduce the Plain Tiger. A horde of such foodplants grow in the wild.

Besides flowers, several species of butterflies will come readily to an over-ripe banana or guava. However, a Common Nawab or the Tawny Rajah is enticed neither by flowers nor by fruits. A rotting crab or prawn head is more to their tastes.

To be continued, as a series of articles on the early stages in the life cycle of some common butterflies.

REPORT OF THE COMMITTEE FOR THE FIFTEEN MONTH PERIOD ENDED 31ST MARCH 1989
105TH 'ANNUAL' REPORT

MEMBERSHIP

The membership of the Bombay Natural History Society (BNHS) remained more or less static and showed only a marginal increase in 1988 over 1987 as shown below:

It is hoped that with the increase in members' activities generated by the various Sub-Committees constituted by the Executive Committee, membership will increase considerably in the coming months. The strength and independence of an organisation like the BNHS depends on its ability to attract and increase its membership.

As on 31st December

Type of membership	1984	1985	1986	1987	1988
Ordinary Members	1762	1764	1680	1960	2008
Corporate Members	132	152	138	81	83
Life Members	562	639	737	986	1057
Compound Corporate Members	107	108	115	115	115
Student Members	192	164	141	190	206
Honorary Members	3	3	3	3	3
Vice Patrons	6	6	6	6	6
Centennary Life Members	3	3	3	3	3

FIELD PROGRAMMES

Membership and Programmes Sub-Committee

Chairperson : Dr (Ms) M. Haribal
Convenor : Mr Naresh Chaturvedi
Members : Mr Parvish Pandya
Dr A. Kothari
Mr Kisan Mehta
Dr A.N.D. Nanavati, Hon. Secretary
Ex-officio Dr Pratap Saraiya, Hon. Treasurer
Mr J.C. Daniel, Curator

With the assistance of many members who volunteered their services for guiding members in field outings and other programmes, the Programmes Sub-Committee could undertake a large number of field activities as described below:

During the year under review, members in the Bombay area were taken on nature walks to areas of natural history interest such as Mamabanja, Chinchoti falls, Kukoba hills, Uran, Jambulwadi, Karnala Bird Sanctuary, Kehim seashore etc. The seashore outings were particularly well attended. Besides, weekend camps were organised at Gaurapur, Jaikwadi, Castle Rock, Prabalgad, Sawantwadi, Malshejghat, Suriamal, Nandur, Madhmeshwar and Palghar. We are examining the feasibility of arranging field programmes in other parts of the country for members of the BNHS.

Three major field camps were held during the year. The first was a high altitude camp in Sikkim which enabled members not only to trek but also to watch the birds and study the rich but-

High altitude, high spirits — Sikkim, November '88 MEENA HARIBAL

terfly and other fauna and flora of the eastern Himalayas. The camp was for 11 days and 3 batches of members trekked from 900 m to over 4,000 m.

The second camp was held in the Manas Sanctuary in Assam, one of the best sanctuaries in India and a World Heritage site which holds several endangered species, including the Hispid Hare and Pygmy Hog. The third camp was held at Ranthambore Sanctuary in Rajasthan, a Project Tiger area (as is Manas). The members in 3 batches stayed for 5 days and 4 nights to look at the tiger and other interesting fauna and flora and observe problems of management of the protected area.

The other programmes at Bombay included film shows and lectures by guest lecturers and BNHS members and research staff. Exhibitions of photographs on wildlife and of stamps were also held.

PUBLICATIONS

Publications Sub-Committee

Chairperson	: Mr C.J. Guzder
Convenor	: Mr J.C. Daniel
Member	: Dr B.F. Chhapgar
	Dr A.N.D. Nanavati, Hon. Secretary
Ex-officio	Dr Pratap Saraiya, Hon. Treasurer

The Publications Sub-Committee undertook the task of reorganisation of the publication structure of the BNHS Journal and the results can be seen in the coming year. The Sub-Committee also proposed to reorganise the processing and management of the publications of the BNHS.

In 1987, the Honorary Treasurer, with the approval of the Executive Committee, negotiated an arrangement for the worldwide distribution of the Society's publications by the Oxford University Press. Under this

arrangement, except for sale to members at concessional rates by the Society, all other sales are being handled by the OUP. This arrangement has proved to be highly advantageous to the Society and has resulted in the re-printing, within a short period, of most of the popular publications of the Society.

Journal:

265 notes and articles were received from members and others for publication in the Journal during the year. From among these and notes and articles received earlier, 157 were accepted for publication.

During the year, 4 issues of the Journal i.e., vol. 84(2&3) and vol. 85(1&2) were published. The 956 pages of these Journals held 247 articles and notes.

Hornbill:

The two issues of the first two quarters of the magazine were published in the usual format. The remaining issues were combined into one as the Salim Ali special issue of the Hornbill. The Hornbill continues to be popular and to attract members. Under the revised rules, this magazine is sent free to all members of the BNHS, while the Journal now requires a separate subscription.

NATURE EDUCATION SCHEME

Nature Education Sub-Committee

Chairperson	:	Mr U. Rane
Convenor	:	Mrs S. Grubh
Members	:	Dr (Ms) M. Haribal
		Mr S.A. Hussain (ODA)
		Dr Arun Joshi
		Ms Heta Pandit
		Mr Parvish Pandya
		Dr A.N.D. Nanavati, Hon. Secre tary
Ex-officio		Dr Pratap Saraiya, Hon. Treasurer
		Mr J.C. Daniel, Curator

The regular activities like field trips, slide shows, camps, competitions etc. involving schools and col-

Teacher's camp at Bharatpur — jungle lore from the local DFO R.B. GRUBH

leges in Bombay were continued during the year. 20 slide/film shows and talks were conducted for schools, colleges and nature clubs in Bombay. These included Municipal schools and teachers' colleges. 41 field trips were organised for schools and colleges at Borivli National Park and Tansa Sanctuary. Additionally, 17 study visits were organised for schools to the Natural History Section of the Prince of Wales Museum, Jijamata Udyan and Taraporewala Aquarium. A quiz programme for schools and junior colleges was organised on World Forestry Day. A vacation camp for children was organised in coordination with R.C.F. club.

The Nature Education Sub-Committee members carried out various educational programmes for the BNHS members, college students and rural children. These included slide shows, film shows, exhibitions, nature trails, competitions in photography, basic courses in natural history subjects, nature orientation camps for members and armed forces personnel, awareness programmes on tree conservation and publicity through newspapers, radio and television. A teachers' camp was organised at Bharatpur. The special features of the programmes conducted in the year 1988 were:

1. Involvement of more voluntary organisations in our rural programmes.
2. Active involvement of the BNHS staff and members in the nature education activities.
3. Introduction of nature education courses for amateurs.
4. Extension of nature education activities to Karnataka and Gujarat with the help of our members in those states.
5. Conservation workshop at Kota for army officers. This is likely to be an annual feature in future.
6. A unique syllabus is being prepared for tribal children (who do not have access to facilities like schools, books etc.) to orient them towards nature conservation with a scientific approach. This experiment is being carried out at Murbad in Thane district in coordination with Lokvidnyan Chalwal and Shramik Mukti Sanghatana.
7. Compilation of educational literature on natural history in English and Marathi.
8. An orientation camp for selected teachers from Bombay was organised at Bharatpur.

COLLECTIONS

Collections Sub-Committee

Chairperson	:	Mr H. Abdulali
Convenor	:	Mr N. Chaturvedi
Members	:	Dr M.R. Almeida
		Dr B.F. Chhapgar
		Dr (Ms) M. Haribal
		Mr N. Jamdar
		Staff in charge of different collections
		Dr A.N.D. Nanavati, Hon. Secretary
Ex-officio		Dr Pratap Saraiya, Hon. Treasurer
		Mr J.C. Daniel, Curator

The BNHS presently holds a reference or study collection of 18,000 + mammals, 26,000 + birds, 7,000 + rep-

tiles and amphibians and over 50,000 insects, a collection of bird eggs and a small collection of shells. The purpose of the collection is to assist in taxonomic studies.

Mammals:

Assistance was given to Ms Chandran who had planned an ecological study of Indian rodents. Another scholar, Mr Sundaraj, collected data on eye measurements. Dr Allan Rodgers of the Wildlife Institute studied skulls of Cervidae and Bovidae in the collection. Hair samples from the collections were sent to Dr Johnsingh for help in the identification of hairs in scats. Otter specimens were studied and a key prepared for their identification. A presentation on otter identification was given at the Otter Symposium held at Bangalore.

The work of computerising the data of the mammal collection was begun.

Birds:

The systematic cataloguing of the collections by Mr Humayun Abdulali was continued during the year. Under this programme, specimens of *Zoothera* and *Turdus* were sent to the British Museum for opinion. Specimens were also given on loan to various workers for studies. 47 specimens of birds collected from Arunachal Pradesh in October 1988 and 28 specimens from Mandapam and Point Calimere bird ringing camps were added to the collections.

Reptiles:

Collection of amphibians made by the Oxford University Students Expedition to the Srivilliputur Hills, Tamil Nadu, was identified. Similarly, specimens received from Dr S.K. Dey, collected by him from Sikkim were also worked out. A small collection received from Dharwad (Dr Kanmandi) and Kerala (Dr M.I. Andrew) were identified and returned. Specimens of the Cobra Naja naja were sent to Dr R.S. Thorpe, Department of Zoology, Aberdeen, U.K., for study.

Insects:

A small collection of butterflies received from the Oxford University Students Expedition was identified. Information on Mantis found in Maharashtra was given to a research worker from Pune. 40 butterflies collected from Perambikulam area and Kashmir were added to the collections.

Besides students and staff of colleges and research institutions, several BNHS members from Bombay and outside visited the collections for reference, research and identification of specimens.

Herbarium:

Specimens donated by Hindustan Ciba-Geigy were added to the collection. Over 212 specimens received from members and staff were identified.

A survey trip was made to the Surat Dangs with a member-researcher and plant specimens were collected and identified.

During the year, 86 field trips were made to the BNHS land at Goregaon and plants of 153 quadrats of 10 x 10 m were identified and studied. The data has been entered into the computer and will be analyzed.

NATURAL HISTORY STUDIES

Natural History Studies Sub-Committee

Chairperson	:	Dr E.K. Bharucha
Convenor	:	Mr S.A. Hussain
Members	:	Mr M.R. Almeida
		Mr Bharat Bhushan
		Prof P.V. Bole
		Dr B.F. Chhapgar
		Mr Rishad Naoroji
		Mr Ulhas Rane
		Dr A.N.D. Nanavati, Hon. Secretary
Ex-officio		Dr Pratap Saraiya, Hon. Treasurer
		Mr J.C. Daniel, Curator

A Sub-Committee was set up this year with the objective of encouraging studies in various fields of natural history by members and students. The committee was assigned the following funds with specific objectives:

It was decided as a preliminary exercise to identify members interested in various aspects of natural history by setting up study groups for members in botany, forest ecology, general ecology, ornithology, mammals herpetology, insects and archnids, aquatic fauna and geology to build up a suitable data bank for this purpose. But the response to the announcement made in the Hornbill about the study groups was negligible.

Some of the activities of the Sub-Committee funded and generated during the year were:

ICBP Membership:
The BNHS was made a subscribing member by providing funds towards subscriptions to the International Coun-

Name of the Fund	Fund Objectives
1. Salim Ali Loke Wan Tho Ornithological Research Fund	To provide an opportunity, through grant of fellowships or otherwise, to undertake study and research on problems of Field Ornithology.
2. Pirojsha Godrej Field Work Fund	To provide assistance for research and training on environmental ecology.
3. Sir Dorab Tata Trust Field Work Fund	To promote field work and research in natural history.
4. W. Boolchand Trust Fund	To provide scholarships for the study of ecology & ornithology.
5. Plant Studies Fund	To provide for research and conservation of floristic elements and studies on inter-relationships between plants and animals.

cil for Bird Preservation (ICBP). It was felt that it would be advantageous to BNHS to become a member of ICBP and initiate moves to set up an ICBP Indian National Section under the leadership of BNHS and with the collaboration of other NGOs.

Waterfowl and Wetlands Newsletter:

The BNHS, in association with the International Wetlands and Waterfowl Research Bureau, conducted the Asian midwinter waterfowl counts in India. Over 300 birdwatchers, most of them BNHS members, participated in the count. The results of the counts were compiled in a newsletter, Wetlands and Waterfowl, partly funded by the NHS Sub-Committee. The newsletter was distributed to all participants as well as to key personnel in India and abroad.

Photographic record of BNHS land in Goregaon:

The BNHS collection staff have been carrying out natural history studies in the land alloted to BNHS at Goregaon. A support grant was given to keep a photographic record of the flora and fauna of the area at different times of the year and record their natural cycle.

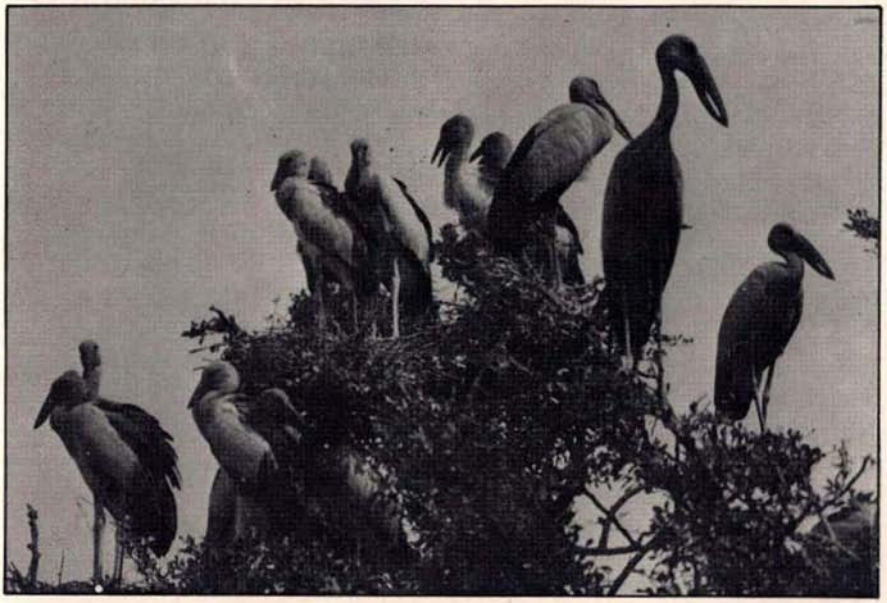
Other studies — M. Phil thesis:

a] Two students of the AVC College, Mayavaram were awarded support grants so as to enable them to write up their respective M. Phil theses. The students had worked at the Keoladeo National Park.

b] One student Mr. Maranko under the aegis of the BNHS field project had studied the wintering behaviour of the Siberian Crane.

Openbilled Stork colony at Puniakshetram

MEHRAB JOHNSON



Backnecked Cranes wintering in Bhutan PRAKASH GOLE

c] Another student, Mr Neduraman, studied the habitat utilisation of the Siberian crane at Keoladeo National Park.

Scholarship:

A scholarship was awarded to Ms Mehrab Johnson of Osmania University for the study on feeding and breeding biology of Openbilled Stork under the guidance of Prof. J.V. Ramana Rao. The field work is being carried out at Kolleru lake, Krishna dist. and Puniakhesturan, East Godavari dist. Andhra Pradesh.

ICBP Asian Section Conference at Bangkok in April 1989:

Two of the BNHS scientists, Mr S.A. Hussain and Dr A.R. Rahmani, were offered grants for attending the above conference for exchange of information on conservation and for establishing communication among the bird conservation organisations of Asia. At the conference, Mr Hussain read out the National status paper prepared by Mr Daniel as well as his own paper entitled "Bird Migration in Asia - a case for regional cooperation" while Dr Rahmani presented a paper on "Bustard Conservation in India".

Mr Hussain was elected as one of the two Vice-Chairmen for the ICBP Asian section for the next four years.

THE SALIM ALI NATURE CONSERVATION FUND (SANCF)

SANCF Sub-Committee

Chairperson	:	Mrs D.S. Variava
Convenor	:	Mr Bharat Bhushan
Members	:	Dr E.K. Bharucha
		Mr D. Solanki
		Mr S.A. Hussain
		Dr A.N.D. Nanavati, Hon. Secretary
Ex-Officio		Dr Pratap Saraiya, Hon. Treasurer
		Mr J.C. Daniel, Curator.

The Sub-Committe continued to initiate as well as support activities of conservation interest from SANCF. Major projects during the year were:

1. A survey of the status of the Black-

necked Crane in Bhutan by Mr Prakash Gole and Col. Chacko. Mr Gole has presented the recommendations to the Royal Government of Bhutan.

2. A survey of the status of the Malabar Civet in the Elayur and Beypore areas of Kerala by Mr N.J. George of Calicut University. Mr George had earlier rediscovered the Malabar Civet after nearly fifty years.
3. A survey of the status of the Dugong in the Gulf of Mannar in Tamil Nadu by Dr Helene Marsh. The preliminary report has been received. The Tamil Nadu Forest Department have initiated follow-up action on the recommendations made in the report.
4. The Mangroves of the Krishna estuary in Andhra Pradesh were surveyed by Mr. Narendra Prasad. The recommendations have been followed up with the Andra Pradesh Forest Department and the area has since been declared as a sanctuary.
5. An aerial survey of the Surat Dangs in Gujarat by Dr E. Bharucha was partially supported as part of other ecological studies of the Surat Dangs.
6. On the basis of a request for studies by the local NGO, Honavar Taluka Parisara Kuta, financial support was extended to Mr. Nitin Jamdar to conduct a short survey of the Sharavati Valley in Karnataka.
7. Wild Buffalo survey in Madhya Pradesh - SANCF sponsored a short survey with funds provided by the Department of Environment, Government of India, to record status of the Wild Buffalo populations in the Bastar and Raipur districts of Madhya Pradesh.

In addition, SANCF extended financial support for a) preparing an exhibition at Bombay on the "Save Sahyadris March"; b) organising a painting competition and a quiz competition for students; and c) organising a nature discovery room for students at the BNHS.

A Conservation Officer was appointed during the year.

PROJECTS

Projects Sub-Committee

Chairperson	: Prof P.V. Bole
Convenor	: Dr R.B. Grubh
Members	: Mr H. Abdullali
	Mr M.R. Almeida
	Dr E.K. Bharucha
	Mr. Karamchandani
	Senior Scientists in charge of major projects.
	Dr A.N.D. Nanavati, Hon. Secretary
Ex-officio	Dr Pratap Saraiya, Hon. Treasurer
	Mr J.C. Daniel, Curator

During the year 1988 the BNHS handled six major field ecological research projects. These were:

1. Bharatpur (Keoladeo) Ecology Project (funded by USFWS)
2. Bird Migration Project (funded by USFWS)
3. Elephant Ecology project (funded by USFWS)
4. Endangered Birds Project (funded by USFWS)

5. Pt. Calimere Ecology Project (funded by USFWS)
6. Bird Hazard to Aircraft Project (funded by GOI)

1. Bharatpur Ecology Project

It is an extension of the original Bharatpur Hydrobiology project and the expected date of completion is April 1990. During the year, the 15 research staff headed by Dr V.S. Vijayan continued to collect data on various ecological parameters governing the Bharatpur wetland ecological system. The parameters included limnological aspects, vegetation, macro-invertebrates, fishes, herpetology, ornithology and mammalogy.

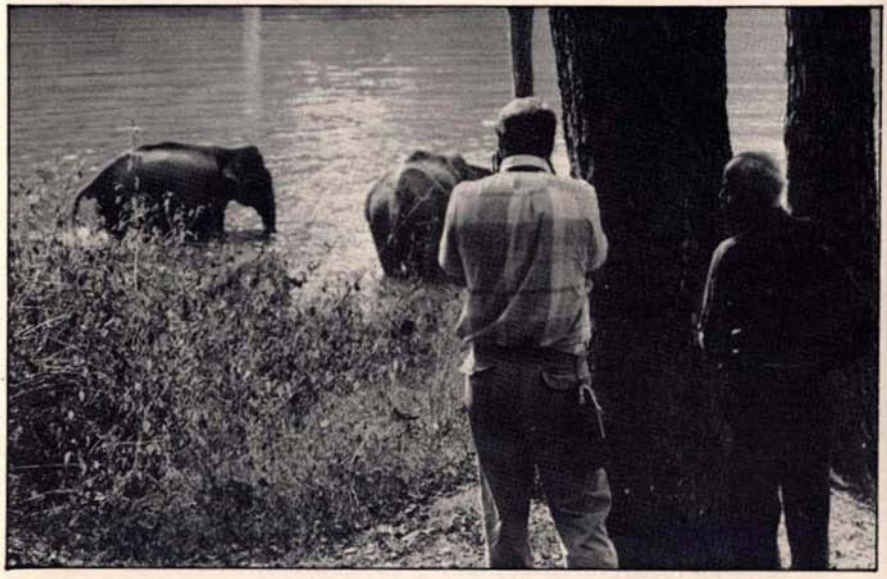
The number of fish species recorded within the Keoladeo National Park rose to 42. Two more amphibian species were collected. The population of aquatic birds was higher than during the previous year. The wintering population of the Siberian Crane did not settle down inside the park because of the drought.

2. Bird Migration Project

This is another extension project of the original project, 'Movement and population of Indian Avifauna. The expected date of completion is September 1992. Mr Hussain, the Project Scientist, and his team of five research staff handled the field programme as well as entering of banding data into the computer. Bird banding was conducted at Shivpuri, Karera (MP), Khabar Tal (Bihar), Hingolgadh (Gujarat), Point Calimere and Mandapam (TN). A total of 2224 water birds of 32 species were ringed during the year. Random netting was done at certain sites in order to assess the species composition of terrestrial birds.

Elephant Studies at Mudumalai

D.K. LAHIRICHOUDHURY



3. Elephant Ecology Project

This project is an offshoot of the original 'Endangered Species' Project and is expected to continue until September 1992. The work is carried out by four research staff under the guidance of Mr J.C. Daniel. The major studies carried out during the year were i) feeding ecology of the elephants, ii) population dynamics, behaviour and conservation problems, and iii) migration of peripheral elephant population. The first two studies were carried out at the Elephant Project Field Station at Mudumalai (TN). The third study was initiated mainly to understand the possible reasons for the unpredictable movements of elephants in the existing degraded forests and even straying out into cultivation fields resulting in lethal encounters with man.

The areas covered were Hosur and Dharmapuri Forest devisions of Tamil Nadu, Chitoor division of Andhra Pradesh and Kanakapura division of Karnataka. The studies conducted at Mudumalai as well as on the peripheral populations of the elephants have given additional insight into the conservation and management problems of elephants. Additional studies were planned for elephants of Dalma in Bihar.

4. Endangered Birds Project

The 'Endangered Birds' project has so far completed an ecological study of the Great Indian Bustard and rediscovery of the Jerdon's Courser. Two more species taken up under the Project for detailed study are the Lesser Florican and the Bengal Florican. The second and final phase of this project is ending in September 1989. Dr A.R. Rahmani and three research staff form the team.

5. Point Calimere Ecology Project

Commenced in 1987, the project aims at understanding the functioning of this complex ecological system with a view to offering management solutions to the forest department. Dr Y.N. Rao (Project Head) and his four colleagues collected field data on the i) phyto sociology of the grazing lands, ii) plant animal interactions, iii) ecology of a few dominant bird species, and iv) ecology of the Blackbuck. Additional aspects are to be taken up during 1989 in order to understand the dynamics of this ecological system.

6. Bird Hazard to Aircraft Project

At the request of the Government of India, the BNHS undertook to make an ecological study of 22 Indian aerodromes. The field work commenced in 1980 and concluded in 1988. During

Male blackbuck, Point Calimere

RANJIT MANAKADAN

RAVI SANKARAN

Bengal Florican: highly endangered, world population of about 400

the last year, field work was limited to follow up observations at a couple of aerodromes with the help of one field staff. The GOI has now financed the BNHS to set up a Bird Hazard Research Cell to help identify bird remnants and to offer advice on bird hazard reduction. The final report of the study is under preparation.

UNIVERSITY DEPARTMENT

During the year the department affiliated to the University of Bombay since 1957 continued to contribute to the scientific study of natural history. Mr Vibhu Prakash submitted his thesis for the Ph.D degree in field ornithology, on "The General Ecology of raptors in Keoladeo National Park" under the guidance of Mr J.C. Daniel. Mr Manek Mistry submitted his thesis

Name of Student	Subject of Study	Guide from BNHS
	M.Sc. Zoology	
Mr S. Alagar Rajan	Ecology of Spotted and Ring Dove	Dr R.B. Grubh
Mr Gurmeet Singh	Ecology of Bank Myna	Dr R.B. Grubh
Mr Ramachandran	Ecology of the Jacanas	Dr V.S. Vijayan
Mr Ravi Sankaran	The Ecology of the Lesser Florican	Mr J.C. Daniel
	M.Sc. Botany	
Ms Neelam Patil	Plant-insect interactions	Mr M.R. Almeida
	Ph.D Zoology	
Mr U. Sridharan	Ecology of the resident ducks of Keoladeo National Park	Mr J.C. Daniel
Mr G. Narayan	The Ecology of the Bengal Florican	Mr J.C. Daniel
Mr S.M.Satheesan	Birds of Prey	Mr J.C. Daniel
Mr Sunderamoorthy	The Ecology of terrestrial Birds of Keoladeo National Park, Bharatpur	Mr J.C. Daniel
Mr V. Natarajan	Ecology of the Crow-pheasant	Mr J.C. Daniel
	Ph.D Botany	
Mr P Balasubramanian	Plant-animal Interactions	Prof. P.V. Bole

for Ph.D degree in botany, on "Contributions to the flora of Ratnagiri dist. in Maharashtra" under the guidance of Prof. P.V. Bole. The following students are registered for M.Sc and Ph.D degrees through the BNHS.

LIBRARY

Library Sub-Committee

Chairperson	: Dr B.F. Chhapgar
Convenor	: Mr Isaac Kehimkar
Members	: Mr M.R. Almeida
	Mr Kisan Mehta
	Mr Kiran Srivastav
	Dr A.N.D. Nanavati, Hon. Secretary
Ex-officio	Dr Pratap Saraiya, Hon. Treasurer
	Mr J.C. Daniel, Curator

The library continued to be a much used member facility. In 1988, 132 books were added to the library out of which 30 were purchased for the projects and 7 for the library. 12 books were sent by publishers to be reviewed in the Journal and 14 were received as complimentary copies from authors and publishers. Out of the 69 books received as donation, 29 books were donated by Mr. M. Hidayatullah, the Society's former President, and 20 books were donated by Mr A.B. Vakil.

The Govt. of India extended financial support for the purchase of a photocopier. It is now possible to attend to requests from members for reprints of articles etc. promptly. The air-conditioning of the library with financial assistance given by the Ministry of Environment and Forests, Govt. of India, is in progress. With this, the preservation of valuable books and manuscripts in the library is now assured.

CONSERVATION

The Society was consulted by the Govt. of India and other organisations and by members of the Society on various matters of conservation interest. The Society's representatives on various conservation committees and organisations offer the expertise available at the Society.

The proposal to construct major dams on the Narmada River and the clearance of the proposal by the Government of India for funding was a cause for acute concern. The Committee consulted other like minded organisations and persons on a possible positive approach to prevent environmental damage.

SALIM ALI CENTRE FOR ORNITHOLOGY AND NATURAL HISTORY

We are glad to report that the proposal has been re-activated and the scope of the Centre enhanced by the addition of "Natural History" to its terms of reference. Negotiations have been finalised and the sanction order has been received and funds released for preliminary expenses. We should be registering the new society and commencing operations in 1989.

DONATIONS

We are grateful to the Ministry of Environment and Forests for a grant to purchase an Atomic Absorption Spectrophotometer for the Bharatpur Field

		Rs
1.	General Donations Received from Members	27,315
2.	**Charles McCann Vertebrate Zoology Field Work Fund**	
	Mr S Chaudhury	750
3.	**Dr Salim Ali Memorial Fund**	
	Mrs Kumud N Pandit	100
	M/s Row Dayal Trust	500
	Mr George Jonkel	2,000
	Col. Guru Ratam Singh	1,000
	M/s Tata Chemical Terminal	10,000
	Ms Rajeshree Gokhaldas	5,000
	Total	18,600
4.	**Salim Ali Nature Conservation Fund**	
	M/s Cheng Kim Loke Foundation	4,00,000
	M/s Cheng Kim Loke Foundation	35,000
	Lady Peng McNiece c/o -do-	2,00,000
	Total	6,35,000
5.	**Donations for Dang Forest Survey & Hornbill Newsletter**	
	Seth Purshotamdas Thakurdas Divaliba Charitable Trust	
	For Dang Survey	30,000
	For Hornbill Newsletter	25,000

Project and a photocopier for the Library.

We are grateful to the many organisations and persons for donations to the Society.

ACKNOWLEDGE MENTS

The Executive Committee acknowledges with thanks the assistance given to BNHS by the Department of Environment, Forests and Wildlife and the Ministry of Defence of Goverment of India, the US Fish & Wildlife Service, the Government of Maharashtra, and the Charity Commissioner, Bombay. It also thanks the various donors, the members and staff of the BNHS for their unstinting cooperation in the various activities of the BNHS.

A.N.D.Nanavati, M.D.
Honorary Secretary

THE SOCIETY'S PUBLICATIONS

The following books can be purchased by the **Society's members only** at the prices shown. Packing and postage will be extra at actual cost. Payment must be made in advance by Money Order/Bank Draft or Cash. Non-members, for their requirements, are requested to approach our Sole Selling Agents, Oxford University Press, Oxford House, Apollo Bunder, Post Box 31, Bombay-400 039.

	(For members only)
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A Synopsis of the Birds of India and Pakistan, by S. D. Ripley, 2nd edition	**Rs. 80.00**
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Identification of Poisonous Snakes, Wall chart in Gujarati and Marathi	**Rs. 5.00**
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Some Beautiful Indian Climbers & Shrubs, by Bor & Raizada, 2nd edition	Rs. 120.00
A Century of Natural History, Edited by J. C. Daniel	**Rs. 145.00**
Grasses of Western India, by Toby & Patricia Hodd	Rs. 37.50

Glimpses of Nature Series Booklets :

1.	**Our Birds, 1** (with 8 coloured plates) in Kannada	**Rs. 0.65**
2.	**Our Monsoon Plants, 4** (with 8 coloured plates) in Hindi	**Rs. 0.80**
3.	**Our Animals 5** (with 8 coloured plates) in Gujarati	**Rs. 1.25**

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- One of the finest research collections in India on Mammals, Birds, Reptiles, Butterflies and other forms of animal life. These are available to members for study on the Society's premises.
- Up-to-date information and advice on birdwatching, wildlife photography and fishing; natural history field trips and information on possible areas for field trips.

In short, the Society offers a range of activities and interests for the scientists, the amateur naturalist, the sportsman, and the lover of nature. Even if you are none of these the Society deserves your support because it is struggling to preserve our natural heritage and to safeguard it for our children.

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