PRANIKEE

Vol. I 1980

PRANIKEE

Journal of
ZOOLOGICAL SOCIETY OF ORISSA

Conference papers
Contributed articles
Seminar Papers

Post-Graduate Department of Zoology
Utkal University
Bhubaneswar-751004

Volume I 1980

The Zoological Society of Orissa has been planning to publish a journal for a long time. It is indeed a pleasure that it has finally materialized. The first issue of the journal is a joint venture. This volume contains several articles and seminar papers by students and staff of P. G. Department of Zoology.

On the occasion of the annual meeting of the Zoological Society of Orissa a two-day symposium was organized on the "Utilization of animal resources of Orissa" in the Post-graduate Department of Zoolygy of the Utkal University under the chairmanship of Dr. B. K. Behura, Professor of Zoology of the University and President of the Society on 22-23rd Mareh, 1980. Most speakers emphasized the need for the utilization of the animal resources in a poor state like Orissa. Veterinarians, fisheries experts and Zoologists participated in the symposium. Some of the papers are also included in the volume.

The financial aid for the publication has been provided by the Director of Public Instruction, Orissa; State Youth Welfare Board, Orissa; Utkal University and Zoological Society of Orissa.

—P. Mohanty-Hejmadi
Editor

CONTENTS

CONTENTS

UTILISATION OF FISHERY RESOURCES OF ORISSA

P. Misra

Department of Marine Sciences,
Berhampur University,
Berhampur-760007,
Ganjam, Orissa.

ABSTRACT

The fishery resources of the state is very extensive. But the present utilisation of the fishery resources of Orissa is not significant, although considerable progress has been achieved in fishery development during the last decade. The sweet water fish production of Orissa can be raised from the present level of 16 thousand tonnes per annum to about 100 thousand tonnes per annum in a phased manner. The brackishwater fish production which is about 10 thousand tonnes per annum can be increased significantly to about 80,000 tonnes of shrimps and brackishwater fishes per annum. The marine fish production of the State which is at present about 25 thousand tonnes per annum can be increased to 120 thousand tonnes per annum by planned mechanisation p.ogramme. Orissa can meet international demands of fish and export substantial quantity of marine products to get valuable foreign exceange in addition to providing profitable employment to a few lakhs of people.

INTRODUCTION

The resources for development of freshwater, brackishwater and marine fisheries of Orissa are very extensive. The rich fishery resources of the state require proper planning to step up production and to utilize the resources in optimum condition.

Inland fish production :

There are thirteen districts in the state and each district is suitable for inland fishery production. Ganjam, Balasore, Cuttack, Mayurbhanj and Puri districts have large number of tanks and offer extensive areas for sweet water fish production. Ganjam is the leading sweet water fish producing district in the state. Balasore, Mayurbhanj, Cuttack and Puri districts are also producing sizable quantity of sweet water fish. People in the western part of the state such as Sambalpur, Bolangir and Kalahandi have shown great zeal for sweet water fish production. Sweet water fish production is also developing in other districts such as Dhenkanal, Keonjhar, Phulbani, Koraput and Sundergarh. Although n merous factors are responsible for fish production, yet the sincerity and honesty of the fish

farmers are of utmost importance. The fish farmers of Ganjam district have shown enthusiasm for sweet water fish production and are keen to avail institutional finance to utilise the water areas for fish production. They have the reputation of repayment of the bank loan timely and thereby facilitate the availing of institutional finance. The attitude of availing bank loan and timely repayment of the loan are gradually developing in other districts of the state and show a bright future of sweet water fish production.

Misra (1972, 1979) reported that the cultivable freshwater area available for sweet water fish production in Orissa is about 2 lakh hectares. At present, area utilised for fish production is about 8 to 10 per cent. Intensive fish production in proper scientific methods is carried out in a few hundred hectares throughout the state. The average traditional production of sweet water fish per hectare of good ponds and tanks is about 500 kg. In order to increase production, pond preparation, stocking with healthy fingerlings of fast growing carps and proper management are absolutely essential. Large number of water areas are chocked with various viable weeds such as *Eichhornia*, *Pistia*, *Salvinia*, *Wolffia*, *Lemna*, *Potamogeton*, *Nymphaea*, *Nymphoides*, *Nelumbo* and *Ipomoea*. Also inside the water occur various submerged weeds such as *Hydrilla*, *Vallisneria*, *Ceratophyllum* etc., and they absorb the nutrients and make the pond water less suitable for fish life and growth. Many a time numero s fish ponds are noticed with algal blooms containing *Microcystics*, *Chlorella*, *Euglena*, *Oscillatoria*, and *Anabaena* etc., and make the ponds almost completely unsuitable for the normal growth of fishes. By proper weed control methods a sizable area can be recovered and utilised for fish production. If only 20 per cent of the available culturable freshwater area can be utilised for intensive fish production, then Orissa can produce above 100 thousand tonnes of sweet water fish per annum from the present level of 16 thousand tonnes per annum.

Brackishwater fish production :

The low lying tidal mud flats, estuarine creeks and adjoining areas of the estuaries offer immense scope for the development of the brackish-water fisheries. Chilka Lake covers about 1000 sq. km and its inshore areas can provide several thousand hectares land suitable for brackish watet fisheries. Thus there will be no difficulty to identify 40,000 hectares of brackishwater areas in the state and if this area is taken up for shrimp culture, about 40,000 tonnes of shrimps can be produced in a phased manner in five to eight years.

The coastal areas of the state are rich in the post-larvae and juveniles of tiger prawn and thus facilitate the culture programme for exportable prawns. Proper organisational set up should be there for the supply of the fast growing prawn seeds to the prawn farmers and to arrange institutional finance. The present shrimp production of the state is about 4000 tonnes and there is severe competition amidst the large number of processors to procure shrimps. If only 4,000 hectares of brackishwater area can be taken up for culture programme, then the shrimp production of the state can be doubled in a year. With the addition of prawns the processing plants can run for more operational days in a year and the ancilliary industries can grow further to supply large number of man days of work to the labourers.

The present level of brackishwater fish production per annum is about 10,000 tonnes. If the brackishwater areas of the state which is about one lakh hectare can be utilised for culture programme, then there will be no difficulty to produce 80,000 tonnes of shrimps and brackishwater fish in the state.

Marine fish production :

The marine fisheries potential of the state has recently been exploited to some extent, Orissa has a coast line of 480 kms and the inshore and offshore fishing areas of the state extend to about 18,300 sq. km (Misra, 1972). With the declaration of the exclusive economic zone which stretches to 200 miles (321 km) the space obtained for exploitation of the fisheries and other materials from the sea is enormous.

Misra *et al* (1973), divide the marine coastal belt of the state into three zones, namely Northern Zone, Central Zone, and Southern Zone. The northern zone stretches from Kirtania where river Subarnarekha meets the sea to Hansua, where Hansua (a branch of river Brahmani) opens into the sea. The Central Zone begins from Hansua and extends upto Puri with Paradip at the center. The Southern Zone extends from Puri to Sonapur situated near the border of Andhra Pradesh, where Behuda river falls into the sea. Only one fishing harbour has been established at Dhamara in the northern sector and it can accommodate fishing vessels upto 11.5 metres (38 ft). The area is more suitable for the exploitation of the pelagic fisheries rather than trawling. The proposal for the establishment of a fishing harbour at Paradip is yet to be sanctioned by the Government of India. But Paradip Port Trust authorities have kindly permitted the

fishing trawlers to operate from the harbour and about 350 trawlers, mostly 9.7 metres (32 footers), some 11.5 metres (38 footers), and few deep sea trawlers of 17-43 metres are operating from Paradip Port with less infrastrutural facilities. A small fishing harbour is coming up at Astaranga in Puri disirict near Devi mouth which is about 60 km from Paradip. But this fishing harbour can only accommodate 9.7 metres (32 footers) and 11.5 metres (38 footers) and is unsuitable to provide landing and berthing facilities to small and medium size deep sea trawlers. The areas of Paradip and Astaranga are suitable for trawlers and are excellent areas for catching shrimps and there is great competition in these areas by the trawlers to catch shrimp. The shrimp ground also extends from Astaranga to Sonapur, but due to lack of landing and berthing facilities the people of the state are unable to utilise these resources to their best advantage. Many deep sea trawlers operating from Visakhapatanam are catching shrimps in Ganjam and Puri coasts and are taking away the rich harvest to Visakhapatanam for processing.

The present marine fish production of the state is about 25 thousand tonnes, but it can be increased to a level of 120,000 tonnes per annum (Misra *et al*, 1975). The fish potentialities of Orissa coast upto 10 fathoms is 30,000 tonnes, and between 10 to 40 fathoms it is also 30,000 tonnes. Hence the total fish potentialities of the Orissa coast upto 40 fathoms is about 60,000 tonnes. By deep sea fishing in between 40 to 100 fathoms, additional catch of 60,000 tonnes is expected. Therefore the total fish potentialities of the Orissa coast is about 120,000 tonnes per annum. By improved vessels and gears and by proper planning, the fish production can be increased considerably from the present level of production.

International demands of fish:

It is considered that the animal protein requirement per person in the country is about 35 grams per day out of which 50% will be met from the fish. In Orissa to provide at the rate of 17.5 grammes fish per day, the expected annual requirement of fish will be about 126,000 tonnes. Thus at present there is a protein gap of about 75,000 tonnes, but by planned development of the fisheries it can be made up and the costlier prawns can be processed for export to earn valuable foreign exchange. The development of fisheries will not only help nutrition and export, but will provide profitable employment to several lakhs of people of the State.

REFERENCES

MISRA, P. M., 1972—Prospects of Fisheries in Orissa. *Orissa Review*, January, Magha 1893, Vol. XXVIII, No. **6**, pp. 52-54.

MISRA, P. M., 1979—Fisheries of Orissa. Symposium on Recent Trends in Aphidological studies, Bhubaneswar, June, Part IV, pp. 10-13.

MISRA, P. M., A. B. ROY and S. K. MISRA, 1975—Seafood from Orissa—their export potential and internal demand. *Seafood Export Journal*. Vol. VII. No. **6**-June.

MISRA, P. M., A. B. Roy and S. K. SENGUPTA, 1973—The present status and future scope of mechanised fishing in Orissa Coast. Proceedings of the seminar on Mariculture and Mechanised fishing. Govt. of Tamilnadu. pp. 180-183.

UTILISATION OF ANIMAL RESOURCES OF ORISSA

B. N. Patra

Director, Animal Husbandry & Veterinary Services,
Cuttack, Orissa.

It has been estimated that 69 % of the gross national product of the United States of America is derived from animals or animal-based industries. In a developing country like India, the need for utilising animal resources is extremely important to improve the economy of the Indian farmer and also to accelerate industrialisation of the country at par with that of the developed countries.

(A) *Cattle* : India has a unique situation in that the milk-producing animals are both cattle and buffaloes. Another important factor in Indian economy is that utilisation of cattle-derived products except milk has a very limited scope of growth due to religious and other local sentiments.

The cattle population of Orissa is 13,479,218. In comparison to the cattle population, the yield of milk in Orissa has been estimated at 250,000 metric tonnes. Utilisation of hides and skins has not been correctly estimated. The average production of milk per cow per day has been estimated at 0.518 litres. It is not for me to quote figures of other countries, but I may state that an internationally registered breedable Frisien cow can now produce 65 litres of milk per day.

Improvement of milk yield in cows is being attempted by the Indian scientists and extension workers through cross-breeding with exotic cattle which have (1) comparatively higher milk production, (2) a very early age of maturity, and (3) longer duration of the lactation period. Against these advantages, the disadvantages of cross-bred animals are : (1) increased susceptibility to diseases, (2) less adaptability to stress and strains like inadequate nutrition, and unscientific housing facilities, and (3) inadequate pasture facility. Inspite of these disadvantages, cross breeding in Orissa has taken a deep root. Cross-bred Jersey heifers and cows which had no existence a decade back, are now to be seen in cities as well as in rural areas. An average cross-bred Jersey cow has been

estimated to fetch an income of Rs. 125/- P. M. to the owner if properly kept. This is a very important factor considering the fact that more than 85 % of Orissa farmers live on an income below Rs. 85/- P. M.

To improve the animal resources, the scientists and the extension workers have to play a joint role since research literature on productivity of exotic cattle are available from the developed countries. It has become a question of extension of already evolved principles rather than intensification of further research. Compared to advanced countries, the utilisation of milk in manufactured products like butter and cheese are limited; excess milk utilised in other industries like textiles has not yet found a scope under Indian conditions. In order to intensify our efforts for increasing the economy of the farmer through cross-bred cattle and supply much needed protein and nutrition to the young children of India, the most important point now is to utilise as much milk as possible for consumption as liquid milk.

Being a daily article of use, the collection and distribution of milk in Orissa has assumed tremendous proportions. For milk transport cheaper methods of movement has to be used and the system of distribution has to be operated in a way helpful to the habits of the people of India.

There is a tremendous scope in the export trade in respect of other animal products. But this aspect has to be handled by scientists with utmost caution.

(B) *Sheep and goat* : Ths present population of sheep and goats is as follows :

Goats	...	3,416,395
Sheep	...	1,432,218

The figure for sheep has remained constant for some years past. The figure for goat has slightly increased. Being the only edible meat under Orissa conditions, necessity for increasing the quality and quantity of sheep and goat meat is very much desirable. Orissa has a very large number of hills spread throughout every district. There are many hills in the districts which have shrubby jungles. The entire surface areas of these hillsides can be utilised for development of goats and sheep which will not then clash with the cattle for the meagre grazing area available in the

plains. This will add not only to the total quantity of meat available in the State but, may have a potential fo export to foreign countries and sale in other States.

Disease problem in sheep and goats is not as acute as in cattle. Skins and hides of goats are valuable. Preparation of more palatable products like sausage may help the farmers to utilise their older goats that may not be so palatable for consumption as raw meat.

Goat milk is not available in plenty from individual goats. But in Ganjrm district where goats are kept in flocks by various farmers, large quantities of milk are available which form a considerable part of the total milk production in that district. Goat milk can be processed into a specific kind of cheese which may have a good export market in developed countries.

Improvement of goat as a milk and meat producer can be done in limited areas by introduction of insemination methods through bucks of foreign breeds. Sannan and Alpine can be used for milk and Anglo-Neubian for quality meat. For sheep, attempts have already been made in Orissa to improve the quality and quantity of meat and wool through cross-breeding with advanced breeds like Corridal imported from Australia.

Processing of meat :

Raw meat trade is the practice in Orissa. This involves some loss both in quality and quantity due to absence of facilities for preserving meat through cold storage. It has also been established that cold storing of meat reduces parasitic contamination and makes meat more palatable due to increase in conversion of glycogen to glucose. Cold storage tenderises meat as well.

The only method of preservation of meat is by drying but this being a cumbersome process, does not make the preserved meat palatable. Canning of quality meat can also help transport of meat to inaccessible areas.

Pigs : Pigs form a very big source of meat supply to the poor people in Orissa. Experiments carried out in Orissa to maintain black pigs under stall-fed condition have shown that there is considerable increase

in the aroma and quality of pork. Orissa pigs under good management and stall-fed care can compete with the meat production capacity of advanced breeds like Yorkshire.

Poultry :

The present population of Poultry in Orissa has been estimated at 8,309,787 the majority of which consist of country birds. Preservation of the country birds through vaccination and ther methods of disease control is being done. The process of improvement of poultry birds through cross breeding or up-grading with exotic birds like R.I.R., W.L.H. and Australorps has been taken up in Orissa for some years past.

In U.S.A. ,poultry production on scientific lines has reached such proportion that poultry meat is the cheapest meat now available in that country and this meat is one of the most excellent items of diet. The major constraint for development of poultry industry is the high cost of poultry feed. Lack of adequate facilities for distribution and marketing is also there. There is a tremendous commercial possibility in manufacturing poultry feeds. Poultry scientists must now be utilised for evolving cheaper formulae of poultry feed with adequate nutritional value. The potential of the State to produce grains suitable for poultry feed is also to be increased or new grains introduced.

It is suggested that the economic condition of at least 34% of the total population of people of Orissa who are below the poverty line, can be improved through animal farming and raising of animal-based products.

because of this "defect" would be a grievous mistake. No breed in the world can substitute the "indigenous" cow, but many of them can contribute to her improvement.

In any effort for suitable improvement, one basic principle has to be kept in mind : the production traits of an animal are the combined results of inheritance and environment. The low productivity of the indigenous cattle and other livestock is due to both genetic limitations and poor management, especially inadequate feeding. It is well-known that the milk yield and draught capacity of even a non-descript country cow can be doubled through better management but, it is also a fact that a highly developed dairy animal will never express its production protential to the full extent unless it is properly fed and well cared for. To increase the milk production by establishing exotic stocks under more or less artificial management conditions is not the answer. Too many "show pieces" and "progressive gentlemen farmers" have failed to make a real impact on the dairy industry. An animal is economically optimum in which the genetic make-up is in a natural balance with the environmental conditions. It would be possible to evolve such a breed through systematic selection out of the available indigenous population but one has to spend decades or even centuries for such a process. The other possibility is to introduce genotypes with a highly developed production potential from outside. Suitable dairy breeds are available and the modern technique of artificial insemination, especially with deep frozen semen, makes such a "gene migration" comparatively easy. But again, unlimited upgrading programmes, usually ending up after a few generations in a highly inbred and too susceptible "foreign population" will not be the solution. Only systematically planned and well organised cross-breeding programmes limiting the exotic inheritance to a certain level, can be successful in launching a state-wide "white revolution".

Cross breds are animals evolved out of a combination of indigenous and exotic inheritance. Both sides have to make important contributions. Adaptability, hardiness, disease resistance etc., mainly come from the local parents, whereas the foreign breed adds the production potential. The proportion of indigenous and exotic inheritance eventually depends on the prevailing level of environmental conditions with which the new genotype has to be kept in a natural balance. Experience gathered through extensive trials extending over 70 years in Military farms and recent work in Indo-Swiss, Indo-Danish and other I.C.A.R. projects indicates that the optimum proportion of foreign blood is somewhere between 50% and 75%.

Under Orissa conditions the optimum proportion of foreign inheritance is nearer to 50% than to 75%.

Similary, upgrading programmes are needed with pigs, poultry and sheep.

i) Milk production :

The strategy in augmenting milk production lies in accelerating its production which can be made by undertaking bold but realistic cattle breeding programmes in selected areas. There is considerable scope for increasing milk production by introduction of exotic inheritance through cross breeding with dairy breeds such as "Holstein-Friestian", "Brown Swiss" and "Jersy". By introduction of exotic germ plasm in indigenous cows in selected areas, it is envisaged to produce crossbred cows capable of yielding about 2,500 kg. milk per lactation under proper feeding, management and health coverage.

It is also expected that through selective breeding and upgrading of buffaloes the milk production and their draught capacity can be augmented. It is therefore imperative that every effort need to be made for not only augmenting their productive capacity but also for the proper handling and processing of milk and milk products to meet the requirements of the state.

ii) Mutton production :

Sheep are prized for mutton. They also yield rich manure and act as a valuable adjunct to agriculture. About one third of the total mutton produced in the state comes from sheep as estimated by the Agricultural Marketing Board in 1972. Since 3rd five year plan action has been initiated in the state for the development of the local sheep by up-grading through well established Indian mutton breds like "Banuri' (Mandia) and "Madras" (Ked Nellore) rams.

It is contemplated to keep "Corriedale" or other exotic sheep in western parts of the state to improve the local stock.

The scope of improvement of wool production of sheep is gaining momentum in the state.

iii) Milk and meat production :

The goat which is commonly known as the poor man's cow can prove to be a very suitable and profitable source for augmenting the state's milk resources. It is the most economical producer of milk as compared to any other milch animals because, it can thrive on a class of fodder on which other animals starve to death. Its milk is also richer in fat and minerals especially those which are utilised in the formation of blood, and is more easily digestible due to finer fat globules. Its milk is therefore of special importance for children, invalids and aged people. The so-called goaty flavour in the goat's milk can be avoided by housing the buck separate from the milch goat and by observing cleanliness in goat pens and at the time of milking. The goat also provides valuable manure and in certain places cultivators pay for penning them in their fields.

It also provides the most popular kind of meat for human consumption besides skin and hair (especially in hill goats) for various industrial uses to meet our requirements. Goat meat is in great demand. Over two third of the total meat produced and consumed in the state comes from goat, A dressed goat carcass yields 9-15 kg. of meat. In case of goat no exotic germ plasm has yet been introduced in the state, but efforts have been undertaken to improve the local stock with "Barbari" and "Beetal" bucks. It is therefore necessary to carry out selective breeding side by side cross breeding the non-descript type with selected bucks.

The scope of Mohair/Pashmina production has little impact in the state.

vi) Pork production :

The pig is a very prolific breeder and is the most economical producer of meat of high nutritive value. They yield the largest returns on the money spent on them as compared to any other species of domestic livestock. This industry is almost entirely in the hands of Harijans and it received a fillip during the last world war when a large number of foreign troops were stationed in the country who demanded various piggery products in large quantities. Since second five year plan, piggery development has been taken up in the state with the supply of improved boars belonging to large and middle white York shire.

v) Egg production :

Poultry raising is a poor man's cottage industry requiring a little initial expenditure and a small flock can be easily and profitably maintained on kitchen waste. While the house owner is busy, his wife and children can look after the birds, their feeding and management during spare hours.

Poultry production has made great strides during the last decade. This attainment has been possible through intensive poultry production programmes both under private and public sector and also by increasing intensive poultry production programmes and projects in the State with the aid of scientific breeding, feeding, management, disease control, marketing, etc. It is also envisaged to become self-reliant in this regard by evolving our own strains of poultry for egg production by importation of exotic germ plasm and also by maximum utilisation of superior germ plasm available in the country. Towards these objectives, an All-Indian Co-ordinated Research Project of poultry for egg is already functioning in various centres in the country, and it is hoped to become self-sufficient at the same time avoiding dependence on imports.

vi) Poultry meat production :

Broiler production provides an opportunity of producing animal protein within two months from the date chicks hatch out. The meat is tender and nutritious due to which the demand in big cities is increasing day-by-day. It is envisaged to tailor our activities for propagating special meat line chicks which are noted for high growth rate and feed conversion efficiency in a comparatively short time, by evolving improved breeds, well suited to indigenous environmental conditions. An All-India Co-ordinated Research Project on poultry for meat is already functioning in the state.

Laboratory animal production :

Research in almost all fields of biological science requires the use of laboratory animals. The demand for such types of animals is increasing day by day. The most important problem facing us at present is to get suitable types of laboratory animals. It is understood, the Indian Standards Institution has made a beginning in laying down the standards that could be applied under Indian conditions for raising standard laboratory animals keeping in view the needs of the scientists It is necessary to create an infra-structure in the state with adequate quality control system to cater to the needs of research organisations. Private entre-

preneours can also join this venture and establish centres for breeding laboratory animals. But these animals should pass through a quality control system to ensure a regular supply of standard animals.

Carcass utilisation :

According to 1972 census, the total livestock population in this state (Orissa) is about 18 million excluding poultry. The average death rate amongst the large animals is estimated at about 8% and in the case of small animals at about 4%. Accordingly about 1.5 million carcasses of fallen animals (1.0 million of large animals and 0.5 million of small animals) are available annually. Most of these are not being fully utilised. Usually all the hides and some of the bones from fallen animals are collected while other products such as meat, fat, horns, and hoofs etc., are generally allowed to go waste. The hides obtained are often found defective due to faulty methods of flaying and curing practised by village flayers. It has been estimated that the loss every year due bad flaying, curing and non-utilisation of by-products of carcasses is about Rs. 2 00 crores,

The fallen carcasses could be converted into bone meal and meat meal for feeding poultry and pigs, and for manurial purposes.

The need for maximum exploitation of the economic values of fallen animals has already been realised. But due to limited financial resources and low priority given to this sector, little work has been done in the state.

It is hoped, with the impartation of training in the technique of flaying, curing and utilisation of various components of animal carcasses as has been done in other states, would save this state from the huge annual recurring loss.

IMPORTANCE AND USE OF LIVE-STOCK WASTES

B. N. Sahoo

Department of Food Hygiene & Public Health,
Orissa Veterinary College,
Bhubaneswar.

Protein is an important ingredient in food. It is mainly required for tissue building and replacement of dammaged tissues. Diet short of carbohydrate or excess in protein may use protein for energy.

Protein in the diet is derived from plant sources, mainly from seeds of legumes and oil seeds, etc. The other important source of protein is live-stock products such as, milk, meat, poultry, egg, fish, etc. Some proteins are also derived from the micro-organisms that grow in the gastro-intestinal tracts of animals.

Protein is made up of amino acids known to be 21 in number. These amino acids are combined together in different combinations to form different types of protein molecules. These amino acids are—

Group I :

Aliphatic	*Sulfur containing*	*Dicarboxylic*	*Basic*
1. Glycine	8. Cysteine	11. Glutamic acid	13. *Lysine*
2. Alanine	9. Native cysteine	12. Aspartic acid	14. Hydroxy lysine
3. *Valine*	10. *Methioine*		15 *Arginine*
4. *Leucine*			16. Histidine
5. *Iso-leucine*			
6. Serine			
7. Threonine			

Group II.

Aromatic

17. *Phynyl alanine*
18. *Tyrosine*

Group III :

Heterocyclic

19. *Tryptophan*
20. Proline
21. *Hydroxy proline*

Protein in the diet are not absorbed as such. They during digestion are hydrolysed to constituent amino acids, which are absorbed in the intestine, and carried by blood to the tissue spaces in the body. There these amino acids are reassembled into protein that the tissue requires. These reformed proteins may be completely different from the native protein that was eaten.

Out of the above 21 amino acids, 10 amino acids (which are in italics above) are considered essential amino acids, because either they are not present in plant tissues, or deficient in plant tissues and also are not produced in adequate quantities by the micro flora in the gastro-intestinal tracts of animals. They can not be formed in the body from other amino acids. Three of these amino acids namely methinine, hydroxy proline and leucine are present only in animal tissues.

Absence or shortage of any of these essential amino acids affects resynthesis of protein that the body requires. Thus the protein in the diet is not fully utilized. This problem is more acute in monogastric animals than the ruminants. In ruminants, the ruminal micraflora provide some protein which contain essential amino acids.

Protein from live-stock products is more complete in amino acid content than the plant proteins and need to be incorporated in the diet for full utilization of protein and to meet amino acid requirements of the body.

Vitamin B_{12} is also not available from plant source. Animal products need to be in the diet to meet the nutritional requirements.

Food from animal sources is more expensive, because animal has to consume large quantities of plant material to produce comparatively smaller quantities of animal products. Shortage of grain etc., has caused shortage of animal products and in India shortage of live-stock products is extremely critical. So attempts should always be made to conserve animal tissues that go waste in our country.

In our cuontry, large number of animals die of disease or natural causes. These are thrown away in the outskirts of the village either to rot or be scavenged by wild animals and birds. Animal disease are communicable to other animals and a number of animal diseases are also communicable to man (zoonotic). It is unhygienic to allow the carcasses to be scavenged.

The recommended method for carcass disposal is through deep burial with a liberal amount of lime. The method involves labour and is expensive. The villagers have no incentive to do a good job.

The next best method is disposal by incineration. The carcass is burnt down to ash with the use of fire-wood, fuel-oil or by electricity. The method is efficient but expensive. In the days of fuel crisis villagers can not be induced to dispose carcasses by incineration.

Tankaging or rendering is an useful method for disposal of fallen animals. The carcass is cooked in an autoclave under 25 lb pressure/sq. inch for 3 hours. In the process the tissues are completely sterilized and separate out as rendered fat, flesh tissue, bone and stick water.

Fat is dehydrated as grease for soap making or for live-stock feeding.

Flesh tissue is dried, milled as meat meal for live-stock freeding and may be used as fertilizer.

Stick water is concentrated for live stock feeding.

Bone is dried, milled as bone meal for live-stock feeding and can be used as fertilizer.

Rendering involves expense on acquiring equipments and in operating it, but the by-products have good market and expenses can easily be recovered with some profit.

In our slaughter-houses a number of tissues goes waste. The following tissues can be processed into useful by-products :—

Adrenal glands :—medula — Epinephrine from cattle, sheep and pig are used.		—Nasal and lacrimal operation, Treating bronchial asthma, spasm of whooping cough, stimulate heat.
	cortex — extract	—Treating Addison's disease, shock during surgery.
Blood (bovine)	Bovine albumin	—a reagent. test Rh factor in human blood. bacterial culture.
	Fibrin	—Fibrin foam to check bleeding.
	Plasma	—Histidine & other amino acids.
	Enzyme	—Catalase H_2O_2 testing. Foam rubber manufacture.
	Fibrin & plasma	—Protein hydrolysate for intravenous feeding.
		—Adhesive for plywood.
	Dried blood	—Animal feeding and fertilizer.
Bone — Xiphisternal cartilage		—Plastic surgery of facial bone.
Hard shin bone		—Calcium phosphate for medicine, pediatric foods.
Bone meal		—Live-stock feeding, fertilizer.
Duodenum	Enterogastrone	Ulcer treatment
Desicated duodenum		—Aid Vit. B_{12} absorption in pernicious anaemia.
Fat—		—Live-stock and human food, industrial use.
Benzoinated beef fat		—Ointment base.
Intestine — from sheep and goat		—Surgical sutures.
		—Sausage casing.
Liver	Liver extract	—Treat anaemia.
Bile	Bile acids	—Medicine in indigestion, Liver disfunction.
		—Tanning industry.

Lungs—	Heparin	—Blood coagulation prevention, strokes etc.
Mammary gland	Extract	—Menstrual flow, milk flow.
Muscle	A. T. P.	—Treatment of muscular dystrophy.
Ovaries	Estrogen	—Treatment of menopausal syndrome.
	Progesterone	—Treatment of threatened abortion.
Pancreas — Islet of Langerhans.	Insulin	—Control diabetis
	Trypsin	—Digest dead tissue without affecting living tissue in wounds. Tuberculous empyemia.
	Chymotrypsin	—When injected works like trypsin.
Parathyroid	Extract	—Treatment of tetany when parathyroid is removed.
Pineal gland	Extract	—Stimulate mental and physical development in retarded children.
Pituitary — posterior	Pressure hormones	—Regulate blood pressure.
	Oxytocic ,,	
anterior	Melanophore ,,	
	Growth ,,	
	Thyrotropic	
	Adenotropic ACTH	—Numerous therapeutic use.
	FSH	
	LH	
Placenta—	Dehydrated powder	—Milk flow.
Prostate		—Treatment of disease prostate and testes.
Spinal cord	Cholesterol	—Preparation of sex hormone products.

Spleen	Extract	—Treatment of malaria, typhoid and other blood and lymph disease.
Stomach	Pepsin	—Aid digestion, feed additive for young pig.
	Rennet	—Infant diet additive for milk digestion. Making cheese.
	Mucin	—Treatment of ulcer.
Testes	Hyaluronidase	—Adjuvent for spreading of drug into cells.
Thymus	Extract	—Functions like thyroid extract.
Thyroid	Extract	—Treat thyroid deficiency, Low blood pressure, cretinism, myxedema.

This by no means is a complete list of all animal tissue preparations. But it does emphasize the importance of animal tissues in the preparation of therapeutic agents, pharmaceuticals, and other byproducts.

UTILIZATION OF TASAR SILK RESOURCES IN ORISSA

B. K. Behura and M. M. Panda

Department of Zoology,
Utkal University
Bhubaneswar-751004

INTRODUCTION

An exclusive craft of the hill-folk and aboriginals down the centuries, tasar culture has now come to stay as an inseparable facet of India's tribal culture. The famous hand-spun 'tussore' so popular in U. S. A. and Europe comes from the obscure remote forest areas of the states of Bihar, Madhya Pradesh, Orissa, Andhra Pradesh and Uttar Pradesh. The first three states are however the principal tasar producing states accounting for over 90 % of the total annual production in India (Jolly, 1966). It is estimated that India produces about 400 tonnes of tasar raw silk (Jolly, 1974). Although India ranks second in the world next only to the Republic of China in terms of tasar silk production, its tasar silk resources have not been fully exploited. Of the 38.0 million tribals of India, 28.62 million are located in tasar cultivating states of the tropical belt. However, 12.7 million tribals live right in the tasar growing districts of whom hardly 1 lakh families are engaged in tasar rearing. Out of 11 million hectare of tasar food plants in the countries of the tropical belt only 0.56 hectare have been exploited so far (Anonymous, 1977a).

Tasar silk cultivation is practised by about 30,000 backward hill tribes and adivasi people in the districts of Mayurbhanj, Keonjhar, Sundergarh and other hilly tracts of Orissa (Panda, 1963).

The important tribes engaged in tasar rearing in the state are known as *Khadia* and *Budha*. Cultivation of tasar silk is one of chief sources of income for these tribals. Orissa produces about 21 tonnes of tasar silk which is negligible in comparison to other major tasar silk producing states like Bihar and Madhya Pradesh which produce 227 and 114 tonnes of tasar silk respectively. In the forests of Orissa inhabited by large number of tribrls, the food plants of the tasar worm grow abundantly and the tasar silk worm found in Orissa is known to produce the best

variety of cocoon. Proper utilisatien of the tasar silk resources is necessary to increase tasar silk production in the state. This will help directly in ameliorating the economic condition of the tribals and other backward classes living in remote forest areas. Some of the salient features of tasar silk cultivation in Orissa and the problems faced by tasar rearers in the state are discussed below.

RACES AND VOLTINISM

The species of tasar silk worm found in Orissa is identified as *Antheraea paphia* Linn. (Panda, 1963; Rao and Behura, 1971). Three varieties of *A paphia* are known to occur in Orissa, viz., Bogai, Nadia and Modal. The first two are semi-domesticated while the last occurs wild. The three varieties differ in morphology of cocoon and voltinism. The cocoon of Bogai is stiff, blackish white, and has a short thick peduncle. That of Nadia is smaller and flimsier than Bogai, greyish white to cream in colour and has a long thin peduncle. That of Modal is longer than the other two, black in colour and has a short stiff peduncle. Bogai is bivoltine, Nadia trivoltine and Modal univoltine.

The first generation af Bogai in grown wild in jungle from June to August and its cocoons are collected as seed cocoons. The second generation is the crop cultivated under semi-domesticated conditions during September and December. After December the moths do not emerge from the cocoons till the following June-July. The first generation of Nadia is grown wild from middle of June to middle of August and the cocoons are used as seed cocoon. The second generation is cultivated from early September to the end of October. The third generation is also reared under semi-domesticated conditions from mid-November to mid-January and is known by the local Oriya name Jadai. Cocoons of Modal are collected along with seed cocoons of Bogai during June-August and the moths do not emerge till the next June-July.

The wild variety, i.e., Modal which grows wild in nature on Sal (*Shorea robusta*) is considered superior to all other tasar varieties occurring in Bihar, Madhya Pradesh and Orissa. An analysis of various tasar cocoons is presented in Table 1. But 'Modal' is considered to be of no use as seed cocoon as it cannot be reared under semi-domesticated conditions. The serious attention of the state Government and research workers is called for to devise suitable methods for its fuller exploitation.

FOOD PLANTS

Orissa is endowed with a prolific wealth of forest flora where the tasar food plants occur abundantly. The important species met with are Sal (*Shorea robusta*), Arjuna (*Terminalia arjuna*) and Asan (*Terminalia tomentosa*). These plants are used as food of tasar worms and every cultivator possesses at least two or three small areas of 100 such plants and pays a nominal tax yearly to the Forest Department. *Adapahi* is the local name used by rearers for these areas. The trees are pruned every year so that fresh leaves may be available for the rearing of silk worms the year following. Each group of plants are utilized in alternate years for tasar cultivation. Too old trees are considered unsuitable hosts for the tasar worm and deteriorates the quality of cocoons.

METHOD OF CULTIVATION

Collection of seed cocoons :—The tasar seed cocoons in Orissa are collected mostly from Sal trees in the interior jungle by a special sect of people known as *Khadia* during the months of June and July. The Khadias sell the cocoons to the 'Mahajan' (Merchants) who in turn sell them in the markets to the rearers as seed. The main trading centres are located at Keonjhar and Dhenkikote in Keonjhar; Bangiriposi, Kaptipada and Thakurmunda in Mayurbhanj and Sukinda in Cuttack districts. These seed cocoons are the first generation crop grown wild in forests. From these the moths emerge out during August to October. The eggs are collected and retained for rearing.

Seed production :—The seed cocoons are tied with strings like a chain and kept hanging from the roof in temporary sheds whose sides are all open. After a few days the moths come out by making a hole usually near the peduncle, the peak hours of emergence being from 8 p.m. to 1 a.m. The moths do not copulate before 3 to 6 hours of emergence. However, unlike the tasar silk moth *Antheraea mylitta* D., found in neighbouring states like Bihar, the tasar silk moth of Orissa do not mate in captivity. So the fertilisation of the female moth is affected outdoors in the jungle. The female moths are allowed to remain hanging on to branched sticks and the sticks are kept hanging from trees preferably from the lower branches. After midnight and mostly between 2 a. m. and 4 a. m. the female moths are copulated by wild male moths. The cultivators remain there in the jungle overnight till their entire lot gets copulated. According to Panda (1963) the pre-requisites for a successful copulation seem to be

Table 1

An analysis of tasar cocoons found in Bihar,
M. P. and Orissa (Jolly, 1966)

Name of State	Local name of reces	Food plant	Peduncle length (cm)	Cocoon wt (gm)	Pupa wt. (gm)	Silk ratio %	Filament length (m)
Bihar	Ampatia	*Terminalia*	4.81	12.40	11.08	10.00	520
Bihar	Daba	*Terminalia*	1.99	12.06	10.47	13.24	750
Madhyapradesh	Laria	*Terminalia*	5.38	9.75	7.87	16.20	785
Madhyapradesh	Raily	*Terminalia*	7.82	12.77	10.11	19.89	1,232
Orissa	Bogai	*Terminalia*	5.50	9.42	7.97	15.40	895
Orissa	Modal	*Shorea*	6.37	14.17	10.53	22.51	1,383

(a) cooler temperature during the night (b) windy nights (c) no rains or slight rain and (d) saturation of male moths in the locality. But it is not known why the moths do not copulate inside the rear's hut. As a result, the cultivators are confronted with tremendous hardship and a lot of time and labour is wasted. Suitable means are yet to be devised to make the moths mate in captivity.

The copulating pairs which remain hanging posterior to each other are brought back to the rearer's hut in the early hours of the morning and the pairs are detached in the dusk following after a period of about 12 hours. The female moths are retained in bamboo baskets covered with lids and the male moths are allowed to fly away. Immediately afterwards, the female moth starts laying fertilised eggs. On an average a single moth lays about 200-250 eggs, 70-75% of which are laid on the first day. The rearer usually does not collect the eggs beyond the third day as they are believed to be of less vitality. Since seed preparation is the most important aspect of the silk industry utmost care is taken in affecting viable and disease free layings. The eggs are rubbed with an indigenous powder before being kept in leaf packets. This is done to separate out the eggs from the clumped lot and to slightly heat up the eggs for uniform hatching.

REARING OF LARVAE

The cultivators generally prefer small pollared Asan trees of medium height with abundance of leaves for raising the larvae. The leaf packets containing eggs are suspended from the branches of such trees. The worms hatching out of the eggs crawl out of the leaf packets and wander over the foliage nibbling tiny bits of tender leaves. The larvae undergo four moults and attain maximum size at the 5th instar. The first two instars extend over 4 to 7 days and the third and fourth instars last 6 to 8 days each. The 5th instar i,e., after the fourth moult till the caterpillar spins a cocoon extends over a priod of 15 to 20 days. Except during the period of moulting when the larva does not take any food and becomes sluggish, it feeds on the leaves of the Asan plant. When the leaves of a host plants are exhausted the branches with silkwnrm are out down and transferred to fresh Asan plants with a lot of foliage. This is done mostly during the cooler hours of morning and evening. The 'ripened' larva stops feeding and wanders over the foliage in search of a suitable place for spinning of cocoons. For complete spinning of cocoon it normally takes 4-5 days.

The tribals have associated a number of rituals with the rearing of tasar. At the time of rearing they observe frequent fast and abstain from all conjugal activities. They neither eat meat or fish, salt or tumeric nor cut hair and nails during the period. With religious seal the tribals also maintain a constant watch over the insects, birds and animals that prey on the tasar worms, equipped with arrow and bow and a long bomboo stick. They believe that the large silvery spots with a black wedge on the wings of the moth are the images of Lord Shiva's disc and if they neglect their duties they may fall victim to supernatural visitations.

ENEMIES AND DISEASES

As per the existing practices tasar culture is being carried out in forests under semi-natural conditions where the caterpillars are heavily exposed to the attack of predators and parasites. The loss due to predators and paraites in a common rearing is estimated at 40 to 50 % and due to diseases about 30 to 40 % (Jolly, 1966). Among the insect predators pentatomid and reduviid bugs cause most of the damage by attacking the larvae of all stages. Wasps and preying mantis also kill worms in the early stages. The tasar silk worms are also eaten away by non-insect predators like bats, mongoose, chamaeleon, rats and birds.

The two most important insect parasites are the Ichneumonid and the Tachinid flies. The Ichneumon fly inserts its long ovipositor into the tasar pupa by piercing through the cocoons where the maggots hatch to eat up the host and kill it. The Tachinid fly lays eggs on the body of the silkworm and the maggots emerging from the eggs penetrate into the body of the host. They feed on the fat body reserves and ultimately come out of the host resulting in its death. Effective control measures are yet to be worked out against the predators and parasites of *A. paphia.* The tasar silk worms suffer mostly from bacterial and viral diseases which are locally known as 'Chara-photaka' and 'Olawa'. The symptoms of 'Chara-photaka' is usually diarrhoea to which larvae of all stages succumb in large numbers. 'Olawa' generally occurs in the later stages of development of the larva. The infected larva stops feeding and shows restlessness by moving over the branches. Ultimately the worm hangs down from the branches with its head downwards and drop down dead. These diseases are so fatal that once they break out in a locality they damage the entire tasar crop. Effective remedy is yet to be found out.

CONCLUSION

The problems of tasar cultivation has not been successfully tackled in our State. As the State is rich in tasar silk resources every attempt should be made for an all round success of this vital agro-industry. This will help in bettering the economic conditions of the poor tribals who are traditionally engaged in this craft. Besides, tasar silk has also proved to be a very good scurce of earning foreign exchange for the country as the hand spun tasar fabrics are in great demand even in the world's most sophisticated textile markets of U. S. A. and Europe. In 1978-79 Orissa exported tasar silk fabrics worth rupees 74.38 lakhs.

For the proper utilisation of the tasar silk resources of Orissa some of the problems like successful copulation of moths in captivity, supply of disease-free layings to the rearers, control of predators, parasites and above all conservation of tasar food plants need the immediate attention of the Government and research workers of the State.

REFERENCES

ANONYMOUS (1977)—*Silkman's companion.* Central Silk Board, Bombay.

ANONYMOUS (1977a)—*Sericulture towards New Horizon,* CSB, Bombay.

JOLLY, M. S. (1966)—*Tasar Research Scientific Brochure,* Central Silk Board, Bombay pp, 1-40.

JOLLY, M. S. (1974)—*Tasar Culture,* Central Silk Board, Bombay, pp. viii + 266.

NANAVATY, M. M. (1965)—*Silk from grub to glamour,* Paramount Publishing House, Bombay p. 205.

PANDA, N. (1963)—Tasar silk cultivation in Orissa. *Utkal Krushi Mahavidyalaña J.,* Bhubaneswar, pp, 18-21.

RAO, C. B. J. and BEHURA, B. K. (1971)—On the Tasar Silk moth *Antherea paphia* in Orissa. *Prakruti—Utkal Univ. J. Sci., Vol.* 8 (2), 155-178.

SOME THOUGHTS ON OUR ENDANGERED FAUNA AND ITS UTILIZATION

B. B. Parida

National Instituts of Genetics, Misima, Japan.

Participants of this symposium may agree with me in that we have a rich heritage of species and genetic strains in the flora and fauna of Orissa, which have not yet been subjected to comprehensive studies for various reasons. I am glad that the Zoological Society of Orissa has recently taken initiative to discuss some of the problems in this regard following the dictum 'better late than never'. However, the challange to explore our animal resources lies with the young dedicated zoologists many of whom are present in this hall. From a long geographical distance I can well imagine that many participants will discuss on different aspects of the focal theme and must have chance to hear about the animal resources of the State. I have every reason to believe that the Utkal University, the foremost citadel of higher learning in the State, should launch a programme in this direction in collaboration with the Zoological Society of Orissa. To me, it seems at this moment, special attention may be paid to study our fauna which are declared by the Wild Life Board to be on the verge of extinction. I herewith want to discuss the genetical background of endangered species and its interaction with the ecosystem although my knowledge in population genetics and ecology is limited.

Genetic diversity in the natural population of animals

A central problem of population genetics and evolutionary studies has been the estimation of genetic variations present in the natural population. In recent years new concepts have been put forward among which theories of balanced polymorphism seems to be most acceptable. The modern biochemical methods, particularly gel-electrophoresis, has unequivocally demonstrated the presence of a great number of allellic forms (allozymes) in a natural population.

Increasing evidence indicates that a major portion of the enormous amount of polymorphism present in the natural population is maintained by natural selection. This polymorphism is necessary for adaptation. On

the other hand, the size of the population is extremely important for the survival and propagation of a species in nature.

The change in the number of individuals in animal populations has been an important concern to population bioloigsts. It appears sometimes periodical, but in other cases it is unpredictable. Its magnitude differs according to species and the environment. As Whittaker (1975, *Communities and Ecosystems*) has pointed out, if the magnitude of fluctuation in the population size exceeds a certain limit, the population may be in danger of extinction.

It is generally accepted that the population growth depends on fecundity and mortality which are genetically controlled and subjected to Darwinian selection. In general, these depend upon the supply of food material. In a community, however, each species has its own niche, and if the niche of two species overlap, they compete with each other for limited food resources. The Lotka-Volteras equation serves as a basis of understanding this relation.

When the habitat is kept stable, the niche width and the population size of each species may be kept relatively constant. When disturbed, the structure of the community is subjected to pronounced changes some parts of which can be irreversible. Although there might be some mechanism of self-regulation in population, for instance, density-dependent behaviours, these cannot be powerful enough to protect all species from extinction.

These are not only ecological but also genetical problems. The niche width may be a function of genetic variability within populations as discussed by Van Valen (1965). Reduction in number of a population reduces the chances of a male and a female to meet each other, and the population will also be threatened by the danger of inbreeding. The population will lose its genetic diversity which is essentially important for keeping up its niche and for surviving in environmental changes.

The mathematical approach to population problem also shows that in small and isolated populations sooner or later each gene locus will be homozygous while in large and open population still there is possibility of maintenance of genetic variations with a small amount of genetic loss.

This loss of genetic variations is compensated by migration and mutation, frequency-dependent selection and multiple-niche selection. It has also been calculated that a population with less than one hundred individuals, in case of higher vertebrates like mammals, in subjected to gene pool diminution.

Effects of loss in genetic diversity in a population
Short-term effect :

Modern agriculture takes advantage of reduction in genetic polymorphism in cultivated plants and domesticated animals by employing selective breeding as this proves to be advantageous in the first few years for higher productivity and yield. But this method will not be useful when some eco-disaster in form of serious pest, outbreak of disease or changes in climate occurs as the population has already lost wild type alleles to withstand these unpredictable situations. The International Rice Research Institute has already issued a warning against cultivating inbreeding stock and neglecting wild stocks. Breeding by selection usually means preferential selection and propagation of certain allellic combinations at the expense of others. This practice of in breeding for uniformity has reduced the potentiality of genetic polymorphism leading to loss in genetic diversita of the population of a species. In the last two decades, the International Biological Programme has been attempting to prevent further loss by organising and establishing "Gene Banks" or "Genetic Stock Centers" to store taxa upholding the genetic diversity for future use and to evade future calámity.

Long-term effects :

An obvious effect of diminished genetic diversity is the reduction of species number. Several plant and animal species which have already become extinct in the past died out not because the very last animals and plants were killed or destroyed by man but simply because the enormously reduced population size and restricted genetic variance could not adapt itself to the often altered environment. With some concept of population biology it can be predited that for similar reasons, several large mammals and some plants too will have to face the same fate in the future. It is need-less to mention here that because of inbreeding troubles, the zoological gardens cannot maintain species indefinitely.

This problem cannot be solved by population biologists and geneticists alone, and ecologists are still in dispute on the ecosystem complexity -stability question. By complexity they usually consider the degree of species richness and disregard genetic diversity in each population representing any species. Furthermore, on a global scale, not only ecosystem's own stability is important but also that of the entire biosphere. This short of stability is indeed great, almost suggesting some self-maintaining ability for the whole earth. But can this homeostasis function without sufficient genetic diversity ?

The global change of terrestrial land surface from natural communities to agriculture, urban areas or so called "man-made ecosystem" will inevitably modify our climate. Accordingly plants and animals will have to adapt themselves to changed and often new environments. If genetic diversity of a population is small, it cannot evolve new adaptive gene combinations in a short time and will consequently disappear.

When this is the state of affairs then why are we so conscious about preserving our endangered animals ? This seems to me similar to providing adequate medical care to a near relative afflicted with cancer and waiting for complete curable methods to be discovered. Thus conservation of endangered animals probably means delaying the process of extinction by which time we may be able to manipulate genetic variability to overcome their threatened existence.

This delaying process is of utmost biological importance to us as we have to learn much from them. In Orissa we are not conscious enough to conserve Nature. The ecological balance is now going to be drastically disturbed with the growing urbanisation and industrialisation that destroy natural habitats, unrestricted massacre of animals in the name of hunting, overgrazing by cattle and illicit poaching and trapping. More efforts towards increasing environmenaal awareness, stricter enforcement of the Wild Life Preservation Act and Indian Forest Act as well as new experiments on breeding of animals are required to withstand environmental changes with the increase of our own population.

Specific examples :

I will only cite two examples as illustrations. One is our sea turtle, popularly known as Pacific Ridley Leathery Turtle (***Lepidochelys olivacea olivacea***) and the green turtle (***Chelonia mydas***). Once they

were abundant in the Bay of Bengal and still come to our shores in quite largenumbers during the breeding season to lay eggs on the sand, especially at Gahiramatha in the Bhitterkanika wild life sanctuary. Recent observations and survey indicate that their number is decreasing rapidly. The possible reason which is believed to be most appropriate is that fishermen, by so-called commereial slaughter, export them to be used as table dishes.

The second example is the decrease in the number of wild jackal population. Some people trap them and kill them for their skin which earns a good price from export.

We have not yet started the study of genetics of wild species which is essential to prevent the danger of extinction of over-specialized man-made stocks of farm animals in one hand and wild stocks on the other. Environmental genetics should be studied if we really mean preservation of species.

THE WHITE TIGERS—A GIFT TO NANDANKANAN

Sudarsan Panda, M. Sc., Past II (1979–80)

The state zoological park of Orissa, the Nandankanan zoo established its international status by producing three white tiger-cubs from the crossing of apparently normal parents. This is unique in the world and there appears to be no previous record of production of white tigers from normal coloured parents.

Distribution of white tigers :

Bombay Natural History Society is said to have recorded seventeen instances of white tigers shot in areas now covered by Madha Pradesh, Orissa, Bihar and Assam during 1907-33. There is no authenticated record of a white tiger from outside Indian limits.

There are about 38 white tigers of Rewa stock in different zoos of the world out of which 23 are in India.

Table 1 :

Distribution of white tigers in different zoos of the world.

		Male : Female
Bristol zoo	—	4 : 6
National zoological Park, Washington	—	1 : 4
Gauhati zoo	—	0 : 1
Hyderabad zoo	—	0 : 1
Calcutta zoo	—	4 : 5
Delhi zoo	—	3 : 6 : 2 (cubs)
Nandankanan zoo, Orissa	—	0 : 1 : 3 (cubs)
		12 : 24 : 5 (young)
		Total - 41

Morphological peculiarities :

The white tiger is a magnificent white animal with distinct ash-coloured or light-black stripes. The colour of the nose is grey-pink instead of normal pink, the eyes are grey-black in place of normal black. The pads of the feet are pink-coloured and the colouring of the eyes are very distinct.

Genetical analysis :

One of the interesting questions that arises in the minds of zoologists is whether the whiteness of the tiger is due to a mutant character or, albinism. Some hold the view that the white tigers are albinoes. But a study of the pedigree and genetical analysis of white tigers over a period of 20 years in the Delhi zoo proves it to be a mutant.

The whiteness of the white tiger is due to the presence of double recessive genes which can be explained by the following :

Tiger is a diploid animal producing haploid gametes. Suppose the gene responsible for the whiteness of the body colour is determined by a single autosomal recessive gene-say w : its dominant allele determining normal yellow colour designated as **W.**

According to this hypothesis, all white tigers must have the genotype—ww (homozygous for whiteness) and the normal coloured tigers must have genotype Ww (heterozygous) or WW (homozygous for normal colour). The crosses between two yellow tigers can yield either yellow or white cubs depending upon their genotypes. When both the parents are heterozygous (Ww), then the progeny may consist of both yellow and white cubs. But the inbreeding of white tigers yield only white offspring.

	White ♂	×	White ♀	
	(w w)		(w w)	
Gametes →	w w		w w	
Offspring →	w w	w w	w w	w w
	(white)	(white)	(white)	(white)

It therefore appears that the yellow tigers that produced white offspring in the Nandankanan zoo must have the genotype Ww and are heterozygous,

Thus, the production of white cubs can be explained by the following :

	Deepak (♂)	×	Ganga (♀)
	(Father)		(Mother)
	W w		W w
Cubs →			w w (white tigers)
			W W (normal tigers)

WILD LIFE TOURISM IN ORISSA: AN INDUSTRY OF THE FUTURE

Radhakanta Pradhan

M. Sc., Part II (1979-80)

INTRODUCTION

Orissa is one of the coastal states of India located between 17°48′ and 22°34′ north latitude, and 81°24′ and 87°29′ east longitude. It covers an area of 1,55,842 sq km. Two regions, like the Eastern plateau and Eastern hill ranges cover nearly almost all the districts providing good forest habitat for wild life. During 1978-79 the total area under forest in Orissa was 66,550 sq km. Orissa, with deep wood land, naturel springs with water of medicinal properties and wild riverine gorges is very much rich in the variety of fauna and flora,

Orissa maintains a growth rate in tourist traffic mainly for its magnificent monuments since 1974. But emphasis has not been given on wild life so far as tourism is concerned which can result in an increase in revenue and foreign exchange.

Tourism and wildlife of Orissa :

In 1974 more than 209 million people crossed national boundaries for a holiday abroad and spent more than Rs. 23,500 crores for which "Tourism" could be ranked as one of the major industries in the world next to "Oil". Although India's share in world-tourism is very small at present, she maintains a growth in tourist traffic against an estimated decline in world tourist arrival. Accordingly, Orissa also maintains a growth rate in tourist traffic since 1974. Orissa is one of the few states in India which can boast of varieties to cater to the multi-dimensional taste of the tourists by her fascinating sea-beaches, exotic wild life, captivating water falls, picturesque flora and fauna and to crown all the magnificent monuments. But proper emphasis has not been given to wild life tourism, as it has been done in Assam and some other states. The following table shows the different aspects of tourism.

Table 1

Year	No. of foreign tourists for India excluding Pakistan and Bangladesh	Gross foreign exchange in crores of rupees	No. of foreign tourists in Orissa	No. of foreign tourists in Orissa in wild life areas	No. of Indian tourists in places of wildlife importance in Orissa
1974-75	423,161	69.7	8,576	22	926
1975-76	465,275	104.0	9,857	99	1035
1976-77	533,951	225.0	13,843	151	3534
1977-78	Not known	Not known	16,826	286	4483
1971-79	Not known	Not known	26,073	407	6488

As regards the fauna of Orissa, it is represented by 11 orders of mammals consisting of more than 50 species besides a good number of reptiles. A large number of long-range migratory birds visit the lakes of Orissa during winter. It is intiresting to note that Orissa is the only state where all the three species of crocodilians (Gharial, freshwater and estuarine crocodile) of India are found in nature.

The exotic wild life of Orissa consists of many endangered species. So commercial utilization of these wild mammals and controlled hunting or harvesting is a dream for the next 3 to 4 decades. For this reason the best way to utilize the animal resources in Orissa is to promote wild life tourism. This can yeild a handsome amount of revenue to Government as well as foreign exchange. Until 1976 emphasis had not been given to wild life tourism in Orissa. However, in the Regional Tourist Committee meeting (Eastern zone) held at Darjeeling in June 1975, the then Director of Tourism, Orissa emphasised the need for wild life tourism in his presidential remarks. Only after that wild life tourism became a part of Orissa tourism.

UTILIZATION

For promotion of wild life tourism atleast three important aspects are to be taken care of viz., (a) Tourist information, (b) Tourist accomodation, and (c) Tourist transport and animal observation.

Vehicles and/or tamed elephants should be available for use of tourists inside the sanctuary, on prior requisition and on payment of hire charges. Some fixed amount of revenue may be collected from the tourists who take camera with them. This has been well practised in Kazinanga of Assam. There should also be adequate number of guides in the area to accompany the tourists.

Observation towers, machans and hide outs should be constructed near water holes, salt licks etc., from where tourists can observe animals without disturbing them.

Some carnivores like tiger and leopard may be trained by conditioning to come to a particular spot to take live baits, from where they can be observed from observation towers or machans. This has been practised in Corbett National Park of Uttar Pradesh. But there should be proper guides so that nothing odd happens. (See—"Twilight of India's wild life" by B. Seshari)

Artificial salt licks and water holes in summer may also be provided near observation towers.

All the above aspects should be looked into in Orissa in order to promote wild life tourism.

Wild life tourism in Orissa if properly managed can become a major industry in future.

Further Reading :

(1) Department of Tourism and Caltural Affairs :

(a) Annual Administration Report for the year 1974/75, 75/76, 76/77, 77/78 and 78/79. Govt. of Orissa Publication.

(b) Orissa Tourism News Leteer—Vol. 1, No. 5 —December 75 and January 76 Govt. of Orissa Publication.

(c) Tourism Directory, Orissa : Govt. of Orissa Publication.

THE BRAVE NEW WORLD IS HERE

P. Mohanty-Hejmadi
Department of Zoology,
Utkal University

In 1932 the late Sir Aldous Huxley published a startling book entitled "Brave New World". In its introduction he said that it is a book about future and the theme of the book is about the advancement of science as it affects human individuals. He believed that research in biological, psysiological and psycholocical lines had far reaching implications than any breakthrough in physical sciences such as the nuclear fission. The book starts with the description of a grab building—"The Central London Hatchery and Conditioning Centre" where human eggs were fertilized *in vitro* and developed in test tubes. By subjecting the embryos to different environmental conditions, people of different capacities labelled as delta's, gamma's and epsilon's were produced. Some groups represented identical individuals commonly referred to as "clones" derived by budding from a single egg. Well, until recently these ideas seemed for removed from reality and at times bizarre. But with the birth of the first test tube baby "Louise" in 1978 it is all in the realms of reality. Interestingly enough although the first test tube baby was not born in London as envisaged by Huxley it did happen in the north west region of England. As prophecied by Huxley many believe that this birth has far reaching implications and has paved the way for manipulation of human genetic material and even hired surrogate motherhood.

In 1883 Francis Galton invented the word "Eugenics" to describe a mixture of science and dogma with its aim to improve the human race by judicious marriages of gifted people on one hand, and by checking the birth rate of the unfit on the other hand. Thus, natural selection has to be replaced by artificial genetical methods. We are all too familiar with the pre-second World War atmosphere when eugenical ideas got completely out of hands in Germany where an attempt was made to wipe out the jews in order to purify the Aryan stocks. This was hardly what Galton had envisaged as a means of controlling the birth rate of the unfit. Galton's original idea was to increase the rate of human genetical change by eugenics in the same direction as that produced by natural selection, only more humanly and efficiently. One of the methods

(a) *Tourist Information*—Tourist information and publicity is vital for projecting the tourist image of the state. For this purpose there are only 4 tourist offices / bungalows in Orissa in places of wild life importance. The number of tourist offices/bungalows should be increased in places of wild life importance so that a good number of tourists will be attracted to the places.

The film entitled "Princess Khairi" produced by the Department of Information and Public Relations (I & P. R.) is a milestone in this respect. Similar films on the wild life of Orissa may be produced for the purpose.

The Tourism Newsletter published by the Department of Tourism and cultural Affairs, which is a two-monthly publication, should contain more information about the wild life of Orissa so as to promote tourist interest in the wild beauty of Orissa.

In 1976 a special coloured folder was published by the above said Department on Simlipal. Similar folders may be produced on different sanctuaries so that tourists will be easily attracted.

The yearly calendar of the Department of Tourism, Orissa should contain some aspects of wild life each year.

As regards advertisements on wild life of the State are concerned, the advertisements should be given in different wild life Journals and magazines as the sister states do.

The most vital aim of tourist information should be to make the foreign tourists visiting India aware about Orissa's rich heritage of wild life.

(b) *Tourist accomodation*—Accomodation is one of the essential requirements in tourist industry. Till the end of 1978-79 there were only 3 tourist bungalows/offices in places of wild life importance. Besides these, forest inspection bungalows also provide some accomodation. But these facilities are not adequate and up-to-date to cater to the needs of foreign tourists. So the number of bungalows in places of wild life importance should be increased with modern facilities like electricity and drinking water.

(c) *Tourist transport service and observation of wild life*—Tourist transport service is another factor which influences tourist traffic. For this reason places of wild life importance should be linked by bus or train.

which has been suggested by late H. H. Muller and Sir Julian Huxley is that there should be attempts to produce a race of geniuses by pre-selected parents. In other words, a line of progeny of high IQ parents should be produced. Well, now comes the news that one of Muller's friends Robert K. Graham of California has funded the "Repository for Germinal Choice", a subterranean sperm bank which collects sperms from Nobel prize winners and supplies them to high IQ women on request. Apparently, three women are expecting these "Superkids" this year. However, the response to this has been rather harsh and especially the other Nobel Laureates have come down hard on this. Many opine that the Nobel prize is no index of social usefulness and there is no guarantee that high IQ people produce better people or better society. As a matter of fact some argue that wars have not only been started by the more intelligent people but the most dangerous weapons have been developed by the most intelligent people. Thus, a world with mostly high IQ people may be a more unstable social and political world.

In any case, by having germinal choice, *in vitro* fertilization of human egg and test tube baby, and germinal choice we have already slipped into the brave new world and only time will tell if it is for the better or worse.

MAGNETOTACTISM IN BACTERIA

Atasi Jena and Jyotsnabala Kanungo

M. Sc., Part II (1979-80)

The bacteria constitute a highly specialised group of one-celled plants. They have a close association with man because of their universal distribution. They are among the most numerous of all living beings. Like other animals, some of these extremely tiny creatures have a process of orientation too.

A class of bacteria which has not yet entered into nomenclature is seen to have "strings of load stones" which assist in determining direction. This was discovered in 1975 by Frankel and Blakemore. That the bacteria can swim towards the North pole displaying magnetotactism was reported by R. B. Frankel and R. P. Blakemore when they examined their locomotion in a weak magnetic field. Along with this discovery several more bacteria including fresh water and marine species located in the USA and the Baltic sea have been reported to show geomagnetic orientation.

Frankel and Blakemore (1975) isolated one starain from fresh water and carried on several experiments in order to study the chemical nature of iron in those magnetotactic bacteria. By spectroscopic analyses, they found iron mostly in the form of magnetite (Fe_2O_4) commonly known as load stone-a naturally occurring compound of iron, present in those bacteria. Magnetite is known to be present in chitons, bees and pigeons which display the unique mechanism of determining direction.

In these bacteria, the strings of loadstones perhaps play the same role for orientation. The bacteria have been founed in latitudes where the earth's magnetic field points down rather than the North. For this magnetotactism the bacteria may swim to the bottom sediments which seem to be their most natural habitat.

THE BLOOD CELLS OF INSECTS

Vijaylakshmi Swain

P. G. Department of Zoology,
Vani Vihar

The haemocytes or blood cells of insects have been one of the most debatable topics amongst entomologists. It is proving to be highly complicated and the most controversial subject of the decade, for, no two schools of thought agree upon one set of findings.

The blood or the haemolymph of insects can be conveniently divided into the fluid plasma and the cellular haemocytes. In most insects these haemocytes freely circulate while in some others they are closely adherent to the tissues while the haemolymph is circulated past them. These free moving cells have been studied copiously by employing varied techniques.

Jones (1962) has attempted to classify them into nine basic types. This structural classification was mainly designed to be used with phase contrast microscope examinations of unfixed haemocytes but, is adaptable to studies with other methods. Such a classification enables even a beginner to seperate each type morphologically.

Prohaemocyte—These are the smallest cells compared to others in the sample. They are usually spherical with a large rounded nucleus almost filling the cell. They are intensely basophilic.

Plasmatocyte—They are highly pleomorphic cells (ranging from spherical to fusiform, stellate and elongated). The ovoid nucleus is centrally placed in an abundant cytoplasmic envelope. They are highest in number in almost all inseets

Granular haemocytes—Smaller than the plasmatocytes these cells bear discrete granules in the cytoplasm, often of a uniform size. The nucleus is small and is centrally placed.

Spherule cell—These are ovoid or round cells with variable sizes, and are usually larger than granular heamocytes. The cytoplasm in filled with dark ovoid glanules which tend to obscure the small nucleus It resembles a berry in appearance.

Oenocytoids—These are generally large often bizarrely shaped cells with a characteristic eccentric nucleus. The cytoplasm may contain filamentous strands or crystatlline inclusions. These cells rapidly lyse but the plasma does not precipitate.

Adipohaemocytes—Typically these are large rounded cells containing refringent fat like inclusions or vacuoles of various sizes. The nucleus is relatively small, round or slightly elongate and is centrally or eccentrically located. Histochemically adipohaemocytes are reported to contain PAS-positive substance in the granular inclusions.

Cystocytes—Cells that rapidly lyse in freshly removed haemolymph are termed cystocytes or coagulocytes. The cytoplasm becomes hyaline and the round cart wheel like nucleus is often ejected into the surrounding plasma.

Podocytes—Very rarely seen among insects, these cells when present resemble enormously enlarged stellate plasmatocytes. The nucleus is as large as an ordinary plasmatocyte.

Vermiform cells—As the name suggests these are extremely elongated cells with slightly granular or agranular cytoplasm. They are extremely rare in insects. The nucleus is thin and elongated. The tips of the cell taper to a point and is almost thread like in appearance.

Ultrastructurally the vermiform cells and the podocytes are indistinguishable from plasmatocytes. The adipohaemocytes are also not recognized by some workers who equate them to spherule cells. There are cases where intermediates have been found between prohaemocytes and plasmatocytes.

All this leads us to the fact that these cells change vociferously according to the physiological conditions of the insect. It may be stated here that all the nine forms are rarely seen in a particular insect. Usually we come across four to five kinds of haemocytes in an insect.

Functions—The functions of haemocytes that have been unmistakably demonstrated in insects are :

(1) Phagocytosis of relatively small particles (e.g,, ink and bacteria, larval tissues etc.). Plasmatocytes are mostly

involved in this process though there are reports of prohaemocytes, glanular haemocytes, spherule cells and adipohaemocytes.

(2) Encapsulation of large inert particles like bacteria, and various metazoan parasites.

(3) Coagulation of the haemolymph by agglutination of haemocytes or by the lysis of specific cells which leads to a granular precipitation of the plasma. Coagulocytes play an important role in this.

(4) Storage and transport of various nutritive materials, eg. fat materials and glycogen. Almost all the haemocytes store mucosubstances and fat in various forms.

Haemocytes are also said to transform into some other tissues eg,. connective tissue, basement membranes, imaginal fat body cells and muscles.

Origin—The origin of haemocytes is the cause of much speculation. Prohaemocytes, plasmatocytes, granular haemocytes and spherule cells have heen reported undergoing mitotic division. Often one encounters with plasmatocytes dividing amitotically.

Prohaemocytes were considered previously as the basic stem cells. ***In vitro*** culture of cells have proved unanimously that the pleomorphic plasmalocyte is the basic type.

There have been reports of distinct hemocytopoietic organs (blood cell producing organs) in which haemocytes multiply or differntiate. These organs are active during periods of metamorphosis.

The haemocytes and phylogeny—Haemocytology can serve as an adjunct to classical methods of taxonomy and may provide a balance in decisions on classification.

A review of the insect haemocyte literature indicates some phylogenetic trends in the diversity of the haemocyte types as we go up the evolutionary ladder in Insecta as a group.

BEES, THE TRUE FRIENDS OF MAN

K. Bohidar

Bees appeared on the earth in the Tertiary period, approximately 56 million years before man came into existance.

In ancient India, bees were considered sacred companions of the gods and occupy a place of honour in mythology. The god Vishnu, who was the embodiment of the sun and gave life to the Universe, was sometimes depicted as a little bee resting in the cup of lotus flower.

Honey bees are social insects that live in large families or colonies in hives, each hive being inhabited by one family. The families are characterized by a feature known as polymorphism and comprise three castes-queens (fertile females), drones (males) and worker bees (infertile females). A bee colony consists of one queen, several hundred workers and approximately ten thousand worker bees.

The queen bee is nearly 2.5 times as long and 2.8 times as heavy as a worker bee. Her function is reproduction and every day she lays 1000 to 2000 fertilised eggs in the hive. Depending on the type of food given to the larvae the eggs develop into worker bees or queens. The drones develop from unfertilised eggs. Occasionally, when the queen dies and there is no larva from which a queen can be raised, worker bees may lay eggs from which only drones hatch. A bee colony that has no queen is doomed to perish as only the number of drones will increase who are incapable of gathering food and rendering any help to the colony. As bees can not live without a queen, the workers rear a larva in a wax cell, feed it with royal jelly so that it grows into a queen. The queen lives for 5 to 8 years, but her fertility decreases with age. Male bees survive only the summer months. Their function is to fertilize the queen. Worker bees spend whole of their short lives in tireless toil. From the third day of birth as adults, they must maintain the cells in a sanitary condition. From the fourth day, they feed the growing larvae a mixture of honey and pollen. From the seventh day, their maxillary glands which secrete royal jelly begin to function and this jelly is fed to the queen and the larvae of future queens. From the twelvth to eighteenth day they develop wax glands and build the honeycomb. During this period, they

guard the hives, examine the nectar and keep the brood warm, acting as a kind of living blanket. From 15 to 18 days, they carry out the most responsible job i.e., exploring, foraging and collecting nectar and pollen. In hot days rows of ventilatory bees energetically vibrate their wings sending a strong current of cooled air into the hive. On bright summer days bees are seen hovering above the flowers from which they collect sweet drops of nectar. To produce honey, a foraging bee must visit nearely a million flowers. It sucks up nectar with its proboscis and fills its honey stomach. A bee colony collects as much as 150 kilograms of honey in a gingle season. Back in the hive, the forager is met by the other workers, the house bees, who relieve it of its nectar load which they store for sometime in their honey stomachs for complex processing. During proceesing, the bee opens its mouth and brings a droplet of nectar into its proboscis and again draws it back into its stomach. This regurgitation and swallowing of the nectar is repeated 120 to 240 times. Then it finds an empty cell in the honeycomb and deposits the nectar. It is not pure honey. Generally the droplet of nectar remains suspended from the upper wall of cells thereby increasing larger surface area which facilitate evaporation of moisture. Nectar contains 40 to 80 per cent water and upto three-quarters of this must be removed to make honey. Pure honey contains only 18 to 20 per cent water. To help evaporation, worker bees carry every drop of nectar several times from one cell to another until the impure honey becomes viscous. This evaporation process also involves many bees fanning their wings (26400 times per minute) to set up an additional circulation of air in the hive.

Apart from this purely mechanical concentration of nectar, it is also concentrated in the bee's honey stomach. Inside the stomach water is absorbed from the nectar and is enriched with enzymes, organic acids, disinfectants and other substances. When the cells of the honeycomb are filled with honey, the bees seal them with wax. The honey thus stored may be retained for years. Honey in the comb has the best flavour (and usually costs more), because it comes in natural packing made by the bees themselves.

There are varieties of honey. Bee keepers name it after the plant from which the necter has been collected. Honey differs from one another in a number of ways. The main types are the floral honey derived from flowers, regional honey pertaining to the area from which it comes, and technological honey. The quality of honey is often judged from its appearcnce, smell and taste.

Honey contains some eighty different substances of importance to the human being but, consists mainly of sugars (glucose and fructose). In addition to simple sugars, honey contains a number of enzymes like diastase, invertase, saccharase, catalase, peroxidase and lipase; salts of calcium, sodium, potasium, magnesium, iron, chlorine, phosphorus, sulpher; and organic acids like malic, citric, tartaric and oxalic acids. It also contains vitamins, proteins, acetylcholine, hormones, antibiotics and other nutritious substances.

In India, honey is used both as medicine and food. In folk medicine, honey is used to heal wounds. Good therapeutic effect has been obtained when honey is inhaled into the upper respiratory tract when one is suffering from cold. Honey has a beneficial effect on the heart because, it contains much easily assimilated glucose. It causes the veins to expand and improves circulation through the coronary arteries. An old saying has it that honey is the stomach's best friend. It has a good effect on digestion, particularly as a laxative and when taken regularly, helps to keep the gastrointestinal tract in normal working order. Honey can be used as a remedy for gastritis or gastric ulcer in which there is hyperacidity. Honey is known to have a favourable effect on the nervous system. People in high nervous tension and suffering from exhaustion are recommended to drink a glass of water in which honey and the juice of half of a lemon have been dissolved, before going to bed. Honey has long been considered as a most effective remedy for many eye diseases. Honey ointment is a good remedy for burns especially affecting the eyes and is an excellent cure for inflammation of the eye., It is advisable for children to take a teaspoonful of honey two or three times a day for better development.

Some people are allergic to honey. In them, it may cause a shortness of breath, vomiting and diarrhoea. They should not on any account be given even tiny doses of honey.

Bee keeping in Orissa

Honey is generally extracted from bee-hives nested in the hollow of trees, on precipitous rocks and on the branches of tall and big trees by some tribes like 'Khadias' and 'Malharas' in Mayurbhanj, Koraput and Dhenkanal districts of Orissa. Scientfic bee-keeping is encouraged by the Khadi-Board.

BEE KEEPING

Kamala Kanta Sahoo, Semester IV (1979-80)

A new born baby in our country has its tongue smeared with honey, the belief is that the child will use honeyed words throughout his life. How far this is true is debatable. But it is a fact that the child is introduced to every rich natural food, though not natural in the same sense as fruits and vegetables are. Honey is a natural product, the manufacturer being the busy bee.

The practice of rearing bees for procurement of honey produced by them is called *Bee-keeping* or *Apiculture*.

There are 4 types of honey bees which are used for Bee-keeping.

Apis indica (Indian bee)—It has so far proved easy to handle as well as rewarding in its output of honey. The output is between 3 to 5 kg per colony per year.

Apis dorsata—It is most difficult to handle. It is commonly called as *Rock bee* and the output of honey is very large, i. e., 15 kg per colony per year.

Apis florea (Little bee or Florea bee)—This bee produces very little honey.

Melipona iridipennis (Dammar bee)—It has the lowest yield of honey.

BEE-KEEPING METHODS

Bee-keeping is of two types.

Primitive method of Bee-keeping.

Modern method or Commercial method for Bee-keeping

Primitive Bee-keeping method— The primitive *Bee-keeping* method involves the construction of suitable containers for the bee colonies to occupy. The containers may be made of straw, hollowed-logs, the bark of trees, mud pipes, bamboo, etc. The container gives the bees protection against the heat of the sun, the entry of the rain and ants and is safe from the attacks of pests such as the ***honey badger.***

The primitive Bee-keeping method is of the following two types.

Wall fixed type—At the time of building a house, villagers construct rectangular vessels or mud receptacles in the wall. These have a small hole on the outside for the entry of bees and a large opening on the inside covered with a board and basket held in place with mud and cowdung. This internal opening is used for harvesting honey and as an observation window.

Movable type—This movable type comprises hollowed out logs, empty boxes, earthern pots etc., which are placed in the verandah of the house. These also have an entrance hole and an opening hole at the back. Swarms of bees are generally left undisturbed till the close of the honey-flow season.

After smoking, water is sprinkled over and then the honey comb is cut out. Honey is squeezed out of the comb by pressing it through a cheese cloth. This method of bee-keeping yields less honey and impure honey.

Modern method or *Commercial method of Bee-keeping*—In order to make Bee-keeping profitable, the modern method of Bee-keeping is adopted.

Choice of site—For the commercial method of Bee-keeping, the choice of site is a very important factor.

Nectar yielding blossoms must be available within a radius of one to three miles from the bee-hive.

Besides major flowers, there must be fruit and vegetable resources.

Hives should be sited as near the water supply as possible, certainly within ¼th of a mile from the bee-hive.

Damp hollows must be avoided.

Areas liable to flooding should be avoided.

Apiary (this is a place where a number of bee-hives are kept for bee-keeping and breeding) must be sheltered from the winds.

Hives must be protected against pests and animals.

Hives should be shaded from the mid-day sun.

Roads and foot paths should be kept away from the apiary as the bees do not like rapid movements near the hives.

The selected apiary must be kept away from other hives so as to eliminate the danger of overstocking.

Bee-house—Under certain conditions, it pays the bee-keepers to keep their hives in bee houses to avoid the uncontrollable bees in the open and thieves.

A bee-house is a small building with a strong bee tight door and well ventilated windows fitted with a bee-escape arrangement. The hives are placed inside round the walls, the ends of the hives which contain their entrances are in contact with the walls and are called as ***entrance holes.*** The bees fly in and out through the walls without entering the the room itself.

Construction of bee houses—The bee house is constructed in such a plan that the internal length is 32 ft. and the internal width 8 ft. Height from floor to ceiling is 7 ft. The bee house should be built of the strongest and most durable materials available. The door should be of 6 ft. length and 3 ft width. Strong lock should be fitted to prevent pilferage by thieves. Frame hives are arranged in pairs with a gap about 5 inches between each hive and a gap of 18-21 inches between one pair and the next.

Advantage of bee-house—

(i) Hives are in total shade and therefore remain cool.

(ii) Hives are protected from thieves.

(iii) The bee-keepers can work on the hives in the day light using smoke to control the bees.

(iv) 20-50 hives can be accommodated in the house.

Collection of honey from the hive—Bee-keepers collect honey combs from the hives at all seasons of the year when the hives contain only good quality of fully ripened honey. Then they separate honey from wax and put honey in proper containers. The best method of honey separation is by means of ***honey press.***

GOMPOSITION OF HONEY

Honey is a useful food which is good for health- The constituents of honey are *water; sugars* (cellulose, dextrose, sucrose, dextrin); minerals like Ca^{++}, Fe^{++}, Po_4^{--}, and Mg^{++}; Vitamin B-Complex.

ADVANTAGE OF BEE-KEEPING

There are many advantages in bee-keeping, but the main advantages are as follows.

Uses of honey—Honey is one of the cheapest foods. A United States Ministry of Health report puts the energy value of a pound of honey at 1.290 cals against the pound of egg (1.200 cal) and a pound of bread (1.280 cals). The Ministry claims that one pound of honey is equal to 30 eggs or 8 pounds of plum or 10 pounds of green peas or 20 pounds of carrots. So honey is used as a nutritious food.

Uses of bee-wax—It is a valuable by-product, and is used as raw material by chemical industries for production of polishes (leather furniture polish and car polish) cosmetics and Bee-wax has also numerous military use and is used in atomic research.

BEE-KEEPING IN ORISSA

The Khadi and Village Industries Commission has helped apiculture through hybridisation of bee colonies and by providing monetary grant and scientific training to people. To-day, people of 3,000 villages cultivate bees in Orissa. Cross-breeding has also been developed by collaboration with the Agricultural University.

Apiculture problems in Orissa—Scarcity of funds and inadequate publicity have been responsiblc for greater interest in bee-keeping. The Khadi and Village Industry Commission spends about 3% of its entire budget in bee-keeping, A vigorous drive is required to popularise apiculture. Greater inflow of funds is necessary. This could create a large market for this cottage industry, thus attracting more willing farmers. Scientific training should be given to the bee keepers.

Blessed as we are with an abounding flora, apiculture can be a profitable occupation. It benefits agriculture and horticulture. Despite all its advantages this cottage industry is neglected in Orissa.

THE 'TUNNEL-MAKERS' AND WEED CONTROL

Jyotsna Kanungo, Semester IV (1979-80)

In 1976, the highest award of the Indian Council of Agricultural Research went to a retired School Headmaster for controlling the weed lantana (*Lantana camara*) by means of an insect, *Ophiomyia lantanae*.

What is a weed?—A weed is a plant that grows where it is not wanted. For example, rye in a wheat field is a weed, wheat in a rice field is also a weed. Weeds include all types of undesirable plants, trees both dicotyledons and monocotyledons, sedges, aquatic plants and parasitic flowering plants. They constantly compete with the major crop plants to exist thus reducing crop yields. Weeds have the ability to readily adapt themselves to adverse environmental conditions.

What are tunnel makers?—Quite often, silvery white serpentine 'mines' or tunnels are found on the leaves of certain ornamental plants which disfigure the textural beauty of the leaves. This is due to the feeding activities of the larvae of a tiny dipterous fly belonging to the family Agromyzidae. These flies also attack many economically important crops like *Cajanus indicus* (Arhar), *Phaseolus mungo* (Moong) and P. *radiatus* (Urd), *Dolichos lablab* (Sem) etc. These dipteran flies are popularly known as 'leaf-miners'.

Life history of Ophiomyia lantanae —The female inserts a well developed ovipositor into the parenchymatous tissue of the plant to deposit the eggs. The female fly has the habit of making several such punctures from which the sap oozes out and is eaten by the male and female flies. In majority of cases, the site of egg-laying is definite.

The larva on hatching starts making tunnels between two layers of tissue. The larva is equipped with sharp mandibular teeth or hooks working vertically by which it eats away the parenchymatous tissue. The feeding activity increases during day time and decreases in the night.

After about 10 days, the full-grown larva pupates and stops feeding, and shortens in length. The colour also changes.

The adult fly escapes from the puparium by opening the anterior region of the tunnel.

O. Lantanae as a weed-controller —The mines or tunnels of Agromyzid larvae are so characteristic that the species can be identified by studying the mine and the host plants. *O. lantanae* is a anthonome because it attacks the thalamus region of the weed *Lantana camara.*

The thalamus is the swollen end of the axis or pedical with the floral leaves inserted into it. *Lantana camara* is a menacing weed growing all over India. *O. lantanae* attacks the thalamus of its flowers and thereby inhibits seed formation and controls weed propagation.

This is one type of biological control of weeds. The tunnel makers usually are harmful to agriculture but in spite of such drawbacks, their weed control potentiality has drawn much attention and encouragingly the ICAR award has gone to the discoverer of this control method.

THE UNDERGROUND CIVILISATION

Snigdha Rao

Today the yardsticks of civilization are large, industrious cities which are well planned and provide all the comforts to human beings. Below the ground, about 6 or 7 feet deep, there exist most complicated, yet well planned cities of the animals world. And these cities are equipped with ventilating shofts, main roads, streets, food stores, sleeping quarters, nurseries, barracks, cemeteries. hospitals, playground, and of course a royal lodge. Do you know, to whom these cities belong ? They belong to the tiny but perhaps most industrious creatures in the world—the ants.

The ants are social insects living in families. In ant society, the most attracting place is the queen's lodge, where she like a royal princess enjoys all sorts of service from others and maintains a perfect order of discipline in her kingdom. She has her bodyguards surrounding her, and lady attendants which fondle, wash and take care of her very well. Inside the ant society there are two other distinct classes, males and workers. Males live as pampered guests of the queen. Only one among them is lucky enough to fertilize the female, after which it dies.

It is the queen which first struggles hard to establish an ant community. With her heavy egg laden body she has to forage for food herself. With prolonged starvation she however survives along with her 1st batch of eggs which always hatches into workers. Then these workers eventually mature and come to the relief of the queen. Soon they are busy in excavating, tunneling and erecting and paving in an irregular manner. Within a very short dutation this work is climaxed by the emergence of a wonderful ant city.

The first and most elaborate construction which come up in an ant city is the nursery. There the queen controls the types of eggs After laying thousands of eggs which develop into immature workers she switches over to lay royal eggs.

In an ant community, majority are workers which form the back-bone of the society. Possibly they do all sorts of activities with a distinct plan of division of labour. Accordingly they are of various types :

Skilled workers—They are the makers of an ant city and each of them can lift about 50 times more of their own body weights. They are the most skillful craftsman.

Masons—These are the engineers of ant society which plan and build the whole ant city and soldiers are responsible for its maintenance.

Farmers and soldiers—These two groups of ants work together and are responsible for food storage. Ants devour almost anything but their favourite food is "ant-bread" which is made from grass seeds brought by farmer ants. The soldier ants crush these seeds with their abnormal large heads and jaws and by a special secretion. Then the farmer ants again reshape this and store them in the storage house.

Nurses—A nurse ant takes the eggs from the mouth of a lady attendant of the queen and carries the same to the nursery chamber where she takes care of the eggs, feeds the newly hatched larvae and also nurses the sick ones.

Doctors —They work in ant hospitals caring for the sick ones and perform a bit of surgery by biting off a broken or useless limb. Ant doctors practise euthanasia frequently.

Security guards —A group of security guards watch the entrance while an another at the exit. Besides, a circle of bodyguards always surround the the queen. Even at the slightest disturbance of peace or at the approach of an enemy they send a tapping message or so called ant-mose code. The result is, within no time the whole city is sealed on all sides. It sometimes so happens that these ants take a major role in fighting along with soldier ants. But the fighting, unlike human beings is only due to food shortage. Other worker ants also participate in fighting. Soldier ants and security guards possess special stings which is filled interiorly with a skin irritant—the formic acid.

Gardners —There is a number of neat, well maintained gardens and gardeners too in an ant city.

Undertakers—Like human beings ants are busy burying their dead in graveyards and this work is done by special groups of workers which are also responsible for sanitation of the whole ant city.

Interestingly enough ants play games in their playground and often wrestle with each other. Their play is a sort of *"rugby"*. They toss the ball (grass seed or a wheat grain) to each other and roll each other on the ground incessantly. They can recognise their fellow beings by their particular-ant-city smell and communicate with each other by "tapping talk". When they go out of familiar ground they usually observe the position of the sun and return safely. Perhaps that is why ants are never seen after sun-set.

They also know how to punish the trespassers. Usually trespassers are welcomed to an ant city. But if it is suspected to be a spy then they never allow the fellow to go out. They usually adopt that ant spy in their own community.

Ants are mostly hospitable especially towards their beetle guests. They keep the tiny beetle pets known as "ant cow". These tiny creatures impart an aromatic odour. Ants introduce their guests first to the queen and then treat them gently as honoured guest. Ants may even carry them and fondle these creatures affectionately.

Thus the underground city is well-planned by engineers, well-run by a stabilized Government and its citizens live harmoniously inside with a perfect orderly discipline. Bismark rightly remarked, "If I would have to take birth again I would like to become an ant !" Let us learn something from these peaceful citizens of the underground.

PISCICULTURE—A MODERN APPROACH

Brajakishore Nayak

Fishes form a major portion of animal proteins of our diet. In spite of the rich potential of fishery resources of our State it is a dream to get fresh and sufficient quantity of fish in the market.

Cultivatable fishes :—

1. *Catla catla* (Bhakura)
2. *Labeo rohita* (Rohi)
3. *Cirrhina mrigala* (Mirikali)

The exotic carps suitable for our country are :

1. *Cyprinus carpio* (Common carp). It comprises 3 types viz.,
   - C. *Carpio* var *specularis* (mirror carp)
   - C. *Carpio* var *communis* (scale carp)
   - C. *Carpio* var *nudus* (leather carp)
2. *Hypopthalmichthyes molitrix* (Silver carp)
3. *Ctenopharyngodon idella* (Chineese grass carp).

The cultivatable fishes feed upon planktons and they have a definite seasonal breeding cycle. Naturally, spawning occurs in flowing water in monsoon rains. In the fish farm they are induced to breed by hypophysation.

Establishment of fish farm :—

The basic elements for the establishment of an ideal fish farm are as follows :

1. Availability of flowing water throughout the year.
2. Water retainting capacity of the soil.
3. Drainage system should be very good.

The area of the fish farm may vary depending upon the rearing and breeding operations. They may be constructed by mud cement or stone and are provided with an outlet for drainage of water.

The ponds should be cleared and manured properly for sufficient growth of plankton and other food of the fishes. The entrance of the unwanted predatory fishes to the pond from the flowing water can be checked by boulders. Aquatic insects and weeds should be killed or removed manually or by applying chemicals.

Fish seed production —

Male and female fishes are caught with drag net and are reared in separate stocking ponds, because sexwise segregation may increase their sexual urge. Mature females have bulging belly due to gravid eggs and the vent is pink while mature males have rough pelvic fins.

Mature males and females are subjected to hypophysation under suitable environmental conditions such as, incessant rains, low temperature (26°-30°C) etc.

Hypophysation—

Hypophysation is the process in which pituitary extracts are injected into mature male and female fishes to induce breeding. Pituitary glands are collected from mature major carps or marine cat fishes and are dehydrated and preserved in absolute alcohol. They are dried on filter paper, homogenised in distilled water and centrifuged. The supernatant liquid is drawn into a syringe and injected intramuscularly at the caudal peduncle of the breeders. The female receives 2 doses, one 3-5 mg/kg body wt. in the afternoon and the other 5-8 mg/kg body wt. late in the evening. The male receives one dose 3.5 mg/kg body wt. at the time of 2nd dose of the female.

Spawning—

The injected male and female are treated with potassium permanganate solution and are released into the breeding "happa" in 1 : 2 proportion. After 4.8 weeks of sexual activity the female lays eggs and the male sheds the milt and the eggs are immediately fertilized. In a single spawn a catla lays 0. 15—0.2 million eggs, rohu 0. 2—0.3 and mirikali 0.4 to 0.7 million eggs. The parents are removed from the breeding happa and are released into the stocking pond the next morning. Then the spawn

is collected and transferred to the hatching happa. The eggs start developing and hatch within a very short period.

When the hatchlings are about 3 days old they are transferred to the nursery pond where they develop into fries and fingerlings.

Transport of fish seed—

The fish fries and fingerlings are kept in nylon nets in running water. They are not fed prior to transport, because deoxygenation due to decomposition of faecal matter is avoided.

The fries and fingerlings are transported in polythene bags containing little water and sufficient oxygen.

The fries and fingerling are finally released into the well prepared rearing pond where they grow into suitable sizes.

Fish seed of *Catla catla*, *Ctenopharyngodon idella* and *Hypopthalmichthyes molitrix* is produced by hypophysation while that of *Cyprinus carpio* can be produced by merely segregating the males from the females for sometime and then putting them together in the breeding cisterns, Casuarina branches or other twigs should be put in the breeding cisterns as the eggs of *Cyprinus carpio* are adhesive. In India *C. carpio* breeds throughout the year and normally during winter and spring.

Fish rearing—

Fish seed is collected from the rivers is a mixture of both wanted and unwanted types but, fish seed produced in farms consists of pure desired types. For profitable pisciculture composite pisciculture has immense value to the pisciculturists. Differerent fishes have different feeding habits and habitats. For example, *Catla catla* is a surface freeder, *Labeo rohita* is a column feeder and *Cirrhina mrigala* is a bottom feeder. So, for full utilization of the food resources of a pond the six species of fishes mentioned at the beginning are advocated for rearing.

Pisciculture is a profitable agro-industry. It could give a net profit of Rs. 500/annum/hectare.

"SAVE THE JUNGLE, SAVE A WORLD"

K K. Mohapatra

India has been famed for its spectacular and varied vegetation, for its great mountains and rivers and for the rich and variety of its wild life. But the hopeless struggle of people against hunger has left no room for wild animals. Neverthless something must be done everywhere on this earth to protect the bounties of nature. In the 1st eighteenth century of our era, one species of animal died out in every 55 years. But since the beginning of 19th century an average of one species a year has been exterminated. Our natural environment is becoming poorer day by day, and the areas in which the last wild animals can find a refuge are shrinking. The number of animal species threatened with extinction is steadily increasing. At present about 12 species of reptiles, 338 species of birds and 288 species of mammals are in danger and are recorded in Red Data Book.of International Union for Conservation of Nature and Natural Resources (I.U.C.N.).

The world has undergone drastic climatic changes within a few decades posing a problem to mankind. Destruction of our natural resources has produced grave challanges to the very existence of human life on this earth. The materialistic world of today tends to remove all contacts with this fascinating world of flora and fauna. All these factors will finally lead to an ecological catastrophe no doubt. Hence to save ourselves from the grave danger, we have to devise methods to preserve our forests, a main component of which is wild life.

When a building of historical and cultural value collapses it is in many cases possible to restore this monument with the lelp ot human creative genius. But with all due respect to science when the last elephant or lion dies it will never be possible again to recreate this vanished component of nature. A striking example is the extermination of the Indian Cheetah (*Acinonyx jubatus*) in 1952 from the Indian soil. So the protection of nature is always of equally great international importance like that of the preservation of an old Egyptian palace or an Iindian Taj.

It seems clear that mankind is rapidly approaching a crisis as the non-renewable resources of the world are becoming searce. It is equally

clear that the future of mankind must therefore be based on the support of renewable resources such as water, forests and wild life. The clearing of forests in marginal land for short term agriculture is an example of this phenomenon leading to the destruction of forest and wild life. At present wild life seems to be at greatest risk in developing countries. In these countries large increase in population, indiscriminate burning of habitat, increased pressure on hunting, large scale tree felling and introduction of domestic grazing animals, all threaten natural resources on a scale never before encountered in the history of mankind. The long-term prospective of conserving wild life is going to be lost because of heavy pressure of human population on available resources.

It is therefore high time to consider wild life conservation on a priority issue. Conservation and management must go side by side for successful implementation of conservation programmes. Wild life management is a very new discipline in Asia. Many countries lack the expertise to prevent their wild life from being hunted to extinction in contrast to the African and American countries where wild life supports a multimillion dollar industry.

Wild life conservation provides opportunities for tourism and recreation. The natural ecosystem can yield appreciable quantities of food and other material for starving mankind. In our endeavour to conserve our wild life one of the important considerations is the symbiosis between wild life and forest—the natural home for wild life. Destruction of forests inevitably leads to destruction of wild life. Therefore if we have to protect wild life we have to protect their habitat first—the forest and our approach to planning must reflect this.

We have today a large number of National parks and sanctuaries. which are the last refuge for our endangered wild life. In India there are 20 National parks and 190 sanctuaries. On the proper management of these depends the future of our wild life. It is righly said, "Save the jungle, save a world".

HOW CELLS FORM ENERGY

Mr. Nirakar Jena and Mr. Satyabrata Kar

Energy which is constant and is defined as the capacity to do work is required by all living systems to carry out their life processes. The most common and cheaper source of energy is the sun. Solar energy is initially utilized by the chlorophyll of green plants and some bacteria to synthesize carbohydrates in the form of starch. Green plants are ultimately eaten by animals and the stored carbohydrates serve as the basic source of energy. However, Krebs and Kornberg pointed out that many different cell compounds which may be classified roughly as carbohydrates, lipids and proteins can also serve as the sources of energy for living systems.

The major carbohydrate in the body is glucose. The metabolic pathway for glucose degradation to carbon dioxide and water can be divided into two parts i) Glycolysis—the breakdown of glucose to pyruvic acid in the absence of Oxygen ii) the Krebs cycle—the conversion of pyruvic acid to carbon dioxide and water in presence of oxygen.

In the above two processes three molecules of ATP, 6 molecules of reduced NADH and one reduced FADH are formed. These reduced NADH and FADH are loaded with high energy electrons and act as electron doners to the electron transport chain for consequent release of energy-

It is estimated that complete oxidation of one molecule of glucose liberates 686 kcal of energy from which about 98 molecules of ATP can be synthesized theoritecally (686/7 = 98, 7 Kcal of energy is required to synthesize one ATP from ADP & Pi). However only 38 moles of ATP are formed in Prokaryotes and 36 in Eukaryotes and the remainder of the energy appears as heat. The above differences in the formation of two molecules of ATP is due to the fact that in Eukaryotes the inner membrane of mitochondria is not permeable to $NADH + H^+$ and a shuttle process involving Sn-glycerol-3-phosphate is employed. In this process $NADH + H^+$, produced in glycolysis is first reoxidised by dihydroxy acetone phosphate in the presence of cytoplasmic-Sn-Glycerol-3-phosphate dehydrogenase. The Sn-glycerol-3-phosphate thus formed is readily

permeable to the mitochondrial membrane and enters the matrix where it is oxidised by FAD. This conversion of 2 moles of $NADH_2$ to $FADH_2$ reduced the formation of 2 moles of ATP in Eukaryotes.

The Neutral fato which is the chief storage form of available energy in the animal cell consists of three fatty acids attached to the three carbon molecules of glycerol. The breakdown and synthesis of these fats are closely associated with the metabolism of glucose because of the formation of intermediates, common to both pathways. The initial step in the breakdown of Neutral fat involves splitting off the three fatty acids from glycerol. The glycerol, being a three carbon carbohydrate, enters the glycolytic pathway by forming dihydroxy acetone phosphate. On the otherhand the breakdown of fatty acids by β-oxidation theory requires coenzyme-A and hydrogen-carriers such as FAD and NAD. It was first postulated by Knoop in 1904 and later confirmed by a number of scientists.

Thus from fatty acid breakdown a number of molecules of carrier H_2 and acetyl-CoA are formed. This acetyl-CoA then enters the Krebs cycle and is broken down to carbon dioxide and water and the energy released coupled to ATP synthesis. On the otherhand the carrier-H_2 molecules resulting from fatty acid breakdown can transfer their hydrogen to the cytochromes in the mitochondria thus providing an additional source of energy for ATP synthesis.

In complete oxidation of a fatty acid to Co_2 & H_2O, 48% of the available energy can theorietically be conserved in the form of ATP that is utilized by the cell for work. The remainder is lost probably as heat.

The metabolism of protein is more complicated than lipid or carbohydrate metabolism. Proteins are formed from 20-different amino-acids, all of which have different chemical structures and require different pathways for their synthesis and degradation. Several enzymes can breakdown proteins into amino acids, some acting on the terminal amino acids in the chain and others breaking the bonds between a specific set of amino acids within the chain. The net result of these enzyme actions is the production of a pool of amino acids in the cell. The amino acids that are present in excess or are not usable are immediataly catabolized and from ATP.

The amino acids are either deaminated or transaminated and then enters Krebs cycle for the synthesis of ATP,

How and where ATP is synthesised in the cell? ATP is synthesized in the cell in a speciale organell known as mitochandria by a complex procedure known as electron transport system. The electron transport system consists of a sequential series of cytochrome oxidase enzymes capable of passing electrons from one another. Electrons taken up by hydrogen acceptors (NAD, FAD) are ultimately transferred to the electron transport system where they are passed down this chain of cytochrome enzymes. The sequence in which the electron carriers of the chain operate is determined by their respective Redox-potentials. The $NADH + H^+$ has got the minimum redox potential value i.e.,—0.32 and H_2O got the maximum i.e., + 0.82. When electrons pass through this system they lose a part of their energy. The point where more than 8 kcal of energy is liberated, a molecule of ATP is synthesized from ADP and iP by oxidative phosphorylation. It is found that the oxidation of one molecule of $NADH+H^+$ will result in the formation of 3 ATP molecules while oxidation of $FADH_2$ will lead to the synthesis of 2 ATP molecules.

SATURATED FATTY ACIDS AND GASTRIC DISORDER

Suresh Chendra Rath

Do you ever think that the food prepared in hotels and restaurants is hard to digest ? Do you often hear that the regular visitors of the said centres suffer from gastric disorders ? The answers to the above quetions are very obvious because every one of us has had the above trouble at least once. Food prepared in hotels and restaurants are usually rich in fats and oils. Fats and oils are broken up in the intestine into simple fatty acids and glycerol by the action of the enzyme lipase. Digested products are then absorbed into the blood stream and transported to target organs for utilisation as well as deposition. Fats and oils are more or less the same type of compounds and are of the same dietary value. But scientifically oil differs from fats having more unsaturated bonds. It is wellknown to everybody that the oil cauldron is placed on the fire almost throughout the day in the hotels. Overheating causes a good deal of changes in the oil at molecular level.

Oils contain a number of unsaturated fatty acids. Continuous exposure to air in high temperature leads to the formation of oxidised products known as peroxides. These peroxide compounds along with many other peroxide derivatives are very much injurious to health.

The second problem is polymerisation products of oils. Polymerisatitn is the process by which millions of same type of molecules are united repeatedly so as to form a larger molecule. Due to excess heating oil molecules polymerise to form giant molecules. It is quite difficult on the part of our digestive enzymes to act upon them. It is hard to digest them and so we suffer from indigestion.

Fats are nothing but comparatively more saturated oils i.e., chemical compounds having less double bonds.

You must have heard the term "rancidity" of fats. The common example is the bad smell of old *ghee* bottle especially in the rainy season. This rancidity is also very harmful to the body.

Rancidity is of two types : (i) hydrolytic rancidity and (ii) oxidative rancidity. Continuous hydration (contact with water), continuous exposure to air and overheating cause rancidity of fats or ghee.

Then again, generally Nickel catalyst is used in industries to convert the oils into synthetic fats. But due to defective filtration in post-synthetic processes, some catalysts are left as such which cause gastric disorders. In cold ghee cauldron the bluish zone in between the junction of ghee and wall of cauldron is due to the deposition of the said catalyst.

Scientists are of the opinion that excess intake of synthetic fat causes gall-stone formation, internal haemorrhage and blood pressure due to deposition of cholesterol in various organs.

Minimize your fat-intake and avoid hotel visiting as far as practicable.

APPLICATION OF "HARDY-WEINBERG LAW" TO ANTIGENIC BLOOD GROUPS

Prekash Chandra Misra and P. Mohanty-Hejmadi,
Department of Zoology, Utkal University,
Bhubaneswar.

An English mathematician, G H. Hardy (1908), and a German Physican, W. Weinberg (1862-1939) independently discovered a principle regarding the frequency of genes (alleles) in a population that has had a wide application to population genetics.

According to the law, "the relative frequencies of two alleles in a population in which the individuals are exchanging genes at random, will remain constant from generation to generation as long as the population is in a state of genetic equilibrium."

The law has two principles : First principle is that frequency of alleles of the genes occurring in the population is the same as in gametes produced by the population. Supposing in a population of 100 individuals, p and q represent frequencies of **A** and B genes, each being equal to 0.5. Taking the minimum figure that each individual produces two gametes the frequencies of each allele in a population of 100 will be as follows :

PARENTS	GAMETES	
	A containing	B Containing.
25 homozvgous AA	50	0
25 homozygous BB	0	50
50 Reterozygous **A**B	50	50
100 A and 100 B	100 A	100 B

Thus the gametes occur in a frequency that is identical with that of the genes in the population which produces them.

The second principle is that mating occurs at random in a population in genetic equilibrium, therefore, all the eggs and sperms have equal chance of uniting to form a zygote.

The relative frequencies with which different types of individuals will be formed in the next generation can be determined by multiplying the frequencies of two kinds of sperms (A carrying and B carrying) with those of two kinds of eggs as shown in the following table :

Frequencies		Frequencies of
Sperms	Eggs	zygotes produced
0.5 A	{ 0.5A 0.5 B	0.25 AA 0.25 A B
0.5 B	{ 0.5A 0.5 B	0.25 A B 0.25 B B

Thus the relative frequencies of A & B genes will remain constant as they were in the preceding generation and will remain the same for succeeding generations. So it can be inferred that the genes in the population are in genetic equilibrium with each other and will remain so till any outside factor upsets the equilibrium. This relationship is expressed by the formula $p^2 + 2\,pq + q^2 = 1.00$.

Hardy-Weinberg law has been used successfully to verify the genetics of blood group antigens. A failure to fit the observed data to the formula means that either the genes are not in equilibrium in the population or that the "two gene hypothesis" itself is wrong. Investigations involving the blood group antigens have shown that in different human populations the blood group antigen frequencies remain constant as proposed by "Hardy-Weinberg Law".

Application to MN blood group alleles—

In the MN blood group system the phenotypes and genotypes are known by the specific reactions of blood cells to anti-M and anti-N sera, the table below showing their relationship :

Phenotype	Genotype	Anti-M.	Anti-N.
M	MM	+	0
MN	MN	+	+
N	NN	0	+

If there are actually two genes determining the occurrence of M & N antigens and if these genes are at equilibrium with respect to each other, certain relationships must hold between the frequencies of these genotypes.

Supposing the frequency of M gene be 0.4 and that of N gene be 0.6, then the three genotypes should occur in the following predictable proportions :

$p^2 = 0.16$

$q^2 = 0.36$

$2pq = 0.48$

So out of every hundred individuals 36 should be NN, 42 MN and 16 MM. By a trial sampling of human 'MN' group in different populations, this hypothesis has been proved to be correct.

Application to ABO blood group alleles—

In this ABO system the phenotypes are known by the specific reactions of blood cells to Anti-A and Anti-B sera, the table below showing their relationship.

Phenotype	Genotype	Anti-A	Anti-B
O	OO	—	—
A	AA or AO*	+	—
B	BB or BO*	—	+
AB	AB	+	+

(*) In ordinary blood group test where only anti-A and anti-B are available it is not possible to distinguish between homozygous AA (BB) or heterozygous AO (BO).

In this system by the application of the Hardy Weinberg formula, an incorrect genetic hypothesis has been replaced by the correct one.

The occurrence of ABO antigens was long known to be under genetic control and the nature of genetic systems was incorrectly postulated. According to this original postulation the system consisted of two pairs of alleles Aa and Bb each with its locus on a separate chromosome pair and with one member of each pair dominating over the other. In

this system the genotypes, AABb or Aabb represent type A blood group; AaBb, AABb, AABB, AaBB represent types AB; aaBB, aaBb represent type B, and aabb represent type O.

When frequency data were observed it did not fit the Hardy-Weinberg formula. So Bernstein in 1924 demonstrated that the failure to fit was due to the fact that these blood group antigens were controlled by three (and not two) multiple alleles, A, B and O whose frequencies, p,q and r added up to 1.00. The various genotypes expected in a three allelic system can be determined by the formula $(p+q+r)^2 = p^2+q^2+r^2 +2pq+2pr+2qr$ where the following represent respective frequencies :

$A = p^2+2pr$

$B = q^2+2qr$

$AB = 2pq$

$O = r^2$.

Bernstein has further shown that p, q and r frequencies expected in the three allele theory can be found by using the following equation :

$r = \sqrt{O}$

Where O represents frequency of O blood group.

$p = 1-\sqrt{O+B}$ where B represents frequency of B blood group.

$q = 1-\sqrt{O+A}$ where A represents frequency of A blood group.

The observed data on the ABO blood group system in different populations has led to the acceptance of Bernstein equation.

Thus the Hardy-Weinberg law which is commonly used in studies of population genetics is of immense value in the field of immunology.

Further Reading :

1. Cushing, J. E. and D. H. Campbell—Principles of Immunology, McGraw Hill, New York.

2. Gardner, E. J.—Principles of genetics. The English Universities Press Ltd., London.

3. Kabat, E.A.—Bloed group antigens. Academic Press, New York.

4. Sinnott, E. Q., L. C. Dunn and Th. Dobzhansky.—Principles of Genetics. McGraw Hill, New York.

HOW THE BODY DEFENDS ITSELF

Pradeep Kumar Mohanty

Our body is always liable to various types of infections by micro-organisms and other foreign substances. Hence our body has a built-in mechanism to defend against them. This phenomenon is known as immunity of the body. For this purpose our body has specialized organs such as thumus, spleen and lymph nodes.

The function of thymus is very poorly understood because it degenerates after childhood. It appears that the thymus primes a line of cells that is responsible for the production of antibodies. The thymus gland of a human adult is very small and is located in the chest. The function of thymus is to stock the body with special cells called lymphocytes. These cells have the ability to travel freely and are more abundant than any other of the body's wandering cells. The thymus is the primary source of lymphocytes in mammals, and these cells are liberated into circulation. They settle down in organs such as spleen and lymph nodes. There these cells and their descendents give rise to cells responsible for some of the immunological functions of the body. In the child the thymus is in the form of two oval lobes that lie in front of the chest. The size of thymus increases upto the age of 8 to 10 years. There after, the gland starts to atrophy.

Immunity during birth —

The foetus inside the mother's womb has connection with the mother's general circulation. The antibodies from the mother's blood get into the circulation of the foetus and protect it from various types of infections. When the baby is born, it does not have any immune response. It does not react to antigens. The mother's antibodies, which are present in the baby's blood protect it from infections. The colostrum or the first milk of the mother also contains antibodies. When this milk is fed to the baby, it gets further immunized. In this case we can say that the baby has achieved passive immunity. After six months of age the baby develops the antibody forming mechanism.

Structure of antibodies—

Antibodies are macromolecules of glycoprotein. These are also known as immunoglobulins. The molecular structure of immunoglobulin was worked out by Gerald Edelman of U.S.A and Rodney Porter of Britain. For this they were awarded Nobel Prize for physiology and medicine in 1972. There are five types of immunoglobulins : IgG, IgM, IgA, IgD and IgE. IgG is the major immunoglobulin component of serum making up 75 per cent of the total blood serum. Immunoglobulin G consists of four polypeptide chains out of which two are designated as heavy chains consisting of a region of variable amino acid sequence (110 amino acids) and a region of invariable amino acid sequence (330 amino acids). The light chains similarly consist of a region of variable amino acid sequence and a region of constant amino acid sequence. The two heavy chains are joined by two interchain disulphide bridges. Each light chain is joined with the heavy chain of its side by one interchain disulphide bridge. Besides these inter chain disulphide bridges, there are also 12 inter-chain disulphide bridges, 4 in each heavy chain and 2 in each light chain.

The whole immunoglobulin molecule may be divided into two units : Fab segment, concerned with antigen binding and Fc or crystallizing fragment.

Immunoglobulin production—

The antibody response resulting from exposure to antigenic substance has certain well-defined characters.

Primary immune response—

After the first injection of an adequate dose of antigen, antibodies can hardly be detected circulating in the blood atleast for several days. There is a rise in titre detectable in the blood by the 10th to 14th day. This is followed by circulating antibodies over a period of several weeks and a more gradual fall in the titre which approaches an un-detectable level for a period of months or indefinitely. This is known as primary immune response.

Secondary immune response—

When the second injection is given to the body, there is much more rapid rise of antibody titre. This level increases logarithmically and maintained at a fairly high level for a longer period of time. This is known as secondary immune response.

Negative phase—

A sudden but temporary drop in the antibody titre following the second injection of the antigen is referred to as a negative phase. This drop is due to the fact that some of the circulating antibody combine with the newly introduced antigen.

Once a person has responded to a single dose of a live attenuated antigen, his body retains the memory of the antigen so that months or years later, it responds with rapid mobilization of antibody forming cells.

Antibody producing apparatus—

The bursa of newly hatched chick and thymus of mammals seem to contain the precursor cells producing the antibody. If the bursa of chick and the thymus of the mammal are removed surgically during the first few days of life, the animal does not develop antibodies. Miller (1963) has shown that the thymus is essential for the recovery of immune mechanisms. In mammals, the tonsil is analogous to bursa of birds. Thymus dependent or bursa dependent immune reactivity has led to the concept of separate central and peripheral lymphoid tissue. Then thymus and bursa of Fabricius are referred to as central lymphoid tissues, whereas lymph node and spleen are the peripheral lymphoid organs.

A tentative scheme showing the relationshjp of central and peripheral lymphoid tissue is given in fig. 1.

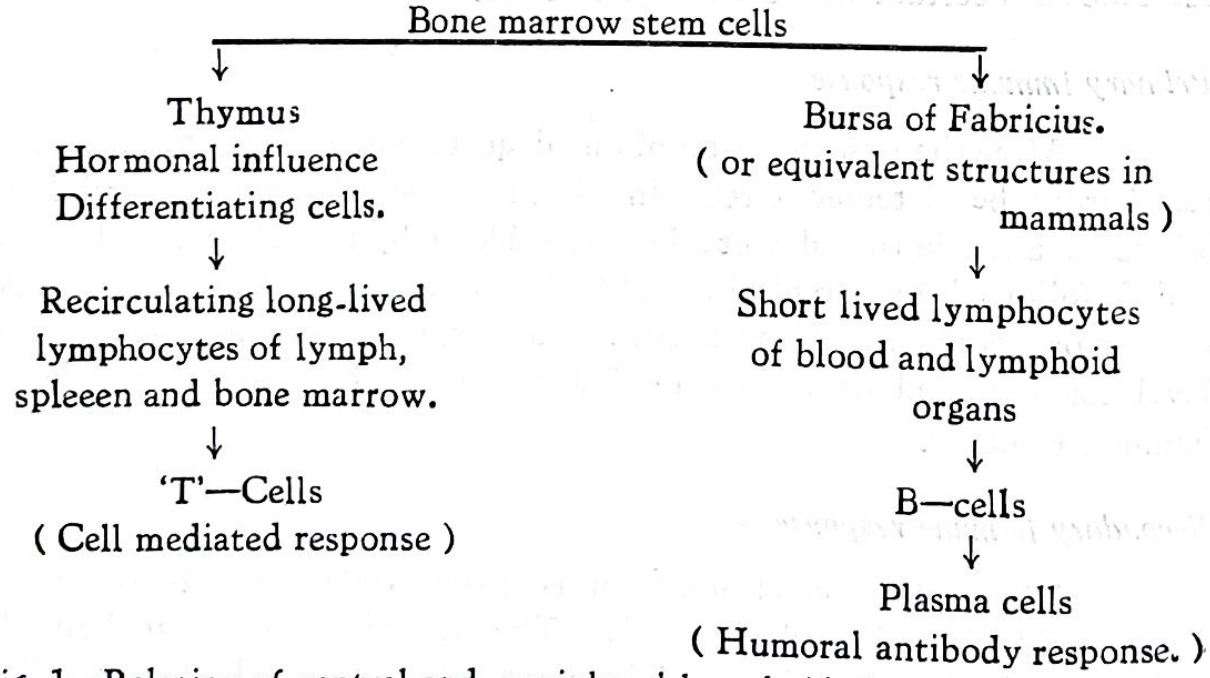

Fig. 1—Relation of central and peripheral lymphoid tissue.

The primifive cells of the thymus are slowly replaced by the cells derived from the bone marrow which migrate into the thymus via the blood stream. A small proportion of these cells leave the thymus and find their way to peripheral lymphoid tissue. Then these cells are transformed into T-lymphocytes which are concerned in the cell-mediated immunity.

Similarly, the cells of burla Fabricius migrate to periphral lymphoid organ where they are modified into B-lymphocytes. These cells are later transformed into plasma cells. These plasma cells synthesize antibody molecules which are released into the blood. Thus these cells are concerned with humoral immunity or circulating antibody production.

Thus the T.cells are responsible for acting against the grafts and the plasma cells produce circulating antibodies which neutralize the antigens.

Conclusion—

In the past, when the antigen—antibody concept was not known, man was struggling against diseases and was trying to find out the causes and remedy for them. It was Edward Jenner who laid foundation by immunizing man against smallpox. Now many diseases caused by micro-organisms have been brought into control by actively or passively immunizing the hosts. Also the antigen—antibody concept has helped successful transplantation of heart, kidney, etc , and in the transfusion of blood.

BIOLOGICAL EFFECTS OF RADIATION, A MIRACLE IN GENETICS

Prafulla Kumar Mohanty, Semester IV (1979-80)

The term radiation includes the whole spectrum of electromagnetic radiation and the fast moving subatomic particles. The electromagnetic radiations include X-rays, UV rays, visible and microwaves. The nature of radiation which usually affects the bioplasm are radio waves from sun and other planets or may be in the form of cosmic rays coming from the depth of space.

Types of radiation—

Radiation is of 2 types—(a) Ionizing, (b) Non ionizing.

Ionizing radiations are able to penetrate the materials including living tissue. They are able to disrupt the large chemical molecules of which living things are made and thus cause biological changes. Fast moving particles line protons, neutrons, β particles or α particles can also cause ionization in tissues.

Radiations like visible portion of the electro-magnetic spectrum-infrared and microwaves do not possess sufficient energy to cause ionization in the living tissues, for which they are known as non-ionizing radiations.

Factors influencing radiosensitivity—

Radiosensitivity of cells is influnced by several factors like environmental, biological and chemical. The important environmental factors are O_2 and temperature which enhance radio sensitivity. Among biological factors age, sex, genetic constitution, health, diet, etc., are included. Generally the radiosensitivity decreases with age.

Radiation effect on cell—

Different parts of the cells may be affected by radiation, the most important cellular components of which are as follows.

1. DNA— Radiation destroys DNA directly or indirectly. Hydrogen bonds between the chains i. e., purines and pyrimidines may

break, a base may be deleted, double chain fracture may occur and sometimes crosslinking may occur within DNA double helix or with protein molecules.

2. *Chromosome*—Muller (1927) could increase the mutation in in the fruitfly, Drosophila, after X-ray irradiation. The X-ray irradiation increased crossover frequency and caused chromsomal aberrations.

3. *Mitotic apparatus*—Chomosomes are most sensitive to breakage at interphase but, this can also be produced at any stage of the cell cycle. As a result, abnormal mitosis or meiosis occurs, may be due to the effect of radiation on the chromosome or on the spindle.

Results of radiation—

The effect of radiation on living things can be of various types depending upon the sizes of the dose :

(a) Somatic mutation that causes cancer

(b) Genetic mutation that affects future generations

(c) Effect on foetus during pregrancy

(d) Immediate death due to radiation.

Mechanism of actian—

However, large immediately fatal doses of radiation produce such molecular chaos that vital intracllular activities are brought to a sudden end and smaller doses act primarily on chromosomes on DNA—RNA mechanism. On the whole changes are the primary result of radiation; the metabolic charges are of course secondary.

Conclusion—

Thus higb energy radiation is very much injurious because it penetrates the body causing death after mutation, or cancer in body. The burning example are the survivors of A-bomb attacks on Hiroshima and Nagasaki. The most effective treatment against malignant tumours is the CAT technique by which the 3 dimentional view of the cell can be known easily and cured. Many things are yet to be known about vatious aspects of atomic radiation.

THE FASCINATING ASPECT OF HYBRIDIZATION

Prafulla Kumar Mohanty, Semester IV (1979–80)

Hybridization may be defined as the offspring of 2 animals or plants of different species. Interspecific hybridization appears to occur very rarely in nature. Most of the hybrids known have been produced in captivity. The following examples are the most wellknown hybrids in captivity, termed as "outer breeding". This outer breeding usually results in stronger, healthier, larger and vigorous individuals in the first generation (F_1). This increase in fitness has been termed as "hybrid vigour" or "heterosis".

Examples—

(i) When inbred bulls of Hereford cattle were crossed with unrelated cows significant impovement was found in the hybrids i. e., F_1 hybrids showed an increase of 12% in body weight.

(ii) Out breeding produces improved strains of sheep which was first used for the production of "*Merino sheep*" in Australia. This hybrid provides an increased amount of meat and wool which have great commercial value.

(iii) *Panthera leo* (♀) × *Panthera pardus* (♂).

Leopons (both sexes) have been produced in various zoos.

(iv) *Presbytis entellus* ♂ (Common langur) × *P. johni* ♀ (Nilgiri langur)

A female hybrid was born at *Nandan Kanan* zoo on the 18th Dec. 1969, but died within 24 hours, as the mother failed to nurse it.

(v) *P. cristatus* ♂ (Silvered leaf monkey) × *P. phayrei* ♀ (Phayre's leaf monkey)

A hybrid born in *Calcutta* reached at least 2 weeks of age. It was light orange in colour.

(vi) *Panthera leo* × *Panthera tigris*

Hybrids of both sexes have frequently been produced in captivity. Ligers (♂ *P. leo* × *P. tigris* ♀) are more common than tigons (♀ *P. leo*

× *P. tigris* ♂). A tigon was produced at *Alipore Zoological garden*, Calcutta. The hybrids are more active than *P. leo*.

(vii) ♂ *P. pardus* × ♀ *P. onca*.

2 vigorous ♂ cubs were born at *Hellbrunn Zoo*, Salzburg, in 1966.

(viii) *Canis familiaris* (Dog) × *C. lupus* (wolf)

11 litters were produced at *Poona Zoo* (Maharasthra) by a ♀ wolf mated with an Alsatian dog. The hybrids were usually like Alsatian in colour but were more leggy and muzzles were lean and snipey.

(ix) *C. familiaris* (Dog) × *C. familiaris dingo* (Dingo)

The hybrids resemble the dingo occasionally reported from the wild, but were highly fertile.

(x) (♂) *Thalarctos maritions* (Polar bear) × *Ursus arctos* (♀) (Brown bear)

The F_1 hybrid cubs are white at birth but later on they turned blue brown or yellowish white.

(xi) *Equus asinus* ♂ (Donkey) × *Equus caballus* ♀ (Horse)

Mule in more easily obtained than the *hinny (Stallion × She.ass)*. Of course, they are sterile but show exceptional hardiness and endurance. So they are used as *beasts of burrden*.

(xii) ♂ *Maccaca fascicularis* (Crabeating macaque) × ♀ *M. silenus* (Liontailed macaque)

A ♀ hybrid born at *Rostock* had characters intermediate between the parental species.

(xiii) *Camelus bactrianus* (2 humped camel) × *C. dromedarius* (1 humped camel)

The cross has occurred in both directions. But ♂ hybrids are sterile; ♀ hybrids are fertile. The F_1 hybrids show hardiness, endurance, longevity and certain blood characters.

(xiv) ♀ *Axis axis* × ♂ *A. porcinus*
(Spotted deer) (Hog deer)

A hybrid reported by Lahiri was slightly taller than *A. porcinus* and coat was spotted like that of *A. axis.* A ♀ hybrid was produced in *East Berlin Zoo* in 1954.

(xv) *Capra hircus* × *Ovis aries*
(Domestic goat) (Domestic sheep)

Hybridization has been reported but the two species do not readily interbreed.

(xvi) Hybrid between different species and even families of Amphibia have been recorded.

Rana fusca × *Reloleates fuscus*

The hybrid shows the characters of both parents.

(xvii) Crosses between different species of *Discoglossus* and *Bufo* gave hybrids with some ♂ characters. (*H. Royer, 1891*).

(xviii) In poultry farms by the crossing of different varieties of fowls new offspring are obtained which have great commerical value.

Rose pattern fowl × Pea pattern fowl

Walnut pattern is obtained in F_1 generation, which is an absolutely new type In the second generation when the cross between walnuts are carried out different types of fowls resulted in the ratio 9 : 3 : 3 : 1.

(xix) Apart from different animal hybrids, in many plants this phenomenon has been carried out as a result of which new varieties of plants with ample potentiality of production have been achieved. This has been extensively carried out in Oryza plants, tobacco, tomato, pea, sweet corn, onion and radish. One intereshing example is—

Radish × Cabbage
Rabbage

This produce is a new type having the characters of both types.

Hybridization has great significance to the present growing world, because inbreeding and outbreeding provide raw material for directing natural selection. This type of crossing also increases the range of variation as well as combines certain desirable characters.

SPEED LINKED AGE

Arun Ku. Das and **Radhakanta Pradhan**

6th yr. Zoology (1979-80)

According to the theory of Relativity, if a man moves at a speed of light, then the time will move slower for him, i. e., his age will not increase with respect to man on the earth. If he moves at the speed of light, then time will not move for him, i. e., his age will remain constant. If he moves at a speed more than light, then time will move back for him, i. e., his age will be decreased. Why do these happen ?

Age is directly dependent upon time. Again time is dependent on light or, time is determined by the sun. Hence light and age are indirectly linked.

Suppose time is a train which is moving at a speed of light and we on the other hand are sitting in a train which is static. So, the time train will seem to move and the time also. If our train moves at a speed nearer to the speed of the time train, then the speed of the time train will seem to be decreased with respect to the previous speed. So time will seem to move slower, so also the age. If the speed of our train will be equal to the speed of the light, the time train will seem as if it is not moving at all. So the time will be constant for us, so also our age which will not increase at all.

If the speed of our train will be more than that of the time train, then the time train will seem to move backward, so time will move back, so also the age.

So the increase of age is directly linked with the speed of the individual. More nearer the speed of individual to light, less will be the increase of age.

However, it is impracticable and impossible to move at a speed of light or more than the speed of light. And no such rocket has yet been discovered with a speed nearer to light. It is a matter of future only.

TOOL USING IN ANIMALS

Kamalini Naik, VI year, (1979-80)

The ways in which animals cope with life's many problems, to survive and reproduce, have fascinated mankind since ancient times. Part of this fascination no doubt was derived from a belief, widely held at one time, regarding a fundamental difference betweeen human and animal behaviour : skilled human performance has been said to depend on intelligence and to develop gradually through learning, whereas animals were supposed to be guided by readymade, inborn, unalterable instincts. Nevertheless, the problem of how adaptive behaviour develops and how an animal's hehaviour comes to 'fit' in with its natural environment—remains as intriguing as ever, and is the topic of much research of the current age.

The ability to use tools and weapons distinguishes man from animals and provides the foundation of his whole culture. Since tool-using has been so important in man's evolution the discovery of such behaviour in a few species of wild animals is particularly interesting.

Essentially an animal's performance may be defined as 'tool-using' if it takes hold of some objects in its hands, claws, jaws, beak or trunk and then proceeds to use that object as a kind of extension of its own body to reach something it could not otherwise reach, to break open something it could only break at the risk of damaging its teeth or to repel something threatening or alarming. So tools and weapons are described as *'extra-corporeal limbs'*.

Among birds, one of the most interesting examples is the woodpecker-finch, *Camarhyncus pallidus* that displays unique feeding techniques.

Mode of catching—When a woodpecker has to get the insect out of a crack, it inserts its long tongue into it. *Camarhyncus pallidus* lacks the long tongue, but achieves the same result in a different way. Having excavated a hole, it picks up a cactus spine or twig, one or two inches long and holding it lengthwise in its beak, pokes it up the crack, dropping the twig to seize the insect as it emerges. If a twig or spine is too short or too pliable, it will reject it and break off or pick up another. Sometimes, the bird carries a spine or twig about with it, poking it into cracks

or crevices as it searches one tree after another. It may use it to drive the insect out or to impale ir, or just to locate it. Twigs or spines not well-suited for the purpose are sometimes worked on by the bird.

The male satin bower-bird, *Ptilonorhynchus violaceus* holds a bark wad between the tips of the beak so that a black, tacky material—made from a mixture of charcoal compounded with saliva—which it has taken into its bill can be forced between the mandibles and applied as a plaster to the inside sticks of the bower.

Obviously, the 'function' of tool-using in these two instances is entirely different, in the first, for food-getting, in the second, as an adjunct to a territorial or courtship display.

Among wild animals primates perform a lot of tool using performances. Polar bears cast or roll blocks of ice onto walruses to kill them. Elephants have been observed scratching themselves with sticks held in their trunks and so on. But tool-use especially for food getting is known in the California sea other, *Enhydralutris.*

Tool-using behaviour—

These otters feed close inshore but in the south they apparently never haul up on to rocks as they do in the Aleutians. An otter would feed by swimming along the coast and diving to the sea bed from which it brings to the surface crabs, urchins, mussels, or a large univalve, the abalone, which is a speciality of the many sea food restaurants in California. It will then float on its back, placing the food it had brought up from its dive on its chest.

It has been observed—if, for example, it has a live crab on its chest, it will hold the crab between its paws and up to its mouth while eating it, and might occasionally bang the crab with a paw. When the otter is feeding off mussels, however, it would come to the surface with a stone, about 5 inches in diameter, and place this on its chest as an anvil. The mussel which is held between the paws, would be banged repeatedly against the stone until the shell is broken sufficiently for the otter to open it up and eat the contents.

Occasionally, the same stone is retained by the otter for several feeding episodes, diving and surfacing again and again with the same one. Apparently the otter retains the anvil stone in its armpit while diving and collecting another mussel. Once, after an otter had fed on

mussels in this way, it dives with the stone, only to reappear with two crabs. Exactly how the otters prise the large abalones off the rocks is unknown. The base of a shell often shows signs of scoring, as though the otter might have banged it with a stone, and sometimes a large section of shell is broken off before it is brought to the surface.

Tool-using in wild monkeys and apes

Primates are supposedly 'the most intelligent' of animals because they belong to the same order as ourselves. It is noteworthy that, in spite of all the recent field studies on baboons, macaques and other monkeys, as well as gibbons, gorillas and chimpanzees, only the chimpanzees, observed by Jena Goodall are found to use tools for obtaining food. The way they do this resembles that of wood-pecker finch. They poke sticks into ants' nests, have them there for a moment, and then withdraw them covered with ants which they put into their mouths and eat. The same technique is used for obtaining termites from holes.

Some chimpanzees are quite discriminating in their choice of tools for this purpose. When working at an exceptionally deep hole, one male is observed to try with several grasses of the usual length, and then to look around intently. Then it gets up to pick a long piece of vine growing several yards away. One male carried a grass stalk in his mouth for half a mile, while he examined, one after the other, six termite hills, none of which was ready for working. Some report that South American monkeys break open oyster shells with stones.

Chimpanzees, to repel something threatening or alarming, brandish sticks as a part of an intimidation display amongst themselves, but when they actually fight, such 'weapons' are abandoned in favour of teeth and hands. Branches or fruits are at times cast down in the direction of an intruder by monkeys and apes.

Kaufmann provides an interesting recent study—he saw a group of Capuchean monkeys chase some coatis from a tree, then proceed to drop nuts and debris from a palm tree onto them The coatis ignored this shower of missiles except to pounce on and eat the ripe nuts that were among them. Other much less clear instances came from observations of baboons or macaques rolling rocks down onto intruders. It is usually very difficult to know whether such rock falls are due to the agitation of the animals or to move 'purposeful acts of aggression.'

Significance of tool-using—The question arises how far such performances are due to learning and to what extent they are the result of some kind of inborn propensity ?

If the sea otter pup were to be reared in complete isolation from its mother and from other sea otters during the formative months, would it when adult, be able to break open mussels in the way as in California ? The answer is, certainly, it would not readily acquire the habit. Probably, however, it would show an inherent tendency to manipulate or play with all sorts of loose objects and even perhaps to bang them against other objects. It would not know how to apply this tendency to specific food objects because it would normally learn this from its mother.

With woodpecker-finch, learning plays a less important part, only leading to some individual improvement, through trial and error, in the skill with which the tool is applied. With chimpanzee, it is learned from the practice of manipulating objects of all sorts. We must be sure that the opportunity to learn by imitating others of the species is even more important as an aid in the acquiring of such techniques than it would be in the sea-otter.

Although it is certainly a fascinating performance to observe, and has the thrill of being an unique piece of mammalian behaviour, it may not be any more significant to the naturalist than the playfulness of other otters or the construction work of beavers.

In monkeys and apes in particular, tool using has sometimes received a greater emphasis than other kinds of 'intelligent' behaviour. This is mainly because those who are interested in trying to reconstruct the course of human evolution from fossil remains have tended to associate humanness with tool making. The so-called ape-men (*Australopithecus*) which were quite small-brained bipedal creatures, were apparently not only able to use tool but also to make simple implements by chipping stones.

The inference, then, seems to be that tool-using is not a particularly significant kind of behavioural adaptation, unless it is allied with powers of foresight and memory, with general characteristics of adaptability and with social factors that can only be guessed at.

A. B. C. OF SPEECH DEFECTS

Kawsar Ara Begum

Man by nature is a restless creature and for his curiosity he began to understand nature and finally he invented the means of communication via sound. That is the so called 'language', for which establishment of complex society system and further development of human culture has been posssble. Speech indeed, is the mightiest weapon of human beings for which he is supreme among his primate relatives and also other animals. But, sometimes it is seen that speeches get distorted due to some reason and it is obvious that when the means of communication itself is defective, the matter of communication and thus the whole world of sense goes wrong.

Speech defect is a very wide term and a person may be unable to speak in a normal way for several reasons which may be psychological.

Psychological effect is the major factor, helping in the development of defective speech which is generally due to the result of trauma or insecure feeling in the early childhood. Taking for example, if attentions are given to the bodily expressions of a child, then the child becomes encouraged and he is keen to learn more. But if all these expressions are ignored there may be a frustration and gradual reduction in his efforts. The same principle may be applied in case of speech resulting either in the better development of speech or leads to its defects.

Apart from psychological basis, another major cause of defective speech is physiological articulation disorders, voice disorders, rhythm disorders, aphasia etc. Of all the articulation disorders the most common one is due to a poor control of the tongue. So a particular word sounds differently such as 's' and 'z' are substituted by 'th' sound. This type of disorder is due to two reasons—neuromuscular inco-ordination (dysarthria) and due to structural defects in oral cavity (dyslalia).

The defects with the voice result in a condition known as dysphonia which includes defect of pitch, loudness and voice quality. The voice may be highpitched or low pitched depending on the size and muscles

of the larynx and the condition of the vocal cords. Similarly the defects in the voice quality produces nasality where an individual may speak through the nose.

Rhythm disorder is another physiological cause of speech defect which includes two symptoms—stammering and cluttering. Stammering begins at 3-4 year of age and during this period firstly words, phrases and syllables are repeated which in the later stage lead to the fixed and prolonged repeatation of these words. Whereas in cluttering due to rapid utterance and improper phrasing of certain words, phrases or syllables are omitted.

Besides all these the most serious disorder is aphasia where there is an inability to express ideas in speech or writing or the inability to recognise a symbol or to recollect the names for different things. Delayed speech is also a type of defect which occurs either by the complete absence of vocalisation or by vocalisation with no communicative value.

All these speech defects are due to delayed physical growth, prolonged illness in early childhood, neurological disorders, nutritional deficiency, irregularities of teeth arrangement, faulty jaw joint, cleft palate, faulty tongue placement, hard of hearing, short membrane attaching the tongue to the floor of the mouth, damage of muscles or nerves of lips, tongue, soft palate and pharynx, development of nodules on vocal cords, inflammation of voice box, laryngeal web and tumour, mental retardation with low I. Q. and the surroundings. Of all, a very few can be got over by one's own effort, some can be cured by therapy while others cannot be helped at all.

Printed at
THE MAMA PRESS
Rajabagicha, Cuttack-9

UTILISATION OF ANIMAL RESOURCES OF ORISSA

Dr. Brahmananda Sahoo

Joint Director of Animal Husbandry & Veterinary Sciences,
Orissa Biological Products Institute,
Bhubaneswar - 3.

INTRODUCTION

The subject of resources and their utilisation is vital to all our developmental programmes, specially to rural development. The economic strategy of a developing state is based on its actual and potential resources to harness them for the welfare of the people for self reliance. This imposes a special burden on us which is indeed fascinating and challenging.

Orissa is well-endowed in resources. In the era of planned development, Orissa's backwardness in the midst of rich natural resources has often been described as a paradox. More appropriately it is an affirmation of the historical experience that resource availability is not a sufficient condition for economic change. In general, crucial difference between a developed and a low income economy lies not so much in the size of the resource base as in the degree of rational utilisation of the existing resources which in its turn depends on the quality of human resources, of technology, and skill in production, and also on the level of employment of capital. The object is to bring about a high degree of rational utilisation of the existing resources, thereby initiating a process of development which will raise the living standards and open out new opportunities for a richer life for the people.

Magnitude of the problem :

Orissa possesses as per 1972 census 11.50 million cattle, 1.40 million buffaloes, 1.40 million sheep, 2.90 million goats, 0.39 million pigs and 8.50 million poultry birds including 0.3 million ducks. Equines are about 0 03 million.

The level of production of these animals is only marginal—the average cow giving about 170 kg of milk per lactation, the sheep and goat

giving about 10 kg. of meat and the poultry bird laying about 60 eggs in a year. In Orissa the per capita consumption of milk is hardly 53 gms. as against the All Indian standard of 148 gms. and as against the requirement of 284 gms. for an adult person.

There are no recognised breeds of cattle in the state but, there are however several established types of animals. These are "Binjharpuri", "Ghumsuri", "Motto" and "Khariar" among cattle, "Sambalpuri" and "Paralakhemundi" among buffaloes, and Ganjam types of goats and sheep in Southern Orissa. These are known after the localities they hail from. Besides there are black Bengal goats in northern Orissa. Until very recently the livestock and poultry populations were the graded stock of "Hariana" and "red-Sindhi" among cattle. "Mura" among buffaloes, "Beetal" and "Barbari" among goats, "Banur" and "Nellore" among sheep, "large and middle white York-shire" among pigs, R.I.R. and W.L.H. among poultry.

Strategy in augmenting production :

It is not correct to say that our livestock population, which forms the most important part of Livestock Industry in the state in providing the most valuable and essential article of human dietary viz., milk and milk products and in supplying the bullock power and in maintaining soil fertility on which the state agriculture almost entirely depends, is a heavy burden on the economy. On the other hand, it represents a tremendous potential for rural development which could be beneficial not only to farmers with extensive land holding but to a very large number of agricultural labourers, and small and marginal farmers possessing atleast one cow, Millions of these extremely low yielding animals could be converted into a powerful source of milk production contributing to a better balanced diet for our human population.

Those who regard our "indigenous" cows as unsuitable for any economic use are basically wrong. It is actually an animal living in full adjustment with its environment. Through natural selection over years it has developed many positive characters like heat tolerance, disease resistance etc., which makes it the most suitable and best adapted animal for our tropical conditions.

Only one thing is lacking in most of these animals—the production potential. To eliminate them from the future picture of the state only