KANO ZOO: Redevelopment Proposal

Towards a Modern Standard.

(MSC ARCH THESIS)

BY

ABDULLAH!, AMINU LA WAN BSC (HONS) ARCHITECTURE

Being a thesis submitted to the post graduate school and the Department of Architecture, Ahmadu Bello University, Zaria, in partial fulfillment of the requirements for the award of a degree of masters of science in Architecture.

DEPARTMENT OF ARCHITECTURE

FACULTY OF ENVIRONMENTAL DESIGN

AHMADU BELLO UNIVERSITY, ZARIA.

OCTOBER, 1999.

DECLARATION

I Aminu Lawan do declare that this work is the product of a research project undertaken by me under the supervision of Architect M. D. Ahmed. It has not been submitted, in whole or part, for the award of a degree elsewhere. Works quoted have been acknowledged by means of references.

ABDULLAHI, AMINU LAWAN. **Date**

CERTIFICATION

This thesis Entitled:

Kano Zoo : Redevelopment proposal,

Towards A Modern Standard

Presented by:

ABDULLAHI, AMINU LAWAN

Meets the regulation governing the award of the degree of masters of science (M.SC) in Architecture of Ahmadu Bello University, Zaria and is approved for its contribution to knowledge.

Chairman, Supervisory Committee	Date
Member, Supervisory Committee	25-10-01 Date
Member, Supervisory Committee	25.10.2001 Date
Head of Department	25/10/01 Date
Dean, Post graduate School	27/06/02 Date

DEDICATION

I dedicated this work to my grandmother,

Zulaihatu Isma'il (Tayi)

ACKNOWLEDGEMENT

All gratitude be to Almighty Allah, who in his own wisdom destined me to be born less privileged, but gave me the ability and courage to perform as others who might be more privileged at birth and background.

I wish also to thank my grandmother Zulaihatu Isma'il (Late), my mother Binta Mohammed for always giving me courage and support form childhood up to this stage.

My profound gratitude also goes to the entire staff of the department of Architecture, more especially my supervisor: Arc. M.D Ahmed, for training and guiding me throughout my stay as a student.

I must also mention Arc. M.T. Waziri and friends like Sani Mohammed, Wali, Usman Mukhtar and many others too numerous to mention for assisting me in one way or the other.

ABSTRACT

The dilapidation and degradation of the *Audit Bako* Zoo at Kano is irritating all concerned minds more especially animal lovers, and other patriotic citizens in the state. Established in 1971 and opened to public in 1972 by the then military administration of the late police commissioner Alhaji Audu Bako. Since that time it has been a major attraction for visitors more especially from neighboring villages and teenagers from within and outside Kano metropolitan. On festival days, *Sallah days,* Children and teenagers troop in mass from the villages around Kano, some inside buses, some truck-full. Just to visit the Zoo as part of Sallah festivities. But in recent years - 90's, the role played by this facility is on the decline due to the dilapidated condition of the structures, reduction in the collection of the animals, poor management and lack of funds.

Such a facility designed and built in the early seventies needs revisiting after about three decades of usage, more especially if the rapid scientific, technological, sociological and urbanisation developments and transformations of the later part of this century are considered. What is obtained now on ground is out-dated. The Old practice of taming animals inside cages affects the physiological and psychological well being of the animals. It makes the animals to be exhibiting some odd behaviors and affects the health of the animals that can even lead to death.

The aims of a modern zoo go beyond consuming animals to be caged in order to please viewers; but a center of study and dissemination of information about the animals, preservation and breeding, in order to produce for other zoos or for possible reintroduction into the wild; more especially the animals that are identified to be endangered species. This can only be achieved by imitating as close as possible the natural habitat of the animals so that to encourage them to exhibit their natural behaviour and breed freely.

The challenges to an Architect in the design of a Zoo are many. Among such challenges is to provide a psychologically healthy environment, so that the animals will not be depressed or exhibiting abnormal behaviours. Attention must be given to the animals natural desires and feelings. The method feeding the animals should also be given proper treatment. All these can only be achieved by trying to imitate as close as possible the natural habitat of the animals.

The design of the animal enclosures should be to discourage such old practices like peepshows or forcing the animals out of their sleeping quarters for the view of the public.

Reconciliation between profit and the welfare of the animals is very important. While the welfare of the animals needs a lot of respect, the revenue generated by a zoo, which is very necessary for the up keep of the animals must not be ignored.

Ways of generating revenue without degradation to the welfare of the animals should be favoured. The requirements of a modern zoo are many. The above mentioned and many others are studied and considered, while at the end a design proposal that integrates all is prepared.

CONTENTS

		PAGE
Title Page		i
Declaration		ii
Approval page		iii
Dedication		iv
Acknowledgement		v
Abstract		vi-vii
Table of Contents		viii-x
List of Figures		xi-xii

CHAPTER ONE

1.0	Introduction	1
1.1	Preamble (Kano City)	1
1.2	Kano Zoo	10
1.3	Aims and Objectives	23
1.4	Limitation and Scope	23
1.5	Architectural Significance	25
1.6	Justification	25
1.7	Methodology	26

CHAPTER TWO

2.0	The wild Life: Zoo Inmates	27
2.1	Marsupials	34
2.2	Primates	34

2.3 Rodents 38

2.4 The Carnivora 41

2.5 Proboscideans 59

2.6 The Drissodactyls (odd-toed ungulates) 62

2.7 The Artiodactyles (even-toed ungulates) 67

2.8 Birds 81

2.9 Reptiles 100

2.10 Aquatic Creatures 106

CHAPTER THREE

3.0 Literature Review (Architectural Requirement of a Modern Zoo) 109

3.1 Zoo (General) Introduction 109

3.2 Zoo in History 111

3.3 The Concept of A Modern Zoo 112

3.4 Zoning 114

3.5 Lighting 114

3.6 The Enclosure 114

3.7 Medical care 118

3.8 Feeding the Animals 120

3.9 Education and Research 124

3.10.0 The Public and Staff 126

3.11 Landscape 127

3.12 Facilities 128

3.13 Conclusion 136

CHAPTER FOUR

4.0 Case Studies 138

4.1 Jersey wild life preservation trust. 138

4.2 University of Ibadan Zoo Gorilla and Cluimpanzee onlubit 145

4.3 London Zoo 153

4.4 Baboon exhibit at Louis Ville Zoo 160

4.5 Otter Exhibit at Zurich zoo 162

4.6 Primate House at Denver zoo

CHAPTER FIVE 169

5.0 The Design 169

5.1 Site Analysis 169

5.2 The Design philosophy and concept 169

5.3 Design Report and Appraisal 172

SUMMARY AND CONCLUSION 181

Reference

LIST OF FIGURES

		TITLE	*PAGE*
1.	Fig. 1.11	NIGERIA: Showing Kano State (SHADED)	2
2.	Fig. 1.12	NIGERIA: Major Soil Types	3
3.	Fig. 1.13	NIGERIA: Vegetation Zones	5
4.	Fig. 1 14	NIGERIA: Mean Annual Rainfall	6
5.	Fig. 1.21A	Location of Zoological Garden in Kano	9
6.	Fig.1.22	Revenue generated from Kano Zoo (1974-1994)	14
7.	Fig. 1.23	Annual Number of visitors to Kano Zoo	15
8.	Fig. 1.241	The site plan of Kano Zoo	17
9.	Fig. 1.26	The Administrative structure of Kano zoo	22
10.	Fig. 2.1	Marsupials	37
11.	Fig. 2.23	Apes (Gibbon)	37
12.	Fig. 2 .41	Lion	43
13.	Fig. 2.42	Leopard	47
14.	Fig. 2.43	Cheetah	50
15	Fig. 2.5	The Elephant	60
16.	Fig. 2.62	White Rhenoceros	64
17.	Fig. 2.75	Giraffe	79
18.	Fig. 2.710	Gazelle	80
19.	Fig. 2.84	Flight Altitude of Birds	91
20.	Fig. 3.0	Tiger on Display	110
21.	Fig.3.4	Kano Zoo (Natural Enemies)	115
22.	Fig.3.5	Mantell's Kiwi	115
23.	Fig.3.6	Zebras and Trees	116
24.	Fig.3.61	Use of concrete in enclosure	117

25.	Fig.3.7	Medical Care	119
26.	Fig.3.8	Feeding	119
27.	Fig.3.81	Specialised Method of feeding	123
28	Fig.3.9	Laboratory Analysis	125
29	Fig.3.10	Viewers	125
30	Fig. 3.12. 1	Kiosk and Restaurant	129
31.	Fig. 3. 12. 2	Public Toilet	131
32	Fig. 3. 12. 4	Education centre	131
33.	Fig. 3. 12. 61	Children's Zoo	133
34	Fig. 3.12. 62	Children's play ground	133
35	Fig. 3.12. 7A	Carp and pike fishes	134
36	Fig. 3.12. 7 B	Sea-horses and common octapus	135
37	Fig. 4 . 1	Jersey wild life preservation Trust	139
38	Fig 4 2	University of Ibadan Guerilla and Chimpanzee exhibit	147
39	Fig. 4.3	London Zoo	156
40	Fig. 4.4	Baboon exhibit at Louisville zoo	163
41.	Fig. 4.6	Primate house at Denver zoo	168
42.	Fig. 5.1	Site Analysis	171
43	Fig. 5.36	The Aquarium	175
44	Fig 5.38	The Nocturnal house	176
45	Fig 5. 310	The Administrative Block	177
46	Fig. 5. 311	The Education Block	178
47	Fig. 53. 12	The Restaurant	179

CHAPTER ONE:

1.0 INTRODUCTION

1.1 PREAMBLE - KANO CITY

1.11 LOCATION AND RELIEF.

Kano is the second largest city in Nigeria and the commercial center of the north, with an estimated population of over three million. Kano metropolutant and its surroundings is underlaid by basement complex consisting of undulating plains. The Dala and Goron Dutse hills are the only imposing landmarks-with an elevation of 518m and 543m above sea level respectively. The lowest reliefs within the municipal area are the Jakara and Challawa rivers falling into the old city and Kumbotso local government areas respectively, with an average elevation of 430m above the main sea level (fig1.11)

1.12 SOIL

The soil type around Kano municipal can be regarded as latasols, which is well drained brown to reddish brown in colour. The hydromorphic soil are dark greyish in color and have a high content of clay estimated to be up to 25%, the silt and clay content of the soil is more than 40%. There is also *Fadama* soil which occurs in depression on the low terraces and abandoned parts of the channels (hydro-morphic soil). Many of these soils lost their natural characteristics due to human activities, particularly in the metropolis. Around the area of study -zoo, there is the *Fadama* soil along drainage system with little hydromorphic soil.(fig1.12)

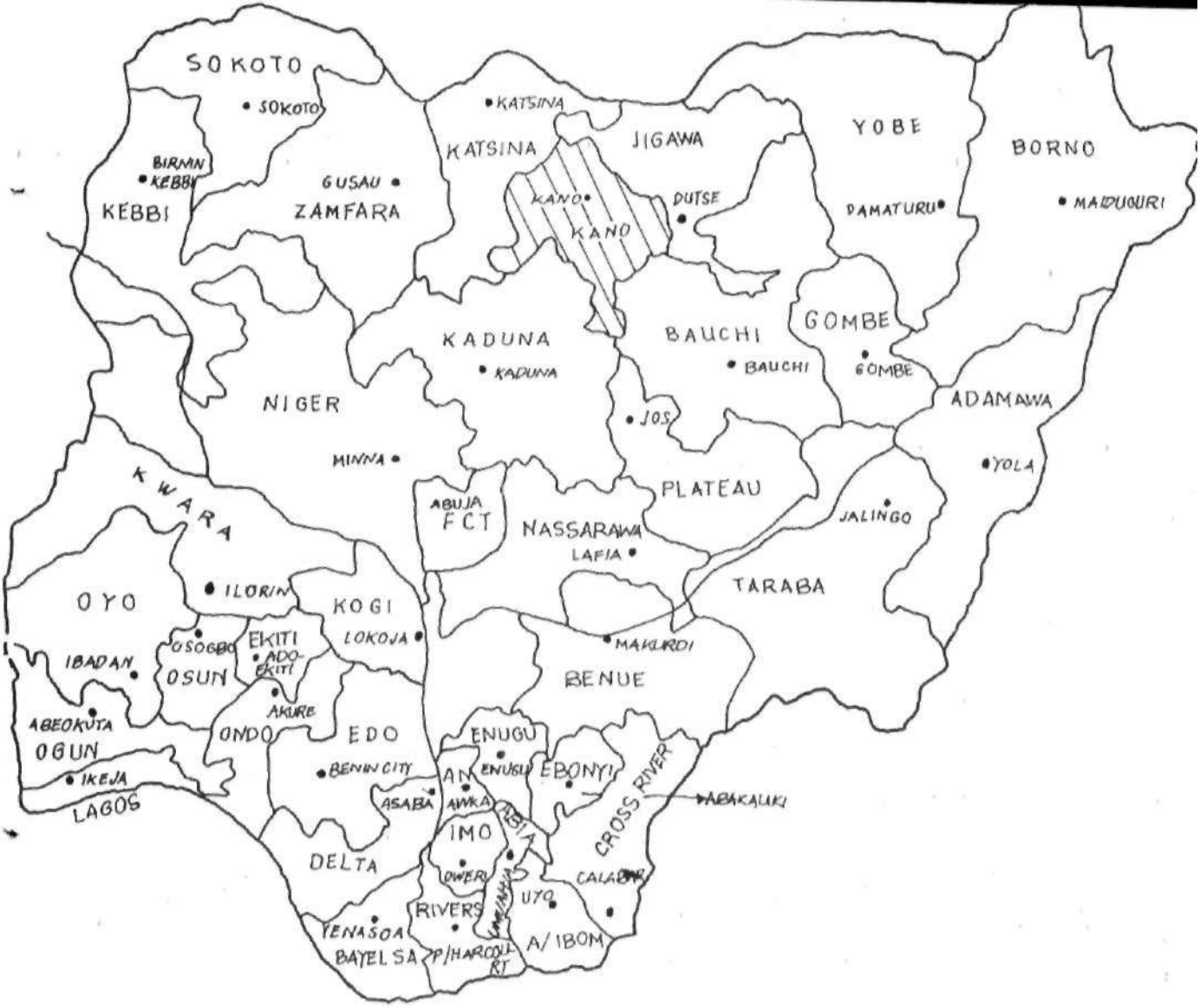


FIG. 1.11 NIGERIA: SHOWING KANO STATE, SHADED.

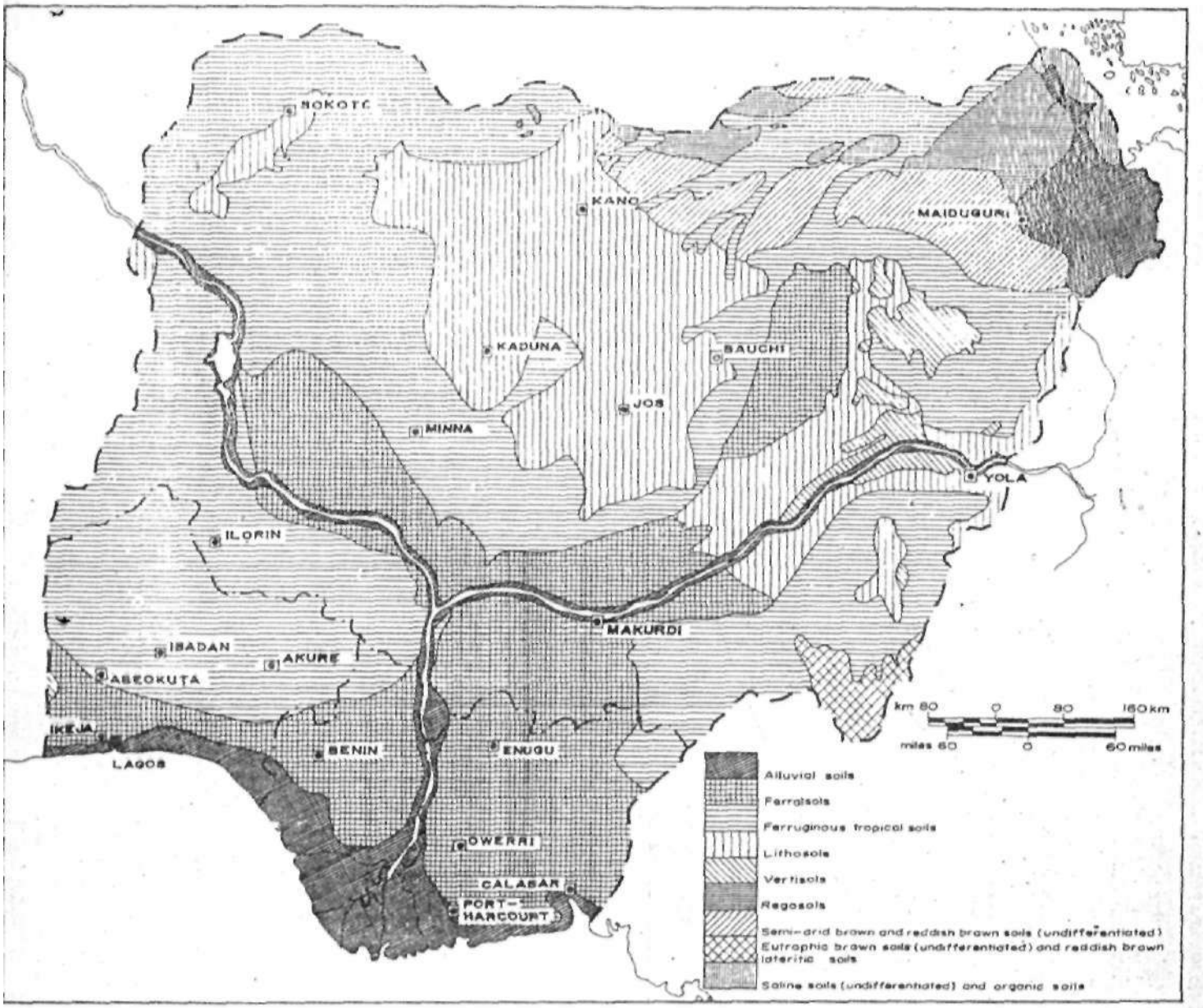


Figure 1.12: Nigeria: Major soil types

Source: Agricultural Atlas of Nigeria

1.13 VEGETATION.

The vegetation in kano was characterised as Savannah vegetation (olofin 1985),mostly Sudan Savannah variety. The trees are scattered over an expense area of grassland, which are usually characterized by broad canopies, cultural vegetation exists due to the replacement of varieties of natural vegetation by a cultural one, such as *Tata* among others. The vegetation around the study area is of Savannah type .(fig 1.13)

1.14 CLIMATE.

According to koppen (1923) urban kano falls within a climatic zone classified as tropical wet and dry type. This type of climate is characterized by deficiency in rain during the dry season which makes it critical element in the region.

1.141 RAINS

In a normal year, the main annual rainfall around kano metropolutant is 800mm. Rainfall season starts from may and terminates around September/October. This is the wet and warm season *DAMINA*.(fig1.141).

The dry and hot season *BAZARA* that precede the wet season is a short transitional period between the harmattan season and wet season, wind are very variable. The season starts from the end of cold season, *harmattan*, and ends in may when rain starts. This the time of hottest temperatures of the year where mid-day air temperature rises to 40 ^{o}C in a strenuous sun screen.

Harmattan is the cold season that is characterized by strong North Easterly trade winds that are cold, dry and dusty. It begins from November and terminates in march. Another short transitional season that begins after the rainy season and before the harmattan, that is dry and warm is called *RANI*. It terminates around November.



Figure 1-13: Nigeria: Vegetation zones

Source: Agricultural atlas of Nigeria

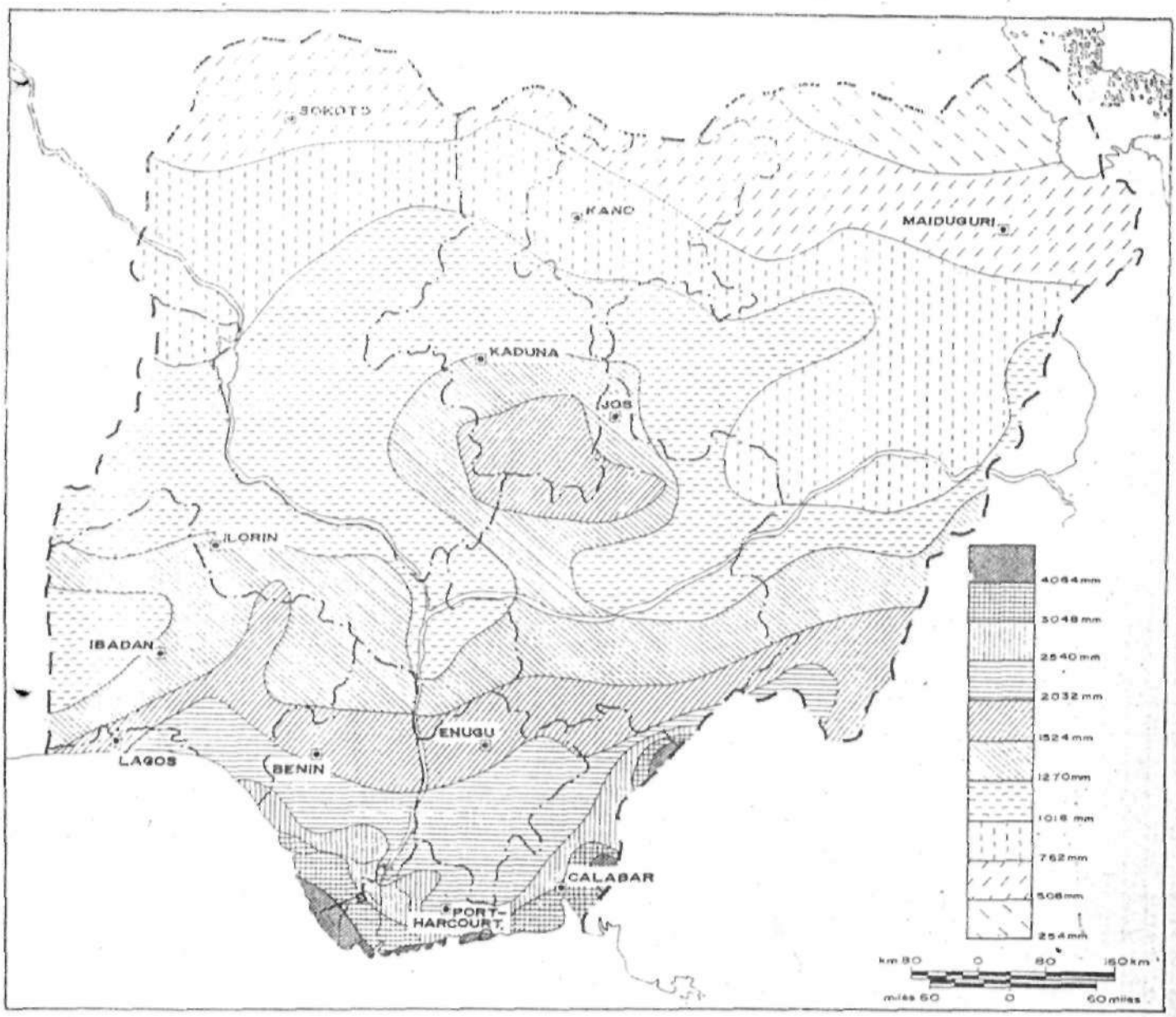


Figure 1.41: Nigeria: Mean annual rainfall

Source: Agricultural Atlas of Nigeria

It should be noted that temporal variations occur at different scale in the amount and duration of rainfall in the area. Most of the normal variations are reflected in the long term records, but probability calculation based on such records must be used continuously.

1.142 TEMPERATURE.

The temperature in kano is relatively high except in the harmattan and during the rainy season. The highest mean temperature of 39 ^{o}C and 40 ^{o}C is usually recorded in may and the lowest mean temperature happens in December with an average temperature of about 12 ^{o}C. The mean annual maximum temperature is about 33.2 ^{o}C and the mean annual minimum temperature is about 20.4 ^{o}C(Olafin 1987).

1.143 HUMIDITY.

The humidity in kano can be described as generally low, it ranges from 60% to 80% in the morning and diminishes to 10% or even 0% in the afternoon, especially during the hot season. This mostly happens in the month of may or late April. The relative humidity also shows large variation from 13% in February up to 94% in August.

The humidity and temperature in April in relation to that of August shows the highest and lowest values of total evaporation, with values of 404mm and 183mm respectively.

1.15 PEOPLE AND CULTURE

Kano as one of the Hausa cities established as early as 13th Century has Hausa people as the dominant ethnic group, with the heterogeneous nature typical with Hausa people. This involves a mixture of different tribes that live among Hausa and largely adopted their culture and language, and intermarried with them. The most notable of such tribes being the *Fulani's*, that are always

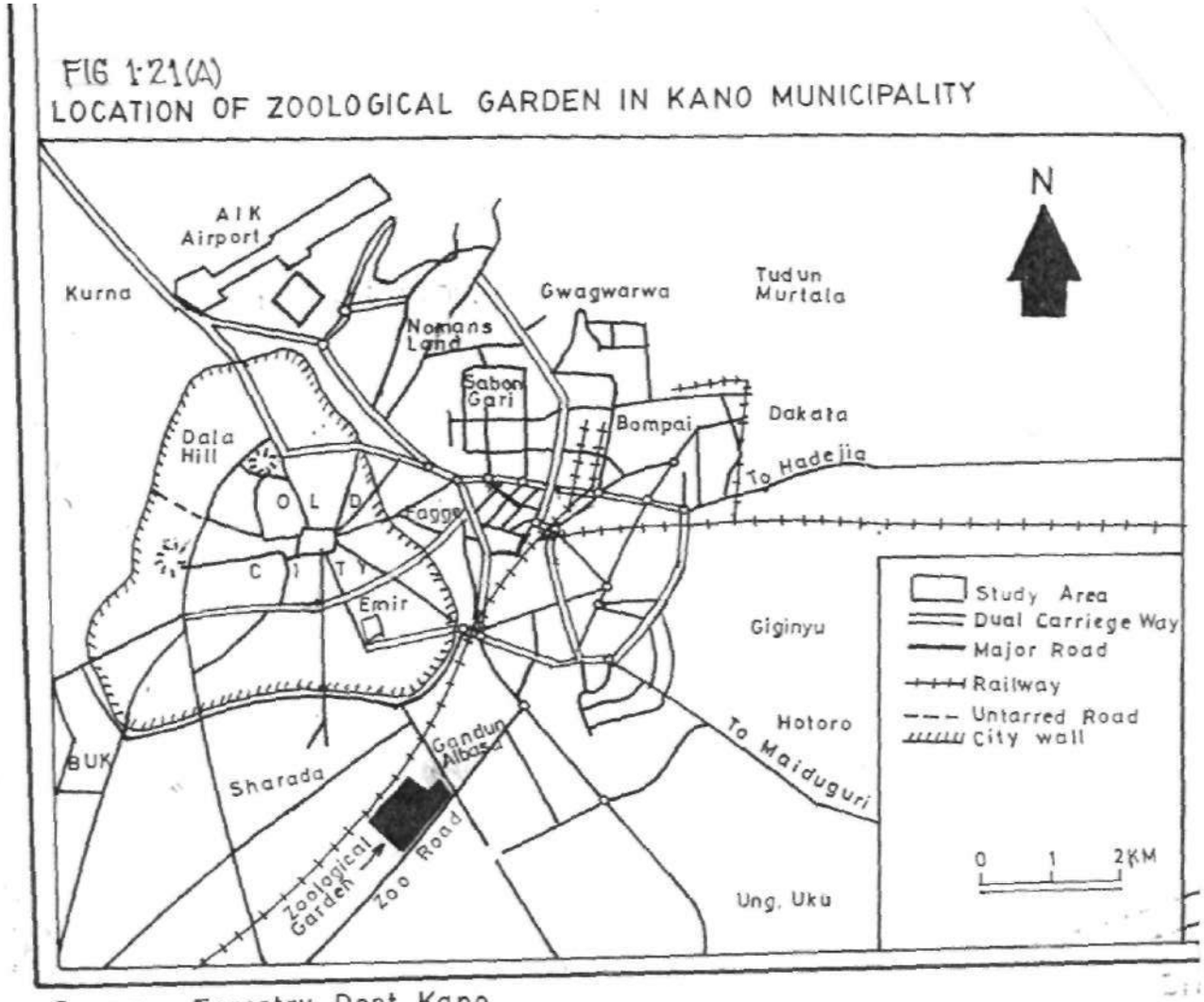
considered the same and termed as Hausa-Fulani. Other such tribes include Kanuri, Nupe, e.t.c.

The Hausa language that is the lingua-Franca in Kano, is a member of the Chad group of the Afro-Asiatic family. The vocabulary reflects heavy barowing from Arabic, African languages and English. Hausa has been written in the Arabic script for several hundred years.

The culture of the Hausa people can hardly be distinguished from their religion - Islam. The religion of the Hausa people before the introduction of Islam by Arabs through trans-saharan trade contacts, is traditional religion governed by superstitious beliefs and practices. The religious priests or noble men communicate with the gods *Iskoki* through *Bori*. Islam dominated the culture and beliefs of the Hausa people over centuries, and reinforced by the fulani Jihad of the early 19th century. A typical Hausa man finds it very difficult to differentiate between culture and religion. That not withstanding there are still many reminents of the traditional religion and practices of Hausa man competing with that of Islam.

Before European colonial period, the fulani people wrested control from the Hausa and established themselves as the ruling elite in the early part of 19th century. The people were organized into chiefdoms called emirates under the emir who owes alligience to the supreme leader at Sokoto, the *Sultan*. These traditional institutions continued to play important roles to the colonial administration and later Governments after independence. The decline in power and authority of the traditional rulers from the colonial period to date does not make them completely irrelevant to the political and social lives of the Hausa people.

FIG 1·21(A)
LOCATION OF ZOOLOGICAL GARDEN IN KANO MUNICIPALITY



Source Forestry Dept. Kano

1.2. KANO ZOO

1.21 LOCATION AND ANIMAL COLLECTION

Audu Bako Zoological and Botanical gardens with an estimated area of about 45 hect is located in the state capital, Kano, in a land that was originally the emirs' Garden *Gan Albasa*. (fig 1.21) the foundation stone of the zoo was laid on the 14th July 1971 and it opened to the general public in 13th November, 1972, by the then military governor of K State, police commissioner Alhaji Audu Bako (late).

The zoo has animals on display in cages, moats, water pools and wide expe enclosures. The original collection was of seventy five (75) species of both east and v African origin. Presently there are only forty two species remaining (table 1.21), with a t number of animals of two hundred and forty three (243).

TABLE: 1.21(a) The animal collection in Kano zoo.

A. PRIMATES

No	Common English Name	Scientific Name	
1.	Chimpanzee	- *Pan troglodytes*	**
2.	Greater While nosed (Red patas)	- *Cercopithecus nititans*	
3.	Mona Monkey	- *Cercopithecus mona*	**
4.	Blue Monkey (Tantalos)	- *Cercopithecus mitis*	
5.	Green Monkey(patas)	- *Erythocebus patas*	
6.	Anubis Baboon	- *Papio anubis*	
7.	Drill	- *Papio eucophaeus*	**

5. Rufells vulture - *Gyps repellii*

6. Nubian vulture - *Aegpius trachelilus*

7. King Reed Hen - *Porphyrio spp.*

8. Fulvous Tree Duck - *Denderocyna bicolor*

9. Black Kite - *Milvus nigra*

10. Barn Owl (spotted eagle owl) - *Tyto alba*

11. Cockatoo

12. Ostritch

E REPTILES

1. Nile Crocodile - *Crocodylus niloticus* **

2. Rock Python - *Python sibea* **

F. RECENTLY DISAPPEARED ANIMALS

1. Elephant - *Loxodinia Africana*

2. Leopard - *Panthera padus*

3. Short Nosed Crocodile - *Crocodile intermedius*

4. Monitor lizard - *Veranus niloticus*

5. Giant tortoise - *Geocholone sulcata*

RODENTS

1. Crested porcupine - *Hynix* Sp.

2. Cane Rat

All the animals with exterix have been designated as endangered by IUCN.

The percentage distribution of the present animal collection is as follows:

TABLE: 1.21(b)

S.No	Animals Group	-	Percentage
1.	Primates 7	-	17.5

Carnivores	6	-	15
Birds	12	-	30
Reptiles	2	-	5
Rodents	2	-	5

Or as graphically represented in (Fig 1.21(b)

1.22 PATRONAGE AND REVENUE GENERATION.

The reduced population of the animals in the zoological gardens as discussed above affects both the patronage of the zoo by the public and the revenue generated. The gate fee as of 1990 was one Naira (N1.00) per adult and fifty kobo (50k) per Child. But the gate fee has now been increased to Ten Naira (10.00) per adult and five Naira (5.00) per Child. The gate fee is the only source of revenue generation, which helps the management in the maintenance of the gardens. From 1976 to 1995; there is tremendous increase in the revenue generated; but this is not due to increase in number of visitors, but as a result of the increment of the gate fee from one naira per adult and fifty kobo per child to ten naira per adult and five naira per Child, (table 1.22 and fig 1.22.).

Comparing figure 1.22 with figure 1.23 which shows the number of visitors each year from 1976 to 1995, it could be seen that the year with the highest record of revenue generation (1995) is not corresponding with the year with highest number of visitors (1981). While the number of visitors is declining, the revenue generation is increasing, mainly due to increase in the gate fees as stated earlier.

The average number of visitors in recent years is 140 per day and 4000 monthly, and fifty thousand (50,000) annually.

1.23 BREEDING SUCCESS.

One of the scale for measuring the achievements of a zoo is the breeding successes of the animals in captivity. In Kano zoological gardens there is a record of such successes. Table 1.23 shows the animals that breed successfully in the zoo from 1990 to 1995 with the number of young ones produced.

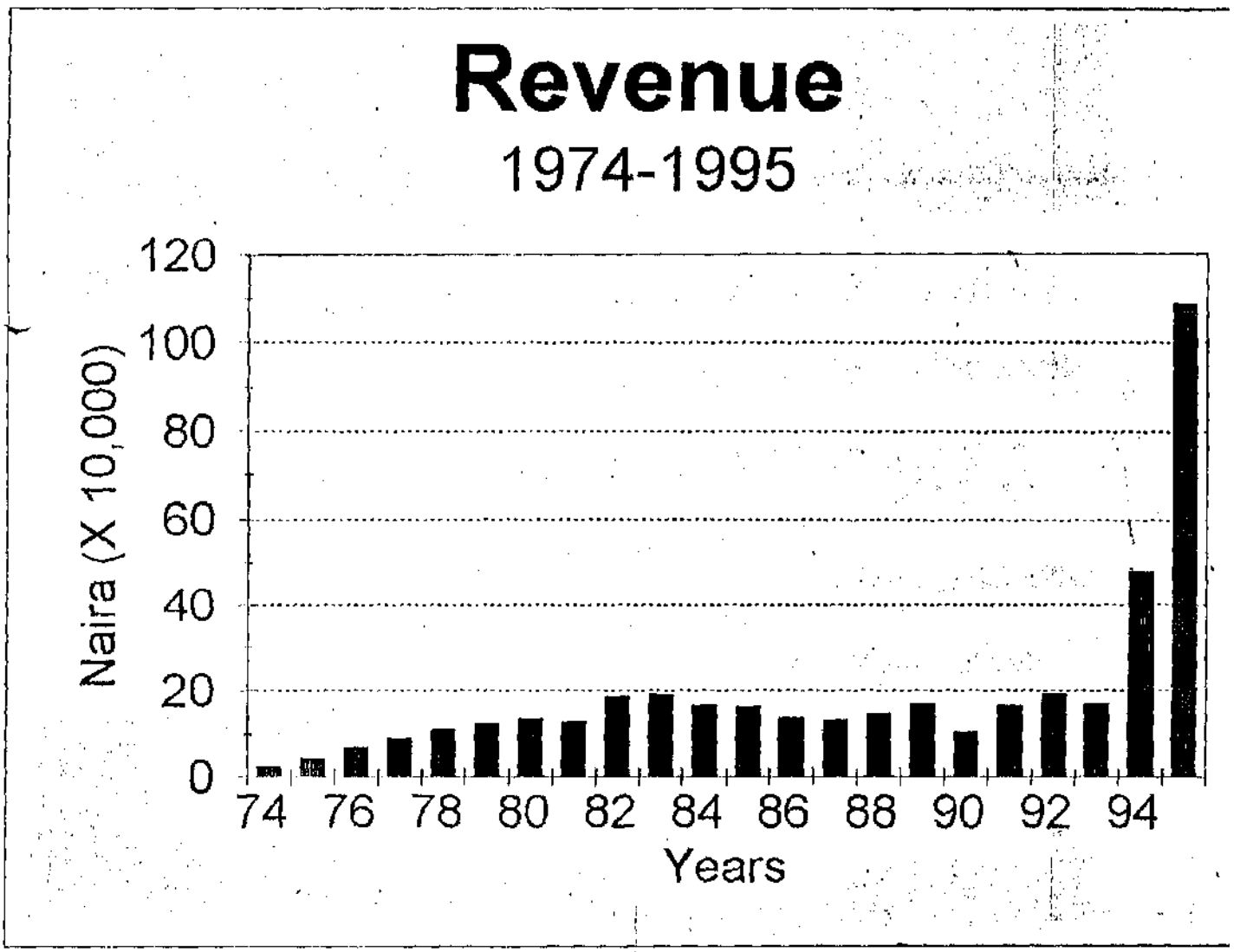


Fig: 1·22: Revenue generated from Kano Zoo from 1974 to 1994

Source: Ministry of Agriculture & Land Resources Kano-state

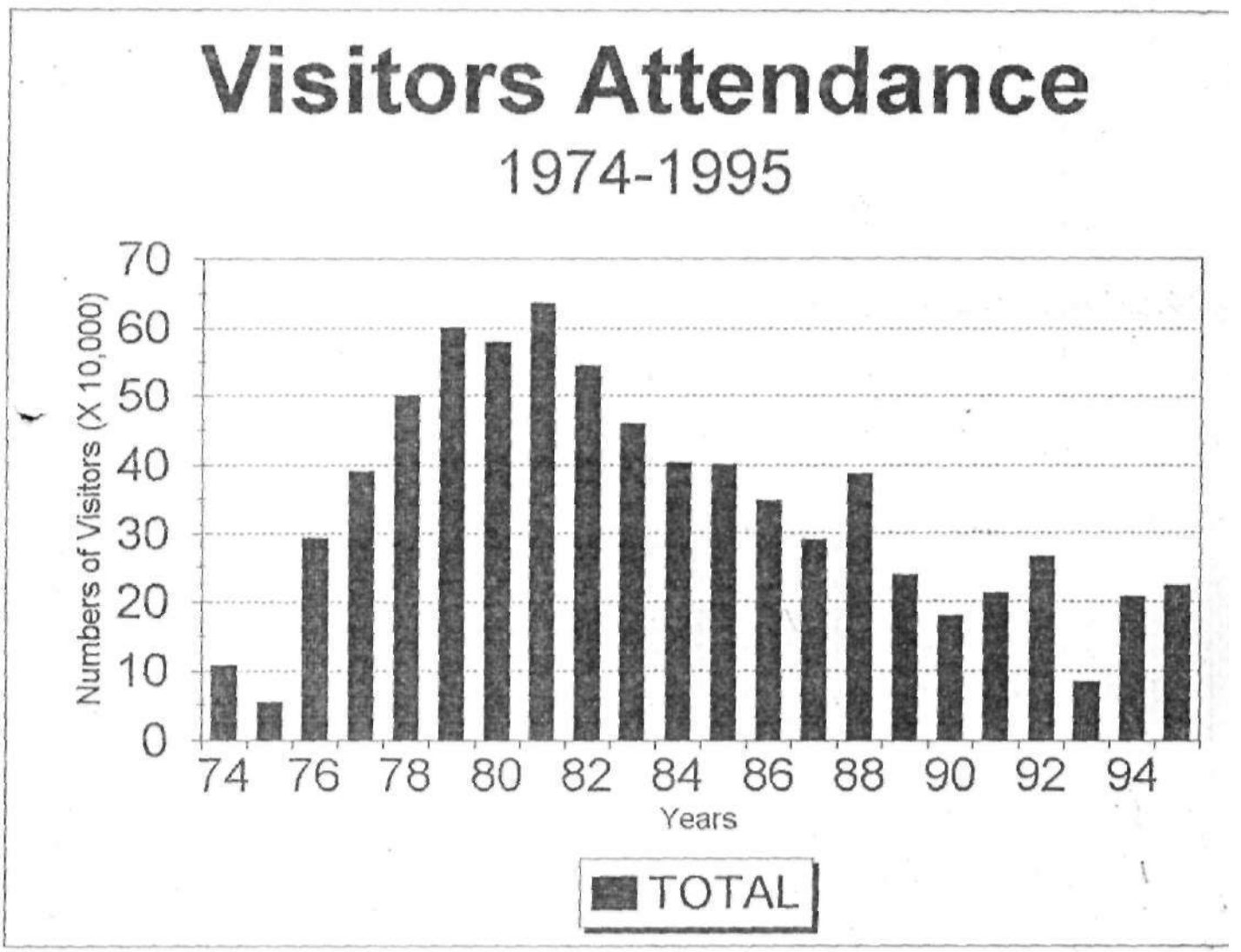


Fig 1.23: Annual number of visitors to kano zoo

Source: Ministry of Agriculture & Land Resources Kano-State

TABLE 1.23 SHOWING THE BREEDING SECCESSES IN KANO ZOO (1990-1995) WITH THE NUMBER OF YOUNG ONES.

S/No	Animal	Number of young ones produced.
1.	Mona Monkey	3
2.	Grimms Duiker	3
3.	Red fronted Gazelle	1
4.	Giant Tortoise	10
5.	Nile Crocodile	30

1.24 The Animals' Houses and General Design of the zoo.

1.241 "*Houses*" or Enclosures.

There are many enclosures that house the animals in Kano zoo (fig 1.241), but they can generally be grouped into four types as follows:

(a) **Cubic cages with concrete Floor**:- These are mainly small cages with concrete floor used for the primates, birds and some small carnivores. Only very few of them have back dens. The average size of this type of cages is 3mx4m,. They are actually too small and lack adequate *"cage furniture"* for the in habitants. Since these cages are arranged in a linear form, they could be merged to make them larger and that may make them suitable for housing small primates e.g. patas, monkeys, mona and Tantalos.

(b) **Large Open Enclosures with Dens:-** Large carnivores: cats, such as lion *panthera Leo*, and Leopard *Panthera padus* are housed in this type of enclosures. These cages have large open spaces, however, they lack climbing provisions for exercising their body and good landscaping elements to create semi-natural environment. Introduction of stimulating

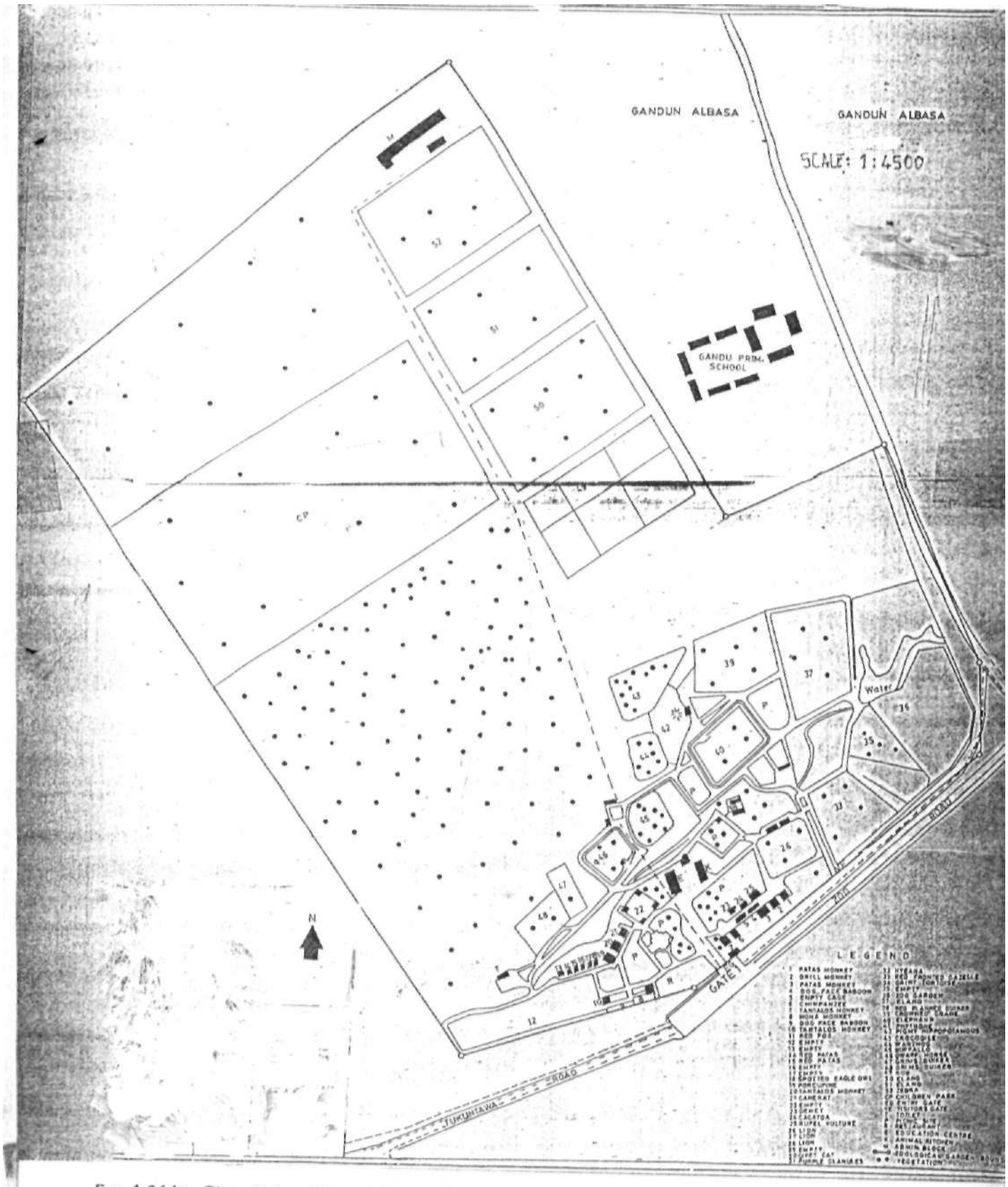


Fig 1-241: The Site Plan of Kano Zoological Garden

Source: Ministry of Agric & Land Resources Kano state

substances for locomotion is highly needed. Rocks, large wood logs and artificial cave, which also provides privacy for nursing young or mating are good example.

(c) **Large Expense Cages without Dens:-** They are large open enclosures without dens, some of them divided into paddocks to allow rotational grazing during rainy season of the year. The animals in these enclosures are mainly large herbivores like Cape Eland, *Taurotragus Oryx,* Buffalo *Synceros caffer caffer,* Burchells Zebra *Equus Burchelli,* Kob *Kobus Kob*, Red fronted Gazelle *Gazella reafitrons,* e.t.c.

The smaller mammals are also housed in enclosures with a very large space. Crush pense should be constructed to provided possibility of restraining when the need arises.

(d) **DRY MOATS:-** There are three number of dry moats housing warthogs *phacochoerus aethiopicus,* the former Rhenocerus dry moats now housing dwarf horse and the one housing rock pythons. Dry moats are very flexible in terms of the animals that they can house.

(e) **WET MOAT:-** There two number of wet moats, one housing the elephant, while the other housing pygmy hippopotamus and crocodiles. There is a mass accumulation of debris that make the water to be very shallow.

General observations reveal the need to modify and improve most of the animals' enclosures for the well being of the animals and ultimately provide appropriate socio-environmental condition of the captive animals as a necessity. And most of the enclosures are not labelled to educate visitors about the animals.

1.242 LANDSCAPE AND CIRCULATION.

The general landscape of the zoo is dominated by naturally occurring trees, which makes most parts of the zoo under shade. This keeps the zoo in a relatively lower temperature than its immediate surroundings. There is also

some decorative shrubs along the circulation routes. The present circulation network adequately links visitors to all animals' enclosures.

There is also a small garden farm used to cultivate some fruits, vegetables and tubers in small quantities. The produce are used in feeding the animals. The garden is not deliberately planned, but an initiative of the zoo staff to supplement the nutritional requirement of some animals. Generally there is no any deliberate attempt to create any interesting landscape scene or use of landscaping elements to make the animals feel at home.

1.243 ADMINISTRATIVE AND OTHER BUILDINGS.

(a) The administrative building:

Located far away from the animals' staff office that is close to the animal houses. There are four offices that accommodate the principal zoo curator, deputy principal curator, personnel officer and the registry where the clerks are housed. The central store is also located near the administrative block.

(b) ANIMALS' "*KITCHEN*".

The zoo has one central "*Kitchen*" in which all meals are prepared for the animals. The Kitchen consist of one room and an outside court behind. Where animals are slaughtered for the carnivores. The same room is also used for the storage of food stuff at room temperature, as no any storage facility such as refrigeration in the Kitchen. Therefore, a cold room, dry store and Kitchen appliances are needed.

(c) EDUCATION BUILDING

In this building there is a small hall for Audiovisual facilities (Television) and an office, that are used for shows to educate visitors more especially group visitors like school children. Library, records and computers are all lacking.

TOILETS:

There are two number of public toilets in the zoo located at different locations. But only one of the two is in use.

SEAT - OUTS

There are outside sitting arrangement under trees in different places in the zoo. Some are located close to animals' enclosures that viewing while sitting is possible. But the sitting arrangement that can provide protection against rain are lacking.

RESTAURANT.

There is a restaurant inside the zoo that serve meals, snacks and soft drinks. The restaurant stop operation due to lack of patronage.

CHILDREN'S PLAY GROUND.

The zoo has a very large area equipped with children playing facilities. The area is reach in trees and is used for picnics and parties.

PARKING SPACE

The zoo has a very limited space for visitor's car park. The space can only accommodate ten cars. On crowded days, Visitors have no option but to park along the road, which causes traffic congestion. The use of the original parking space for building shops contributes to the problem.

ENTRANCE

The zoo has two visitors entrance where tickets are sold. At each entrance there are three cages for sales of tickets. But on ordinary days, only one of the two entrances is used; except on crowded festival days like sallah days when the two are used.

The two entrances are not celebrated to be inviting passers-by. There is a proposed area for new entrances and car park.

AMENITIES IN THE ZOO

Water supply to the zoo is very important to both the animals and maintenance of the beautiful plants

the zoo is inadequate. The water pressure is very low and the supply irregular. At present there is no back-up tank; however an attempt was made in the past to install a large water storage tank and a borehole. The borehole was drilled, but the effort did not go further than that. There are also two open wells with good quantity of water, but with no pumping equipment.

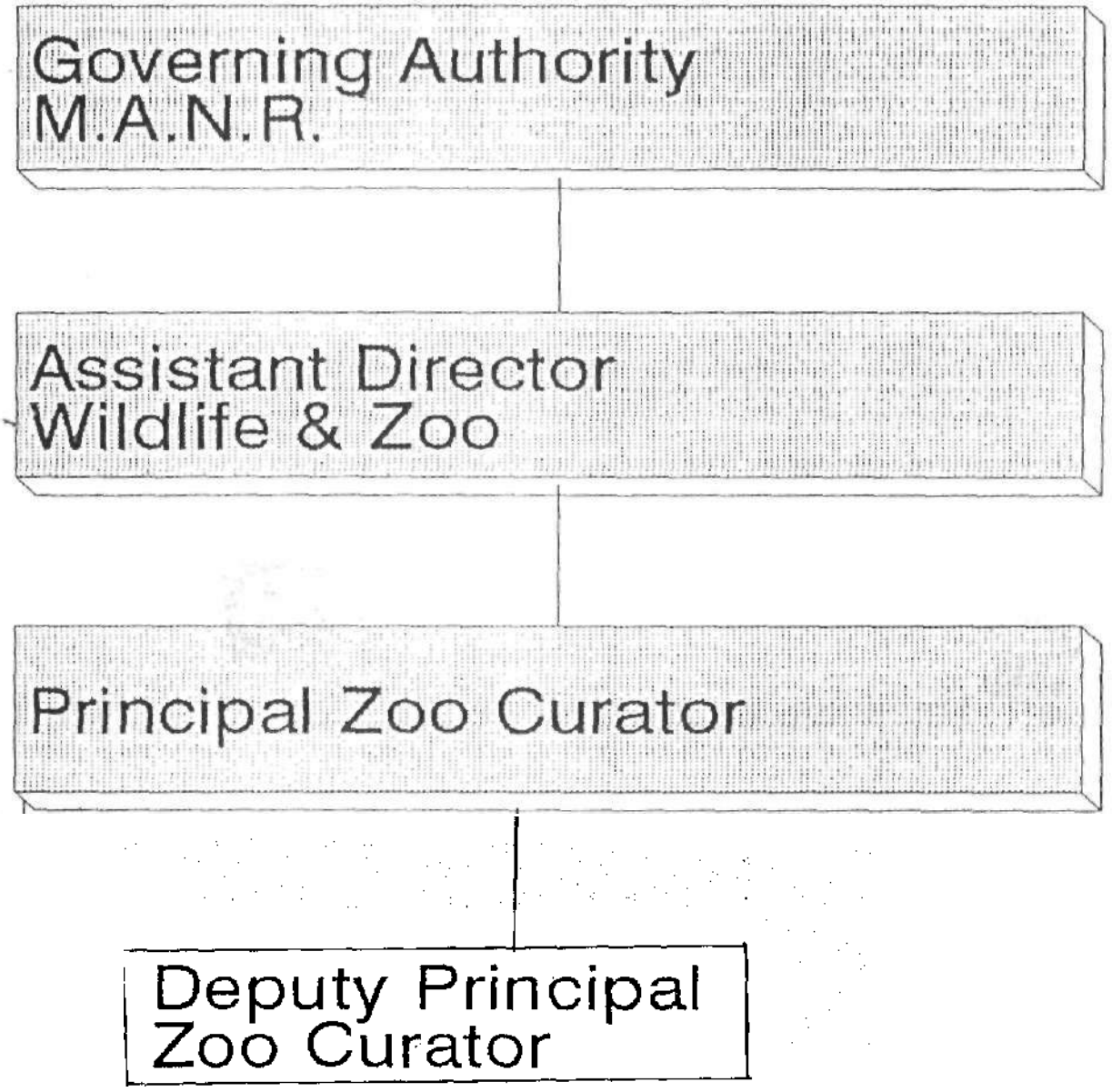
Constant Electricity supply is necessary for security purposes, profer functioning of the facilities and the use of the animals, more especially the noctunal animals that the lighting condition in their enclosures are reversed. But the cables supplying most of the security lights and some other places are burnt.

1.25 ADMINISTRATIVE STRUCTURE OF THE ZOO

GOVERNING AUTHORITY: The zoo owned by the state Government, is directly under the forestry department of the state ministry of Agriculture and Natural resources. The ministry of agriculture, out of its annual budget, allocates money for the capital and recurrent expenditures in the zoo. This covers staff salaries and allowances, feeding and medication of the animals, maintenance, e.t.c.

All the financial requests of the zoo are passed by the zoo curator to the assistant director wild life and zoological gardens, who recommends the requisition and pass it to the director forestry, wild life and fisheries, who also recommends and pass it to the commissioner of the ministry for approval. When the approval is made, it is passed to the Director finance and supply, who is responsible for the process of releasing the money to the zoo. In some instances when the ministry could not meet the financial demand of the zoo, a memorandum is drafted to the state Governor for special monetary allocation to execute a project. (fig 1.26)

FIG 1.26 THE ADMINISTRATIVE STRUCTURE OF KANO ZOO.



1.3 AIMS AND OBJECTIVES

The aims and objectives of this thesis are as follows:

1. To study and document the existing design and facilities in the zoo for the purpose of Assessment and finding areas that need improvement or total *overhauling*
2. To study both the macro and micro climatic condition of the study area with the view of finding its own infact on the animals that are of primary importance in a zoo.
3. To study the individuals and families of the animals inmates in the wild so as to discover their physiological and psychological needs with the view of finding ways of satisfying them.

1.4 LIMITATION AND SCOPE

1. Only animals that are of west African origin are going to be considered in the design of the zoo and provision of Accommodation. Animals from other parts of Africa, whose survival in the natural climatic conditions of Kano it assured, may be considered. This is not in order to make the zoo a specialised zoo as some zoos are, but to avoid the huge material and technological inputs that are needed to create artificial semi-natural environment for the animals.

2. Another important restraining factor is the site. There is no room for expansion due to developments at all sides of the zoo. Relocation to another position may also not to be considered due to the role the zoo plays in breaking of the dense and congested settlements around it. But an *Annex* can also be a possibility.

3. In view of the above the animals that belong to the same family, only a sample of animal(s) that represent the family may be considered.

4. The design will be within reasonable and realistic budget.

ARCHITECTURAL SIGNIFICANCE

Many of the problems in the zoo translate into architectural, the challenges to an Architect in a design of a zoo are many.

Providing the animals with natural environment and satisfying their desires includes that of privacy and shyness, while bringing them at a close view to the public. Zoning and grouping the animals as they are supposed to exist. Designing of unconventional facilities like *animals kitchen* etc. the traffic and circulation more especially on crowded days; the safety of the animals and the public and incorporating facilities such as kiosks, Restaurants, clinics, laboratories etc. and many others.

Accommodating and display of some creatures like the reptiles or the very many aquatic creatures has a lot of peculiarities and requirements. The nocturnal house where the lighting condition is reversed is not in anyway less challenging.

1.5 JUSTIFICATION

It is very unfortunate that Africa as the richest continent in terms of flora and fauna, but the awareness for the importance of conserving nature is minimum. The damage done by civilisation to the diverse, rich and beautiful natural ecosystem, that Africa is known of, is very serious. The natural habitat of many animals has been destroyed through construction and Agriculture. Nigeria as a developing country, more of such activities are expected.

Therefore, it is now, more than any other time efforts are needed in that direction. One of such efforts in zoos more especially now that zoos are symoymous to wild life research education and conservation centres. We owe it as a duty to save the animals from extinction.

1.6 METHODOLOGY

The primary sources of information used in this work are review of relevant literature and field studies.

Other source, include interview with relevant personnel's: the animals keepers, Administrative staff etc. Questionnaires were also extensively used.

The use of audiovisual documentaries was also employed.

CHAPTER TWO

THE WILD LIFE: ZOO INMATES.

2.01 STRUCTURE OF THE ANIMAL COMMUNITY

Every major habitat, together with the plants and animals it support, constitutes self-sustaining system which is organized in a particular way. The organization is basically the same in totally unlike habitats. Each ecosystem is essentially an association of producing, consuming and decomposing organisms.

The trees, grasses and other green plant are the primary producers. By the alchemy of photosynthesis they alone can transmute simple inorganic substances into complex proteins and other organic compounds which are the stuff of life. Directly or indirectly, all animals are dependent for their food upon plants. As one scholar wrote in a book titled *Life (1923): It is chlorophyll 'which makes the world go round'*.

In the second category of organisms-the consumers-are the animals which according to their food-habits can be classified broadly as herbivores, predators and scavengers. Secondary producers-herbivores at the bottom of the food hierarchy-are often very small and numerous, such as copepods, aphids, ants and so on. These are basic industry animals that provide food for the various grades of carnivoras.

At the head of the food chains are terminal species. These are the master predators, or animals of formidable size or powers of defiance which have nothing to fear from predatory attack. Such are the large Carnivora, the great ungulates, many storks and birds of prey, crocodiles, tiger fish and Nile perch.

Between the basic industry animals and the terminal species is a bewildering variety of interconnected forms-many of them insectivorous

invertebrates and such as the mantis, tree-frogs, or chameleons - which feed upon creatures smaller and more numerous than themselves, and which are in turn the prey of large and less numerous hunters whose status is near or at the summit of the food hierarchy.

The third category, the decomposers, consists of organisms that break down dead organic material-excrement's, exuviae, wood and corpses. This vital work of recycling the contained carbon, nitrogen and minerals is carried out by fungi and moulds, putrefying bacteria, and by such animals as termites, mites, earthworms, scavenging vertebrates, and by scarab beetles. An example of the latter is the giant dung beetle *Heliocopris dilloni* which feeds on elephant dung and provides for its offspring by laying its eggs in a buried cache of the same material.

2.02 THE FOOD WEB

In the first months of life the hatchling crocodiles prey extensively upon giant waterbugs (*Belostomatidae*), nymphs of dragonflies (*Gomphidae, Libellulidae*), various water beetles (*Dytiscidae, Hydrophilidae*) and fresh-water crabs (*Potamonautes*). These invertebrates in turn feed upon young frogs and fish-fry, whose food consists variously of vegetable matter, zooplankton or detritus. The young crocodiles themselves fall prey to many enemies ranging from the soft-shelled turtle *Trionyx* and monitor lizards to such waterbirds as Marabou, Saddlebill Stork, Great White Egret and Fish Eagle. Meanwhile adult crocodiles include in their diet some of these eaters of their young; and after death the crocodile's body is attacked by different grades of scavengers and decomposers - vultures, blow fly maggots, river crabs and by cannibal crocodiles.

A glance at such relationship, demonstrates the interdependence of animals in terms of feeding; thus is the case with all animals in the wild at various levels or niches of the web, and irrespective of the habitat.

2.03 NICHES AND ANALOGIES

We have seen that animal communities in very different habitats resemble each other in their essential ground plan. This resemblance in the organization of ecosystem is more apparent when we consider the role played in the community by particular species. The concept of the niche was first admirably developed in 1927 by Charles Elton in his classical work Animal Ecology. 'The "*niche*" of an animal means its place in the biotic environment, its relations to food and enemies'. There is often, as Elton has pointed out , an extraordinarily close parallelism between niches in widely separated communities.

There is a niche that is filled by 'cleaners' which rid reptiles of ecto-parasites. In Uganda this office is performed by the Spurwing plover ,which removes tsetse flies and leeches from the Nile Crocodile. In Aldabra a gecko phelsuma feeds on mosquitoes which swarm on the island's Giant Tortoise. In the Galapagos a scarlet Grapsid crab takes ticks from the marine lizard Amblyhnchus.

Again, in tropical regions there is a niche for mammals which, as gastronomic specialists, feed almost exclusively on ants and termites. In Africa this habit is practiced by the Aardvark (*Orycteropus*) and in Brazil by the unrelated Giant Ant-eater (*Myrmecophaga*).Both are fairly large terrestrial forms which rip open the nests with powerful claws and take the insects on their long extensible tongue. In the trees the same role is played by the African Long-tailed Pangoli (*Manis*) and by the South American Two-toed Ant-eater (*Cyclopes*): both animals, belonging to different orders, are well equipped for this strange mode of life, being strong-clawed and toothless, and having a tubular mouth, long sticky tongue and prehensile tail.

The sunbirds in Africa and hummingbirds in the Americas provide another example of close resemblance between animals that occupy a similar niche in different parts of the world. In both group the beak and tongue are modified to probe for ant to extract nectar and tiny insects from flowers. It happens that the birds also share other characters, being diminutive in size and having brilliant iridescent plumage, though they belong to different avian orders: humming birds are more nearly related to swifts than to sunbirds.

Another niche is that occupied by eaters of birds' eggs. Such predators are found in every habitat and in every geographical region: Greater Black-backed Gull, Carrion Crow, Magpie, Jay and Marsch Harrier in Europe, or Great Skua and Sheathbill in the Antarctic are examples. For animals of high latitude egg-eating is of course a seasonal occupation. But in the tropics, where birds of different species are found nesting all the year round, it is possible an nimal to become entirely addicted to eggs. One such is the very remarkable African egg-eating snake, *Dasypeltis scaber*. Only three feet in length and proportionally slender in girth this snake is even able to swallow a hen's egg. ventral spines that penetrate the dorsal wall of the gullet serve, like a tin-opener, to slit the shell as it passes towards the stomach, enabling the reptile to swallow the contents without loss, and to regurgitate the collapsed shell.

2.04 THE ROLE OF PREDATORS

Predators play a key role in the life of the community; and paradoxically, they tend to benefit the species on which they prey. In the first place, by a selective process they promote the survival of the fit. Birds of prey and carnivorous mammals are quick to detect and pull down sick, weak or old individuals immediately they lag behind their companions. In a book, *pirates and predators* by Colonel Meinertzhagen it is reported that hawks and even crows and ravens are very quick to spot a 'pricked' bird: Any bird accustomed to the protection of the flock; he writes, 'falls an easy victim to the predators

without that protection ...There is little doubt that predators exercise a selective effect in choosing abnormal birds whether in colour, health or some physical or mental weakness.

From the field studies of kuhme and the van lawick-Goodalls it seems to clear that the hunting technique of the African Wild Dog enables members of the pack to select from the herd an antilope that is weaker or slower than his fellows .Hard proof of this type of selection is not easily obtain; and a study of the feeding habits of cormorants, carried out by Dobben in Holland, is of special interest in the statistical evidence it provides . The birds' main prey in the study area were roach. Examination of stomach contents showed that 30 per cent of the fish captured by the cormorants were infected with a tape worm: whereas the incidence of worm infection in the free roach population was only 6.5 per cent.

Secondly predators play a vital part in regulation and so preventing ungulates from increasing beyond the carrying capacity of their habitat. A classical example of the imbalance which can result from the elimination of wild carnivores is offended by the history of the deer population on the kaibab plateau of arizona. originally pumas and wolves seem to have maintained the population well below the capacity of the range at about 30,000 head. Between 1907 and 1939 over 800 puma and 7,000 coyotes were killed; and wolves were exterminated. After the shooting the deer population rapidly rose to outgrow the winter food supply; and by 1924 had reached 100,000 animals. Then followed a catastrophic drop within one year to 40,000, and by 1939 the population stood at about 10,000 deer living on a depleted range.

In Africa awareness of the problem began in the early thirties when Stevenson-Hamilton, for many years Warden of Kruger Park, reported an increases of Impala, which he related to the almost total disappearance by 1933 of the park's formerly large packs of Wild Dog. Today in Uganda it is probable that the excessive number of baboons which forage in large troops on the

Acholi and Bunyoro banks of the Victoria Nile may be attributed to growing scarcity of their main enemy, the Leopard.

Thirdly, predator-and especially the pack-hunting Wild Dogs and Spotted Hyaena - tend to enforce beneficial movement among the herds of ungulates, driving them off a grazed area to no grounds, and generally fulfilling the same function as wolves in northern latitudes. In winter the American White-tailed Deer tend to hang about, or *'yard'* in one area; wolves prevent yarding, split up the herds, and so help to conserve the habitat.

2.05 REACTIONS OF THE PREY

Many writers have commented upon the strange lack of concern which herbivores show in the presence of enemies when the latter are not actually hunting. Prey animals give on the impression that they are aware of the predator's intentions, and react accordingly, 'It is not an unusual sight', writes Stevenson-Hamilton, 'to see in open country an old bull wildebeest grazing within a hundred and fifty yards of some resting lions.' The same authority recounts how a ranger came on a lion and two lioness taking their midday siesta less than a hundred yards from a troop of zebra. 'Neither party was taking the least notice of the other. One lion was lying on its back with all four legs in the air, like a cat before the fire, while the zebras were standing about apparently half asleep. The lions must have been clearly visible to them. Incidents such as this illustrate the perfect understanding which the wild creatures have of each other's ways, and how far man is from a clear comprehension of them'.

Warning signals which denote alarm are infectious, and are recognized not only by companions but by members of other and often quite unrelated species. Crocodiles, by no means as sluggish and dull- witted as they seem, are extremely quick to take the cue not only from their regular avian companions the Spurwing Plover and Water Dikkop, but also from the Egyptian Goose and

other birds that frequent the basking grounds. The alarm honking of a goose or the bark of a baboon is enough to send the reptiles stampeding to the water.

There is no question that birds warn game of the approach of man. When oxpeckers fly up, uttering their harsh, scolding notes, the animal they have left is at once alerted, as a man would be by an alarm clock. Meinertzhagen thus records the reactions of a Grevy's Zebra which caught as a foal, had been over a year in captivity and was very tame and gentle. 'He had seven yellow-billed birds on him; as I approached they rose and yelled; this threw the zebra, who normally would come for sugar, into a panic and he raced round as though the devil were after him..

Among vertebrate animals generally, each species has its own language of signals, which is unintelligible to or ignored by member of another species. pointed out, alarm signals are the exception to the rule-they are recognized as a warning not only by herd-members but by associated species. 'Any ungulate that stands erect or stares in one direction, or suddenly breaks into flight, alerts all nearby game.' The alarm snorts, often accompanied by stamping with a foreleg, are 'basically alike and mutually alarming'. Thomson's Gazelle also signals visually by twitching the flank skin, or by 'stotting' just before taking to flight, and so semaphores a warning to all animals in the vicinity.

To witness a kill is for the human observer a distressing experience especially when-as with prey of the Wild Dog-death comes slowly. It does seem likely, however, that in certain circumstances the terror and physical pain of the wounded animal are to some extent mitigated by traumatic shock.

Henry Fosbrooke speaks of Grant's Gazelle sitting in a state of equanimity whilst wild dogs proceeded to disembowel them, as though they were under an anaesthetic. In Ngorongoro a terrier belonging to the same writer was taken by a leopard and severely bitten in the small of the backs so that the kidney were protruding. 'It was obvious', he writes, 'that the dog felt

no pain. He was in a state of deep shock, and pathetically wagged his tail and licked our hands as we patted him'.

Although the human sepectator naturally feels pity for the animal that is dragged down in the hunt, we do well to remember that as George B. Schaller remarks in his *Serengeti-a Kingdom of Predator*, 'Predator are the best wildlife manager'. Owing to the mistaken belief, formerly held, that they harm the species on which they subsist, the predators themselves have suffered most from persecution by man; and today in many parts of Africa it is the hunting rather than the hunted species whose continued survival is threatened.

2.1 MARSUPIALS.

Marsupials are remarkable mammals because their young are born at a very early stage in their development. In most species the mother has a pouch in which the young suckle and continue to grow.

Young wallabies and Kangaroos Leave the pouch when they are ready to fend for themselves, but continue to return there for rest, shelter and to feed. Young Kangaroos will still suckle even when they have grow too big to be carried, "*Joeys*".

At one time marsupials inhabited most parts of the world, but they are now found only in central and south America. Whence some have colonized parts of North America and Australia and its neighboring Islands.

Wallabies are simply the smaller versions of the Kangaroos and both these animals are the typical herbivorous mammals of Australia. Albino forms of Bennett's wallabies- white, with red eyes are from Tasmania. (fig 2.1).

2.20 PRIMATES

Primates are mammals which are basically primitive in structure, retaining, for example, five fingers or toes on each limb . Although some member of the group live on the ground, the primates are adapted for a life in

trees. their limbs are well designed for grasping branches, thy have a reduced nose and large and efficient eyes, which are placed on the front of the head in order to facilitate judging distance. the most advanced primates have very large brains and are more intelligent than any other animals which have lived. This trend reaches its peak in man.

2.21 BUSHBABIES

Bushbabies or galagos come from Africa south of the Sahara desert. they are mainly active by night and have huge eyes so as to be able to take advantage of every glimmer of light . Bushbabies have quite small noses , but round their nostrils there is a patch of bare skin like that on the snout of a dog . the ears are large and naked. their hind legs are very long and can kick powerfully, propelling them as they leap from branch to branch , often covering a distance of several feet . Even when on the ground bushbabies bound along on their hind legs ,looking rather like small kangaroos. their long tails enable them to keep their balance. By day several bushbabies often sleep together inside the trunk of a hollow tree , but at night they move about the bush on their own, sometimes keeping in touch with their loud wailing cries. They feed on fruits, leaves and juicy plant stems, and are also fond of insects and even small vertebrates.

2.22 MONKEYS

The Woolly Monkeys is a South American animal, and like the other monkeys from that part of the world has a rather flattened nose with slit-shaped nostrils. Like some other American monkeys, but unlike the monkeys from any other part of the world, it has a prehensile tail which is used as a fifth limb. On the underside of the tail, near the tip, is an area of bare skin, ridged rather like a human fingerprint, and this helps the monkey to get a good grip when the tail is curled round a branch.

Like almost all the other monkeys, Woolly Monkey live in groups and are active by day . At the season when the wild fruits ripen in the Amazon forests , the adult males sometimes grow very fat .

The Rhesus Monkey belongs to the group of old world monkeys called the macaques , all of which come from Asia , with the exception of the barbary Apes of North Africa and Gibraltar. the rhesus is found in India, Pakistan, Burma, Tibet China, Siam and indo-china ,it inhabits wooded country and cultivated areas but is especially fond of bare, rocky hillsides, although it is never found far from water. in parts of India Rhesus monkeys together with some other species, are regarded as holy and are allowed to roam freely near certain temples, to the detriment of crops growing in the vicinity. Being sociable animals, Rhesus monkeys live in large colonies. Each colony has a well-marked social structure and each member knows its place in society, being aggressive to presumptuous inferiors, and respectful to superiors.

2.23 APES

Gibbons, like Orang-utans, Chimpanzees and gorillas, are anthropoid apes and, in structure are much closer to man than the true monkeys, one important difference between the monkeys and the apes is in their mode of climbing. typically monkeys run on four legs above the branches, using their tails in order to keep their balance, while the apes swing beneath the branches on their long arms and are tailless. of all the apes, the gibbons are the most lightly built and they are, therefore, the most active and expert climbers. A gibbon on the move is a most remarkable sight. Like an acrobat, it swings from bough to bough at incredible speed. On the ground it runs upright, holding its arms flexed above its head. To drink, it sometimes dip its hands into the water and licks the drops off the hairy backs.

An example is the Lar Gibbon, which comes from Sumatra, Malaya, Cambodia, and parts of Siam and Burma. This species has white fur on the



fig 2.1 Marsupials



Fig 2.23 APES

hands and feet, and an elegant white border round the face. Like the larger apes, most gibbons are unable to swim, and so they can be confined by a water barrier only, i,e on an island. There is only one thing for which their keepers must watch carefully-and that is when the winter frosts are sufficiently hard to form ice. The gibbons can walk on the thinnest of ice and could escape if they were not safely enclosed in their cage in time.

Wild gibbons live in small family group consisting of one adult male and female and their young. Each family of gibbons defends its territory from neighbouring by uttering whooping cries. Although there are no other Lar Gibbons for many miles, the ringing call of Zoo gibbons can often be heard echoing round the Park. (fig 2.23).

2.30 RODENTS *ORDER RODENTIA.*

The word "*Rodent*" means "*Gnawing*" and all rodents have big, chisel-like front teeth. They are relatively small animals, the biggest in Nigeria being the grass-cutter which measures up to 60cm in length and weighs 7or, 8kg. Grass-cutters live in places where there is a dense vegetation. Sometimes they hide in burrows and sometimes in the open. Four to six young make up the litter and they are born covered with hair and with eyes open, ready to walk soon afterwards. Grass-cutter sometimes called *cane rat* are very good to eat and sell for high prices. Experiments in rearing them in captivity for food are being conducted in Ibadan University.

Rodents are the most numerous of living mammals and are found all over the world from the tropics almost to the polar regions. The biggest is the Capybara of South America, which is about 4 feet long. The teeth are an important feature of this group. In particular the incisors are chisel-shaped and, although they undergo considerable wear, are well adapted for gnawing at the harder parts of plants.

The Crested Porcupine comes from Africa, Italy and Sicily. It is about 2 feet long and its back is covered with long quills which are actually very stiff and exaggerated hairs. Porcupines are fearless and like to rattle their quills to advertise their presence. Their short tails carry a special rattle made up of huge, hollow quills. When threatened a porcupine turns its back and than, erecting its spiny armour, lunges backwards towards its attacker. After the encounter some of the quills will remain in the flesh of the would-be porcupine hunter, and even Lions keep well clear of the Crested Porcupine.

Porcupines are largely herbivorous and are most active at night in the wild. They are expert burrowers, and the dens they have made for themselves can extend for many feet.

The Guinea Pig probably a variety of the Peruvian Cavy, which was domesticated long before the discovery of America by Europeans. As is often the case with domestic animals, many differences of colour and coat exist. The "*Abyssinian*" variety has a short coat dotted with rosettes of longer hair, while "*Peruvian*" or "*Amazon*" variety has long, silky hair.

The Patagonian Cavy or Mara is found in the desert steppes of Patagonia. It is a most unusual animal in appearance, being rather like a hare with longer, straighter legs. The hind feet bear three toes with hoof-like claws. The upper part of the body is grey-brown in colour, the sides are yellow and the underparts white.

The *Prairie Marmot* is sometimes known as the *Prairie Dog*, but this second name is rather misleading. Marmots are not at all dogs, being much more closely related to squirrels. Living in burrows and on the ground, marmots have no need of the long, bushy tail which squirrels require for balancing in the trees, but otherwise they are very similar to squirrels in their appearance. They put their short tails to good use, frequently waggling them as signals to other of their kind.

Prairie Marmots were once common on the plains of North America. Large areas were pock-marked with the burrows forming Prairie Dog "*towns*". In recent years their numbers have been greatly reduced by farmers, who cannot look kindly on the damage these animals cause to crops and grass.

Alpine Marmots are larger than the Prairie Marmot, and come from the grassy slopes of mountains in Europe and Asia. In addition to their tail-semaphores, Alpine Marmots have an effective signaling system to give warning of danger. When one member of a group is alarmed it makes a shrill whistling noise to warn the others.

Another very important rodent is the giant rat, often called *pouched rat*. The giant rat has a long tail, measures up to 45cm from nose to tail tip and may weigh as much as 1kg. It dig a large burrow which may have many side entrances and separate "*rooms*". Giant rats hunt for food at night, always feeding on fresh plant material and never rubbish. They carry the food in the mouth and store it in the burrow, to be eaten in the day time. Two to four young are born and female and young live together in the burrow. Giant rats are good to eat and become tamed easily in captivity. They are happiest in a double cage, with a covered sleeping apartment and an open run where the food can be placed. As in the wild, the tame giant rat collects the food in the open and takes it into the covered part to eat later. In the university of Ibadan they have been kept for fourteen generations and have been proved to be very good as domestic animals (1980).

Beavers come from North America, Asia and Europe, and at one time they were common in Britain. The Beavers of the Old and New Worlds are very similar. Beavers live in and around water and swim powerfully with the broad, flat, hairless tail, which is also used to slap the surface of the water to warn other Beavers of danger. In the past they were much hunted for their rich brown fur.

Like all of their kind, the Beavers are very shy and spend much of their time out of sight, but the evidence of their industrious lives is always to be seen. Beavers are extremely skillful at building dams, both with mud and with trees which they fell with their strong teeth. In the broad, shallow expanse of water formed above the dam they construct their "*lodge*". They pile boughs and mud on an islet or a foundation of peatmoss so as to construct a floor a little above water level. The walls of the lodge are made with branches cemented by mud, and the dome is made by boughs which allow ventilation. Inside the chamber made in this way, a pair of Beavers live and rear their young.

2.4 THE CARNIVORA

The African fauna is richly endowed with members of the Carnivora. They range from the lion-master predator who can kill an adult buffalo bull or male giraffe-to very small forms like the Dwarf Mongoose whose food is mainly insects.

The animals may be conveniently divided according to size into three categories. The first contains the three outstanding species - Lion, Leopard and Cheetah. The second-Wild Dog, three species of hyaena, of which the Spotted Hyaena is the most common and widely distributed and the Caracal. The smaller members, belonging to several families are of course the most numerous and include three species of jackal. the Bat-eared Fox, Honey-Badger, weasels, otters, civets, genets, many species of mongoose, the Serval, and other small cats.

The striking about the African species is their number and diversity. Each of these species occupies a particular niche, and plays a more or less distinct role in the ecosystem, the various members of the order making, between them, the fullest utilization of the terrain, with its food resources, that is their home.

In the following short account we shall be looking at some of the larger, more spectacular and better known carnivores.

2.41 THE LION

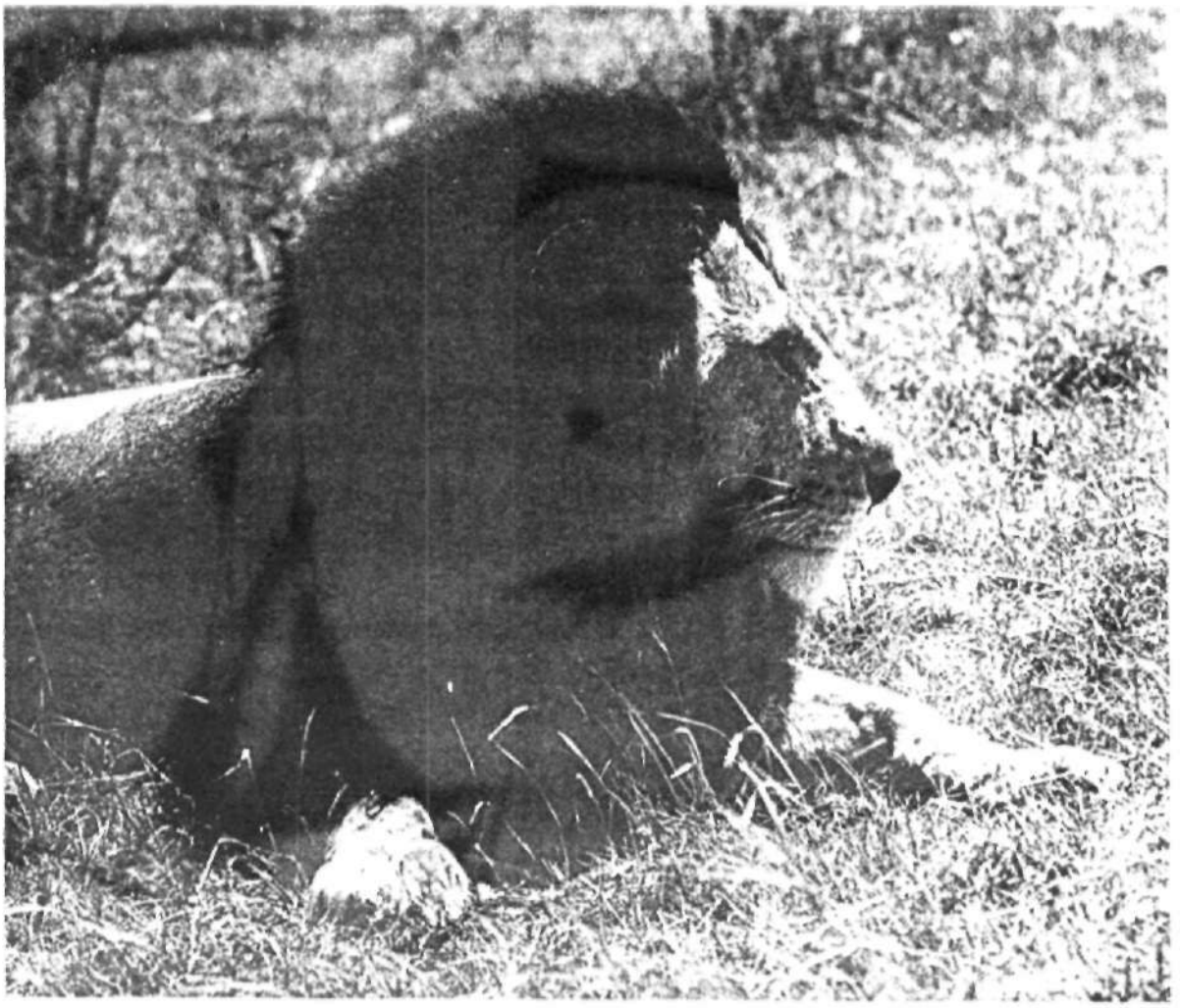
The Lion is distinguished from all other cats by the massive *mantle hair* carried on the neck and shoulders of most adult males (FIG 2.41); by the black terminal *tail tuft*, with its curious concealed horny spur; by its *social habits* and by its *voice*. The roaring of lions is the most remarkable and moving sound of the african bush. heard at night from camp it never fails in its power to stir the imagination. In its urgent quality and tremendous volume there is no other sound in the least like it The great volume of sound dying away in a series of *diminuendo* grunts. on a still night lions can be heard over a great distance- perhaps up to five miles. to hear members of a pride thus communicating over long distances is a thrilling wonder. The strong development of sociable behaviour is another feature unique among the true cats. lionesses are rarely seen alone. members of the family-group stay together, and their numbers continue to grow. very large groups are sometimes seen, composed of one or more adult males, several females and -the majority -of cubs and adolescents . A pride of up to 36 members has been recorded.

Prey of the Lion

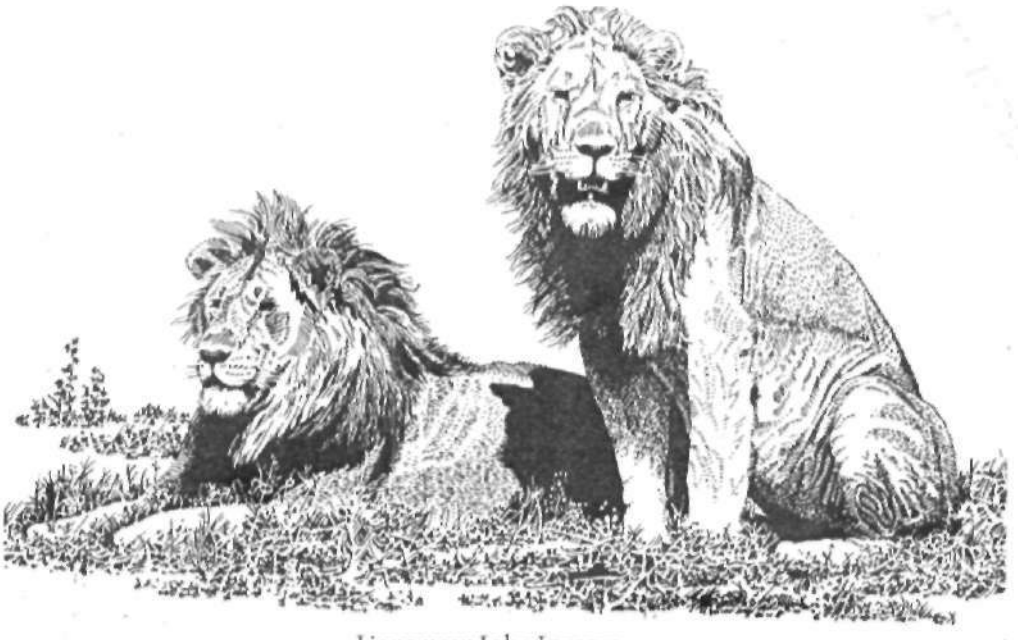
The lion's prey includes the larger and medium- sized ungulates, such as zebra, wildebeest, hartebeest, topi, impala, eland and buffalo; also young of elephant and hippopotamus. Warthogs are sometimes dug from the burrows they occupy at night . in some areas full- grown giraffe and buffalo are pulled down. Lions will also take baboons, monkeys, poultry and even fish, pythons and crocodiles.

Crocodiles, with their extremely keen olfactory sense, are quick to take advantage of another animal's kill, and there are reliable records from Tanzania.

Fig 2.41 LION



15. A fine black-maned Lion seen in profile, Seronera



Lions near Lake Lagarya

whereas their relative abundance was 35 percent and 24 percent respectively; and the number of Kongoni killed (2 percent of the total) was proportionately far below their availability (15 percent) as potential prey.

HUNTING METHODS

Lions hunt by sight and sound rather than by scent. Hunting is mainly a nocturnal occupation, but lions move about freely in the early morning and evening and in country where they are not themselves hunted, as in National Parks, diurnal hunting is often seen.

The methods adopted depend upon the terrain and the quarry. Lions are intelligent animals, and the hunting pride is a well-organized group whose individuals understand the use of ground, cover and wind-direction. When game is heard or seen several lionesses stalk off and hide down-wind from the quarry. Once they are in position others of the pride circle round up-wind and then, with scent streaming down towards the prey, they act as 'beaters' and stampede the herd into the ambush. Usually it is the female who do the actual killing.

Often lons rely on the stalk-charge technique. One or more individuals make a slow, concealed approach, which may last for hours, until they are near enough to charge down upon the quarry. A herd of game may be entirely surrounded by a large pride of lions whose approach, owing to lack of wind, had not been detected.

Killing is usually done by strangulation. Often the fleeing animal is thrown off balance by the final charge and breaks its ack in falling. Large prey such as giraffe and buffalo are killed by the males of the pride, and then sometimes only after a prolonged struggle during which the quarry may first be ham-strung and thus disabled. Buffalo in a herd combine in defence against

lions, facing the enemy in a compact armoured front. Solitary individuals - usually-lack su protection, thirty of the thirty-seven buffalo kills examined were males. Herds of the Maya buffalo sometimes succeeded in driving off the attacking lions. In one case, after killing buffalo, five lions- a male and four females-had to take refuge in a tree from the herd tw hundred strong, and were unable to come down to their meal until the herd finally left in th evening. On another occasion Park rangers saw a herd chase a lioness with three cubs. Tw cubs and their mother escaped by climbing: the third cub was trampled and killed.

SIGNIFICANCE OF SOCIALITY IN LION

The importance of sociality in the Lion has been stressed by Sir Frank Fraser Darlin The loose structure of the pride, as he points out, is of the highest survival value to the speci that, on account of its size, has got into an evolutionary cul-de-sac.

The cubs are born small and helpless; and since the coverts where they lie are accessib to jackals and hyenas, they cannot be left alone. Danger from predators is averted by son lionesses of the pride staying with the cubs while other hunt. Litters of about equal age a nursed promiscuously by females of the pride. Unlike other cats, lions do not bring meat to th cubs, so they depend entirely on the mothers' milk until they are old enough to walk to a kil

Is it that the questionable asset of size has been met by sociality and division of labou both in hunting and in rearing offspring. From his ecological in the Mara plains of Ken Darling concluded that if lions become so reduced in an area that the females cannot combin they can not be assumed as a successful breeding species.

2.42 THE LEOPARD

Unlike the Lion, which is an inhabitant of lightly wooded country, open grassland, or even sub-desert, the Leopard's preferred habitat is where cover abounds, in gallery forest, dense bush, thickets and rocky ravines.

Leopard are unsociable, and they are generally silent. The voice, once heard, is unmistakable- the call consisting of harsh coughing grunts repeated in quick succession, somewhat resembling the sound made in sawing wood. Except during mating time the male and female leads solitary lives.

In temperament the Leopard is most unpredictable, and it has a reputation for stealth, daring, and intrinsic savagery. The animal can be surprised in long grass: his jaws parted: the upper lip inflated and draw back in a snarl which pulls the skin into wrinkles about the nose to show the long white canine teeth; and above all the eyes, fixed in a straight steady stare at his enemy, seen filled with murderous intent. (FIG 2.42)

PREY AND HUNTING BEHAVOUR

Leopards are nocturnal hunters, and have been said to hunt entirely by night. But wild animals follow no fixed rule. We are often told that a species behaves in this ways, or in that way: yet the fact is that individuals differ greatly from one another, and an individual adapts its actions to circumstances.

An incident occurred one morning in 1962, at about midday, driving to the Kabalega Falls from Masindi. A family party of warthog-two adults and four young-scampered on to the road from the long grass verge. They were in disorder and appeared bewildered. One adult hesitated, and rushed back into



Fig. 2.42) Sleeping Leopard

the grass, when suddenly from the same side a leopard sprang on to the road. Amidst a flurry of dust and squeals of alarm, the big cat seized a piglet, carried it across the road and climbed with it into a tree. The whole action was over in a few seconds.

Leopards prey on a variety of small game. In the Serengeti Thomson's Gazelle are the most important prey; in the Kruger National Park, Impala. In addition to other small antelopes, hares, cane rats, and hyrax, the Leopard takes game birds and domestic poultry. It is partial to Bush Pig. Baboons are another favorites prey, and the present-day scarcity of Leopards may in part account for the large population of baboons which are so destructive of crocodile clutches in Uganda. There are many accounts of leopard entering houses at night and taking dogs even from off a bed where its master is sleeping. An incident of this kind is described as follows. One come into a bedroom occupied by two brothers, both light sleepers and first-rate shikaris, and take a dog from a mat between their beds without either of them waking'

The hunting technique of the Leopard and of the Lion differ in many respects. The Leopard is a solitary hunter, and it is unusual to find more than one on a kill. In the fascinating study of predation in the Serengeti area, it was described how a Leopard, when moving in for a kill, takes full advantage of its covered habitat. It stalks with the bossy held touching the ground, 'proceeding with almost snake-like movements, eyes and ears fixed on the spot where the prey is'. From the stalk-ambush position the fast final dash is very short: usually the prey can be reached in one bound. The taken to a tree, and hung over horizontal limb or wedged into a fork, where it is secure from the attentions of lions, jackals and hyaenas.

THE LEOPARD'S LARDER

One day a safari group visiting Seronera had a wonderful demonstration of the use of a tree larder. They had come upon a leopard cub perched in an Acacia tortilis. Two hundred yards away, and eighteen feet up in another acacia, a full grown and freshly-killed Thomson's Gazelle was draped over a branch; the female leopard lay sprawled nearby. As they watched she climbed to the kill and began to prepare the meal. First she scraped fur from the flank and spat it out. Then, opening the abdomen, she tore out and partly ate the intestines while rejecting their contens. The stomach was similarly treated. She then jumped down to a lower branch and called twice to her cub, who trotted over, nimbly climbed into position, and began a prolonged meal-eating from the kidneys, liver, heart and lungs. This done, the cub jumped to a more comfortable seat, washed face and forepaws like a domestic cat, finally climbing to his mother's side to be licked clean. The Leopard's arboreal habits enable such domestic matters to be settled without haste and free disturbance.

Even so, the larders are sometimes raided.

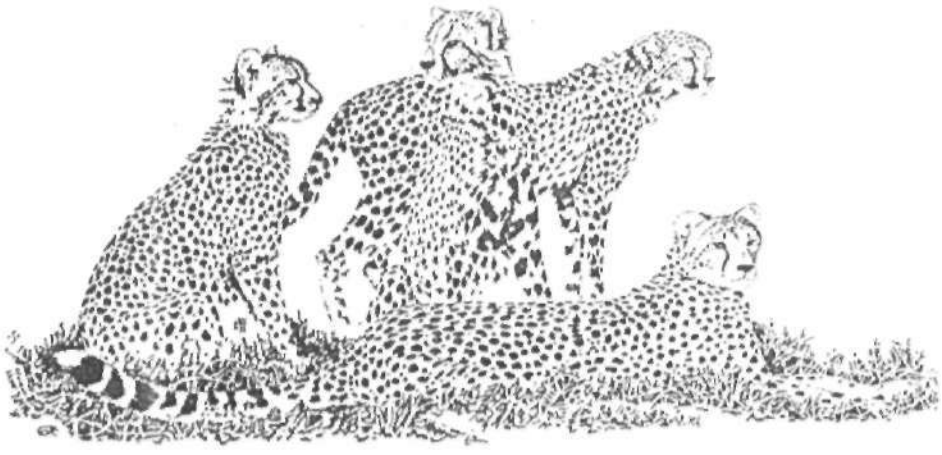
2.43 CHEETAH

The graceful Cheatah is an aristocrat of the animal world. It is also the fasted animal on earth. Long in limb and slender in build, it is entirely fashioned for a speed - a greyhound among the Felidae. Its slim body, small rounded head, and long legs distinguish it at once from the Leopard. The round black spots of the coat are single as in the Serval, not in groups office as in the Leopard. A characteristic feature is the black stripe running from the innner-corner of the eye to the angle of the mouth. A slight ruff on the neck extends past the withers, and the bushy tip of the long tail is white. Unlike the true cats, it lacks fully retractile claws(Fig 2.43).

FIG 2.43 THE CHEETAH



Cheetah looking back



Family of four

The Cheetah is less nocturnal than other members of the family, and much of the hunting is done by day, mostly in early morning and late afternoon. It preys mainly on smaller antelopes up to the size of Grant's Gazelle or Impala, and on hares, bustards, franclin and guinea fowl. In a detailed study of the Cheetah's hunting behavior in the seregeti it was discovered that 89 per cent of kills were Thomson's Gazelle-the most abundant species of appropriate size in the park. Although Cheetah and Leopard tend to feed upon the same species, they are ecologically separated - the former hunting in open plains an d the latter in thick cover.

The Cheetah's method of hunting is quite different from that of other cats. Relying on its ability to outstrip the fastest antelope over a short distance, it selects its victim and rushes down upon it with burning speed, knocking its hind feet from under it with a fore-paw and seizing the throat to kill by strangulation.

Be ingunable to defend its kill, or to climb with it, a cheetah settles down to eat its kill hurriedly, before vultures have revealed the position of the car cass to lions and their camp followers, the hyaenas and jackals.

The Cheetah is agentle, timid and inoffensive animal, docile and responsive in captivity. Vulnerable to changing conditions in Africa and sensitive to increased disturbance-and in this respect tourism not blameless-this sprinting world record-holder is fast losing ground in the race for survival. Cheetahs have been exterminated in southern and north Africa. elsewhere their range is shrinking another numbers dwindle. 'In Kenya', 'the species is balanced precariously on the brink of extinction and may already have passed the point of noreturn'.

2.44 THE SPOTTED HYAENA

Of the three African species, the Spotted Hyaena is the largest, commonest, and most widely spread, ranging as it does almost over the whole continent south of the Sahara, from sea level to the snow-line of Kilimanjaro, and from semi-desert to forest.

In appearance hyaenas are not attractive, and they are often referred to by such adjectives as 'uncouth' or 'repulsive' and branded as 'low-caste creatures'. From the massive head and ruffed neck the back droops way behind, so that the fore and hind quarters seem out of proportion; and when on the move the animal has a slinking lope. the furtive, cringing manner is also deceptive, for the hyaena is both cowardly and ferocious. where bold and numerous, as formerly in north-west Botswana, there were reports of hyanas severely mauling sleeping natives and dragging children out of the huts at night. In the 195os in Nyasaland there was an outbreak of killings, most in hot weather when people were sleeping out. Theodore Roosevelt believed that they were far more apt than leopard to prey upon human beings. Their attacks are always made at night, with extreme caution, and when the victim is sleeping. Usually they seize the face ..

The calling of hyaenas is one of the familiar sounds of the African night. The typical cry 'whoo-eee-oo' begins on a low, hoarse note rises in a slurred interval of a musical fifth, and then drops back to the first tone. this eerie call is only one of a variety of sounds and modulations of voice by which the animals communicate over long distances. The most hideous concerts and ghoulish chuckles are heard when hyaenas are stealing a kill, or mating. The scene described as: 'Shrill shrieks and yells, accompanied by deep emetic gurgling, made a background for peals of maniacal laughter'. When an over-venturesome hyaena had been wounded by a lion at a kill, 'its last cries were

accompanied by peals of laughter from the other hyaenas waiting in the background' . Such mustic is not to everone's taste: and it is not surprising that the hyaenas play a part connected that the hyaenas play a part connected with witchcraft.

When hunting by day hyaenas share with lions jackals the habit of following vultures to the place where they congregate. In quest of carrion they will also follow lions and wild dogs. In the daytime, single hyaenas will pull down unprotected wildebeest calves. Near Seronera I have seen a hyaena hunt a young Thomson's Gazelle despite intervention by several adults which continually tried to head it off. One of the gazelles jumped clean over the hyaena as it relentlessly followed ever erratic movement of the fawn. The end was inevitable - the prey was grabbed at the grow and carried away. At times they are surprisingly bold and will attack and devour a lion that is too old to defend itself properly. Occasionally they will follow a scent with nose to the ground, like a fox-hound; and in Rwenzori National Park a hyaena was seen trail a fresh-water terrapin (pelusios) which it seized and carried off. The fact is that lon their feeding habitas hyaenas are extraordinarily versatile opportunists.

Hyaenas' jaws are most powerful. On each side, above and below, there is shearing 'carnassial tooth, with a sharp V-shaped cutting edge.

These carnassisals meet like bone-forceps, and the animal is even able to crack the femur of a hippopotamus, to get at the marrow. Bones and marrow form a considerable part of the diet. the droppings are consequently rich in mineral matter, and they dry out pure white. The animals use regular latrines, made conspicuous by the accumulations of white faeces.

It has generally been thought that the hyenas' chief role was that of scavengers. But remarkable observations in Ngorongoro Crater have thrown new light on the animals' strange and hitherto unsuspected night-life.

The mammalian fauna of the caldera is more or less sealed off from the surrounding country by high (200 foot) walls. By marking - for subsequent identification - a known proportion of the hyena population, it was found that about 420 hyenas inhabited the crater floor, and that this area (about 120 square miles) was divided into eight home - ranges - each range being the hunting ground of a 'clan' of from 10 to 100 hyenas. The clans prey at night on wildebeest, zebra and Thomson's Gazelle. Of 1052 hyenas which was observed feeding at night, 82 percent were eating from an animal killed by hyenas. It is clear that they are the key predators in the area. There is thus the bizarre situation that the normal lion-hanoi relationship is reversed: the Nogorongoro lions steal the kills and have become the scavengers. There is good evidence, 'that the lion population in the Ngorongoro Crater obtains its food largely in this way!

On the boundless Serengeti plains it was found that while some animals adhered to the clan system, many hyenas were migratory and followed the wildebeest herds; while in a third category were 'commuters' that made long excursions, often lasting several days, between their permanent dens and the area where the herds happened to be grazing.

2.45 HUNTING DOGS

Wild Dogs-the wolves of Africa-are highly organized as team hunters. Monadic in habit, they roam over the plains and only stay in one area when the whelps are too young to travel. Hunting is confined to the first and last hour of daylight. Otherwise daytime is spent by the pack members lying-up close

together in cover. The packs number from six to thirty or more individuals: packs of over ninety have been recorded.

Antelopes ranging from small dikes to adult waterbuck and wildebeest are hunted. In Ngorongoro Crater and the Serengeti steppe Thomoson's Gazelle are the main quarry. In other areas Impala and Reedbuck are favourite prey. The method of hunting has been described as follow. The pack detect prey, by sight, at about 250 to 500 yards, and approach at a slow walk, only beginning to run when the herd wheel round in flight. "Often several dogs would each chase an animal, usually shifting from one gazelle to another; soon one of the dogs, frequently the dog which had been leading the initial search, would go in pursuit of one individual gazelle and stay with that one. Immediately the other dogs then followed the leader.'

The trotting speed is about 7 m.pp.h. and the sustained hunting speed 30 m.p.h. Contrary to stories that the prey-animal, once selected by the pack, is irretrievably doomed, it was found that only 44 percent of 91 observed chases were successful. When coming in reach of the quarry, they bite where they can, causing it to fall, and then disembowel and tear it apart at once. Wild Dogs kill only what they need, and nothing is wasted.

Older members of the pack will give way to young dogs that are learning to kill. One evening in 1965 near Lake Lagarya a pack was seen to come upon a newly-born wildbeast that had lost its mother. The older dogs ran past, and left it to the younger members of the pack to kill their helpless victim.

The community feeding arrangement, as revealed by field observations in the Serangeti, Ngorongoro Crater are of great interest. In marked contrast to the behaviour of lions at a kill, adult wild dogs give precedence to young animals, standing aside untill they have fed. The dogs then move in, bolt down hand-size pieces of meat without chewing, and run off to the den where they

disgorge meat to the adults of both sexes that have stayed to guard the pups. For callow young the females bite up and later disgorge partly digested meat. If a mother dies adult males will continue to feed whelps until they are old enough to move with the pack. Adult dogs will also beg and receive food from their companions. If a lame animal reaches the kill late, to find everything eaten, it is fed by regurgitation as in parental feeding.

As a result of communal treatment of the food supply, 'the whole pack can be sustained on the produce of a few successful hunters'; and division of labour is possible between dogs that catch prey, adults that defend the family, and members of the pack that bring meat to the den.

2.46 SMALLER CARNIVORA

In the short account which follows it is only possible to mention a few of the smaller species. The jackals are popularly regarded as scavengers, feeding on carcasses of animals killed by lion. But the Black-backed and the Side-striped Jackal, besides feeding on reptiles and insects, also kill for themselves small antelopes such as Dik-dik, duikers and Thomson's Gazelle. Has been described how both species employ the same efficient system of pair-hunting for gazelle fawns: one jackal concentrates on finding and catching the fawn while the gazelle is occupied chasing the other away.

When a lion pride is moving up for a hunt, Black-backed Jackals can often be seen lurking nearby, alert and taking a watchful interest in development. At the kill they keep their distance until the lions have moved away, and then take their chance with vultures and hyaenas to snatch what they can.

disgorge meat to the adults of both sexes that have stayed to guard the pups. For callow young the females bite up and later disgorge partly digested meat. If a mother dies adult males will continue to feed whelps until they are old enough to move with the pack. Adult dogs will also beg and receive food from their companions. If a lame animal reaches the kill late, to find everything eaten, it is fed by regurgitation as in parental feeding.

As a result of communal treatment of the food supply, 'the whole pack can be sustained on the produce of a few successful hunters'; and division of labour is possible between dogs that catch prey, adults that defend the family, and members of the pack that bring meat to the den.

2.46 SMALLER CARNIVORA

In the short account which follows it is only possible to mention a few of the smaller species. The jackals are popularly regarded as scavengers, feeding on carcasses of animals killed by lion. But the Black-backed and the Side-striped Jackal, besides feeding on reptiles and insects, also kill for themselves small antelopes such as Dik-dik, duikers and Thomson's Gazelle. Has been described how both species employ the same efficient system of pair-hunting for gazelle fawns: one jackal concentrates on finding and catching the fawn while the gazelle is occupied chasing the other away.

When a lion pride is moving up for a hunt, Black-backed Jackals can often be seen lurking nearby, alert and taking a watchful interest in development. At the kill they keep their distance until the lions have moved away, and then take their chance with vultures and hyaenas to snatch what they can.

It is an undoubted fact that when searching for a carcass jackals will watch the movements of vultures in the sky, and when they see them descending they hurry off towards the line of drop. It has been described how on the Athi plains of Kenya once came across a jackal actually lying on its back and turning his head in all directions as though watching something in the sky. Quite suddenly he jumped to his feet and scampered off, continually looking up into the skies, and on following his gaze vultures descending from all directions on to a carcass was seen. The vultures got there first but were soon scattered by the jackal and had to sit around while he had his meal!

The Ratel or Honey-Badger is renowned both for its commensal relationship with the Greater Honey Guide (Indicator) which feeds on bee-larvae after its partner has broken down the hive with its long claws in search of honey, and also for its fighting spirit, tenacity of purpose and utterly fearless temperament. And its colouring is aposematic, as befits and animal whose strength, impervious skin, and power of endurance make it virtually 'indestructible.'

One of these animals, was kept in captivity, and it has been mentioned the fury mood when the Ratel reached a state of intense blind ferocity. In fighting with a dog the Ratel having once taken hold tenaciously retains its grip, allowing itself to be thrown about-jerking and twisting inside its tough loose skin -until the dog collapses from exhaustion. In this way the Ratel can overpower animals much larger than itself, and it is held in respectively lion and leopard.

A ranger in Kruger National park once saw a Ratel engaged in mortal combat with a ten to eleven foot python. Stones and dust were being scattered in all directions, and the fight continued for over fifteen minutes. When the ranger finally approached, the python was found to be 'so mutilated that it looked as if it had been run over by a train'.

In hunting mammals such as hares and small antelopes, ratels are said to trot unhurriedly with a long, swinging stride, overtaking their prey not by speed, but by sheer endurance; and a Ratel may cover twenty miles in a night's forating. They are also said to assist each other by hunting in pairs; and in Uganda it was observed that, they do in fact sometimes work in parts when excavating crocodiles eggs at night.

The East African mongoose range in size from the Large Grey Mongoose, measuring 48 inches and weighing up to 8 lb, to the Dwarf Mongoose, a mere 12 inches long and as little over 1 lb in weight.

The larger species -Marsh, large Grey and White-tailed- are nocturnal, and are usually to be found singly or in pairs. In marked contrast the two small mongooses- Dwarf and Banded- are sociable, gregarious, strictly diurnal in their feeding habits, and take refuge for the night in warrens or deep chambers excavated in disused termite mounds.

One evening at Kilaguni a pack of the Dwarf Mongoose was seen returning from a foraging excursion. All seemed in a hurry to get home before darkness fell, scampered in ones and twos or groups, all coming from the same direction. This particular pack had thirty- one members. At time these very gregarious animals travel in tandem so closely together that the pack in its winding course resembles a large fast-moving snake.

There is little detailed knowledge of the behaviour and ecology of the various species. But an exception is the Banded Mongoose which has been the subject of a fascinating study in Uganda it was found that dens in termite mounds, excavated by the mongoose themselves, had a central chamber some 60 by 35 inches in area and 20 inches high in the center, with three or more entrance tunnels. The packs forage gregariously by day, investigating and tearing open elephant droppings in search of insects. Field observations

and dung-analysis showed that the basic food animals were beetles-including dung beetles-and millipedes: and Neal draws attention to the interesting fact that this small mongoose is very dependent upon buffalo and elephant whose droppings provide its invertebrate prey.

2.5 PROBOSCIDEANS

Probscideans are the largest living land mammals and are characterized by possession of a trunk which is really an elongated nose and upper lip. This is used in bathing, dust bathing and drinking, but is particularly important for the part it plays in the considerable task of keeping its owner supplied with food. A fully-grown zoo elephant eats about 100 lbs. of hay and 50 lbs. of root vegetables daily, and washes it down with about 30 gallons of water, but wild elephants feed mainly on the leaves of trees, which are not so nourishing as hays, and they must strip over a quarter of a ton of leaves from the branches of their favorite trees each day. In dealing with this vast amount of food their huge molar teeth become worn and so, instead of growing all their adult teeth at the same time, elephants' chewing teeth are brought into use one after another. As each one wears out it is gradually replaced by another, which slowly moves forward from the back of the jaw. (F1G 2.5).

The African Elephant, with its characteristic large ears, is the taller species. Large males may be over 10 feet tall. Indian Elephants are stockier, being about a foot shorter in height, but are just as heavy. Fully grown males may weigh 6 tons, while cows weigh up to 4 tons. The tusks, which are really huge incisor teeth, reach their greatest size in the males of both species. Female African Elephants may also have quite large tusks, but those of female Indian Elephants are merely small "tushes" and scarcely visible when the mouth is closed. Zoo elephants are almost always females, because these animals require

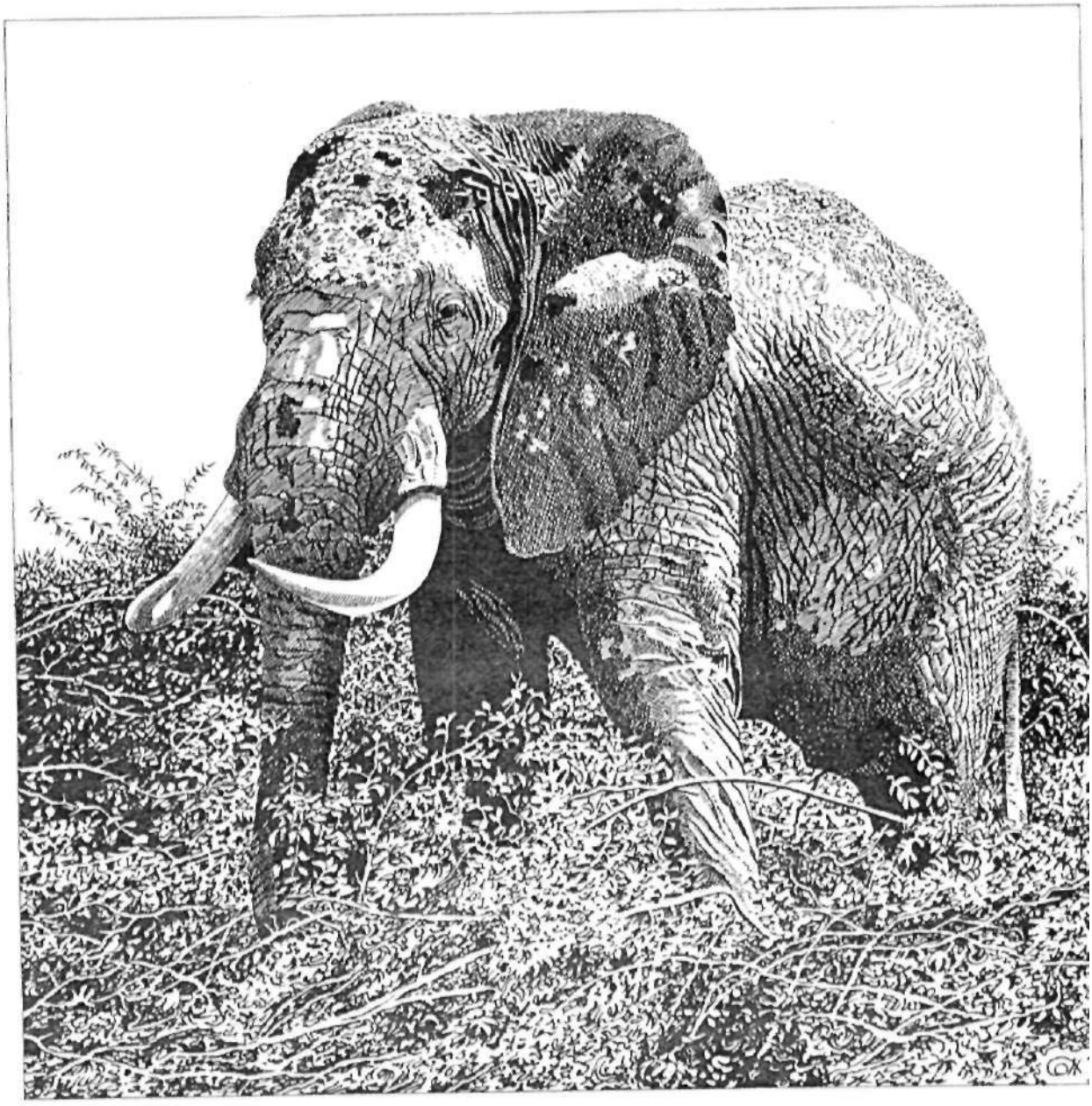


FIG 2.5 Bull Elephant, Ishasha, Uganda

Great deal of attention from their keepers when they are groomed and manicured and bulls have uncertain tempers, can, with their massive weight, be deadly.

Although, they have a gestation period of 22 months, elephants have a life- span very comparable to that of a human being. They take about as long to become mature and live for about as many years as we do.

KING OF BEASTS

The African Elephant is the true king of Beasts. Among all the varied assemblage of animals in Africa, he is the most imposing-the absolute master. His huge bulk and unchallenged strength are tempered with gentleness and sagacity. He has style, intellect, a natural dignity, a majestic presence. To walk along in the wild solitudes where elephants have their home is to feel an indefinable thrill of wonder, known only to those who have experienced it if you cherish ideas of man's superiority over the animal creation, they will avail you nothing as you stand in the midst of a herd of elephants. Your status is diminished and you meet the animals on their own terms: you become aware that you are an intruder into a world that rightly belongs to others

A fine trait in the elephant's character is the concern they show for companions in distress, for the young, and the very old. The literature contains many accounts of elephants coming to the assistance of a wounded comrade and trying to help it to move out of danger. There is a report from Zambia of elephants coming back to the dead body of a companion that had been shot: they succeeded in lifting the head and front legs and persisted in their efforts for an hour and a half.

2.60 THE PERISSODACTYLS OR ODD-TOED UNGULATES

The Perissodactyls or Odd-toed Ungulates are large, herbivorous mammals which run on the tips of their toes, the toenails having become modified to form hoofs. Although their ancestors originally had five digits on each limb, this number has gradually been reduced in the course of evolution. The middle finger or toe is always the largest of those which remain.

2.61 TAPIRS

Tapirs are the most primitive surviving members of this group. They are forest animals. With their squat outline they are well adapted for pushing through thick bushes, while the long, mobile upper lip, not unlike a miniature elephant's trunk, is useful when its owner browses.

Unexpectedly, for odd-toed ungulates, tapirs have four toes on the forelimb, only the thumb being absent. On their hind feet, however, both the big toe and the little toe have been lost.

The Brazilian Tapir is found from the north of South America to Northern Argentina. It likes to live along the banks of lakes and rivers where it can escape from its only important enemies, Man and the Jaguar, by dashing bears only one spotted young at a time, which is able to trot at her heels soon after it is born.

The Malayan Tapir has a very distinctive pattern. The head, neck, shoulders and legs are dark grey while the rest of the body is silvery white. The young, however, are brown with yellowish-white streaks and spots. Malayan Tapirs are found in the thickest forests of Southern Burma, Siam, Malaya and Sumatra. They tend to sleep during the

day, coming out to feed on water plants and succulent herbage by moonlight, when their colouring provides excellent camouflage.

2.62 RHINOS

The rhinoceroses are odd-toed ungulates which have become adapted to escape the attacks of carnivore by virtue of their weight and armoured skin rather than by running. Once they were to be found in North America, Europe, Asia, but today only five species remain and rhinos are confined to Africa and Southern Asia.

The Indian Rhinoceros is the largest of the Asian rhinos. The single horn which it bears on its nose grows from the skin and is made of the same substance as are human hair and fingernails. A rhino's horn continues to grow until the animal is quite old, but zoo rhinos often rub their horns against bars and, because of this wear, rarely have horns of great length.

The skin is very tough and is, an inch thick. In this species it is marked by many rounded tubercles like rivet-heads.

In its native territory of Assam, Bengal and Eastern Nepal, the Indian Rhino lives in Swampy areas of tall grass. It was once abundant, but now only a few hundred remain. Over the years it has been ruthlessly hunted, mainly for its horn, which is believed in the Orient to have medicinal properties.

The black Rhinoceros is the more common of the two African species, but even this is dereasig in number. perhaps ten thousand of the species still survive. In spite of its name it is not really black but greybrown. It has two horns and is the most pugnacious of all rhinos. The upper lip is pointed, and with this it browses on the bitter and Pricky



FIG 2-62 White Rhinoceros,

branches of acacia bushes. The black Rhino has been much hunted for its horns and is extinct over much of its former range. Most of those which survive are in East Africa.

The White Rhinoceros is a little lighter in colour than the black Rhino, but may owe its name to the Boer word which describes its square, wide lips. Adults may weigh about as much as an Indian Rhino, and hunters in South Africa a hundred years ago mentioned specimens well over 6 fee tall at the shoulder. The head is elongated and the leading surface of the foremost of two horns is flattened. A pronounced hump is apparent about the shoulders. white Rhinos are usually inoffensive and live in small family grassy areas.

They are found in two widely separated parts of Africa. Some live in game reserves in Natal, while the remainder live hundreds miles to the north on the west bank of the Nile in Uganda, the Sudan and the Congo. In recent Years members of this species have been introduced to a number of game reserves in areas in which they had become extinct or which were outside their former range. (FIG2.62)

2.63 HORSES

The wild horses and their relatives are odd-toed hoofed animals in which all digits save the middles finger and toe have been lost. Having long, slender legs and very light feet, these animals are admirably adapted for running. All living domestic horses are derived from the various kinds of wild horses that were once common in Europe and Asia. The only true wild horse today is the Mongolian Wild Horse. Domestic donkeys are descendant from the African Wild Ass.

The Mongolian Wild Horse or Przewalski's Wild Horse was once common on the plains of Mongolia and in the Gobi Desert. but is now so rare that it is domed to extinction. It is a small animal, but has a large head and a short, upright hog mane. In summer the coat is reddish brown with a darker dorsal stripe, the ends of the legs and tail being black. In winter the coat becomes lighter and the dorsal strips is less distinct. The shetland pony is tiny, measuring only about 3 feet 4inches at the shoulder. it can be bay, brown, all black, piebald [black and white], or skewbald brown and white]. The new Forest Pony has a big head and a shot neck and is extremely sure-footed. it has lived semi-wild in the new forest for hundreds of years. Thoroughbred blood has been introduced at various time in order to improve the strain. The Asiatic Wild Ass comes from the high plains and deserts of central Asia and is noted for its speed. It can gallop at 40 m.p.h. for a mile or so, but than slows to about 35 m. p. h. one has been chased to a standstill after 29 miles of which he averaged 30 m. p. h. several varieties are known, including the anger of Persia, and the kulan or kiang of central Asia.
The pigmy donkey is a variety of the domestic donkey kept in Ceylon. As a result of careful selection of the breeding stock by Man it is considerably smaller then most donkeys.

The common Zebra is found on the African plains from the Sudan and Abyssinia to south- west African and the Transversal. there is much variation in the markings of this species and different kinds are found in different areas. one of these varieties, Grant's zebra, is found from Somalia and southern Abyssina, through East Africa to Zambia. It is distinguished by the broad stripes on the neck and the stripes on its legs, which continue right down to the hoofs. one of the commonest animals in East Africa,

it forms large herds. chapman's Zebra is found farther to the south. On the body it has pale "shadow" do not reach down to the hoofs.

The Mountain Zebra is the smallest of all Zebra, with a characteristic gridiron pattern on the rump. The body stripes are very clearly delineated, the cars having a white horizontal stripe, and there are black and red-brown stripes on the side of the side of the muzzle. The Hartmann's sub-species is only found in the coastal mountains of South-west Africa and Angola.

2.70 The Artioctyls Or Even- toed Ungulates

The Artiodactyls or Even-toed Ungulates are adapted for the same mode of life as the odd-toed ungulates, being herbivorous animals that rely on speed in running to escape from danger, but they Most Artiodactyls have no thumbs or big toes, and the largest, the claws of these two digists forming the "cloven" hoof. The lateral toes are sometimes lost, but are usually present, although they arc always easy to see. Most members of this group chew the cud.

2.71 PIGS

The members of the pig family are the primitive living Artiodactyls and do not chew the cud. All domestic pigs are descended from the Wild Boar, which is rather short-legged as an adaptation to charging through the bushes of the forests where it lives, feeding by rooting in the ground. The Viet-Nam Pot-bellied Pig is a small, black domestic breed from Asia. It has a flattened and a body that drops so low that it almost touches the ground.

The peccaries are only distantly related to the true pigs, from which they differ in tooth and bone structure. The superficial resemblance between these two groups is almost entirely due to the fact that they have become adapted for the same mode of life. The Collared Peccary, like all peccaries, come from the New World, where it occurs from the southern parts of the United States southwards as far as Patagonia, in habitats varying from thick forest to semi-deserts. Collared Peccaries live in herds and are never entirely at ease if they find themselves alone. On the back, about 8 inches in front of the tail, is a musk gland and a faint odour of musk can often be detected at the Peccary Paddock, especially when the animals have been startled in any way.

2.72 HIPPOS

Hippopotami are also distantly related to the pigs and are adapted for an amphibious life. Their feet each have four well-developed toes, which are essential to support the weight of the larger of the animals when they walk on soft mud. The Hippopotamus can weight up to 4 tons. It is still common around the rivers and lakes of Africa from Khartoun to as far south as the Orange River and, although it is not usually dangerous, it can be ill-tempered at times. Hippos live in large herds, spending the day in, or near, the water where they feed on water plants which they pull up using their immense canine teeth. As the eyes and nostrils are situated on top of the head they can breathe and observe whilst almost totally submerged in the water. When a Hippo does submerge, special muscles close the nostrils. Hippos are the heaviest land mammals-if, indeed, they are considered to be land animal-after the elephants, and have correspondingly huge appetites. After feeding in the water during the day, at night they

go ashore to eat grass.

The Pigmy Hippopotamus is relatively small, being about as big as a pig and weighing about 400 lbs. It comes only from a small area of West Africa in Liberia and Sierra Leone. It is slightly less fond of water than its larger relative and tends to stay on land, moving quietly even through the thickest cover. Pigmy Hippos usually live singly or in pairs.

2.73 CAMELS

The original home of the camel family, which includes the humpless Liama and its relatives, was North America, but wild camels have long been extinct there. From this center the camels spread westwards into Asia and North Africa while the Llamas went southwards, so that the two branches of the family are now completely separated geographically. All members of the group are hornless and chew the cud. Although they are technically hoofed animals and have only two digits on each foot, they walk on broad pads and their claws are not very hoof-like.

The one-humped Arabian Camel or Dromedary does not now exist as a wild animal. As a domestic it is used for riding in North Africa and Asia as far east as India. When traveling in desert areas camels are able to live on a minimum of food, drawing nourishment from coarse vegetation and using some of the food which is stored as fat in the hump in times of plenty. The ability of camels to go for days without drinking is legendary, but only recently have learnt the way in which this feat is achieved. Most mammals lose moisture by sweating or panting, in the process of holding their body temperature steady.

When water is scarce camels allow their body temperature to vary so that it falls below normal in the cool of the desert night. When the sun comes up they are thus able to absorb much heat before their temperature rises above normal and even then they do not start to pant until the body temperature is several degrees above normal. When conditions are normal camels drink as often as other large herbivorous mammals do. the two-humped Bactrian Camel is a native of central Asia, where some still run in the Gobi Desert. it is not clear whether these animals are completely wild or whether they are the descendants of escaped domestic animals. Bactrian camels are used by man as load carriers. in their natural home these camels have to face an extreme climate. for in the middle of Asia the summers are shot but the winters are very cold. Their winter coats are accordingly very long and worm, while their summer coats are correspondingly shot. In spring they moult the woolly winter coat rapidly and even the best-kept camels look very untidy and neglected at this time of the year. The Guanaco is the wild ancestor of the Llama and lives in the Andes at heights of up to 18, 000 feet above sea level. its range extends from southern Peru and Bolivia to Tierra dell Fuego. it is more lightly built than the Llama and is brown, with darker marker making on the face. The wooly hair is exceedingly fine in texture, although not so fine -or so costly- as that of its smaller wild relative, the vicuna. The Llama was domesticated long before the white man reached south America. Llamas are sturdily but are much smaller than the humped camels and cannot go without food and water for very long. Nevertheless, with their small padded feet and nail-like hoofs they are extremely sure-footed on high mountain paths. They can carry loads of 100 lbs. over tracks impassable to horses, covering up to 20 miles a day Usually the males are used as pack animals being kept for breeding and

for their fleece. Like many other domestic animals Llamas exhibit wide variation in their coloring. They are kept in the mountains of Peru, Bolivia, Ecuador, Argentina and Chile.

2.74 DEER

The growth of the males' antlers is interesting. The antlers are formed of bone and are covered with furry skin, the "velvet", during growth, which usually occurs in the spring and early summer. At rutting time, in the autumn, the velvet is rubbed off. This enable a male to fight with other stags for the domination of the herd. After the rut, usually in the spring, the stag loses his antlers, but a new set starts to grow from the bony pedicles on the head almost at once. As the male grows towards maturity each year he grows a more magnificent set of antlers. The females give birth to their young, usually only one, in the summer.

The Muntjac or Barking Deer owes its name to its peculiar cry and is one of the smallest species of Asiatic deer, being a native of India, Burma and South-East Asia. It is dark chestnut-red with a paler under-belly and the male has short antlers. In this species, as in every other kind of deer except Reindeer, the females do not bear antlers. Muntjac do not run in large herds.

The Hog Deer is rather short-legged and is dark brown tinged with red or yellow, although the white tips of many of the hairs give it a speckled appearance. In summer the coat often become paler and may develop white spots. Males have short antlers with a single brow tine coming forwards and a fork at the end. These deer come from Assam, Northern India, Burma, Siam and Indo-China, and have been introduced to Ceylon.

The Spotted Deer, Axis Deer or Chital is one of the most beautiful of deer and is a native of India and Ceylon. The light red-brown coat is sprinkled with white spots. The head and throat are lighter in colour, but the muzzle is black. The antlers have one tine near the base and a fork at the tip.

The Swamp Deer or Barasingha is reddish-brown with lighter under-parts. This is a large species and can measure over 48 inches at the shoulder. It is found in the forests, plains and swamps of Assam and Northern and Central India. The antlers have four to eight points and sometimes even more.

Sika Deer have been kept for many hundreds of years in the parks so China and Japan. The Japanese once regarded them as sacred, and the Chinese used the antlers for medicinal purposes. Although there are several varieties within this species, all are medium sized with simple antlers, usually with four tines each. The Japanese Sika Deer has a chestnut coat with white spots in summer, and a rather darker coat with few or no spots at all in winter. The Formosan Sika Deer is slightly larger and has no dark winter coat and is always spotted.

Pere David's Deer have never been known in the wild, although fossilized remains exist in parts of china. When first discovered, by Pere David in 1865, the animals were living in the Imperial Hunting Park near Peking. Fortunately a few specimens were taken to Europe, where they settled and bred, since most of the Chinese animals were killed for food by starving peasants following floods. The few that remained were killed in the Boxer Rebellion in 1900. The Duke of Bedford collected all the European specimens,16 in all, from various zoos and established them at Woburn, where they now number about three hundred. The Zoological Society of London keeps

a World Register of Pere Davd'and, indeed, many specimens now exhibited at Chinese and other zoos were hand red at Whipsnade and exported from there.

Called the Mi-Lou, or "Five Unlikes", y the Chinese, they are distinguished from all other deer by the backwaedly pointing tines the antlers on the male, the length of the tail, the breadth of the feet, the size of the ears and the shape of the neck.

Their natural home is in the countries bordering the Mediterranean Sea. The coat is light brown and is spotted. The tines of the spreading antlers are broad and flattened. The Red Dear is a large reddish-brown species, the males having magnificent antlers. The number of points varies, in mature specimens there are usually five or more on each side. A stag with 12 points in all is called a "Royal". Red Deer inhabit much of Europe, Asia Minor and North Africa. Their favourite habitat, is forest,and forest deer are large and have particularly fine anlters. The Wapiti is closely related to the Red Deer and is a native of North America, where it is called the Elk. It should not be confused with the European Elk, otherwise Known as the Moose. The Waptiti is now found only in the Rocky Mountains of the United States and in parts of Canada, here it receives Government protection. In the past it was hunted for its flesh and for hides. The Rocky Mountain herds live on very high ground in spring and summer but are forced down to the lower valleys in winter, and large herds tend to collect at this time.

Wapiti are larger than Red Deer and prefer woodland to grass. The stag has huge antlers and during the rutting season in the autumn is one of the most dangerous animals at zoos. His rutting cry can be heard all over a park.

The Moose (which in Europe is known as the Elk)inhabits the northern forest of Europe, Asia and America. It is the tallest of all deer and has a very long legs and a

short neck. The coat is dark grey-brown and the antlters are flattened and spreading. Moose are solitary for much of the year but collect into small herds in the winter. They browse on leaves,twigs and bark and often wade into shallow lakes to feed on water plants. Moose are not often to be seen in zoos.

Reindeer, which inhabit the tundras of Europe, and Asia, and the Caribou of Northern America, are regarded by most authorities as belonging to the same species. The antlers are long, slender and considerably branched and, in this species alone, are borne by the females as well as the males. As adaptation to cool climates, the tip of the nose in these deer is not naked, but is covered with fine hair. The ears and tail are short to reduce heat-loose, and the hoofs are spreading in order to provide support on snow.

Wild Reindeer feed in winter on a lichen known as Reindeer "moss" and even at zoos this forms parts of their diet, being specially purchased.

The White-taild or Virginian Deer is yellow-brown with very distinctive white markings on the rump and underside of the tail. The markings are exposed when the tail is raised as an alarm signal. The antlers have a rather flattened spread with many point. White-tailed Deer live in the woods and forests of America from Manitoba to Mexico and are also found in the northern parts of South America.

Chinese Water Deer are small and brown with very short tails. They have no antlers, but an obvious characteristic of the males are their long canine teeth. Unusually for deer, the females generally bear more than one young at a time, three or four being the most common numbers. The young are spotted. These deer inhabit Korea and the marshes of the Yangtze River in China.

At zoos the Water Deer have the run of the Park, but they are timid and most difficult to approach. They can easily cross many of the fences, being able to jump 6 feet vertically. When the young are born in the summer the mother usually place them at the sides of one of the

paddocks, but it is rare to see two together, for she spaces out her calves and visits each of them in turn.

2.75 GIRAFFES

Giraffes are the tallest living mammals. Although the average height is about 14 feet, really large males may be 18 feet tall. This height is invaluable when Giraffes browse on the leave and bark of acacia trees in their native Africa. They are timid animals and run at the first sign of danger, easily covering the ground at over 30 m.p.h. at a swinging gallop.

Only one other animal, the rare forest-living Okapi, belongs to the Giraffe family, and there is only one species of Giraffe, but several distinct forms can be recognized, including.

Cotton's Giraffe, which is regularly patterned with sandy-buff markings separated by quite wide cream-coloured lines. This variety is found in Northern Uganda.

The Barring Giraffe is very like Cotton's Giraffe but has darker markings. It is common in North-West Kenya and South-East Uganda. The Reticulated Giraffe has very large red-brown blotches separated by narrow cream stripes and comes from South and East Kenya and Abyssinia. (fig 2.75).

2.76 PRONGHORN

The Pronghorn Antelope is not a true antelope but is the only species of a North American family. Uniquely, it has branched horns, the outer sheaths of which are shed each year. The reddish-brown body has distinctive black markings on the neck, muzzle and throat, whilst white patches occur on the face, throat, sides and underparts and rump. Pronghorns formerly inhabited the prairies from Canada to Mexico, living in herds and running away from danger at speeds of up to 50 m.p.h. They were once in danger of extinction, but now, under protection, this threat has passed. Pronghorns are rarely seen in zoo

2.77 CATTLE

The domestic cow and its relatiuons are heavyweight even-toed ungulates, less well able to run away from trouble than the lighter deer and antelopes, but big enough to defend themselves against most carnivores. The wild species from which Man originally bred the first cows has become extinct and in its place we have a large number of varied types which are useful to a greater or lesser degree.

Highland Cattle are a very hardy, well protected from the weather by their long hair. They still have value as beef cattle on poor pasture.

Ankole Cattle are a domestic breed kept in parts of Uganda. They are in impressive appearance, and have the largest horns of any cattle. It is for the beauty of their horns that these animals are kept by the Ankole tribes since, as a source of beef and milk, they are less valuable than most other cattle. Ankola Cattle are, however, useful for barter, particularly in exchange for wives.

Sometimes Ankole Cattle are born with a shield-shaped mark on the forehead. This is a royal mark, and all bulls marked in this way become the property of the omugabe or king of the Ankole people. The Banteng is quite closely related to domestic cattle but is a separate species found in Java, where some have been domesticated. females are light brown but bulls are darker in colour, but bothare easily distinguished by their white caudal patches. in the bull this is even more noticeable when the black tail lies on it like a dark stripe. The spread of the horns is narrow and the head is on the small side. The yak is yet another distinct species which has been domesticated in the mountains of China and Tibet it is kept as a beast of burden and for its milk, hair, which almost brushes the ground, it is a hard animal and its range covers mountainous territory as much as 20.000 feet above sea level. Wild Yak are usually dark brown all over, but domesticated specimens are often marked with white.

There are several species of buffalo-large beasts, with relatively sparse hair and flattened,

spreading horns-found in Africa and Asia. cape Buffalo live in large herds in Africa south of the Sahara, and are never found far from water. When frightened they become very aggressive and are probably the most feared of all African animals.

The American Bison was once numerous on the prairies. It is estimated readily reduced by indiscriminate slaughter during the second part of the 19th century so that by 1900 only a few thousand were left. Through preservation in reserve in Canada and the United States the numbers have now been built up to a safe level.

In their heyday in North America the Bison herds were remarkable for their spectacular annual migrations, sometimes of a thousand miles.

2.78 SHEEP

Sheep are nimble, even-toed ungulates which are adapted to live on grassy or rocky hills, usually in temperate climates. Where horns are present they are usually spiral in form. A number of wild species exist. The Mouffon is a wild species from Corsica and Sardinia, where it lives in small flocks in mountain thickets. Mouflon are small, measuring only about 27 inches at the shoulder,,and are dark reddish-brown in colour.

Males have light patches on their backs and long, curving horns, but most females are hornless.

Also kept in parks is a Spanish four-horned sheep, which have a distinctive black and white fleece and, as the name suggests, four horns.

2.79 MUSK-OX

The Musk-ox superficially resembles the cattle and sheep, but is not very closely related to them. It lives in herds on the tundras of the Arctic, being protected from the

climate by a dense, shaggy, darkcoloured coat. Fully-grown males measure 5 feet at the shoulder, but females are smaller. Both sexes have flattened, spreading horns, but only the bulls have a facial musk gland. When frightened, Musk-oxen huddle tightly together, with the young ones in the center of the group and the horns of the adults pointing outwards. They have been much reduced in numbers in recent years, and are rarely to be seen in zoos.

2.710 ANTELOPES

Antelopes are primarily African animals, but some are found in Asia. They are even-toed ungulates which rely on fleetness of foot for safety. In some species both sexes bear permanent horns, but in others only the males are horned. Like the cattle and sheep, antelopes chew the cud. The White-bearded Gnu or Wildebeest is greyish in colour with darker stripes down the sides of its neck and body. It comes from the plains of East Africa and forms an important part of the diet of the Lion. Gnus are unlikes any other antelopes, having an ungainly head with curved horns and a graceful body.Their movements can be very amusing to watch, as the males are fond of prancing and showing off.The White-bearded Gnu breeds regularly in zoos.

The Gazelles are small and exceedingly swift-running antelopes. Thomson's Gazelles inhabit the dry plains of Central Tanzania,

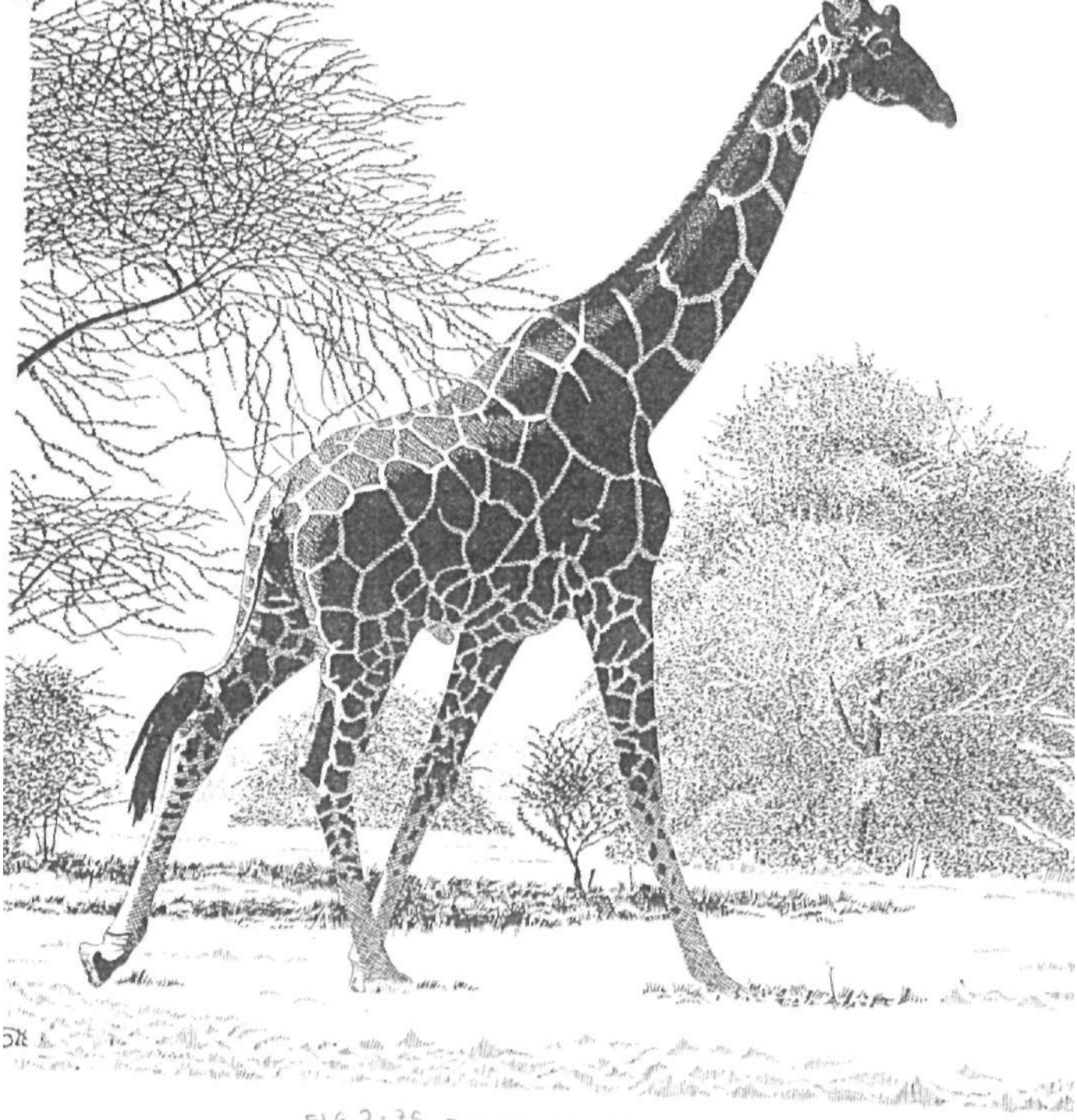
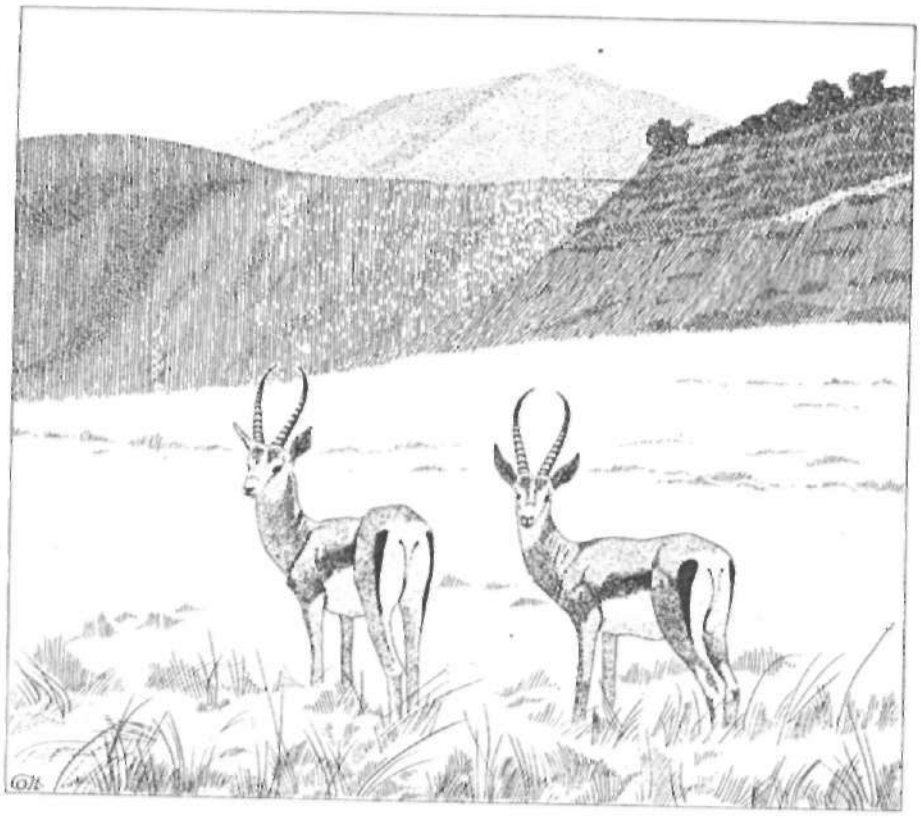


FIG 2-75 Reticulated Giraffe pacing



Grant's Gazelle



Thomson's Gazelle and fawn

FIG 2·710

2.80 BIRDS

Any of a class (Aves) of warm-blooded vertebrae animals with feather-covered bodies. Next to the mammals, birds are the most important group of land-living vertebrates. All birds have feathers, although in some types, particularly those that cannot fly, the normal structure of the feathers may be much modified and be downy, woolly, or strawlike. The forelimbs of birds are modified into wings. The bony part of the tail, except in the very earliest fossil birds is very short, and the visible tail is composed of feathers only. Teeth are absent except in some fossil forms. As in mammals - the only other group of warm-blooded, but the arrangement of veins and arterial and venous blood, but the arrangement of veins and arteries by which this is accomplished is different in the two groups. Birds have keen hearing, although they have no external ears. The sense of sight also is very keen, but the sense of smell is weak or lacking, except in a few vultures and other birds.

2.81 EVOLUTION

Birds evolved from reptiles and still share so many anatomical characters with them that the biologist Thomas Huxley referred to birds as "glorified reptiles". Some of the carnivorous dinosaurs had a skeleton similar to that of birds in many ways. These dinosaurs ran on the hind legs, and the forelimbs were very small. Birds evolved from some small dinosaur or dinosaur-relative of this general type. The reptilian scales over time became modified into feathers, first perhaps for insulation of a creature that was gradually becoming warm-blooded, but later for use in flight.

Undoubtedly, gliding or parachuting preceded the development of true flight. But

it is not known whether the achievement of flight occurred in a ground-living form that flapped its wings to increase its speed of running, as does the rhea today, or whether it occurred in a tree-climbing form that used imperfectly developed wings to aid it in leaping from limb to limb.

But the evolutionary processes are not of much importance to an Architect of a zoo.

2.82 CLASSIFICATION OF BIRDS

The earliest classifications of birds relied upon easily recognised external characters or upon peculiarities of behaviour or appearance. all webfooted birds were planned in one group, all seed-eating birds in another, and so on. Following Darwin's publication of his theory of evolution in the middle of the 19th century, classification was placed on a sounder, more scientific basis. Since that time scientists have sought to arrange birds (and other living things) in a way that will best express their blood relationships and lines of descent.

Classification of birds based on behaviour and appearance is rather more important to an Architect that is designing their enclosures. This is because such behaviours as the feeding habits, breeding, nesting requirements etc are more relevant to an architect. However, for general understanding, more conventional scientific classification is going to be considered below.

Birds make up the class "AVES in the subphylum Vertebrata of the phylum Choidata. The class is divided into the following super orders, of which the first two contain only extinct orders of birds.

PALEOGNATHAE: This group contains only the reptile like bird of the Jurassic period. Archae-opteryx. It is the earliest avian fossil.

ODONTOGNATHAE: Five group contains Hesperornis and the other tooted birds of the Cretaceous period. Five fossil species have been found in Kansas and Montana. The group probably is an evolutionary offshoot, since no living birds seem to be descendants of the group.

NEOGNATHAE: This group includes all living birds as well as the extinct forms from the more recent geological periods. The Neognathae are divided into two main groups - the Ratitae which contains only a few large flightless forms and several extinct forms, and the Carinatae, or flying birds.

Ratitae: Extinct forms of Ratitae are the moats of New Zealand and the elephant birds of Madagascar. They were the largest of all known birds. Both became extinct before Europeans discovered their habitats. Living forms are the rhea of South America, the ostrich of Africa, the kiwi of New Zealand, and the emu and cassowary of the Australian region. These birds no longer have a bony keel on the breastbone for the attachment of flight feathers, and the wings themselves are small and degenerate.

Carinatae: Carinate birds have a breastbone keel. A few have become flightless, and in these the keel may be somewhat reduced, but it is never completely absent as in the ratitae. Carinate birds are divided into a number of main orders. The following are the most important:

Tinamous (Tinamiformes): Quail-like birds of tropical America; probably related to the South American rheas.

Fowl-like birds (Galliformes): A large and important world-wide group that includes the

domestic chickens and turkeys, pheasants, quail, grouse, and guinea bens?.

Penguins (Sphenisciformes): The most highly specialized of living birds adapted for life in the water. The wings are modified into sea-like flippers.

Albatrosses and petrels (Procellaruformes): Sea-birds that come to land only during the nesting season.

Loons and grebes (Gaviiformes, Podicipidi-formes): Freshwater birds that are expert divers, hence the name "hell-diver" used for the grebes.

Pelicans and related species (Pelecaniformes): Aquatic birds that usually live on fish. Besides the o-war birds belong to this group.

Day-flying bird of prey (Falconiformes): A worldwide group that includes the falcons, hawks, eagles, kites, and buzzards and also the vultures of the New and Old World, and the African secretary-bird.

Herons, ibises, storks, flamingos (Coconiformes): Long-legged wading birds that feed on fish and other aquatic life. Some of the storks feed on carrion.

Waterfowl (Anseriformes): The ducks, geese, and swans, which form an important group because of the value of the domestic species and the large numbers shot for sport and food.

Cranes and relatives (Gruiformes): A diverse group, most members of which inhabit swamps and marshes. The cranes, rails, coots, seriamas, and bustards belong here.

Shorebirds, gulls, terns, auks (Charadriiformes): Another diverse group, most of whose members live in or near the water.

Pigeons, sand-grouse, dods (Charadriiformes): An important group of game birds,

which includes the domestic pigeon.

Parrot (Psittaciformes): A well-known, colorful group, chiefly tropical, numbering more than 800 species.

Owls, goatsuckers, swifts. (Caprimulgiformes, Apodiformers). The owls are the nocturnal equivalents of the hawks, the goatsuckers, also nocturnal, feed on insects, the swifts, which pursue flying insects in the air, may be related to the goat-suckers.

Hummingbirds (Trochiliformes). A remarkable group of small, brilliantly colored birds found only in the New World and chiefly in the tropics.

Rollers and allies (Coracuformes). A diverse group of often brightly colored birds, chiefly tropical, which includes the rollers, kingfishers, hornbills and bee-eaters. The brilliant trogons and the curious little mousebirds of Africa may be related to this order.

Woodpeckers and allies (Piciformes). In addition to the familiar woodpeckers, this group includes the brilliant, huge-billed toucans of South America, the barbers, and the honey guides of Africa.

Perching birds (Passenformes). This is the most advanced and successful group of living birds. About 5,000 of the approximately 8,600 species of living birds belong to it. There are two main groups of perching birds: the nonsongbirds (Clamatores) and the true songbirds (Oscines). The latter have certain specializations of the muscles controlling the vocal cord that are not present in other birds. The more primitive group, the nonsongbirds of Clamatores, is found in South America and includes the tyrant fly-catchers, the cotingas, mankins, woodherwers, antbirds, and ovenbirds. In the Old World the pittas and the broadhills belong to this group. The true songbirds, or Oscines, are most richly represented in the tropics of the Old World, but there are numerous species

in the New World as well. Most songbirds are rather small; the raven is the giant of the group. Typical families are the larks, swallows, thrushes, fly-catchers, wrens, orioles, titmice, crows, finches, and many others.

2.83 DISTRIBUTION

Birds are found over the entire surface of the globe. They are, of course, limited to the land during the nesting season but some of the marine albatrosses, petrels and penguins usually come to shore only during the nesting season, spending the rest of the year wandering over the remote expanses of the ocean. Almost all the land areas of the globe are occupied by birds; only the Antarctic continent is almost too barren to attract them, although the snowy petrel has been found nesting many miles inland on the mountains of Antarctica. In the north a few species of sea-birds, such as the rosy gull, winter to some extent in the Arctic Ocean, searching for the occasional open "leads" of water in the expanse of snow and ice. The great deserts of the world also present something as a challenge to bird life, but some species are especially adapted for life there and can exist in the most inhospitable and driest regions. In general, bird life is most abundant in those parts of the globe that have a warm, moist climate, since it is there that food and cover are most abundant. Many birds that nest in the north migrate to the tropics to spend the winter. In summer, temperate and northern regions may support as rich a population of birds as the tropics. Even in the Arctic there is a great abundance of mosquitoes and other insects during the brief summer, and innumerable shorebirds and waterfowl find ideal feeding and nesting conditions there. Marine life is often more abundant in cool than in warm waters. It is for this reason that one finds

immense colonies of sea-birds on the islands near Alaska and off the coast of Peru.

As already suggested, the distribution of birds is governed in large measure by the degree to which a given species or family of birds if adopted to a particular environment. One does not expect to find penguins in a desert or praine chickens in a forest. Many species are almost limited to a given type of vegetation; others are restricted by their need for a particular type of nesting area. The peregrine falcon, for example is cosmopolitan but nests, as a rule, only where suitable cliffs exist near large bodies of water.

The so called "life zone: concept is an attempt to classify the environmental factors controlling the distribution of birds. As applied to North America, several zones were recognized, including the Hudsonian, Canadian, and Sonoran, each defined by the average summer temperature and each characterized by a different group of birds, plants, and mammals. More recently the tendency has been to minimize the importance of temperature as a direct controlling factor in bird distribution. The type and nature of the vegetation seem more important. Vegetation is strongly affected by temperature, but it is also affected by soil and rainfall. It is more satisfactory to study the distribution of each species of bird in terms of the habitat it prefers. Some species, such as the Americans robin, are found in a great variety of surroundings, while others are more exacting in the selection of areas that suit their requirements.

The pine warbler of eastern North America is absent from numerous apparently suitable areas of pine forest in the Old World. In such cases the explanation lies in historical factors; a species of bird is often kept by oceans or mountains or unsuitable habitat from reaching regions that would be suitable for it. There are very few native

songbirds in the Hawaiian Islands because it is almost impossible for small birds to cross the thousands of miles of ocean separating those islands from the nearest continent. Yet numerous other species, when introduced by man, have found the Hawaiian Islands a congenial home. The same is true, in the United States, of the house sparrow, the starling, and the ring-necked pheasant, all of which were introduced from the Old Wold.

2.84 **FLIGHT**

As already noted, birds alone, of all living beings, posses feathers. In most birds feathers do not grow uniformly over the body but are arranged in definite regions or "tracts" whose variations are of some value in classification. Not only the feathers but the entire anatomy of birds show an adaptation for flight. The bones of the pelvic or hip region are fused into a single mass, the synsacrum, which includes the sacral vertebrae. The bones corresponding to those of our ankle have become a part of the long bones above and below them. The bones of the foot (carpals) also are fused together. These modifications permit the legs to give a strong upward thrust as the bird takes off in flight and help it withstand the shock of flighting. The bones of the skull are also fused and grown together so that the sutures between them are no longer visible. This fusion strengthens the skull; injury is less likely if the head strikes against twigs or other obstacles in flight. The eyes are large, and in hawks, which sometimes fly very recklessly as they pursue their victims, they are protected by a bony shield.

The long bones of the bird's body are hollow; the hollowed column gives one of the lightest and strongest types of support. These bones are connected with system of air tubes that connect with the lungs and serve as part of the respiratory system. There

are additional air sacs in the body cavity and sometimes just beneath the skin. Birds lack sweat glands and it is probable that this system of air sacs helps to cool the body during the exertion of flight and also ensures a constant supply of fresh air for the lungs.

Anyone who has watched a swift or swallow fly tirelessly hour after hour in hot weather will realize that the avaian body is highly efficient. The normal body temperature of most birds is about 105°F (41°C) - in some it is even higher - fitting hem for a life of intense activity.

The mechanics and speed of glight vary greatly according to the habits and size of the bird. Soaring flight, of the type seen in hawks, vultures, and storks, is almost restricted to large birds with ample wings. Small birds are buffeted too much by air currents to be successful at this type of flight. The whirring wings of humming-birds are visible only as a blur. Birds with short, rounded wings usually cannot fly far, but if the flight muscles are powerful as in grouse or quail, such species are capable of very rapid bursts of speed. Birds of rapid, smooth flight, such as plovers and falcons, have pointed wings of medium length. The golden plover makes nonstop flights of 2,000 miles (3,200 km) over the ocean. Wild ducks and geese also fly strongly for great distances, but their weight is rather great in comparison with their wingspread so that they cannot readily maneuver in the air or dodge obstacles. The most efficient flyers are cultures which stay aloft for hours with scarcely a flap of the wings by using the ascending air currents.

Now that actual measurements are available, speed of flight has proved to be less than was once claimed. Most small birds travel at rates of only 15 to 30 miles (25 to 50 km) per hour, and even ducks and geese seldom exceed 40 to 60 miles (65 to

95 km) per hour. The peregrine falcon, one of the fastest of all birds, has been clocked a speeds of about 100 miles (160 km) per hour, and there are few other species, notably some of the larger members of the swift family, that also are capable of such speeds. These figures are for straightway flight, unassisted by a following wind. When diving, many birds can attain greater speeds. The golden eagle sometimes plummets earthward from great heights with such velocity that the sound of the air whinning through its wind quills is audible for considerable distances.

The upper limit of weight at which flight is possible seems to be about 35 pounds (15 kg). among the heaviest of flying birds are swans, furkeys, and some of the bustards. These species are exceeded in wingspread by vultures and condors and by the Larger albatrosses, whose 11-foot (3-meter) wingspread is the greatest of any bird.

Flight altitudes for birds generally are below 3,000 ft, but some birds occasionally attain much higher altitudes. One of the highest - flying birds, the bearded vulture, reaches 25,000 ft. The Mallard has been encountered at 21,000 ft, and the evening gross beak at 12,500 ft. European swifts have been seen at altitude of 7,000 ft and whistling swans at 4,000 ft (Fig. 2.84).

Providing the natural flight altitude for birds in zoos, in an attempt to provide a more natural condition for the captive birds, is not feasible. In most cases the altitude of about 30 ft (10 m) is used in birds aviaries. But a more natural approach is to create a rich environment that will attract the birds to the desired area.

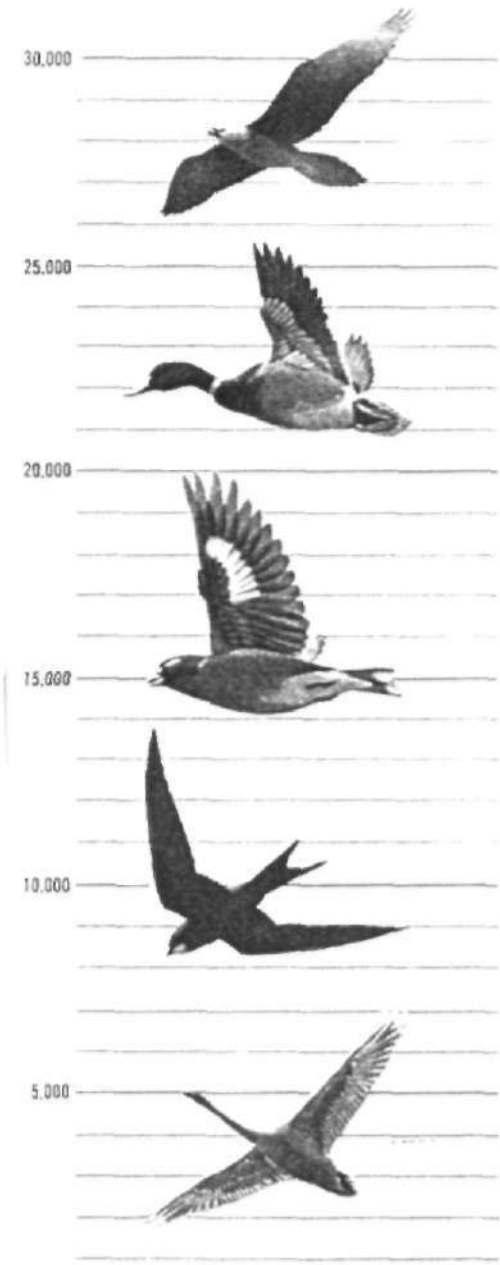


FIG 2.84 FLIGHT ALTITUDE OF BIRDS IN FEET.

2.85 LONGEVITY

Birds live longer in captivity than in the wild. Canaries may live for (12 or 13 years, but small wild birds, as were know from thousands of banding records, seldom reach an age of five or six years. Large birds with few exceptions, have longer lives than small ones. Eagles swans, crows, and many other large birds have a potential life span of at least 25 or 30 years. A great honed owl in a zoo lived to be 68 years old, and there are reports of parrots reaching the century mark, although few, if any of these reports are fully authenticated. The average life of birds is much lower than would be expected from the above figures. There is a tremendous mortality particularly in the period before and shortly after the young leave the nest.

2.86 FOOD AND FEEDING HABITS Birds utilize almost every potential source of food-insects, worms, and snails. The bill and the feet of birds are variously adopted to aid int he many ways of seruring food. Macaws and other large parrots crack nuts and seeds in their powerful bills and then hold them in one foot while extracting the meat with the aid of the tongue. In other species, such as the chicken, hard kernels of grain are swallowed and ground up in the muscular gizzard, by the action of small stones or grit, which the bird swallows. Hawks and owls catch their prey with the aid of their sharp curved claws and then hold it with their feet while rending it with the hooked bill. Loons and cormorants propel themselves swiftly beneath the water in pursuit of fish. Swallows, flycatchers, whippoorwills, and swifts catch insects in the air. The bill of these birds is rounded with stiff bristles, which help to enmesh insects. Woodpeckers dig deep into rotten or soft wood in search of the grubs of wood-boring insects, which

they extract with their long, barned tongue. While feeding, they clung to tree trunks with their sharp, curved claws and brace themselves with their tail feathers, which are stiff and pointed. Spoonbills sift through fine mud and silt with the aid of strainerlike projections on the edge of their flat, broad bill. Sunbirds and hummingbirds probe with their needlelike bills in flowers and suck up nectar with their tubular tongues or entrapsmall insects and spiders with the aid of a brushlike tip on the tongue. These are but a few of the principal feeding adaptations of birds.

Because of their great activity birds consume far more food than might be supposed. This is particularly true of young birds, which grow very rapidly and require large amounts of food. A young owl, for example, has been known to bolt down half a dozen mice at one time, even though the tail of the last victim dangled for a time from the bird's mouth until the rapid process of digestion made room for it.

Many birds, because of their feeding habits, serve man by destroying harmful insects and weed seeds. Flocks of birds often gather in areas where there has been an invasion of insects or rodents, and, by consuming great numbers of the invaders, help bring such plagues under control.

Relatively few birds are injurious to man. Blackbirds and crows sometimes rob grainfield; robins and starlings pilfer cherries and other small fruits; some hawks catch poultry and game birds, but most of them also destroy greater numbers of harmful rats and mice. Such losses to man usually can be prevented without destroying the birds.

2.87 CAMOUFLAGE, DISPLAY, AND COURTSHIP

The colours and plumage of birds are extremely varied, and these variations have a relation to behaviour, function in courtship, but if a bird is too conspicuous it may both be able to avoid its enemies. In many birds the colours blend with the surroundings and thus camouflage the birds from their enemies. Larks and other grassland birds have streaked plumage and almost invisible as they crouch motionless in the grass or sit on their nests. Perhaps the most remarkable example of camouflage is found in the ptarmigans. These Arctic grouse molt into a pure white plumage in the wingere and area then almost invisible against the prevailing snowy landscape. In the summer they acquire a patchwork plumage of black, white, and brown, making them inconspicuous at that season.

In many bird species the males are brilliantly coloured, while the females and young are protectively coloured. This is the case in such North American species as the scarlet tanager and the indigo bunting. So great is the difference between males and females that it is difficult to realize that hey belong to the same species. In the two species mentioned and in many others, even the adult male molts into a dull plumage after the breeding season. He does not acquire his bright plumes again until the following spring.

In those species in which only the male is brightly coloured, he as a rule, does not participate in the duties of incubations or of rearing the young and hence does not jeopardises their safety by attracting enemies to the vicinity of the nest. It must also be remembered that some of the enemies of birds, including most mammals, are, unlike birds, color-blind. Among the most brilliantly coloured birds-pheasants, hummingbirds,

birds of paradise-and others-one finds many polygamous or promiscuous species. In these, even though more males than females fall victim to predators, the number of males left is sufficient for reproduction.

Birds that possess ornamental plumes display them during courtship. Such displays serve to attract the females and also in some instances, to drive away other males. The elaborate display of the peacock, in which the stiff wing feathers are audibly rustled to attract attention to the displaying birds, is known to everyone. Cock grouse of several species gather on communal display grounds to start and perform. They have large, brightly colored sacs on the sides of the head that are inflated with air and then quickly deflated so as to produce a booming noise audible for long distances. The hens come to these display grounds, and their presence leads to much jockeying and fighting among the males. But each male is restricted to a small territory, which he does not leave where he does not permit other males to set foot.

The angus pheasant of Broneio carefully clears an area in the jungle so that he can display his long wing plumes without obstruction. Some birds of paradise also make such cleared dancing areas, and the bowerbirds build bowers of twigs in and around which they display themselves and briht objects they bring to the bower. The satin bowerbird of Australia, a blue species with birth blue eyes, decorates its bower with the petals of blue flowers or with any other blue objects it can find. In many species courtship is performed in the air. Male hummingbirds dash through the air to display their iridescent plumage. March hawks perform acrobatics in the air. In species in which the sexes are alike in color, courtship displays often are mutual. for example, albatrosses bow and dance grotesquely as they stand bill to bill.

Displaying birds often call attention to themselves by songs or call notes. Woodpeckers drum with the bill on a dry, resonant branch; snipe produce a whistling sound with their stiff outer tail feathers by diving through the air. In many dull-coloured species courtship consists chiefly of the singing of the male. The song serves both to attract a mate and to warn off other males.

2.88 REPRODUCTION

The season of reproduction for birds is usually the spring, when food for the young is abundant. Even in the tropics most species nest only once a year, but in equatorial forests this may be at any time of the year. Northern birds that migrate to the tropics to winter do not nest here.

Nest Birds lay fewer eggs than do oviparous reptiles, but unlike reptiles they incubate them and care for the youngs after hatching. This increased parental care in birds usually requires a nest to hold the eggs during incubation and the young after hatching. Some reptiles show the first crude beginnings of nest building. Crocodiles and alligators scrape a mass of wet vegetation over their eggs and are said to guard this "nest" until the eggs hatch, although they do not incubate or care for the young. From such crude beginnings have grown the often elaborate nests of birds.

Although most birds build nests, those that lay their eggs on the ground often do not. Many shore birds and terns merely scrape a slight hollow in the sand or grass in which to lay the eggs. The young of such species are usually "nidifugous" or precocial-that is, they ar covered with down and follow their mother as soon as they hatch just like chicks or ducklings. In other birds the young remain where hatched for some time, and

a substantial nest is usually necessary. The young of such birds are often ugly and naked when hatched for many weeks.

Birds that nest in holes in trees or in the earth often build no nest. Most parrots and owls are examples. Many birds dig a hole in the ground or in a tree in which to lay their eggs. They may or may not make a lining or nest cup in this burrow. Examples are the woodpeckers and many ground-nesting birds-kingfishers, burrowing owls, and others.

The wood duck and other tree-nesting water fowl line the nesting cavity with feathers, as do their more numerous relatives that nest ont he ground in marshes. In the latter situation the down serves to keep the eggs warm and dry Elder ducks nest on the bleak, rocky coasts of Norway and Labrador. The mother bird plucks so much down from her own covering to protect her eggs from the inclement weather that the down can be gathered by man and used for blankets or pillows. When the duck leaves her nest, she pulls the down over the eggs to keep them warm and to hide them from enemies.

The earliest known fossil bird, Archacopterys, was evidently a tree dweller and probably built a nest. All birds that do not now build nests presumably had nest-building ancestors. The most striking "throwback" to a reptilian mode of egg laying is found in the brush turkeys of megapodes of Australia and the South Pacific islands. They bury their eggs in mounds of sand or decaying vegetation which the birds scrape together with their powerful legs and feet. The eggs are not incubated and the young care for themselves as soon as they hatch.

It is already evident that the nest-building habits of birds are easily modified according to conditions and habitats. For this reasons nests are not of much help in

classifying birds. Most of the American orioles, for example, build elaborate hanging nests, but the cowbirds a closely related member of the same family, builds no nest at all, instead it lays its eggs in the nests of other birds and leave to them to hatch and rear the young cowbirds. In other cases the nests of related birds do show a certain uniformity. All swifts have a glucide saliva that hardens on contact with the air. It is used to glue together the nest materials and to attach the nest itself to a supporting surface. The chimney swift of the United States breaks off dead twigs from trees with its feet and then carries them to the inside of a chimney where they are glued together into a frail platform nest. The edible nest swiftlet of south eastern Asia builds a nest entirely of hardened saliva. This gelateous object is melted down by the Chinese and forms the basis of "bird's-nests soup".

2.89 MIGRATION

Most birds in the Northern Hemisphere migrate from their nesting regions in fall to a warmer territory and feeding ground the winter months. In the spring they migrate back to their nesting areas. Smaller numbers southern Hemisphere birds migrate northwards.

Migration may be merely an altitudinal moment, in which the birds descend to a lower attitude ofr the winter. Birds that migrate in the include some grouse, nuthatches, and chich such as that of bluejay. However, other species travel over long distances to the south or across the Atlantic Ocean or parts of the Pacific. These birds include storks, birds of prey, ducks, geese, swallows, and some songbirds.

Although the exact mechanism of the spring and fall migration impulses is not

known, it is believed to involve hormonal factors associated with the sex organs, or gonads. In the spring the gonads grow, and they produce hormones; in the fall they shrink, while their activity falls off. Photo-periodic variations (the seasonal changes in the lengths of night and day) are believed to be an important factor in stimulating the gonadal responses. However, other factors, such as the state of vegetation and the abundance of food, and in some cases the amount of rain, probably contribute to the migratory impulse. Some birds do not migrate unless there is an immediate stimulus, such as the lack of food, or a sudden change in the weather, while otheres have a strong migratory impulse and depart on a regular schedule.

In migration, the over-all direction of flight is determined by the geographical position of the breeding and winter areas. Among North American birds this direction in autumn is generally south and southeast or south west; among European birds, it is south and southwest. Some birds determine this direction by the postion of the sun in the daytime and the stars at night, but there still is much to learn about the subjects of navigation and homing.

Some species of birds migrate dureing the day, otheres during the night. Pelicans swallows, storks birds of prey, and most seed-eating birds migrate during the day. water birds, American orioles, tangers, and insect-eating species of the pesserinces migrate during the night. These species sometimed fly from dusk to dawn, avoiding the danger of landing in unknown territory in the dark. Energy for flying is supplied in part by the unusual amounts of fat, which accumulate in the bodies and these birds before migration.

Although some birds (such as cuckoos, hummingbirds, shrikes, and birds of prey) migrat alone, other s (such as wild ducks and geese) migrate in pairs, families, or flocks.

Most, however, migrate in flocks, which may include many thousands of birds.

The flock may be a disorderly grouping of its members, or it may be arranged in a specific sahpe. Rooks fly in an elongated cresecent, while Canada geese fly in the well-known sedge-shaped flock. Migratory altitutdes range from 200 feet (60 meteres) to as much as 29,500 feet (9,000 meters) in the case of geese that migrate over the Himalaya. The height is determined generally by the nature of the terrain and by the weather. However, height above the ground seldom exceeds 3,000 to 4,000 feet (900 to 1200 meters).

Migratory flying speeds also vary. The chipping sparrow flies at a ground speed of 15 mph (25 km), while ducks and geese fly at speeds of 40 to 60 mph (65 to 95 km). Single flights in night migrants are often several hundred miles long. The birds usually accomplish the long journey in a series of stage; they often rest and feed for a few days at some favourite stopping place.

2.90 REPTILES

The popular name for members of **REPTILIA,** comprise an important class of vertebrates that have, on the one hand, developed from the amphibians and , on the other, given rise to birds and mammals. In Linnaean classification Amphibian included what we now call reptiles. Even in the middle of the 18th century the term Reptilia (late Latin reptiles; v. repo; pp. repium) signifying creeping things, was applied undiscriminatingly to amphibians (frogs and toads, slanders, caccilians, etc) before their status as a distinct class was recognized. Indeed, if one takes into consideration the transitional fossil representative of the two groups, it is almost impossible to formulate

one exclusive clear-cut definition, based on structural characters, by which the whole classes may be separated. This, however, may be achieved by restricting the definition to characters displayed by living reptiles.

Existing reptiles are cold-blooded vertebrates whose developing embryo, surrounded by a protective fluid, is enveloped in a membranous sac (the amnion), and nourished by a supply of yolk contained in smaller sac connected with its digestive system. From the lower end of that system the waste products of the embryo's metabolism are deposited in a third sac (the allantois). neither amnion nor allantois are present int he amphibian egg which, if laid at all, is usually spawned in water, whereas the reptilian ovum, if laid, must be deposited on land where it is protected by a porous, parchment like (in some turtles, some lizards, and all snakes) or brittle (some turtles, most geckos, and all crocodilians) shell whose highly vascular lining membrane, connected with the amnion, absorbs oxygen and discharges carbon dioxide. Those species of lizards and snakes that give birth to live young dispense with an eggshell. Thus the young of reptiles do not pass through an aquatic gill-breathing state, instead, whether hatched from an egg or born, they make their appearance a s lung breathing replicas of the parent.

Contemporary reptiles also from the classes of higher vertibratres (bird, mammals) in being cold-blooded, their temperature being but slightly higher than of their surroundings. The reptilian heart consisted of a right and left auricle and a vein except in crocodilians, for these have an additional ventricle.

2.91 CLASSIFICATION

Living reptiles, however, represent, small fraction of the great class that dominate the habitable globe in the Mesozoic, an era approximately over a hundred million years. During this period reptiles successfully filled most of the niches in sky, sea and on land that were later to be occupied by their descendants - the birds and mammals - as cohorts of diverse and frequently bizarre-looking reptiles were vanishing from the earth. The survivors of today-the turtles and tortoise (Testudinata), the tuatara (Rynnchocephalia) the lizards and snakes (Squamata), - represent but four of the sixteen orders now generally recognised.

The scaly reptiles (Squamata) include the lizards (Sauria) and snakes (Serpents) of today, their respective ancestors being first known from the Jurassic and Cretaceous Lizards differ from the tuatara in having only a single temporal aperture. Otherwise the structural similarities between sphenondon and certain lizards are so striking that the former was at one time classed with the Sauria. It is not unreasonable to assume that both Rhyachocephalia and Sauria sprang from he Eosuchia, though alterative views are also held. Of extinct lizards the best known are probably the dolicholsaurs and mastoscirrhus of the Cretaceous, the former a semiaquatic group related to the monitor lizards (Faranus) of today, and the mosaurs, one of which attained a length of twenty-five feet, marine reptiles with paddle-shaped limbs.

Living lizards are grouped in a score of families of which several have had their members take to a subterranean life with consequent loss of limbs, sometimes of sight also. Others, like the geckos (Gekkonidae) and skins (Scincidae), by successfully adapting themselves to a great variety of conditions, now enjoy the widest distribution

of any reptilian families with representatives in every continent. In contrast to this we find the Iguanidae, whose teeth are fused to the inner side of a parapet along the jaw (pleurodont dentition), are today restricted to Madagaster and the Americas with a single isolated genus int he Gijis, while their counterparts the Agamidae, characterised by acrodont dentition, that is with teeth achylosed to the summit of the jaws, confined to the Old World. The nearest approach has been achieve by members of the Og Oriental agamids which plane from tree to tree on winglike expansions of skin supported by the greatly elongated ribs.

Because of their close osteological affinities with Agama, the chameleons (Cahmaeleonidae) of Africa, western Asia, the Seychelles and Madagascar, are now included in the Sauria, though for long relegated to ta separate sub-order (Rhiptoglossa) on account of their peculiar extensive tongue. The only family of lizards (Helodermatidae) whose members have developed poison glands, is restricted tot he United States and Mexico.

Present day snakes are characterised by an absence of external limbs and eyelids (neither of which distinguishes them from all lizards) coupled with lower jaws whose rami are not fused but united anteriorly by a more or less elastic ligament, and by vertebrae so numerous that there may be several hundred. Though limbs are absent several families of snakes exhibit in their skeletons vestiges of a limb girdle of which external evidence is displayed only by boas and pythons in the shape of a claw on either side of the transverse anus, from which a pair of evertible hemipenes can be extruded during mating. Others of the more primitive serpents are burrowers whose glossy scales reduce friction to a minimum as three reptiles force their way though the soil, suing the

truncated (Uropeltidae) or spiny-tipped (Typhlopidae) tail as a fulcrum. The tails of those snakes that have adopted an aquatic life are apt to be rudder-shaped and serve to propel their owners through the water, fresh or marine. Prehensile tails indicate the arboreal habits of other snakes, but the preponderating majority of species are terrestrial, a minority are provided with poison fangs and only a few of these are dangerous to man.

Crocudicians (Crocodylia) first appear in the Triassic and their descendants of today differ from other living reptiles in the possession of a four-chambered heart, a movable valve that enables them to close the tympanic canal, an anal opening that is longitudinal-instead of transverse as in the Squamata, and a single penis - not paired like those of Lizards and snakes. Crocodiles and their relatives the broad-snouted alligators and the slender-snouted gavials, may well have arisen from the eosuchia by way of the rather lizardlike thecodont (Thecodontia). From the same source came the flying pterosaurs (Pterosauria), batlike reptiles of the Mesozoic, some scarcely larger than sparrows while others (Pteranodon) measured as much as 25 feet between wing-tips.

They were contemporaries of the carnivorous and amphibious dinosaurs (Saurischia). Some of the former like Tyrannosaurus walked erect and were of large size but none equalled in bulk the presumably amphibious Brachiosaurus of North America and East Africa whose weight has been estimated as near 50 tons. Its length however, was probably under 80 feet and surpassed by the better known diplodocus of the Wyoming Jarassic, which was slightly over 87 feet. While the pelves of these dinosaurs show three projecting (tiradiate), four (tetraradiate) or displayed by herbivorous dinosaurs of another order (Ormnaischia) showing tendencies to more quadrupedal habits. One such Stegosaurus with small head and short but protected by a huge crest composed of

compressed plates extending along the and back almost to the end of the tail. Another (Triccratops) possessed a pair of horns above orbits in addition to one on the end of the snout. However, horns and strange looking bony casques, besides other types of ornament, were displayed by many chains appearing in the Cretaceous.

2.92 PRESENT DISTRIBUTION

As might be supposed the present distribution of these cold-blooded creatures is largely influenced by climate, and but two-the common viper and viviparous of Europe - penetrate the Arctic Circle in Scandinavia the adder ranges to 67° N, its lizard pery to 70°, but in Siberia only 60° to 64° respectively. As indicated by their names both species produce their young alive. In the temperate zones a more representative selection of reptiles occurs, including numerous forms of egg-laying turtles - marine, freshwater, and terrestrial, the tuatara, lizards and snakes. In the United States and China the southern temperature zone is actually penetrated by alligators, but the majority of crocodilians are now confined to the tropic. There, under congenial conditions to the pear reptiles in maximum variety invading a great diversity of habitats. In the oceans, a huge crocodile, iguana, numerous snakes and turtles), and in rivers and swamps (crocodiles, lizards, snakes and turtles) are species specially adapted to a marine or lacustrine life. On land occur the purely terrestrial types, some of which become strictly subterranean, while others (both lizards and snakes) are arboreal, rarely descending from the forest canopies in which they dwell. The evidence suggests that contemporary reptiles develop the Old World tropics spreading northern temperature zones where most existing species are either members of tropical genera or of tropical. Some migrant

generate that once and adopt almost cosmopolitan distribution, failed to move in northern clies where only their fossil remains acquatic with the extent of former range.

2.10 AQUATIC ANIMALS

Are animals that live constantly under water as well as those that swim on its surface or plunge beneath it for their food.

Aquatic Members of the Animal Kingdom: Aquatic animals are found at almost every level of the animal kingdom. Most crustaceans are aquatic, but a few, such as the wood louse and the sand crab, are modified for life ashore. There are both aquatic and terrestrial forms among the mollusks, and many other mollusks illustrate a structural transition from life in the water to life on land. The ascidians, or tunicates, are exclusively marine. Although the fishes, have a limited capability for life out of the water.

The transition from an aquatic habitat to a land habitat is seen in the individual life histories of the amphibians. In the frog, for example, the tadpole, or larval, form is fishlike with gills, but the adult frog has lungs and no gills. The black salamander of the Alps, whose life is entirely terrestrial, has no tadpole stage, but there is a gilled stage in the adult.

Among reptiles, there are numerous aquatic forms - turtles, lizards, snakes, and crocodiles. The absence of gill respiration in these forms, however, marks a progressive general adaptation to terrestrial life. Whereas terrestrial amphibians, such as the tree frog, seek water to rear their young, which are gill-breathing tadpoles, reptiles such as the sea turtle, which are aquatic, return to the land to lay their eggs. In both cases, the

place in which the young are reared indicates the ancestral habitat of the adult.

Although birds occupy an aerial habitat, the structure of some, such as the penguin has become adapted to a type of life that is almost exclusively aquatic.

Some of the water mammals are the whale, the sea cow, and the seal.

2.101 STRUCTURAL ADAPTATION TO AQUATIC LIFE

Animals in the water are subjected to environmental influences that are different from those on shore. Consequently, aquatic animals differ from terrestrial animals in modes of motion, form of respiration, and body temperature. There is also variation in the aquatic habitat itself - in composition, current, pressure, food and oxygen. Because of these differences, aquatic animals have a great diversity in structure.

Modes of motion vary among aquatic animals from the swimming bell of the jellyfish, which contracts and expands in the tide, tot he paddling of the frog and duck. These modes of motion are both adaptations to and necessary results of the condition of aquatic life.

Respiration is by gills in aquatic animals that have never left the aquatic environment. The blood is usually oxygenated by travelling through vessels spread out in feathery gills that trap the oxygen dissolved in the water. In terrestrial animal forms that have reverted to an aquatic habitat, respiration is by lungs and is accomplished cases of insects and spiders, the air is entangled in their hairs and conveyed into their submerged homes.) Transitional methods of respiration can be observed in larval insects, crustaceans, and fishes on land with a minimum of water above their gills, and also in the air-and water-breathing fishes.

The body temperature of aquatic animals is not much higher than that of the surrounding medium, and these animals often survive the freezing of the water. Warm-blooded vertebrates that have returned to an aquatic habitat however, have various modifications, such as thick fur or plumage, waterproof varnish, or blubber, that serve as protection against the cold.

CHAPTER THREE

THE ARCHITECTURAL REQUIREMENT OF A MODERN ZOO

CHAPTER THREE

THE ARCHITECTURAL REQUIREMENT OF A MODERN ZOO

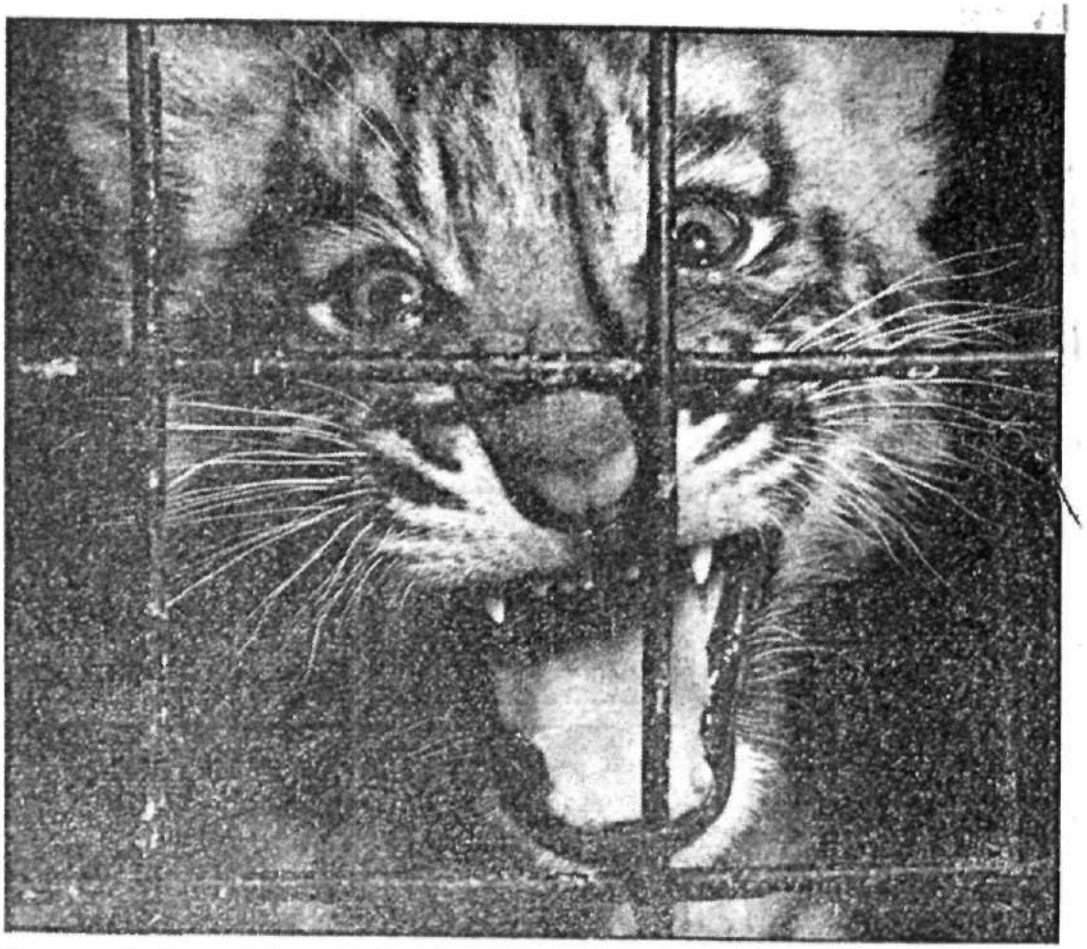
3.0 INTRODUCTION.

Who in the world could subject a wild animal to such cruelty that it would be drving to bite off., chew and swallow the living flesh of its own limbs? The answer is the zoo. This was the alarming picture of tawdry institutions in which animals are entombed in abysmal condition by uncaring owners who pay no attention to conservation. It tells of squalid dungeons in which psychologically - scarred animals face endlessly up and down, rock from side to side, eat their own faeces, pick at each others skin until they bleed, chew their fingers off or continually masturbate out of boredom, loneliness and frustration.

Too few zoo-owers pay sufficient attention to their animals' natural desires and feelings. When they are stifled by confinement in tiny cages, their pent - up emotions erupt in frenzied abnormalities. A typical example was a solitary mandrill that ate part of its own hand. The standards of animal husbandry very pitiful. The use of thunder flashes to drive terrified animals from their sleeping quarters, or peepshows (fig 3.0).

Of all the stories of degradation and neglect the worst concerns a sloth, a creature of sluggish habits which spend most of the day fast asleep, hanging down from a branch. Every day a keeper swept the sloths cage, brought fresh food and change the water. These routine chores were carried out with mechanical regularity until one morning the keeper accidentally struck the sloth with his broom and it crashed to the floor in a heap of maggots. It had been dead for days. Elephants chained up at night; animals locked out of their sleeping quarter to ensure that the public gets a good view are just some of the accusations.

Zoo goers are portrayed at best as holiday crowds come to laugh at defacating elephants; at worst as weird voyeurs hoping to glimpse a lascivious coupling or sadist who



Tiger on display: captive peepshow for an uncaring public

Fig. 3.0,

delight in slipping the animals a titbits of food lethally laced will razor blades. Is that what we want? A peep show or a bank for research, education and conservation?

3.2 ZOO IN HISTORY

The earliest approach to modern zoo was the park of intelligence created by a chinese ruler about 1150 B.C. in the province of Honan and maintained for several hundred years thereafter; mammals, birds, turtles and fish were kept under natural conditions. The ancient Egyptians, Assyrians and Babylonians also kept wild animals, primarily to enhance the glory of their rulers, and large numbers of animals were imported by Romans, for combats between man and beast, or beast and beast, in the arena. In the middle ages, lions, monkeys, peacocks and similar exotic fauna were exchanged as presents between the rulers of states. These collections, furnishing a ready supply of animals for hunting or kept for reasons of prestige, led insensibly to the establishment of royal or public menageries on a more or less permanent basis in many parts of Europe. As the scientific sprit of inquiry developed in the 18th and early 19th centuries, the menageries lay ready to hand both the works of such celebrated naturalist as the comte de Buffoon, Georges cuvier, and the chevalier de Lamarek.

The great early collections of wild animals were connected for the most part with courts or cities in the old world, but in the New world had its counterpart under the Aztec ruler Montezuma, who built enermous insultalations for mammals, birds, reptiles and fishes and employed specialist to catch and breed animals for his collection and to look after their health. The collection was destroyed by Hernan cortes in 1521. while in Africa it has been the practice of many rulers to keep wild animals more especially wild beasts as a symbol of prestige. A good example are the rulers of Ethiopia or the Kabaka of Buganda in Uganda.

At the end of the second world war there were few zoos, but the boom came in sixties, this was the decade of safari parks, which blossomed in western Europe. But it was profit rather than conservationist idealism which provided the motive. With a large number of visitors in a year, animals were big business.

The economy of a country at a time make zoos to acquire large groups of animals, for instance at the time of inflation when cost of caring for animals is minimum. But when the economic circumstances change such large number of animals become a burden to the zoos and the only way to survive is to employ all means of maximising profit even at the expense of the welfare of the animals.

3.3 The concept of a Modern Zoo.

There are only there justifications for the existence of zoos in a modern society, these are to research, educate and provide gene-bank for endangered species. What is needed is a wildlife collection that are aware of the fact that individual groups require distint forms of accommodation and styles of husbandry, and attempts to satisfy these requirements. Victorian menageries where animals are simply marchandise put on show in return for hard cash, no longer, but twenty first century Noah's Ark equipped with laboratories and classrooms.

Concepts of how animals should be presented to the public in a zoological garden are constantly changing in the direction of more natural surroundings and greater liberty for animals, and special exhibits or situations are created to demonstrate the animals' normal way of life. The trend from restraining bars began in Germany at the end of 19th century and moated or barless enclosure is now common place. It has been found even free flying birds can be conrolled within exhibition buildings, without restraining wire or glass. Typical examples are at the St. Louis and Philadelphia zoos, where the exhibits are heavily planted, providing concealment and perches. The public space beyond is comparatively bare of these

so that birds tend to stay in the habitat exhibit. Else where *"walk through"* exhibits of birds introduce the visitor into the birds habitat, as in the san Diego zoo, where visitors may stroll through a screened tropical rain forest exhibits containing hundreds of birds. Since the screened area is comparatively large -170 feet long ,80 feet wide and 90 feet high-and contain many large trees ,the birds are essentially at liberty to lead lives in nature .The endeavor in such installations is to display the animals against its own background insofar as possible , so that a visitor carries away an understanding of its way of life rather than a mere impression of form or color . mammals also lend themselves to ingenious and modern method of display , as found in many zoos.

The challenges to an architect in the design of zoo are many. Among such challenges is to provide a psychologically healthy environment, so that the animals will not be depressed or exhibiting abnormal behaviors. Attention must be given to the animals' natural desires and feelings. The method of feeding the animals should also be giving proper treatment. All these can only be achieved by trying to immitate as close as possible the natural habitat of the animals.

The design of the animal enclosures should be to discourage such old practices like peopshows or forcing animals out of their sleeping quaters for the view of the public.

Reconciliation between profit and the welfare of the animals is very important. While the welfare of the animals needs alot of respect, the revenue generated by a zoo, which is very necessary for the up keep of the animals most not be ignored. Ways of generating revenue without degradation to the welfare of the animals should be favoured. The requirements of a modern zoo are many depending from which perspective it is looked at. Some of these requirements are discussed in the remaining part of this chapter.

3.4 ZONING:

In the design of a zoo the zoning or grouping of animals is very important. The animals that feed on the same type of food are grouped together to ease feeding by the keepers. Animals that share other needs like lighting air conditioning, rotational grazing e.t.c are put together. Sensing the presence of a natural enemy or prey can scare or stimulate the animals respectively. therefore the animals that are natural enemies in the wild must not be put close together (fig 3.4).

3.5. LIGHTING

There are many animals that are either completely on partially nocturnal. In the day when the visitors are around they will be sleeping, and will be performing all their activities in the evening when there are no viewers. Usually lighting of the house of these type of animals is reversed artificially, the rooms are designed to be dark doing the day so that they will be performing their activities normally, while in the evening at the closing time a very powerful artificial light is put on so that they go to sleep. Example of such animals includes kiwi, Hyaenas, porcupine e.t.c (fig 3.5).

3.6 THE ENCLOSURE:

Cages are no longer ideal; large enclosures are rather used in order to provide the animal with large open space in which inside, all efforts are made to immitate the natural habitat of the animals. The natural vegetation and features like rocks or hills are provided (fig 3.6). Trees are very important more especially for the tree climbing animals. An example is chimpanzee who is a very agile climber. If it is restrained in cage were there is no such provision, it can affect the health of the animal. A large open space also give room for race, which is an exercise to the body and good for health.

While some animals breed in captivity without much difficulty, some need a lot of privacy to mate. Therefore privacy is very important in the design of animal enclosure. After



Fig 3.4 (Kano Zoo),
TO THE RIGHT OF THE PICTURE IS LION'S HOUSE, WHILE TO THE LEFT IS THAMPSON GAZELLE'S - Two Natural Enemies.

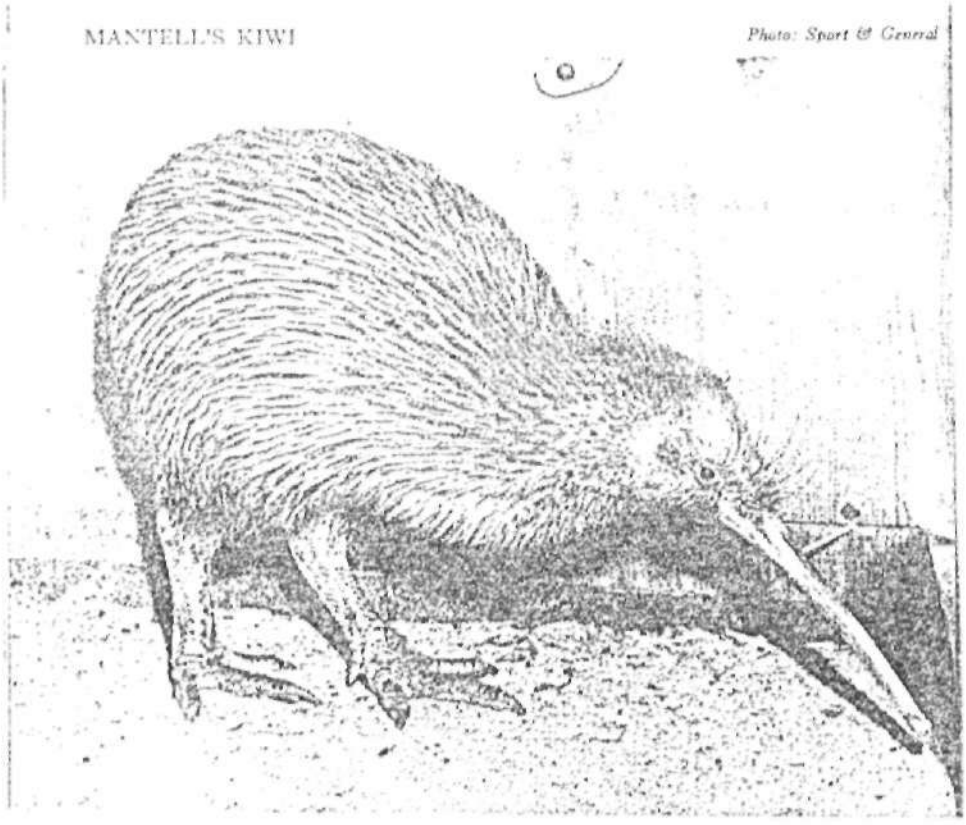
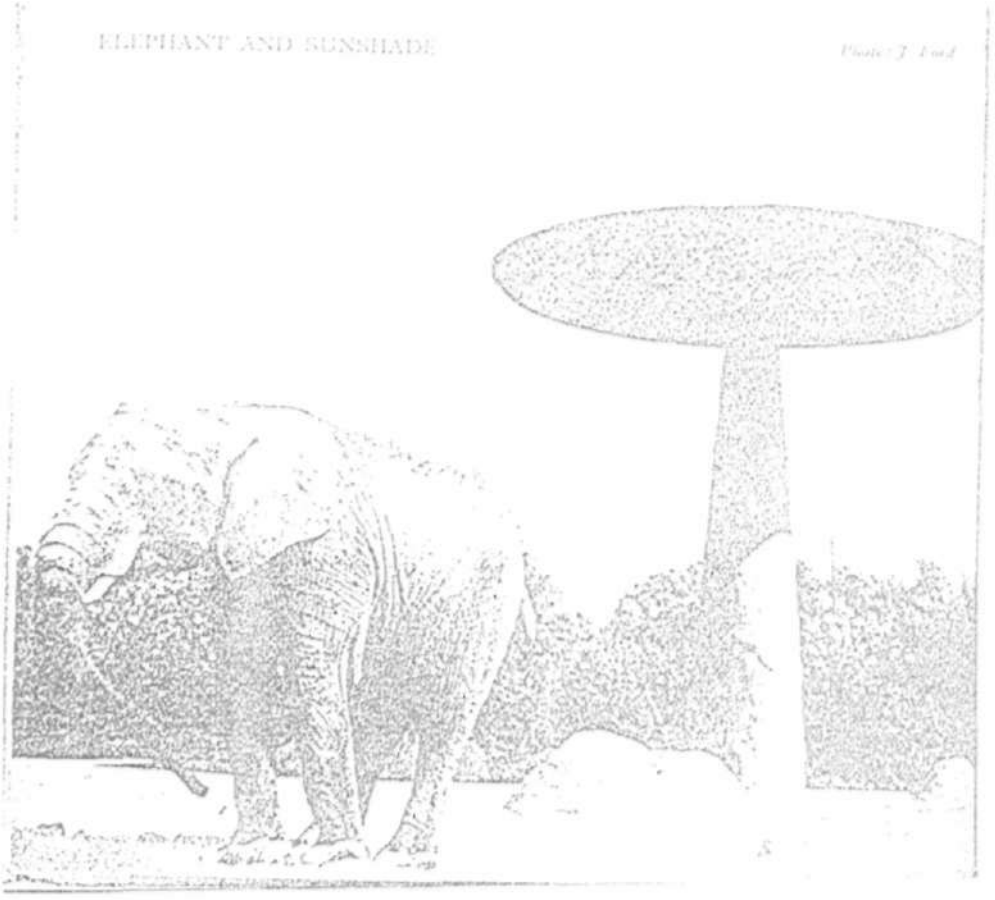


Fig 3.5, HIGHLY NOCTURNAL



◀ *Grevy's Zebras*

Fig. 3.6, TREES



a



b

FIG 36 USE OF CONCRETE IN ENCLOSURES.

successfully producing young ones, the animals' need for nursing the young one should also be taken care of , or hand reared as is done in some zoos.

Items like wood logs, rocks, concrete rings, ropes e.t.c. are called cage furimtures. The type of furnitures in an enclosure depends on the needs of the animal inmates. Those that are good climbers need trees, ropes e.t.c while some like elephant will need a sun shade and a place for scratching its body or sand - bath (fig 3.61). Concrete rings can provide the privacy needed by some animals, because of their resemblance with natural caves or burrows.

There are many ways now of making the enclosures' boundary fence, it might not necessarily take the conventional form of using wire or rods; but an animal can tamed by understanding its own weaknesses. For instance, Gibbons can easily be tamed by a body of water because of their inability to swim. This type of enclosure is what is called *wet moat*. Where as, animals like elephant, which because of their own size, they can not cross over a ditch, can easily be tamed with a ditch that contains no water. This is what is called *dry moat*. Another good example are the birds' aviaries, where birds are kept in a semi-natural state; in aviaries birds can rest, feed, and fly freely, but still in captivity.

Now the question is when you provided the animals with such semi-natural environment, how do you feed the animals, clean their cages, provide medical care for them, or bring them at close range to the public?

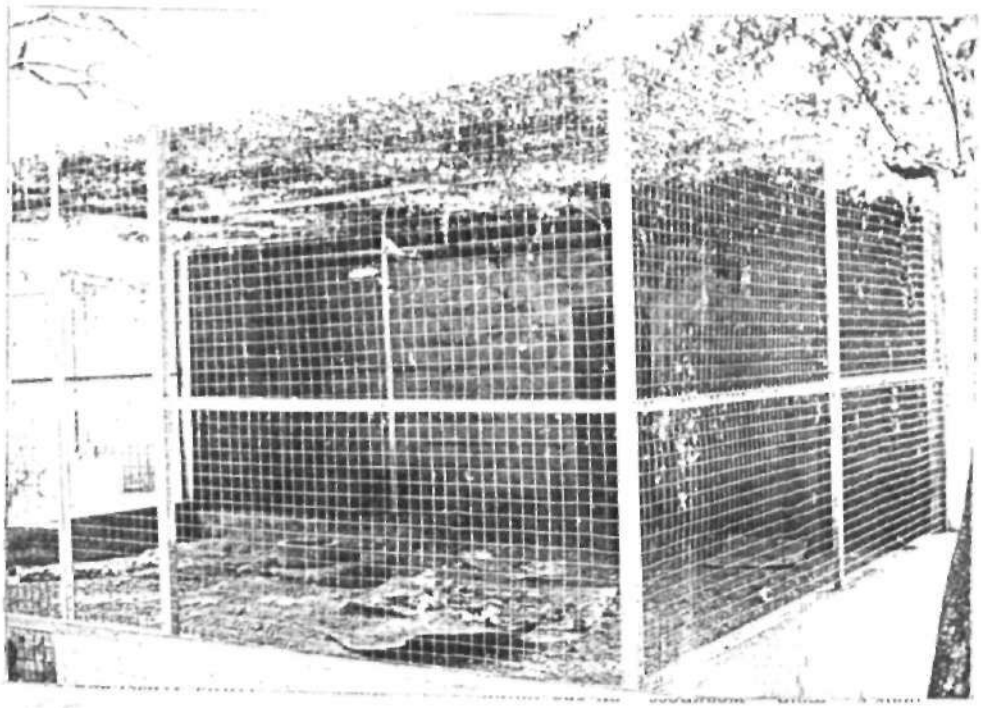
3.7 MEDICAL CARE

To maintain groupof animals in captivity and to breed them successfully, it is essential that they should be kept free of diseases and injury; fed the correct diets, and kept in the best possible conditions. Prevention of diseases is the key to success in maintain good health in the animal collection, and this challenging task is the responsibility of the veterinary Department.





Fig. 3.7 MEDICAL CARE



FEEDING

FIG 3.8,

Routine monitoring of healthy animals, quarantine - isolation of animals introduced from wild or from other zoos, and vaccination programmes where appropriate, all help to safeguard the health of the animals collection.

In the laboratary the veterinery Biologist examines samples of faeces, blood and urine for vital clues that may aid clinical diagnosis in sick-animals, and equally essential information may be obtained through post-mortern examination of any animal that has died. :The pathology department of any institution close-by may provide very valuable support of this investigative service.

The veterinary hospital includes a consulting room, an operating theatre and a ward for in-patients, and it should be well equipped with sophisticated facilities for radiography, endoscopy and ultra- sound examination, Animals that need isolation or special care can be accommodated in the hospital until they are progressing well enough to be returned to their normal home. (fig 3.7).

Getting the patient to the hospital can present its own peculier problems, the larger mammal species they may require the use of a blowpipe to inject an anesthetic drug into the animal from a safe distance. Once asleep the patient can be transferred to the hospital for further attention. The skills and experience of consultants from other hospitals or institutions should always be seek to ensure that these superb animals receive the best possible care and attention.

3.8 FEEDING THE ANIMALS

Spectacled bears stripping the bark off logs in search of insect food, or gorillas using tools to obtain sweetmeats from an artitricial termite nest is a reflection of the trend in modern zoos. Animals in captivity are fed in the same natural ways they feed in the wild. They have to make some efforts thus exhibiting natural behavior rather than just providing them with abundant food on routine basis. Because of their nature the animals tend to

contaminate the food with the faeces and lose their ability to hunt for food, which will make it very difficult to be reintroduced into the wild (fig 3.8). Some animals like lions for instance are allowed to go without food at least one day in a week. This is good for the health of the animals and same with the situation in the wild. Cats are generally known to go for days without food in the wild. Feeding them every day in captivity makes them to add too much weight that is not good for their health and movement with ease.

However each specie is provided with a diet that has been carefully and scientifically fornulated so that it offers all the essential feeding requirements in as satisfying and natural a way as is possible. The ideal diet is one that most closely resembles the feeding habits of the specie in its natural environment. Each feeding programme is designed to offer the animals an appropriate number of apportunties to feed each day and to forage for food at other time. Gorillas for example, receive four meals of fruits and negetables each day, interspersed with opportunities to foreage for nuts and raisin, or to browse on leaves and branches and sip an occasional cup of Yoghurt on Ribena.

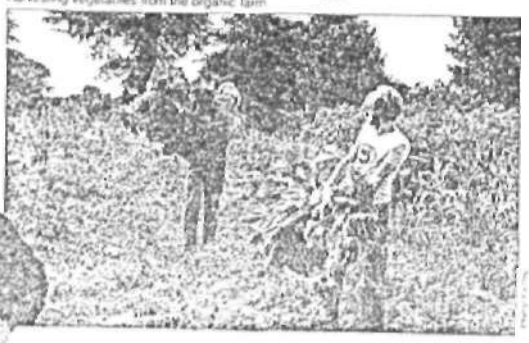
Most food for the animals in the zoo is purchased. Some specilised food items are produced in the zoo (fig 3.81). The organic farm grows flowers, fruits and vegetables without the use of artificial fertilizers, and also provides hay and leaves, and branches of hedgegrow trees. Feeding whole plants to animals is often more stimulating to their apetites.

A variety of insects and rats and nice are also produced on the premises and these are important components of a diet of a wide range of species, from tortoise to snow leopards and owls to marmosets. Another essential ingredient of the diet of animals kept in captivity is the supplement of vitamins and minerals that helps to promote good health and successful breeding. Young animals,pregnant and nursing Mothers, old animals, and sick animals may have special needs in their diets, and these also have to be catered for.

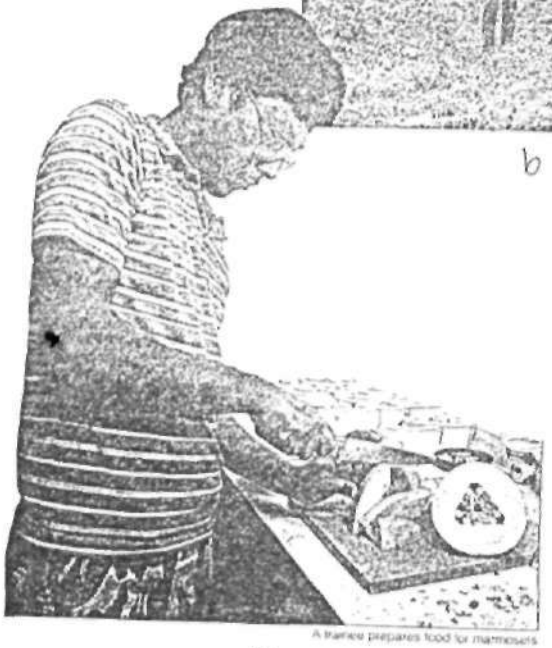
All the above description on the feeding of the animals suggests the nature and type of *Kitchen* needed in a zoo. It dictates the facilities and appliances that might be needed in an animal kitchen. The nature of the food that is to be prepared will determine the arrangemnet of the kitchen.



a



b



A trainee prepares food for marmosets

C



e



Hand-rearing baby Thick-Billed Parrots

d

FIG 3.81, Specialised methods of feeding

3.9 EDUCATION AND RESEARCH

Education as one of the most important functions of a zoo can be looked at in two ways. Educating the public about wild life and the need for conservation, and research into the animals' behaviour and physical condition.

There are many ways of educating the public about wild animals; public lectures, film show, written materals like books and pamplets, or even the label board at the various animal enclosures. Through this the public get enlightened about the ways of life of various animal species and the need for conserving nature. It is through this process that the public can know the role they can play to help in conserving nature. Learning about wild life can also be very amazing and entertaining.

Understanding every aspect of the lives of the animals in the collection is an essential requirement for their successful management in captivity and their conservation in the wild. Most research involves observation of animals without disturbing them and includes studies on general behaiours, on feeding, on parental care of offsrpring, e.t.c; and can be conducted in the zoo grounds or in the fields.

Some researches however are undertaken in the veterinary laboratory and includes analysis of diets to determine their nutritional value where problem of a dietery origin are suspected, and investigations into causes of illness or death where disease problems are regularly encountered (fig 3.9).

Where animals are confined within limited space there is a need to enrich their enviroment and strimulate natural behaiour. Studies conducted in zoos now provide better means to maintain the quality of life for animals in captivity. When a new specie is introduceed into the collection there is a need to know as much as possible about its way of life in the wild in order to maintain it successfully in captivity. Where there is a gap in



Trust biologist in the veterinary laboratory

a



Veterinary research in the laboratory

b

FIG 3.9, LABORATORY ANALYSIS

BEAR PIT



FIG 3.10 VIEWERS

knowledge the research Department can institute studies to increase the understanding of a species' requirements.

When a captive breeding programme has reached the point where reintroduction to native habitat can be considered, then we need to know how captive bred animals may adopt to naturalistic envronments, for example by studying the controlled release of a family of tamarines into a woodland home in a corner of a zoo. It can be learned surprisingly quickly about animals actual food preferences, and their problem of orientation between adjecent treetops when they are librated within the zoo grounds.

To acheive its full potential, research must be conducted in collaboration and cooperation with other institutions; and research Department partiapates fully in interernational discussions and initiatives to explore the understanding of the animals under care.

3.10.0 THE PUBLIC AND STAFF

The general public that visit zoos for education or entertainment are very important. The public is the only source of income for most zoos. The revenue generated from the bulic play a significant role in managing zoos. Therefore the satisfaction of the visitor must be given no less serious attention.

The opportunity to view animals at a very close range amuses visitors. (fig 3.10.0). It is a challenge to a designer of a zoo, to reconcile viewing of animals at close proximity with the natural requirements of the animals for privacy, and living in a natural condition without much disturbance. This is more so if some attitudes of the visitors are considered. Such attitudes include feeding and teasing of animals or even a more dangerous attitude of harming the animals by some sadists. Imagine a sadist visitor who delight in slipping the animals titbits of food lethally laced with razor blades.

Many services are rendered to visitors by zoos, from restaurant and bars to animal ride and many more. These extra services rendered by zoos generate revenue, and should be encouraged as far as they do not affect the animals negatively. The staff of the zoo also need supportting services for their own welfare: Clinic, canteen, or lavotory to mention few. There are many services that are needed in common by both visitors and staff, e.g. parking space.

3.11.0 LANDSCAPE.

Through careful planning and landscaping, the animal in the collection are provided with shelter and privacy, and further more, where it is possible they are enclosed and protected by the plants that are native to their country of origin. A variety of attrative vistas, areas of special botanical interest and enclosures that afford the animal occupant a natural and sympathetic envitonment should be created. A zoo is no longer a home for animals only, but a place where visitors can find a very pleasant landscape, vistas, plants and even water falls.

An excellent example of landscaping to provide a natural environment, in a cheetah padddock for instance, is the use of flat-topped acacia of east Africa. Where it is too tender for the climate the effect can be achieved with hardy robinias, honey locusts (Gleditsia) and the pink mimosa - Like *Albizia Julibrissin.* The blue flowered *Agapanthus Africanus,* red-hot pokers, and the unusual wand flowers with its graceful arching stems under the trees. The effect can be enhanced by the addition of a miniature African "Kopje", a rocky outcrop which can occur naturally in the plains.

Or a white-Eared pheasant; itself a native of china, in a chiness garden. Many fine specimen plants can be used, one of the most beautiful being_ *Magnolia Sinensis* from western china, a large wide spreading shrub with white, nodding flowers which appear with

3.12.0 FACILITIES

The facilities required in a modern zoo are many, some related to the subjects discussed, some independent. But all facilities can be grouped into three: visitor facilities, Staff facilities and animals' facilities. But many of the facilities can be of common usage.

The facilities that are needed in a zoo are discussed blow:

3.12.1 KIOSKS AND RESTAURANTS.

These are Kiosks and restaurants that serve meals, snacks and soft drinks, located at strategic places withing the garden. The number will depend on the size of the zoo and number of visitors. In large zoos, as many as five restaurants with one or two reserved for members of a society is common (fig 3.12.1).

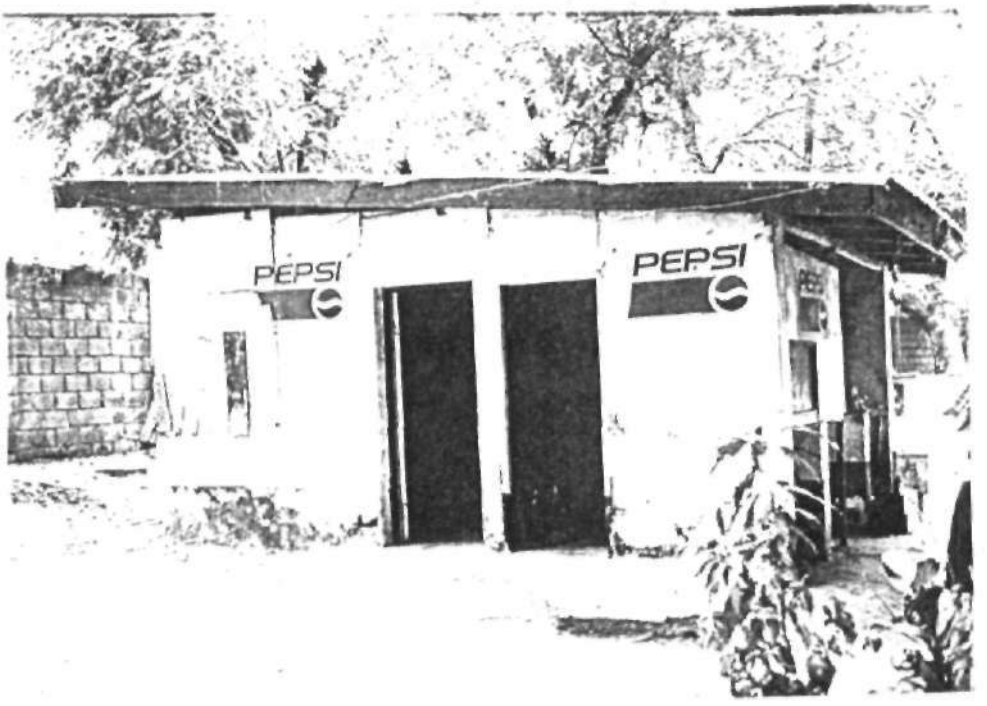
3.12.2 PUBLIC TOILETS AND SEATS.

A number of public toilets is very necessary in zoos, considering the number of visitors recorded. This should be at strategic locations with labels boldly written for easy identification. This will prevent people, more especially in the developing countries, from indiscriminately littering the environment.

Open-air covered sitting arrangements should be provided for the public for resting and taking cover from sun or rain (fig 3.12.2)

3.12.3 VETERINERY AND PUBLIC CLINIC.

Under the veterinery clinic there are sanatorium, prosectorium and Quarantine. The sanatorium contains quarters for sick animals where veterinery officer is stationed. In the prosectorium, the bodies of animals which die in the gardens are examined in order to



a) KIOSK (KANO ZOO),



b. FELLOWS' RESTAURANT

Photo: Zoological Society of London

FIG 3.12.1, KIOSK AND RESTAURANTS.

ascertain the cause of death, any parasite which may be present e.t.c, blood and other specimens are also examined regularly.

There is a Quarantine station outside the gardens. Many animals on arrival must spend a certain time here to ensure not only that they shall be in the best condition before being put on exhibilition, but also to make certain that they are free of infectious diseases which they may communicate to other animals.

Other supporting facilities in the clinic include laboratory for tests, pharmaceutical stores and ward for in-patients e.t.c.

There should also be a public clinic for treating people, in case of injury or any other accident like snake bites e.t.c.

3.12.4 EDUCATION CENTRE

Educating the public as one of the most important functions of zoos, facilities for such functions should be provided. This includes a library, museum for specimen display and audiovisual centre. (3.12.4)

3.12.5 "KITCHEN" AND FOOD PRESERVATION FACILITIES.

An animals' Kitchen, a place for preparation and preservation of food for different animal species is very essential. This should include working area, cold store dry strore and a mini abbatoir for carnivores.

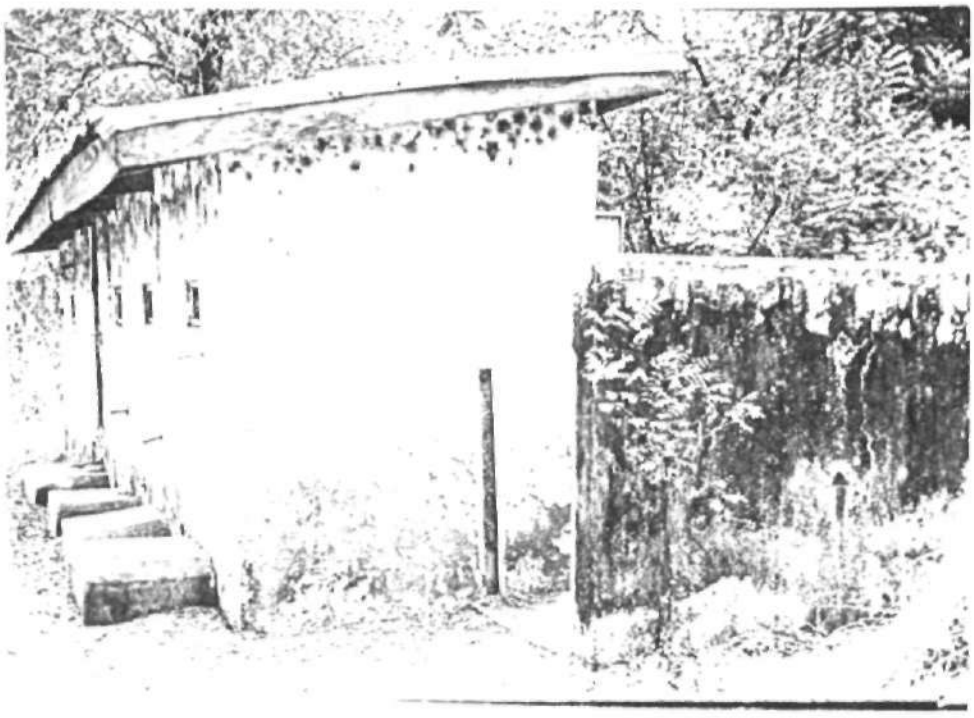


FIG 3.12.2, PUBLIC TOILET (KANO ZOO)

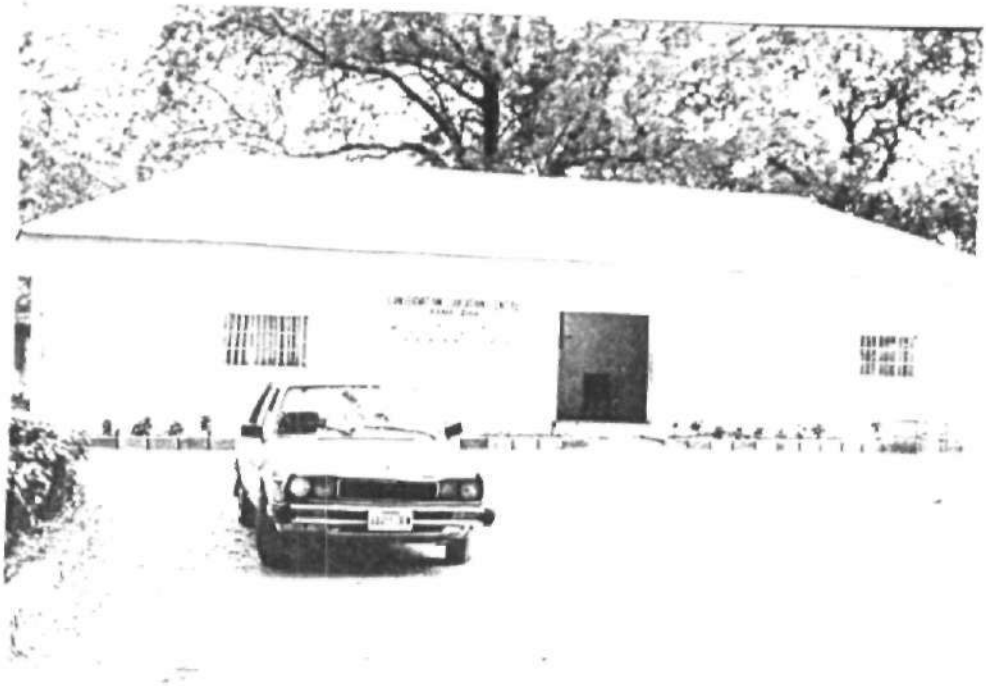


FIG 3.12.4 EDUCATION CENTRE (KANO ZOO)

3.12.6 CHILDREN ZOO, PLAY GROUND AND OTHER RECREATIONAL FACILITIES.

Among the animals in this enclosure are those which are commonly kept as pets, and visitors can find such creatures as mice, Rats, Rabbits, squirrels, Domice Hamsters, Guinea-pigs, Lambs, Goats, Parrots, Budgerigars and Tortoises, (fig 3.12.61). Information on their treatment can be obtained from the attendants. Both Children and adults may become familiar with young Llamas and shetland ponies, and pets of a more unusual kind may greet the visitor, such as baby bears and lion cubs, Baby chinpanzees e.t.c. It seems to fascinate adults as much as children. Here you can see eggs due to be hatched, and if you are prepared to wait long enough, you may see the hatching from the first tapping of the shell to the emergence of the chick.

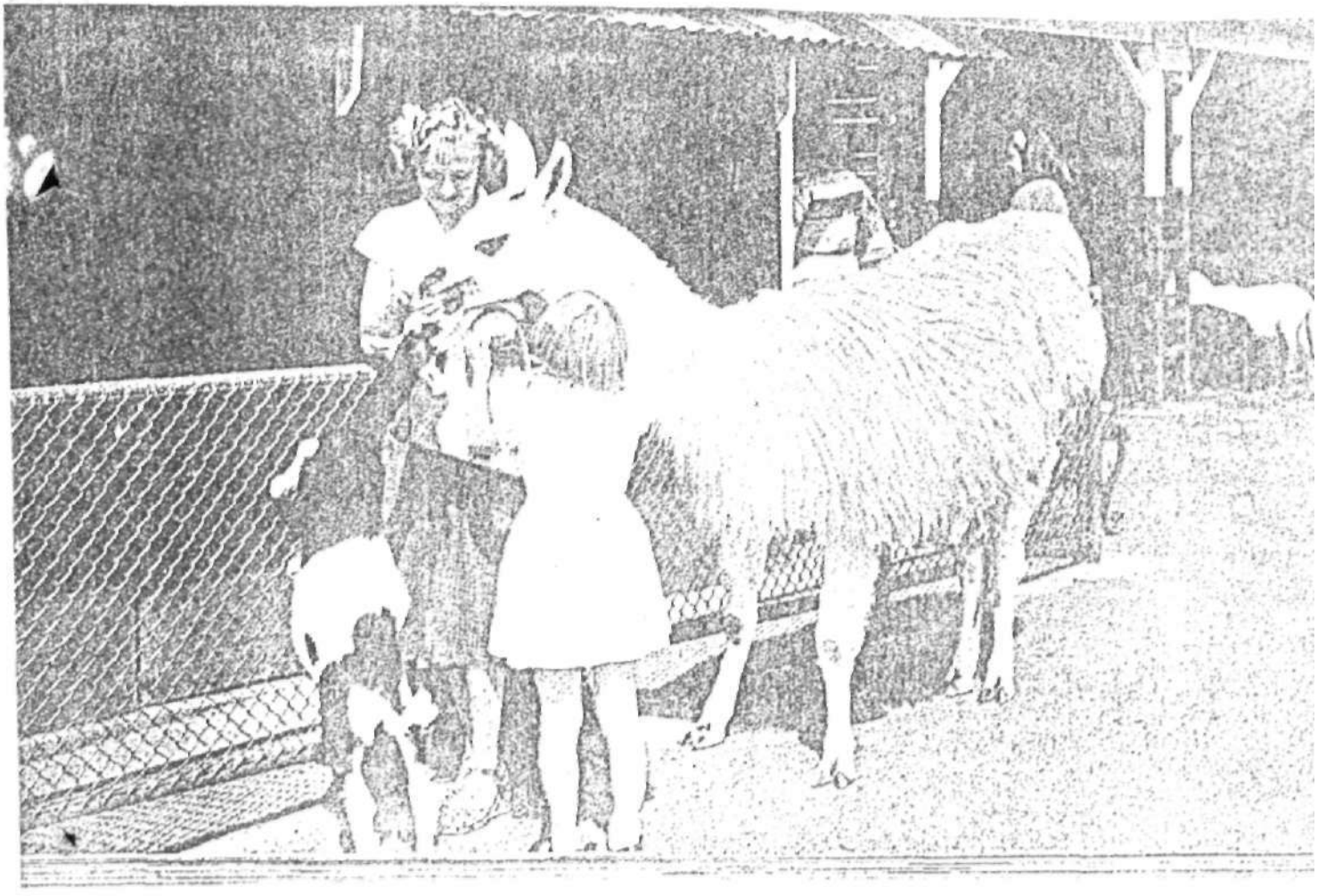
The children zoo performs two useful functions as well as enteraining thousands of people every year. It is in the children's zoo that orphaned animals from other part of the park are brought to be hand reared, and they can often be seen by visitors. Again when deer are to be sent to other parts of the world, they will be hand reared in the children's zoo untill they are ready to go.

In some zoos there is children's play ground, open air cultural performance theatre e.t.c. to diversfy the activities in the zoo (fig 3.12.62).

3.12.7 THE AQUARIUM.

An aquarium is usually a large transparent tank where aquatic creatures are displayed in a semi- natural enviroment. In a zoo an aquarium comprises of many of such tanks containing different creatures.

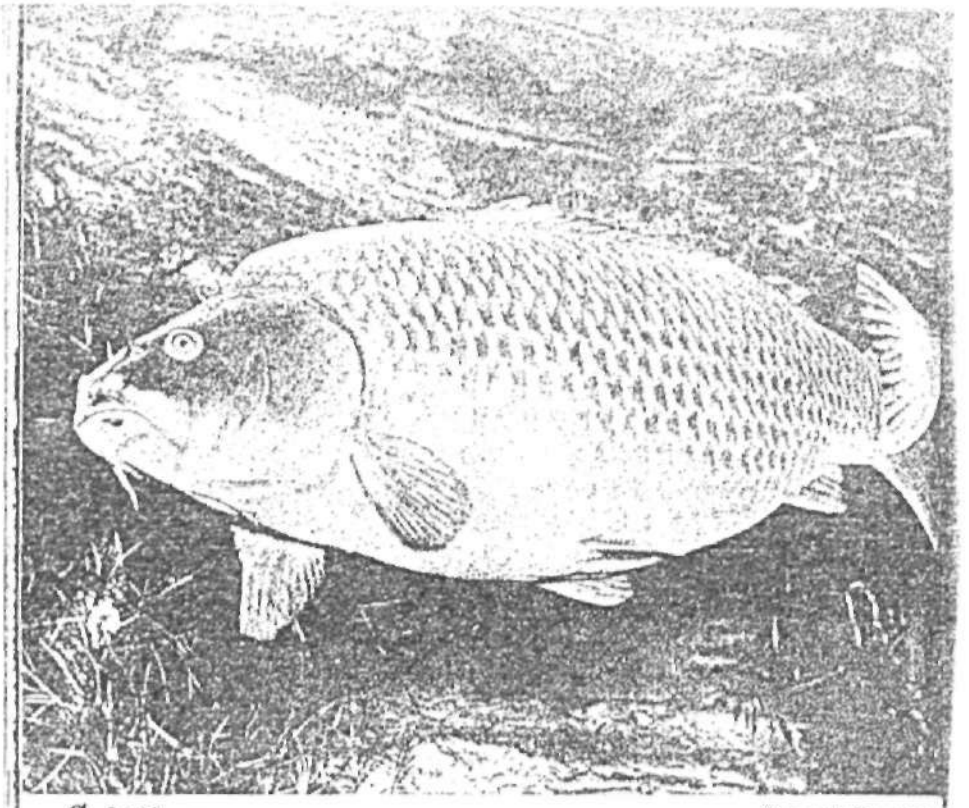
Aquariums are generally divided into two types: fresh water tanks where fresh water animals like fresh water fish, pike , garfish e.t.c .are displayed. While the other



3.12.61, CHILDREN'S ZOO

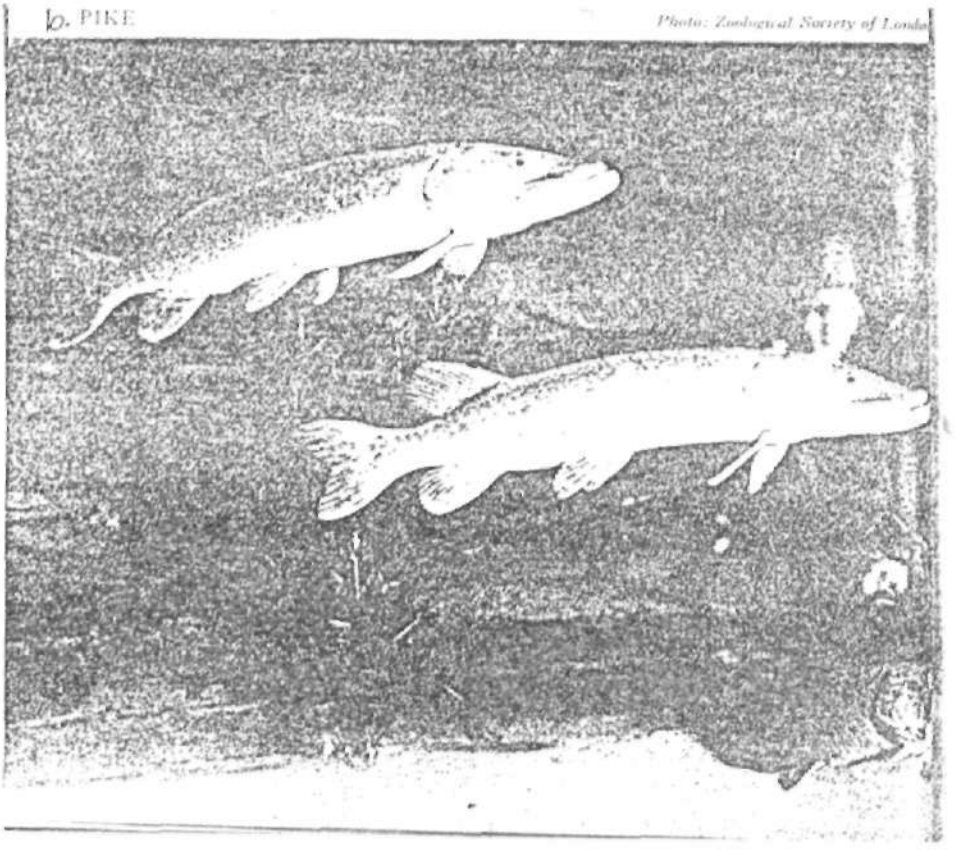


FIG 3.12.62, CHILDREN'S PLAY GROUND



a. CARP

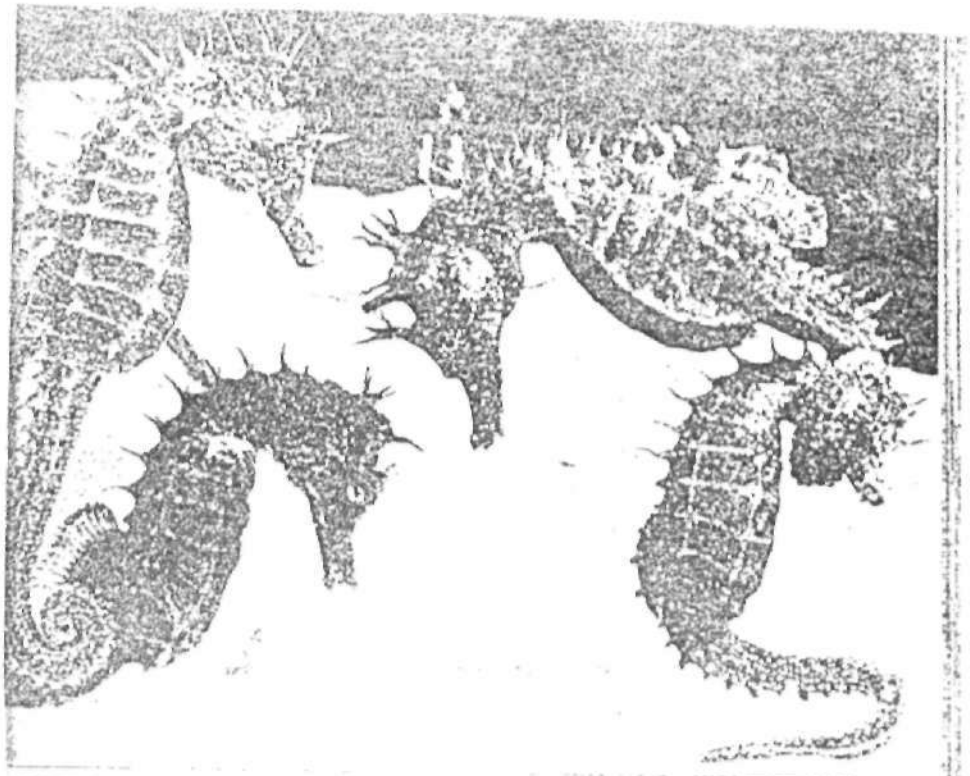
Photo: Angling Times



b. PIKE

Photo: Zoological Society of London

FIG 3.12.7,



c. SEA-HORSES

Photo: Fox Photos

d. COMMON OCTOPUS

Photo: Fox Photos

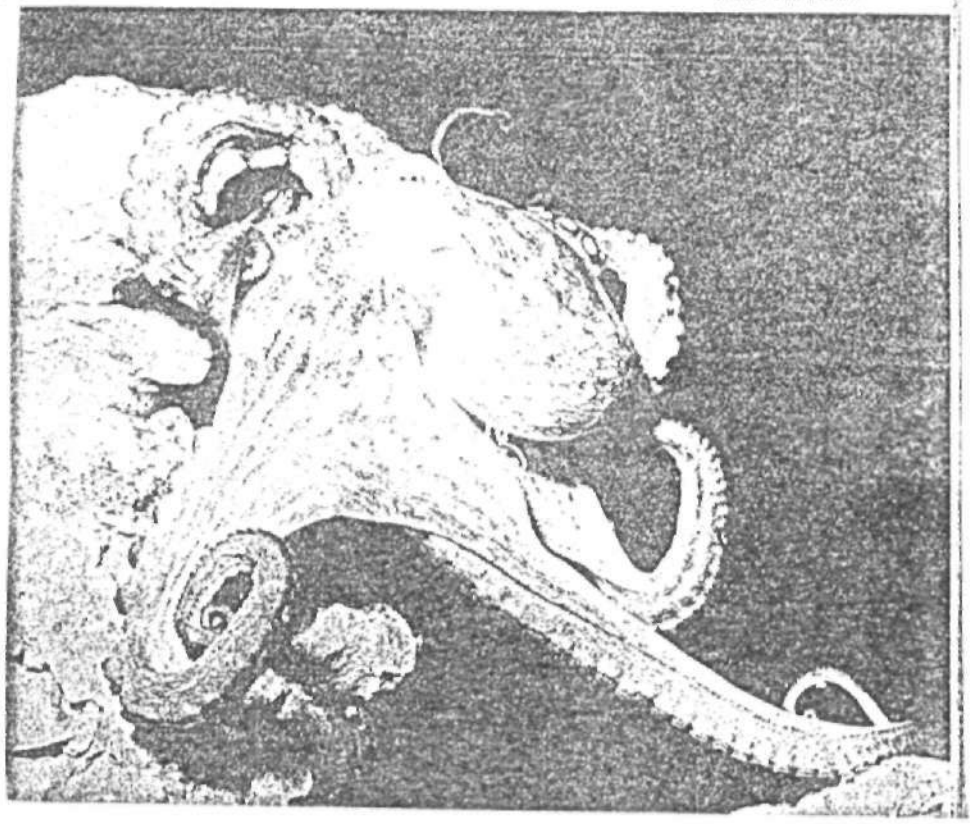


FIG 3.12.7

tanks are of salt-water, creatures like sea-horses, flat fish, octopus e.t.c.(FIG 3.12.7) are kept. In these tanks fresh supplies of sea-water is required at interval.

3.12.8 ENTRANCE GATES, TICKET BOOTHS, AND PARKING SPACE

Convenient entrance gate and ticket booths are required to facilitate traffic control at the gate.The design of the gate should also deficts the activities and functions of the zoo and be inviting. A carefully planned and adequate parking space for both visitors and staff is needed .Negeligence in this part can bring a lot of inconveniences to the users.

3.12.9. ADMINISTRATION BUILDING.

A befitting office accommodation for the administrative and other supporting staff should be provided at a very convenient location. This will include the various departments involved in the business of running a zoo.

14.0 CONCLUSION.

From the above discussion it can be established that the architectural requirements of zoos in modern sense is shifting from the old victorian menageries where animals are confined within a very limited space and compelled to be exhibiting some unnatural, odd behaviours,to a modern Noah's Arks, where animals are kept, as close as possible, in a natural habitat. The animals are given much freedom as regard method of feeding, mating, and privacy without disturbance, whilst trying as much as possible to bring them at close view to visitors.

The primary function of zoos is no longer to exhibit animals for the entertainment of visitors but to educate, research and provide a convenient place for the conservation of endangered animal species.

For a zoo to perform its functions effectively, there is a need for many supporting facilities such as veterinary clinic, animals kitchen e.t.c.

While the challenge to an architect in a zoo is to find ways of putting all of the above to work together.

QED.

CHAPTER FOUR

4.0 CASE STUDIES.

Zoos almost all over the world have the same approach and attitude towards the animals i.e, exhibiting the animals to the visiting public. Wated dens, artificial air conditioning etc are a common features. Until recently there has been no attempt towards imitating the natural habitat of the animals. Two very good examples of zoos with such approach are: The Jersey wild life preservation trust, which specialized in keeping endangered species and the other is whipsnade zoo, which is like an annex. To the London zoo, but the animals kept in as close as possible to natural habitat. However, due to non-availability of materials, only Jersey wild life preservation trust is included in the case study that follow.

4.10 JERSEY WILD LIFE PRESERVATION TRUST

This is relatively small zoo established through the effort of one person; Gerald Durrel. It specialized in keeping endangered species of animals including birds. In line with that, their logo is the flightless bird Dodo which is now extinct.

The zoo has the collection of other forty eight different specie. In addition to the animals' enclosures, play area, birds aviaries, there are other facilities like visitors centre and shops, restaurant, Kiosk, Toilets, Nursing mothers facilities, first aid, public telephone, inquiries and information, veterinary laboratory, veterinary hospital, bird propagation center, education centre, training center etc. (Fig 4.1)

The major achievements of this zoo apart from the breeding successes of the zoo are as follows:



Fig. 4 . 1 Jersey wild life preservation Trust

i) The semi- natural habitat that is provided for the animals as will be seen in the botanical guide of the zoo

b) It is a common sight in the zoo to see an animal foraging leaves on searching for insects in a very natural way. The animals are fed naturally, even though supplemented with artificially enriched meals.

c) Play area and cage furniture are also provided in the animals, e.g an example is the orangu - utah play area, where the animal exercises.

d) There is an education centre used in educating the public about wild life in the zoo. This is very excellent as one of the justification for the existence of zoos in *modern sense.*

e) The zoo also gives attention to the breeding of the animals and have breeding centre for some that is the Nubel Bird propagation centre.

f) In the plan of the Ecological park, there is an attempt to group animals in harmony. Natural enemies are separated from each other.

However, the disadvantage of the zoo is its own limited collection of animals.

4.11 A BOTANICAL GUIDE TO THE PARK AND GARDENS

The parkland and the gardens around are designed to give pleasure to every visitor especially those who delight in the discovery of rare and exotic flowers, shrubs and trees from around the world. Of even greater significance is the fact that through careful planning and landscaping, the animals in the collection are provided with shelter and privacy, and furthermore, where it is possible they are enclosed and protected by the plants that are native to their country of origin.

The design and planning of the gardens is the responsibility of the landscape committee, and the care and maintenance is undertaken by a team of four or five gardeners. The park as it is seen today was first planned in 1970 and the talented people who volunteer their time and services to the Trust have painstakingly developed a variety of attractive vistas, areas of special botanical interest, and enclosures that afford the animal occupants a natural and sympathetic environment.

There is much of botanical interest in the Chinese Garden, which is situated just off the main driveway, and which provides an attractive and fascinating habitat for the White Eared Pheasant - itself a native of China.

There are many line specimen plants to discover here, one of the most beautiful being Magnolia sinensis from Western China, a large wide-spreading shrub which appear with the leaves in June. Another, lovely summer-flowering shrub in rosa moyesii, which can be found tucked away in the corner in front of one of the aviaries, a medium-sized, erected branched shrub which carries shinning carmine flowers in June and July. In late summer, in the same corner of the garden is an unusual sight of metallic blue pods on tail stems, surrounded by large pinnade leaves. Its name is Decaisnea largessa, from Western China. As you walk through the garden towards the babiusa paddock, stretched along the pargota is a vigorous climbing rose. Rosa hetanae, the creamy white fragrant flowers are born in June and are followed in autumn by large, fruits. Once back on the main pathway, a shrub rarely found in cultivation is seen on your left on the back of the border. It is a leathery leaves which are automatic; its name is Illicium henryi.

Near the Babinrusa paddock is a group of euryphia, highly ornamental trees with white flowers in summer. Around the paddock, Liertia formosa of the iris family

products white spike flowers in May, and there is myrtile grove near the main drive. Piumes of tall pampas grass, the smaller variegated pampas and clumps of blue and white agapanthus surround the cheatah and bear paddocks.

On the north side of the bear complex is a planting of Dirmys winteri (winter's bark). a May - flowering South American tree. On the south side are two Brewere's weeping spruce, growing well. The walls of the complex are clothed in escallonia, mainly apple blossom' peach blossom' and 'donard seedling'. Solanum jasminoides 'album' orivudes clusters of pretty white flowers and Ercilla volubilis grows on the shady wall.

The cheetah paddock is an excellent example of landscaping to provide a natural environment. The flat-topped anacin of East Africa were too tender for the climate, so the effect was achieved with hardy robinias, honey locusts (Gledisia) and the pink mimosa-like Albizia julibrissin. Under the trees are the blue-flowered Agapanthus africanus, red-hot pokers, and the unusual 'wand flower' with its graceful arching stems. The effect was enhanced by the addition of a miniature African 'kopje', a rocky outcrop which occurs naturally in the plains.

The water fall area was constructed in 1979 using a two-ton slab of granite and a pump to make the water flow into he round pond. Later the wooden bridge was constructed and exotic ferns planted, although survivors have been the more common hart's longue and buckle ferns, and marsh marigolds. On the bank above, a white Clematis montana climbs into an old oak and the bank is covered with loxgloves and campion. Among the many waterside plants tried, the yellow flag iris, bamboo, miscanthus grass, bulrushes, gunnera and the umbrella plant Cyperus allernifolius have

been the most sucessful.

The marmosel ranges are planted with South american species wherever possible, to give an Amazonian jungle effect. Climbing plants, to imitate the forest canopy, include the cruel plant arguajia sericolera with white flowers in late summer, solanum, ercilla, berberiodopsis, several species of azara and a sophora tree. The linking tree groves are the Chilean Notholagus antarctica and Maytenus boaria.

As you walk from the marmosel ranges beneath shade of the Italian alders Alnus cordata, in from of you a tall, graceful planting of bamboo Phyllostachys bambusoides draws you around to the Keller aviaries, which were completed in 1976 for the Edward's Pheasanis, native to the bamboo forests of Vietnam.

Bamboo plays an important part in the Trust's gardens. Not only is it an attractive screening plant and tough enough to resist damage inside enclosufes but it provides excellent forage for many of the animals, including the gorillas. The original bamboo collection was started here with fifteen species, and Nandina domestica the sacred bamboo, which is of the berberis family. The bamboo theme opens out towards the gorilla complex, with the fall still ARundinairia fastuosa at the entrance to the gorilla house, and elsewhere are to be found other species such as Pseudosasa japonicam P. nitida and P. muriella.

The gorilla enclosure contains three Indian pean trees Catalpa bignonioides one tree of heaven Ailanthus alt ssima and bamboo to provide shade and interest. The wall surrounding the enclosure is planted with actiniida the Chinese gooseberry, the vine Vitis coignetiae, honeysuckel, wintere jasmine, pilostegia and schizophagera.

Approaching the manor house, the tall drystone wall of pink Jersey granite, which

is so much a feature of the island's gardens, is covered in the summer months with the small pink and white daisy-like flowers of Mexican fleabane Erigeonon mucronatus.

Through the archway is Les Augre Manor, the headquarters of the Jersey Wildlife Preservation Trust. The manor is built typically with jersey grantite and its history goes back beyond 1695.

As you face the manor, to your right is an unusual shrub from the Andes, Vatlea stipularis pyrilolia. Considered rare in cultivation, this plant originally came from Kew gardens. It is a summer-flowering shrub, tall growing with rose-pink flowers. Equally unusual is the almost unknown hypericum augustinii, a line shrubby St. John's wort with golden-yellow flowers in the autumn carried on the graceful arching branches. The manor forecourt includes a formal garden with a box-hedge lattice in which are planted a variety of seasonal bedding plants, including arum lilies, agapanthus, bearded iris, the double pink peony Sarah Bernhardt' and some unusual white lilies, L. crinum 'Asiaticum'. In the corner is a large old Camellia japonica and a border of rhododendrons round the lawn.

Beyond the archway is the start of the Camellia Walk, which can be enjoyed from February through to early summer. There is a special camellia bed of rare varieties donated by members of the international Camellia Society. As you begin to walk along the path, on the right is the fish tail camellia, C. kingyo-ysubabi, so called because of the 'fish-tail' shape leaves. Not all the shrubs on this walk are camellias, there are several magnolias also. Of particular note is Magnolia x Soulangiana 'Brozzonii', a tryly beautiful flower - large, elongated, white, cup-like flowers, shaded purple at the base. It is one of the largest flowered and latest of the x Soulangiana group.

Returning towards the Visitors' Center, the tree groves of dawn redwoods Metasequoia glyptostrooidies, which stretch from the Chinese Garden down towards the lakes, are of particular interest. These metasequoias are vigorous, deciduous conifers, bright larch-green in summer turning pinky-gold in autumn. They are the living relic of a fossil genus found in China, and were thought to be extinct until they were rediscovered growing in the wilds of Central China in 1941.

Unfortunately, so much of the 1970 plantings of trees and shrubs were lost in the 'great storm' of October 1987, when the landscape was changed forever by the dramatic events of that night. Nearly a hundred trees, including many old favourites in the park and many line specimen trees, were lost or had to be felled. A very sucessful plant adoption scheme has been instituted in order to provide schools and individuals with the opportunity to participate in the restoration of the park through the growth and development of new trees and shrubs, and so a further phase in the progress of the park and garden has begun.

A detailed botanical guide to all the plants to be found in the park and gardens of Les Augres Manor is on sale at the Visitor Centre.

4.2 UNIVERSITY OF IBADAN GORILLA AND CHIMPANZEE EXHIBIT

This exhibit was designed by Robert R. Galoding, a curator, university of Ibadan zoo, Zoology Department as a response to the problem of providing accommodation for the rapidly growing lowland gorillas and chimpanzees. The animals had been kept in old, medium sized cages, schedule for demolition. due to rapid growth of the animals, it was imperative to provide larger, more hygienic housing as soon as possible.

The possibility of traditional barred, completely enclosed cages was rejected due to: high cost per ground area covered, unsightly appearance and reduced display value of the animals.

Another possibility of high, unclimbable wall, either built from ground level or sunk into the ground in the form of dry moat was rejected due to the amount of heat and light reflected from large areas of concrete or stone in this climate. Reducing the amount of reflection by trees or roof was turned down due to safety and cost consideration.

The option of water-filled moat was better, but the danger of the animals being drowned. Apart from outside compounds, it was considered necessary to provide indoor accommodation for the apes, such accommodation would provide compartments into which the animals could be shut to facilitate cleaning and maintenance.

A composite approach was however chosen.

A concrete moat is built with each end against opposite exterior ends of the 5.5m (18 ft) high wall of the compounds. a 5.5 m (18 ft) high, stone - faced wall is built out at right angles from the centre of the outer wall of the building and is carried forward to meet the moat. Due to the relative positions of other existing buildings, the compounds are slightly unequal in size as can be seen in Fig 4.2.

In order to provide a certain amount of cover from the sun and rain the roof of the building is continued foreward and slightly upwards over the compounds for a distance of a 4.6 m (15 ft). This roof extension also shades the wall beneath from the sun, thus eliminating much potential heat and light reflection.

It seemed necessary to divide the moat into two sections, with the section on the animals' side separated from the remainder in such a way that if the apes entered the

water, either deliberately or accidentally, they would be prevented from rolling across into deeper water and would be able to scramble back to safety easily. On the other hand, it also seemed important to have the section accessible to the animals sufficiently deep and wide to maintain their respect for water even if, as suspected might happen in the case of the gorillas, the animals became accustomed to it and entered deliberately. Thus, if this latter situation developed, to minimise any desire on the part of the apes to cross to the other, wider, deeper section on the visitors' side was necessary in case the animals, when adult, did somehow manage to cross from the near section, it is preferable to have a drowned gorilla to an escaped gorilla, especially in such a densely populated area.

The floor of the moat was therefore designed to slope down fairly steeply from the inner side to a horizontal distance of 1.4 m (4½ ft). At that point a 30 cm (12 in) high wall is built along the floor of the moat, parallel with the sides, into which are concreted a series of uprights supporting three horizontal underwater rails. The uprights and rails are made from 3.1 cm (1½) galvanized tube, and are welded together. The water at this (deepest) part of the section available to the animals is 1.06 m (3½ ft) deep if the moat is full. Should one of the apes find itself in difficulty here, the 30 cm (12 in) wall prevents the feet and legs of the animal from slipping under the bottom rail, and provides a firm base against which it can thrust with its feet to gain dry land. The rails, as well as acting as a barrier, also provide firm hand holds. The moat floor, from the inner edge to the wall and rails, has a roughened surface to prevent the animals from slipping and also has two 3.1 cm (1½ ft) high raised ridges running parallel with the edge to provide additional finger and foot holds.

To prevent the apes passing over the top rail and into the deeper water on the other side a series of vertical metal rods were welded to the rails. The upper ends were twisted into a circular shape and covered with insulating material and a long length of bare wire threaded along the entire length of the moat. With the ends firmly fixed, the wire was suspended about 25 cm (10 in) above the top underwater rail and about 20 cm (8 in) above the maximum water level. One end of the wire was connected to an apparatus designed to operate an electric cattle fence. This is powered from a car battery and passes at intermittent pulse along the wire at the rate of about one per second.

From the wall and rails the moat floor slopes down rather less steeply to the far (visitors) side and unlike the inner section the surface is of smooth, rendered concrete. With the moat full the water depth as this side is 1.98 m (6½ ft). The outer wall of the moat is raised a further 60 cm (2½ ft) to bring it to the level of the visitors' path, which is thus raised above the level of the compounds for improved viewing.

Three chimpanzees (one male and two females) and pair of gorillas were finally released from the building into the completed compounds in March 1970. It was anticipated that he animals, particularly the chimpanzees, would be somewhat excited when first released and might behave erratically. Therefore adjusted the water level in the moat so that in the inner section it was only a few inches deep. This also gave the animals easier access tot he electrified wire which the designer wanted them to experience for its unpleasant properties as early as possible.

When the adult male chimpanzee emerged for the first time into the compound he was in a highly excited and aggressive state with all his body hair erect. He walked

around the compound briefly, then went down the side of the moat into the shallow water and grasped the wire, obviously with the intention of climbing over. he immediately received a shock, screamed, and then retreated with his body hair rapidly subsiding. He looked up, wanted to be held and comforted. He again tried to cross the wire, apparently in an attempt to reach out (although of course this would have been impossible because of the deeper water on the other side), and again received a shock which evoked another loud scream. This happened perhaps six times in the space of a few minutes, after which he rushed back, still creaming, to the far corner of the compound where he sat motionless for a long period. From that day on, whatever the depth of the water, he has never attempted to leave the edge of the moat.

The two young female chimpanzees were more cautious in their initial explorations but each nevertheless soon touched the wire and received a shock. They, too, have never since attempted to leave the edge of the moat although one of them very occasionally stands with her feet and ankles in the shallow water at the edge itself, carefully holding on the raised concrete kerb all the time. There can be little doubt that all three chimpanzees remember these unpleasant incidents of the first day, but apart from this they have also kept their basic dislike of water, and except for the rare occasions just mentioned have never bodily entered the moat deliberately or accidentally. Even if one of them were to fall in accidentally, it could either scramble back or hold on to the underwater rails and stand up with its head above water.

The gorillas, when released, were also initially cautious and moved around their compound inspecting their new surroundings with great deliberation. Their self-confidence soon increased however, as did their chest-beating, and eventually both

climbed down into the moat and grasped the wire. The reaction of the female was to retreat immediately, accompanied by a low whimper and frequent puzzled glances over her shoulder at the wire. She has since done her utmost to avoid contact with the wire and has certainly made no attempt whatsoever to cross from the inner most section.

The reaction of the male, on receiving a shock, was to screw up his face and duck as though he had been attacked from above. He climbed back to the moat edge and moved around the compound sitting down frequently and staring at the wire. After a few minutes he again went down and reached out and then withdrew his hand several times before his fingers eventually made contact with the wire and he received another shock. Again he ducked and retreated, and after a few more stares renewed his inspection of the compound.

The gorilla maintained the low water lever for some days, with a keeper on constant watch and then, after the moat had been emptied for a structural inspection, it was finally filled to near the maximum water level. As said, the chimpanzees have presented no problem whatever, although as a precaution a keeper is permanently employed to watch both groups of animals at all times.

A development of great interest, however, occurred with regard to the gorillas. Within a few days of having access tot he maximum water depth in the inner most section, both animals were entering the water with tremendous enthusiasm. They sat on the bottom of the moat with the water up to their chins, always taking care not to submerge their faces below the surface. As their confidence increased they began to beat at the water with their hands, delighting in the variety of noises that could e thus produced and standing up frequently, with water pouring off their bodies, to beat their

chests violently and then submerge again. With the water up to their necks they were, of course, very buoyant and soon they began to propel themselves along in a sitting position - their faces just above water - by pushing their hands and feet against the underwater rails and moat bottom. They took great pains to avoid the electrified wire, soon becoming adopted at moving along the moat with just 5 to 8 cm (2 - 3 in) separating them from it. Their prowess in the water developed rapidly and it was only a week or so before the male was able to launch himself with a kick from the moat bottom, travelling several feet in a horizontal 'breast stroke' position with arms out straight in front of him, before slowing down and kicking out from the moat bottom again. He also launched himself by pulling with his hands against the underwater rails.

Both animals soon learned to run across the compound and either leap diagonally into the water in a tremendous belly-flop or twist around at the last minute and plunge in backwards, all the time being careful not to submerge their faces. They took turns in chasing each other along the edge of the moat, the one behind attempting to push the other into the water.

Within a few days of being outside, the male gorilla discovered that by lying flat on his stomach he could squeeze sideways between the top rail and the electrified wire without touching the latter. Further, he developed a technique of squeezing between the top and centre underwater rails by carefully passing first his legs then his body between the rails and moving across until only his head was left above water. Then very quickly he pulled his head under the water and between the rails to the other side grimacing furiously on surfacing. Having crossed to the deeper section by one method or the other he then walked sideways up and down the moat, hanging on to the top rail as he did so.

he was able to regain the inner section by jumping clumsily back into it from the top rail at the bend to the moat, where the electrified wire ran somewhat inside the curve of the rail instead of being directly above it.

Both methods of crossing the barrier were easily stopped, however. Alternate rods supporting the electrified wire were removed and replaced by another set of supports consisting of lengths of 2.5 cm (1 in) galvanized tube projecting above the maximum water level to a height of 45 cm (18 in). Three hooks were welded to each new support and it was thus possible to suspend three wires one above the other with a narrower space between the bottom one and the top under water rail. Despite attempts to cross this new electrified barrier, the male gorilla was unable to do so and he soon showed no further interest in the matter.

To stop him from passing underwater between the rails, lengths of wire rope were woven criss-cross fashion across the spaces. These have now been removed as the animal has grown too big to pass through.

Even though this approach has the advantage of using the animal (inability to swim) to tame it, it has the disadvantage of non-natural setting.

4.3 LONDON ZOO: THE ZOOLOGICAL GARDENS

The Gardens in Regent's Park were first opened tot he public on 27th April 1828. Since then their area has been added to from time to time, but even now the total area of the Gardens in Regent's Park amounts only to some 35 acre. The collection of animals is the largest and finest in the world. More varieties of different living creatures can be seen within the 35 acres of the Gardens than in any similar area of the globe.

The Society receives no aid from any public funds. For current expenses, for all improvements and for the scientific work imposed on it by the terms of its royal Charter, it relies almost wholly on the gate money paid by the general public and on the subscriptions of its Fellows. The Fellows' subscription has not been increased for over a hundred years.

The Society has been in existence for over a century and a quarter, having been established in 1826, incorporated by a Royal Charter on May 18th 1948. Sir Stanford Raffles, who persuaded the East India Company to buy Singapore and was thus one of the most notable founders of the commonwealth in the East, was the moving spirit in its foundation. A bust of him is to be seen in the Lion House. He received much help and support from Sir Humphry Davy, then the acknowledged leader of British Science, famous among other things for his invention of the miners' safety lamp.

Originally, the Gardens consisted of a small portion f what is now the Main Garden, a triangular area comprising roughly the space between the Main Gate, the Old Tunnel and the Three Island Pond. By 1851 this space had been extended to the edge of the grass verge of the Broad Walk in Regent's Park, and considerably enlarged to the south; in addition, most of what is now called the Middle Garden had been added. By 1979 the Main Gardens had again been somewhat extended, and the eastern part of what is now called the North Garden had been added. By 1902 most of the North Garden had been developed, together with further small extensions of the Main Garden. By 1914, the Mapping Terraces had been constructed, the Park Paddocks added on the South, and the offices transferred from their old home in Hanover Square to the east end of the Middle Garden. By 1929, the year of the Society's centenary celebrations, the

Aquarium, the new Monkey House and the Reptile House and the Main Refreshment Room and been built, the layout of the Mian Garden much improved, and, most important, the area required for the Zoological Park at Whipsnade had been bought (Fig. 4.30).

In 1947 an Architect's Department was created to cope with the very necessary new planning of the whole Zoo. This department has already produced a wonderful lay-out, including the reconstruction on modern lines of most of the rather anti-quated buildings now to be seen in the Gardens. It is only necessary now for permits to be granted and funds to be raised to enable the Society to go ahead with these new projects.

During the war years the Zoological Gardens suffered considerably from enemy action and although very few of the buildings received direct hits, great havoc was occasioned by blast.

Although many animals escaped from time to time and were duly recaptured, not a single animal was injured.

It is thought by many people that most of our animals were evacuated to Whipsnade during the war, but his was not so. With the exception of the poisonous snakes the Menagerie remained intact throughout. Besides the buildings accessible to the public - the houses and enclosures for animals and the restaurants and kiosks - the Gardens at regent's Park contain other buildings. Among these are the *Sanatorium* and *Prosectorium* near the Bird House. The Sanatorium contains quarters for sick animals, where the Veterinary Officer attends daily. There is *Quarantine* Station outside the Gardens. Many animals on arrival must spend a certain time here, to ensure not only that they shall be in the best condition before being put on exhibition, but also to make

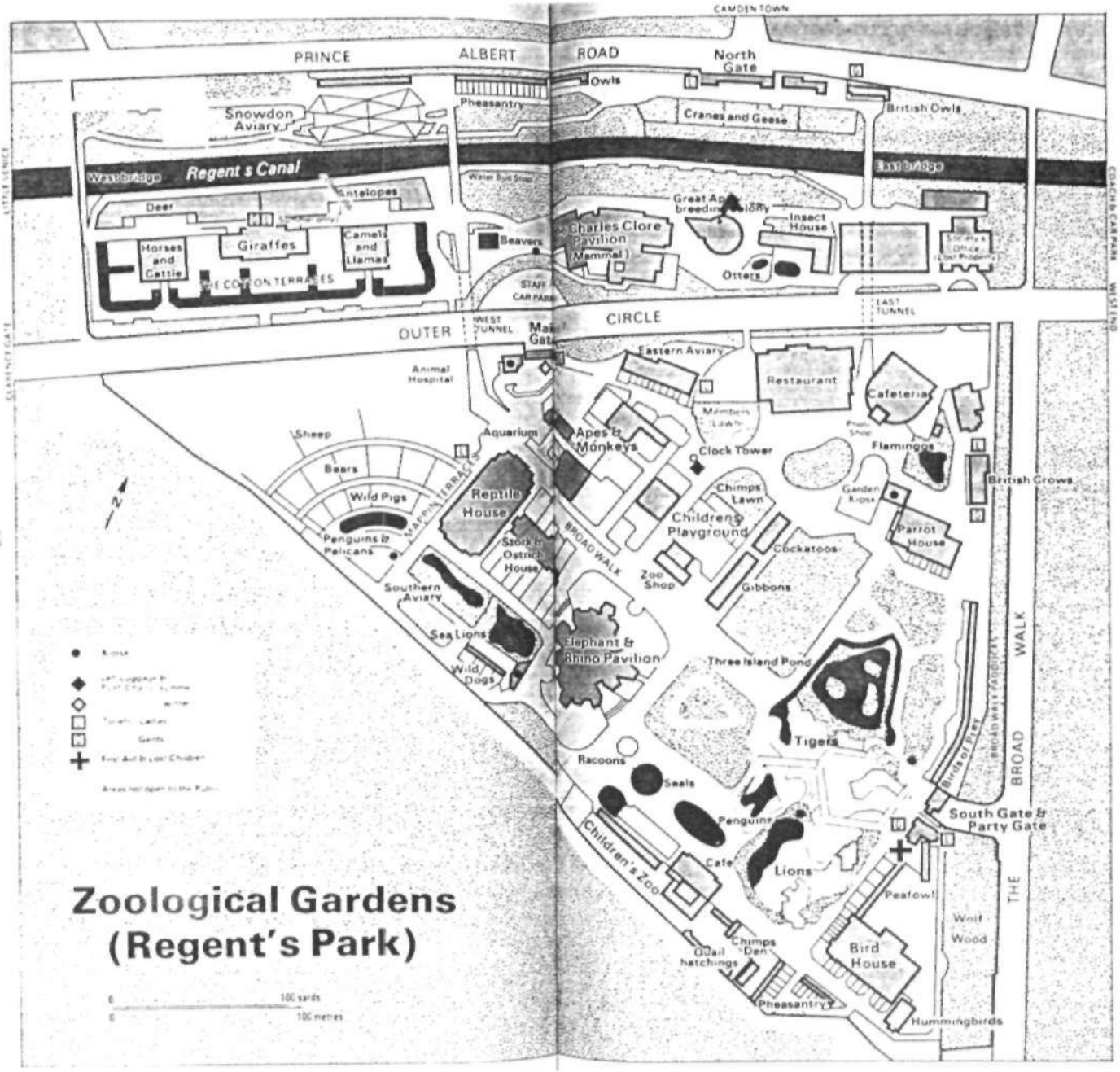


Fig. 4.3 London Zoo

certain that they are free of infectious disease which they might communicate to other animals. In the Prosectorium, the bodies of animals which die in the Gardens are examined in order to ascertain the cause of death, any parasites which may be present, etc.; blood and other specimens are also examined regularly. This is of great assistance in improving the conditions under which animals are kept in the Gardens. Much valuable anatomical and pathological material is also made available to various museums and scientific laboratories. Fellows and the public are not admitted to either of the above.

The Society spares no effort to provide perfect housing conditions for every animal. The older buildings, some of them dating from the Zoo's first opening over a hundred years ago, are being modified or replaced as fast as conditions permit.

4.3.1 FLOWER GARDENS

Many visitors to the Zoological Gardens do not realise the full extent of the floral attractions, which are well worth more notice and appreciation than they usually receive. The Botanical side of the garden will prove a constant source of pleasure throughout the year for the observant.

Their situation amid the fine trees of Regent's Park at once gives the Society's Gardens an excellent background, enhanced by the trees planted within the grounds themselves. Trees are well represented by several kinds of *Oak, Horse and Spanish Chestnuts, Hornbeam, Sycamore, elm, Lime, the "London" Plane and Black and Lonmbardy Poplars*. An avenue of the latter, inter-planted with Cornish Elms, flanks the Outer Circle within the Zoo perimeter. Several large weeping Ash trees, trained over iron framework to give a pergola effect, are seen at the North Gate and elsewhere.

Other fine trees, such as the Indian Bean, Tree of Heaven, Black Walnut, Locust Tree and others are seen in the vicinity of the Main Walk. a row of Mulberry trees stands in the inner paddocks of the Ostrich House. Willows, Purple cherryplum, woolly-fruited Poplar and other smaller trees are planted in the Three Island Pond area. Most specimen trees are labelled with English and scientific names, and country of origin.

Conifers are few, but several Deciduous Cyoressesm a beautiful American confer, grace the lawns near the Parrot House. Dwarf confers, junipers, cypresses and pines are seen on the rookeries, and young trees of the aberrant, primitive Chines Maidenhair tree, or ginkgo are planted on the edge of the Fellows' Lawn, and outside the Main Office. Evergreen trees are mainly Holm Oak, and the smaller Bay Laurel. There are many Privet hedges, this and Elder being among the few shrubs which will survive in the bird aviaries.

April sees the ornamental Prunus trees, collectively known as "Flowering or Japanese Cherries," in full glory. Many trees of various species and varieties, large and small, with masses of pink and white-usually double-blossom are seen in most parts of the gardens together with the less spectacular pink-flowered Almonds. Red and pink Hawthorns follow in May, and the Rhododendron-like blooms of the Indian Bean.

4.3.2 NOTES ON ANIMAL FEEDING

Different kinds of animals, of course, require very different diets. A few sample menus are appended.

MONKEYS. These are given fruit of various sorts, cabbage, onions, nuts, bread, margarine, jam, and potatoes. a medium-sized monkey eats about 1 to 1½ lbs of the

mixture daily. Many monkeys also like insects, such as meal worms and gentles.

LIONS: Daily, 10lbs. of meat (including bones), once a weak a handful of coach grass; occasionally small amounts of offal, rabbits, pigeons, and preparations containing vitamins. One day a week the lions go without food, to keep them in better health.

SEA-LIONS: About 20 lbs of fish (mostly whiting and herring) daily.

ELEPHANTS: In summer, daily 1½ tones of hay; 6 bundles of green fodder, a quantity of potatoes, carrots, and apples. In winter, mangolds and other roots are substituted for the green-stuff.

HIPPOPOTAMUS: Daily about 1 cwt. of hay, greens and roots in equal amounts.

FRUIT BATS: Chopped figs, dates, apples etc.

EAGLES: 10-12 OZS, meat daily, with rabbits, rats, mice and pigeons as frequently as possible.

PENGUINS: (Smaller species). about 6 lbs. of fish daily.

HUMMING BIRDS AND SUNBIRDS: A synthetic food made of honey, condensed milk, a proprietary patent food, and a few drops of meat extract; also a vitamin compound and live fruit files.

SMALL BIRDS: Insectivorous birds are fed on a special mixture made in the Gardens, consisting of soya, shrimp and liver meals, ants' eggs and fat, sometimes with the addition of a little minced raw meat. Meal-worms and other insects are given separately. Seed-eaters are given seed mixtures and green food.

GIANT TORTOISES: These are fed almost exclusively on gree-stuff-lettuce, cabbage and grass-clippings-with a little fruit. However, some appear fond of meat and are given a little as an occasional treat.

GECKOS AND SMALL LIZARDS: These are fed mainly on files, meal-worms and other small insects when obtainable. Some will take earth worms.

4.40 BABOON EXHIBIT AT LOUISVILLE ZOO

Among the three projects of the early development of the Louisvile Zoo presenting naturalistitc exhibits with extensive use of artificial rock work ('gunit'). the baboon cliff is perhaps the most striking if not the most popular one. it can be seen readily from the zoo entrance and dominates the access to the 'African area' of the garden.

An existing hillside was utilised by opening it up from above and one side, and an egg-shaped retainer wall was erected around the inner perimeter of the crater-like hollow. This reinforced concrete wall is 3.96m (13 ft) high, the ovaloid area enclosed measure 23.77 x 20.22 m (78% 66 ft). Within this area a 'mountain' 8.08 m (26½ ft) high was built, supported by a framework of galvanized steel pipes. A door provides access to the hollow core, and 12 drainage pipes discharge around the base of the structure. The minimum safety distances are 2.13 m (7 ft) between the base of the mountain and the concrete wall, and 4.57 m (15 ft) from the receding rock work (beginning at a height of 1.52 m (5 ft) to the upper edge of the wall. The rock work closely resembles stratified layers of limestone.

The surface of the rock has been designed so as to give enough grip to allow the primates to climb virtually every square metre, even of the steepest precipice. There are four vaces or niches, facing east, south and west, at different elevations, and a rather

spacious niche as a feeding shelter for aoudad Ammotragus lervia at the bottom of the mountain. The caves are large enough to give some protection from wind and rain and good 'visual shelter' from dominant individuals, yet they are all in easy view of the public. While there are horizontal shelves of various lengths and widths, there is one particularly spacious flat area that contains a small pool measuring 1.52% 1.37 x 0.45 m (5½ x4½ x 1½) which is fed by a narrow waterfall; a small depression with sand and a tree limb are also located in this area.

The baboons have free access to the indoor quarters during the daytime and are confined to them during the night. The indoor area, not accessible to the public, is located underneath the public walkway, on the east side of the exhibit; it consists of a keeper's area with direct access to the dry moat of the mountain, and three interconnected cages. The two larger ones, measuring 3.05 x 3.05 x 2.85 m (10 x 10 x 9.4ft) each, have an isolation cage and is of smaller dimensions, 2.74 x 1.22 x 2.85 m (9 x 4 x 9.4 ft).

The concrete block walls are expoxy-coated, and between the west wall and the poured concrete wall is a layer of foamed plastic (styrofoam) for insulation. Each cage has several stainless steel framed pressed wood shelves with formica tops upon which the animals rest and sleep; these are attached to two walls at different heights. The cage sides facing the keeper's corridor are of woven wire having a mesh of 3.2 cm (1¼ in), each wire being 0.3 cm (⅛ in) in diameter, except for a framed opening 67.3 x 67.8 cm (26½ x 27 in) which are fixed so that the animals can reach into them through the barred section of the fence. a concrete drinking trough forms part of each cage. All floors are of trowelled concrete. The sliding doors are operated from the keeper's corridor; the

guillotine doors to the outside by cable, pulley and counter weight, and the stainless steel sliding doors between the compartments by pull bar. In addition, during the winter a heavy plastic apron is suspended at each opening to the outside to minimise draught and loss of heat.

Three thermostatically controlled electric space heaters of 7.5 KW capacity hang below the ceiling. An exhaust fan changes the air, and light is supplied through a series of four safety-glass casement windows, 0.76 x 0.76 m (30 x 30 in), and by fluorescent lamps. Attachments for hoses exist in the keeper's area, but the cliff can also be washed by means of fire hose from the visitors' walkway.

A dozen Gelada baboons Theropithecus gelada and three aoudad Ammetragus lervia live in the exhibit. Interaction between the two spacies is friendly, and riding and frequent grooming of the aoudad by the baboons is a feature. (Fig. 4.4)

This exhibit has the credit of using rocks that are natural features for the animals. But natural setting is not complemented with the use of trees or cage mixture. The use of artificial ventilation and thermal control is also a disadvantage.

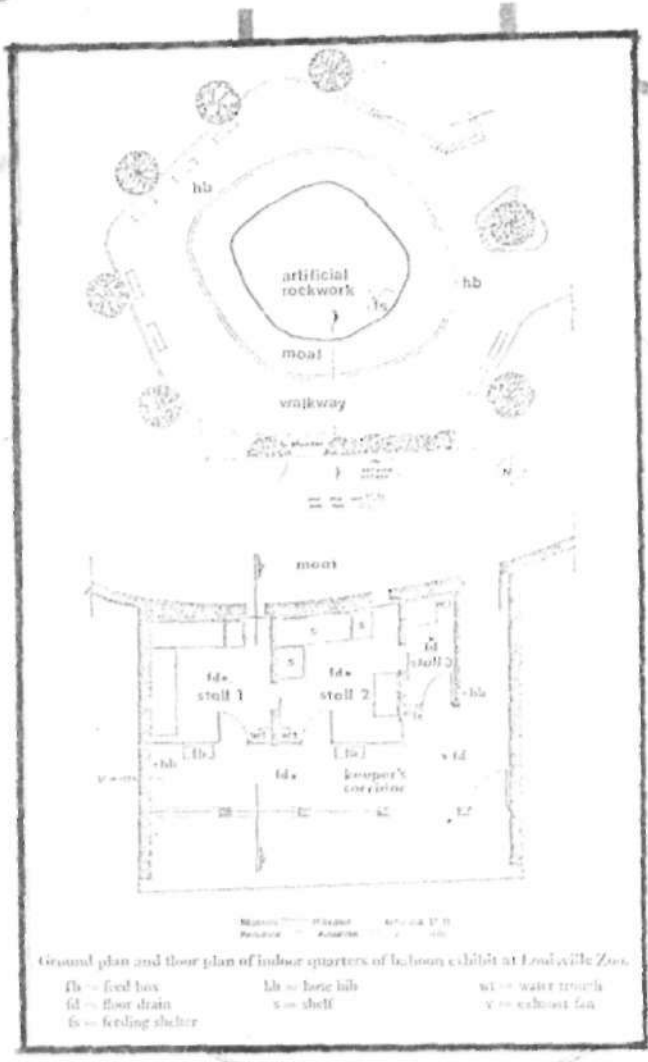
Another disadvantage is the unnatural method of feeding the animals.

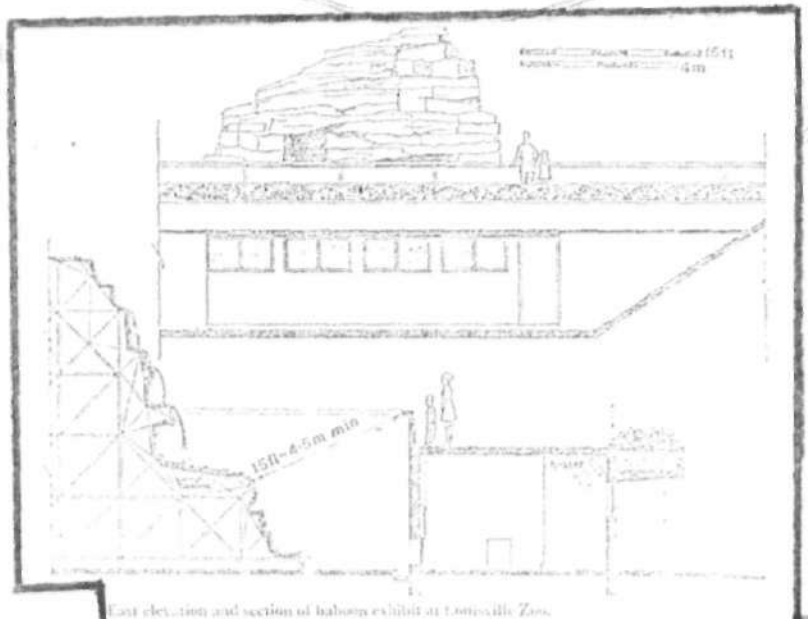
4.50 OTTER EXHIBIT AT ZURICH ZOO

The European otter Lutra l. lutra was exterminated in Switzerland many years ago because it was considered, wrongly, to be the main competitor of fishermen. The Swiss government even paid a bounty for every otter killed (Hediger, 1966). In 1938, Hediger (1940) as still able to record free-living otters in the center of Berne. In 1946 the last bounties were paid for live specimens (Hediger, 1966), and finally in 1952 it was

BABOON EXHIBIT AT LOUISVILLE ZOO (CASE STUDY 4)

Fig. 4.4 Baboon exhibit at Louisville zoo





protected, thanks to the initiative of Professor Hediger. Some 40 to 60 specimens were allegedly surviving at that time (Kreber, 1959) but these have since vanished. Once more protective measures were taken too late. The species was persecuted not only in the wild, but even in the zoo; Zurich Zoo lost three European otters due to visitors during its first 25 years! One of these was killed by a boy throwing stones (Huber, 1954).

All these were important factors taken into account in planning a new exhibit for otters. The usual pool with a small concrete island for displaying one, or perhaps two, otters was no longer justified. It was, therefore, decided to build a compound with the aim of keeping and breeding others on a larger scale and under almost natural conditions. We also hope to educate the public that this species is not a pest, and eventually to re-introduce surplus specimens into suitable wild Swiss habitats. Mr A. Zulauf was the landscape designer and Mr. M. Perrin directed the construction. The costs, amounting to 200,000 Swiss francs, were kindly donated by the Tiergarten-Gesellshaft, Zurich.

The compound consists of four large outside enclosures (tonne of them double-sided) and two small outside pens (see Fig. 4.5). A heated keeper's room with a sink, refrigerator, a tank for keeping food fishes and the otteres' sleeping dens lies in the center. On the opposite wall there is a 4,500 (990 gall) aquarium to show native freshwater fishes such as bream Abramis brama, perch petta fhviatllis, and pile Esox lurius. A room behind this aquarium contains three filters for the two front otter-pools for the aquarium circulation rate of 7,000 l (1,540 gall per hour. In the same room are reserve tanks with separate filtering so that we can quarantine new fishes.

The compound is built into a slight slope, 1.6m (5¼ ft) high concrete walls

border the hexagonal enclosures. The partition between adjourning enclosures is made of sheets of glass 1.4 m (4½ ft) in height. The visitor stands beneath a roof and can see directly into the two front exhibits through four plate-glass windows. This precaution was taken to protect the animals from vandalism. The two 70 cm (27½ in) deep 2,500 l (550 gall) pools have a glass front 3 cm thick, enabling underwater viewing. These pools never freeze, even during hard winters, because the water is kept moving by the filtering and by the otters swimming. Gravel is spread around the pools and all the enclosures are provided with hollow logs. The large land area is planted with grass and bushes. However one must be careful not to plant trees too close to the edge. Our female Himalayan otter L. lutra harang once climbed an adjacent tree, escaped and killed our precious breeding pair of steamer ducks Tachyeres brachypterus as well as other waterfowl. After reintroduction into her enclosure one month later she immediately went back to the former site of the tree and tried to jump out.

Proper sleeping dens are most important. A high percentage of captive otters die of pneumonia because they can not dry their fur. All our enclosures, therefore, give access to special sleeping dens. The otters first enter a gangway were they have to squeeze through narrow holes in four wooden boards. The diameter of these holes 14 cm (5½ in) for Small-clawed otters amblonyx cinerea and 16 cm (6⅛ in) for European otters. A lot of the water is lost from the fur in squeezing through these holes and the animals are quite dry by the time they reach the actual sleeping dens, which measure 80 x 40 cm (31 x 15½ in). Hay is used for bedding, and the dens are heated by lamps. Hard rubber is used for the floor. Visitors are allowed to look through double glass directly into he two front sleeping dens. The otters have accepted this arrangement well

and after installation of light bulbs - do not seem to be disturbed.

The European otter has decreased alarmingly over its entire range and we were able to secure only a single male specimen from Hungary in spite of an intensive search lasting many months. a female Himalayan otter was purchased as a mate. Two pairs of Small-clawed otters were bought to live in the second front enclosure. These were allowed outside even during the coldest days. In fact, they liked to play in the snow, but refused to enter the pool when water temperature was below 14°C (57°F) at 1000 hours each receive two fresh fish (mostly Scardinus erythrophthalmus and Rutilus rutilu) or two chickens or four mice, and at 1700 hours some 800 g (28 oz) of minced beef and one-third of a raw egg supplemented with vitamins. Occasionally, shredded carrots are added to the mixture, and sometimes the otters are given crayfish.

The three otters grew very well, and graph showing their growth in weight, compared with that of a young male European otter raised many years ago at Berne Zoo.

The compound has proved to be very successful with visitors, mainly because the otters can always be clearly observed even under water and in the sleeping dens. There is great hopes that breeding will start, especially in the secluded enclosures at the back for technical data.

There is an attempt in this design to satisfy the animals. However, the use of machine, filter, steps and glazing is very artificial and unnatural. Likewise, the use of glass to expose the animals even in thier sleeping quaters.

4.60 PRIMATE HOUSE AT DENVER ZOO

In July 1970, Denver Zoological Gardens opened a new Primate House as part

of its long-range development programme. For many years, only a few of the more common species were kept here and facilities for arthropods were completely lacking. Now, a representative collection of apes, monkeys, baboons and lemuroids are shown in modern, glass-fronted exhibits.

The building encompasses 1,040 m^2 (11,200ft^2) of space and contains 19 exhibition cages of varying sizes. Two cages for gorillas and orang-utans measure 6x3.6x2.4 m (20x12x8ft) while the cage for chimpanzees measures 4.8x3.6x2.4m (16x12x8ft). These three cages are all fronted with electrically-charged, laminated safety glass 19 mm (¾ in) thick. Interior cage walls are faced with glazed ceramic tile of a soft green colour. This same tile is also used as a wall surface in the public areas of the building and in the remainder of the cages. All cages contain elevated reclining benches for the animals' use as well as an intricate system of welded pipework for excersisng. Nylon chain is provided for climbing and play. The gorilla exhibit contains a platform scale which registers the animal's weight for the interest of the visitors. All the ape cages communicate with transfer cages and with each other by means of sliding stainless steel doors. There are no outdoor cages or moats, and all animals are kept under controlled environment conditions.

There are 13 cages measuring 2.4 x 2.2 x 2.1 m
(8 x 7½ x 7 ft), houses larger species. At each end of the
building are two cages of 4.3 x 2.2 x 2.1 m (14 x 7½ x 7 ft).
(Fig. 4.6).

All these settings are too artificial and will cause psychological distress to the animals over time.

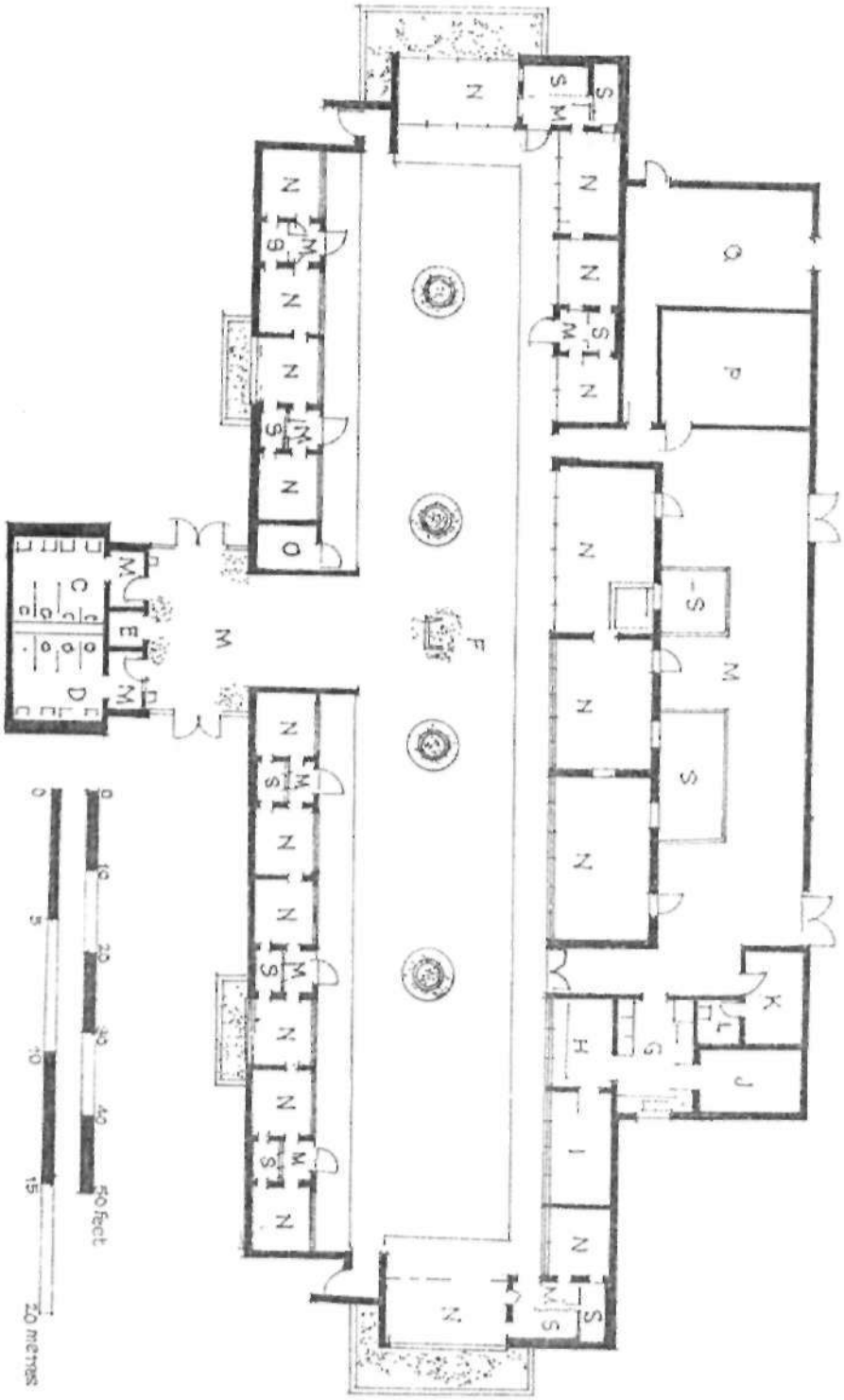


Fig. 4.6 Primate house at Denver zoo

DENVER ZOO (CASE STUDY 6)

CHAPTER FIVE

5.0 THE DESIGN

5.1 SITE ANALYSIS

The site where the zoo is located has basically four characteristic features: the enclosures, where the animals are kept; the supporting building facilities such as stores, administrative building, education center e.t.c; the tree covered land set aside for future expansion; and the water stream that is passing through the site.

It would be a wise design decision to use such natural features of the site like the water stream, aquatic animals like crocodiles or hypotamus. But I deliberately avoid that feature for the health of the animals. As all waste water from the neighbouring settlements pollute the waters. And chlorinated pipe-borne water is known to be lethal to aquatic animals. As other natural features like rock are not obtained on the site no much exploitation of the natural features of the site is made.

The existing animals enclosures were analysed according tot he group of animals they have in relation to others. An attempt was made to understand whether in the original design the animals were zoned according to their groups. (Fig 5.1)

5.2 THE DESIGN PHILOSOPHY AND CONCEPT

Careful study and understanding of the structure of the animals community and the role of groups and individuals, (Chapter 2) together. The architectural requirement of a modern zoo (chapter 3) will clearly define the problem and challenges of the design of a zoo.

In response to that, in this design, instead of designing an enclosure for each

individual animal specie as it is conventionally done, the natural relationships of the animals as found in the wild is maintained. This is done in two ways;

For the Carnivores that comprise of the master predators - Lions, the scavengers - hyenas, jackals and vulture are all combined in one complex. There is a central court that each can have access through a dastardly operated guillotine gates. The master predator - i.e lion is opened first after releasing a prey. The lion will naturally attack and kill the prey while the scavengers watch. After the lion has finished its meal, then the scavengers can be allowed to come and scavenge. The culture in particular moves freely to any of the enclosures as it will be on trees while others as it will be on trees while others are on ground.

This activity is carefully controlled and motivated from a control room, that the guillofire gates are being operated. In this way, the animals will maintain their natural roles as in the wild. And it serves as a training for survival in case of being reintroduced to the wild again.

While for the herbivores, symbiotic relationships such as commensalism are very common. It is well known that animals with common enemies also combine efforts for defence and alert each other for incoming danger. The interdependence of some insectivores birds on some animal species that disturbs insects as they graze, while the bird in turn removes ticks from the animals body is very popular. All animals with such interdependence or known to be staying together in harmony with each other are grouped and put in the same enclosure.

Advantage of this approach is that the tiny spaces that each of these animals used to be confined in a conventional method, combined together,will give each of the animals

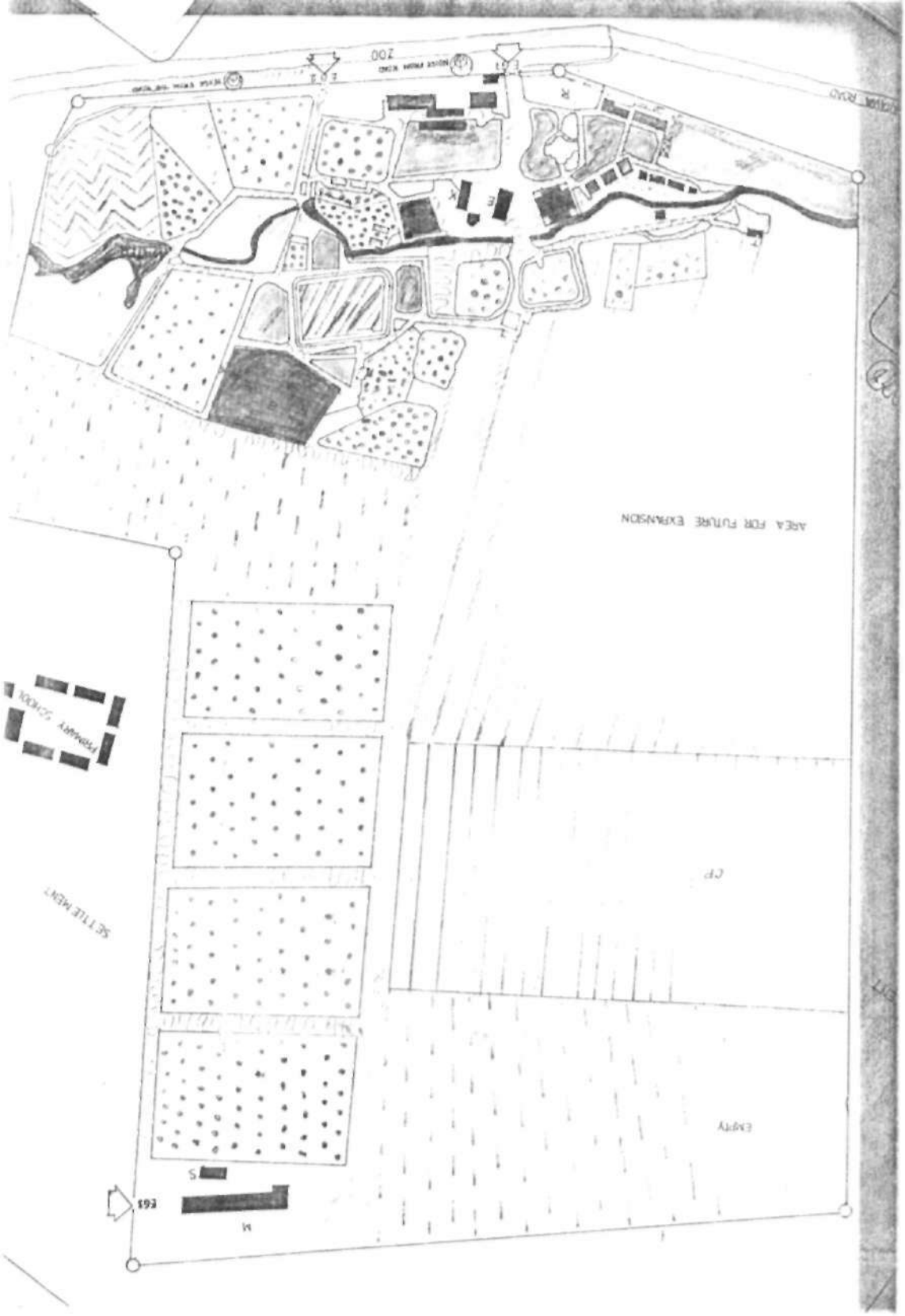


Fig. 5.1 Site Analysis

longer space to roam about. In some combinations each of the animals will prefer different parts of the enclosures without conflict with the other. For instance, the primates and birds will prefer to live on trees, while antelopes for example will be on ground preferably open grassland. In this design each of the cages os both birds away and mortal animals enclosure.

Another feature of the enclosures is the artificially arranged rocks that perform the function of dens. This is because the block rectangular dens conventionally used are too artificial and in conflict with a semi-natural setting.

The restraining niches are also provided in all of the enclosures. This makes it possible, using the fuillotine door controlled from outside, to confine an animal for transfer of medical attention.

It should also be noted that the overall design of the zoo is deliberately planned to be constructed in phases according to the prevailing financial circumstance.

5.3 DESIGN REPORT AND APPRAISAL

5.31 CHILDREN'S ZOO

This is the section for the zoo where pet animals are kept. In this section there is also children play ground. There are additional charges on going to the on going to the children's zoo. In this section the former tiny cages that were housing the animals are planned to be sued for the pet animals. Other services available in the children's zoo include Horse, Camel or Donkey ride.

5.32 THE ENTRANCE GATES

There are four entrance gates. Two pedestrian and two Velinclar. One of the pedestrian gates lead directly tot he children's zoo and the charges are higher, while the other one is the main pedestrian gate to the zoo. The main vehicular entrance lead to the car park while the other one is a service entrance that lead to the animals Holding Pens and sanatorium, and other facilities not opened to the public.

5.33 THE SANATORIUM

This is the clinic for the animals. It comprises of laboratory facilities for tests, small and big animals treatment rooms, offices and conveniences. At two of its sides lie the Holding Pens.

5.34 THE HOLDING PENS

There are two holding Pens; one very close to the service gate - Quarantine holding Pens. These are basically cages used to keep animals for screating on animal for the first time in the zoo. The other holding Pens is used to keep sick animals that are receiving treatment. The two holding pens share the same clinic facilities.

5.35 THE STORES

These are places for storage facilities. It comprises of two blocks, the existing store and the former administrative block that is converted into a storage facility.

5.36 THE AQUARIUMS

There are two Aquariums: fresh water and salt water aquarium. Each comprises of four compartments. It is a miniature aquatic environment artificially created to keep aquatic animals for display. (Fig. 36).

5.37 THE TERRARIUM

The terrarium is a miniature glazed environment for smaller reptiles that is keeping them in an enclosure or cage might present alot of difficulty. There are also two in number. Terrariums only difference from Aquariums is that they contain no water.

5.38 THE NOCTURNAL HOUSE

This is a terrarium where by the lighting condition inside is reversed. During the day it is lit with artificial red light, which research shows that nocturnal animals can not defect. And at night when there are no visiting public a powerful artificial light is put on.

This is in order to provide the public with a view of highly nocturnal animals like kiwi e.t.c (Fig 5.38).

5.39 THE CAR PARK

The car park has a total capacity of parking 235 cars; both for staff and visitors.

5.3:10 THE ADMINISTRATIVE BLOCK

The administrative block has an office each for the principle zoo curator, Deputy principal zoo curator, higher zoo curator (Animals) higher zoo curator (public services)

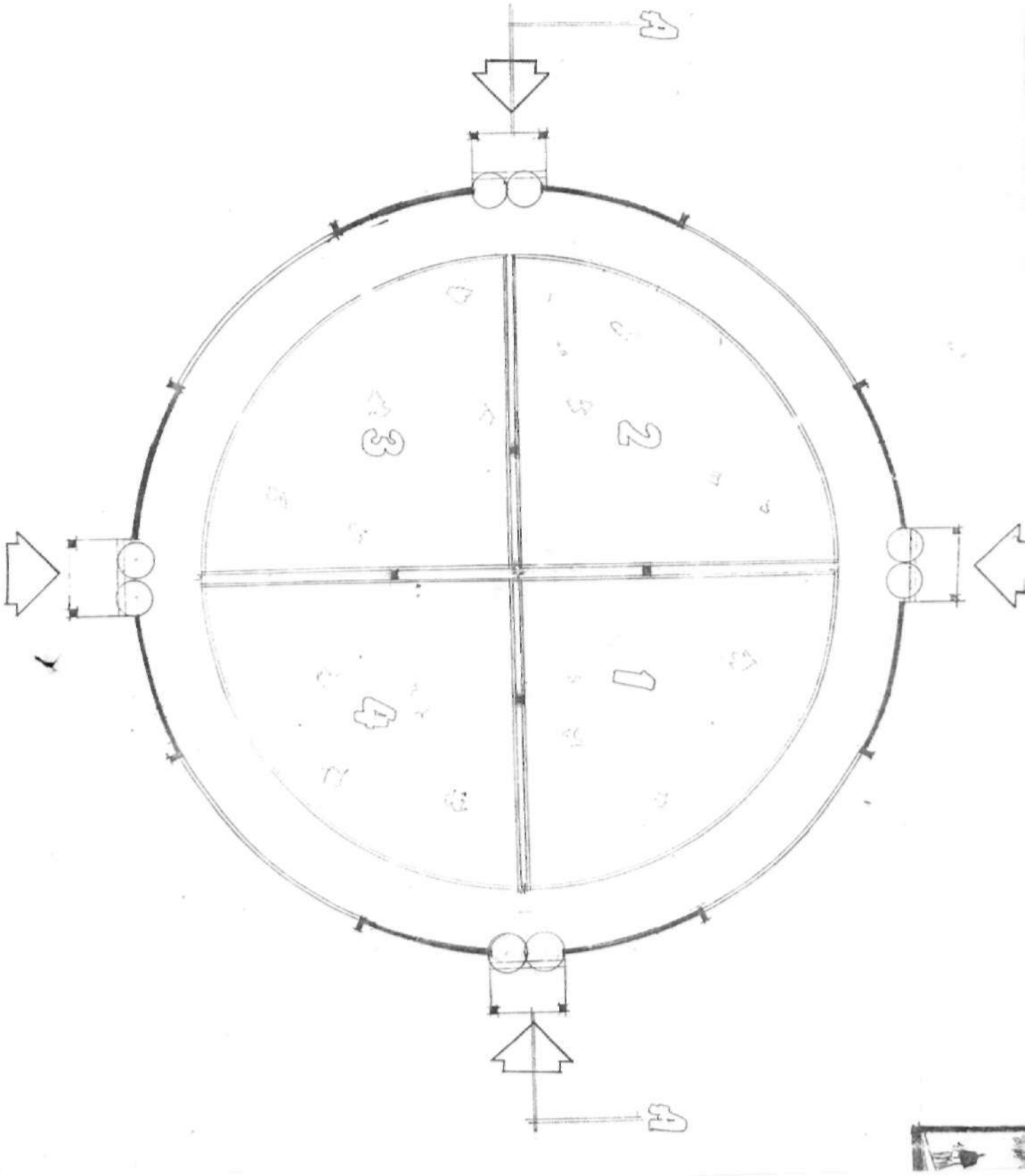


Fig. 5.36 The Aquarium

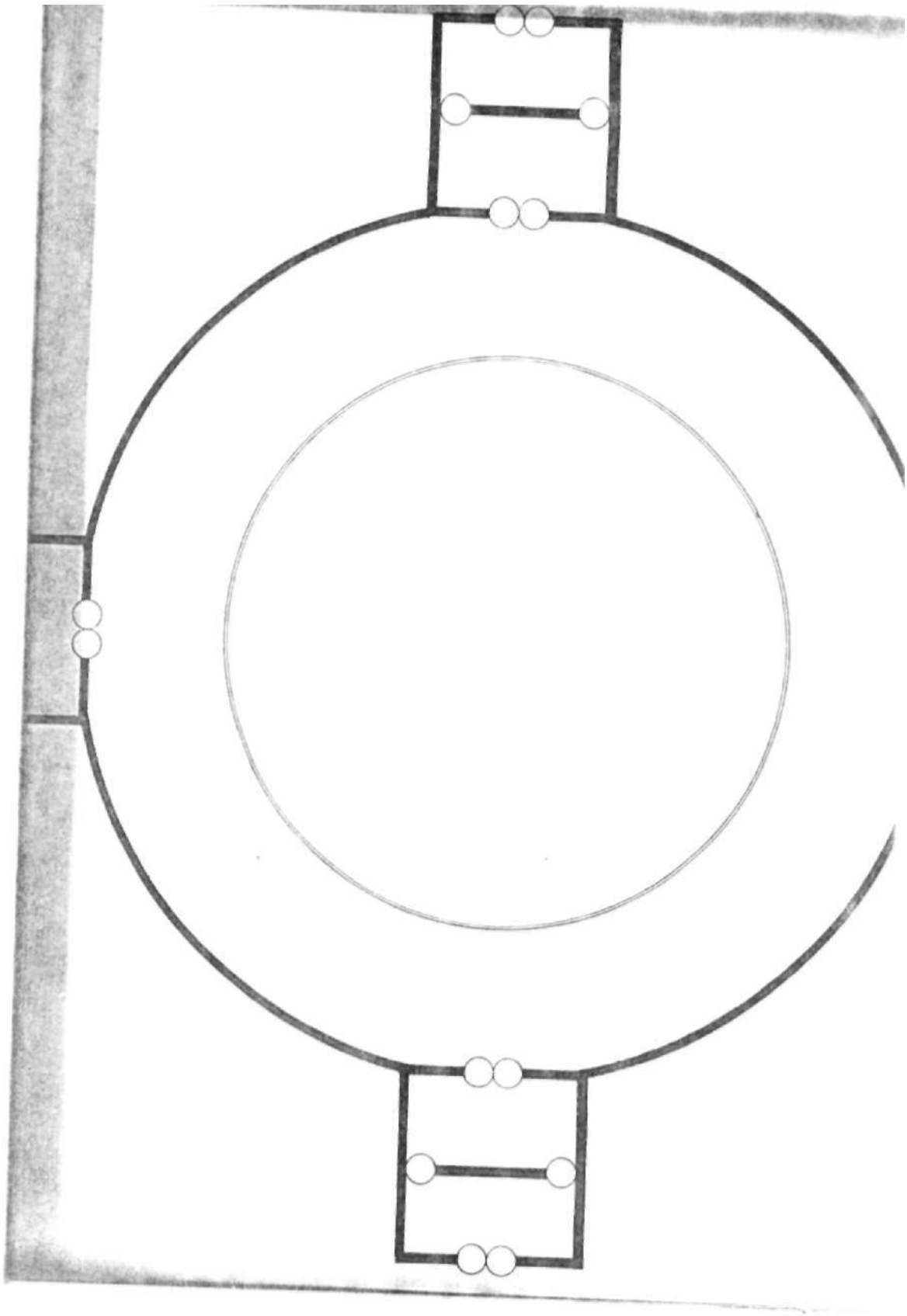


Fig 5.38 The Nocturnal house

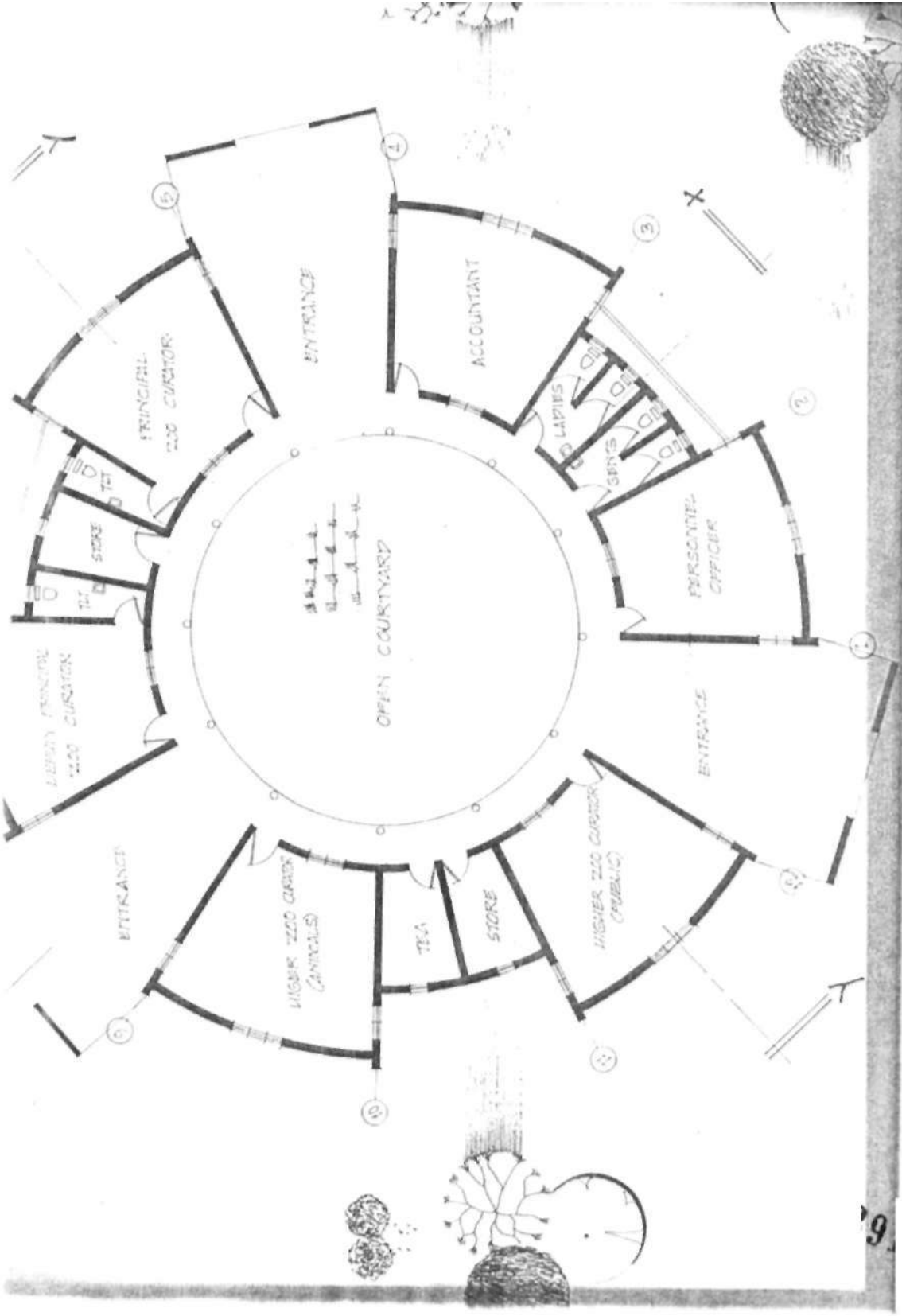


Fig 5. 310 The Administrative Block

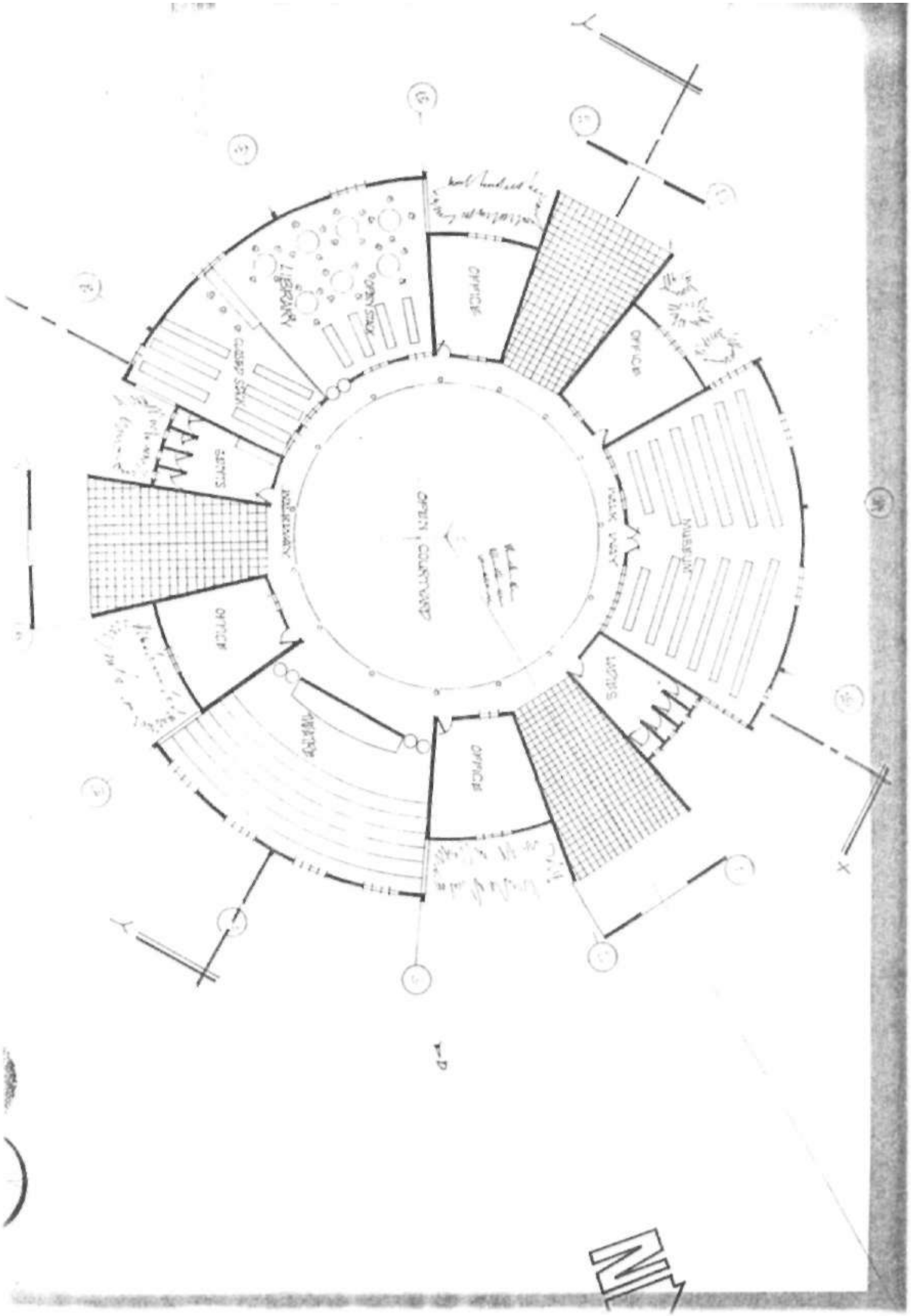


Fig. 5. 311 The Education Block

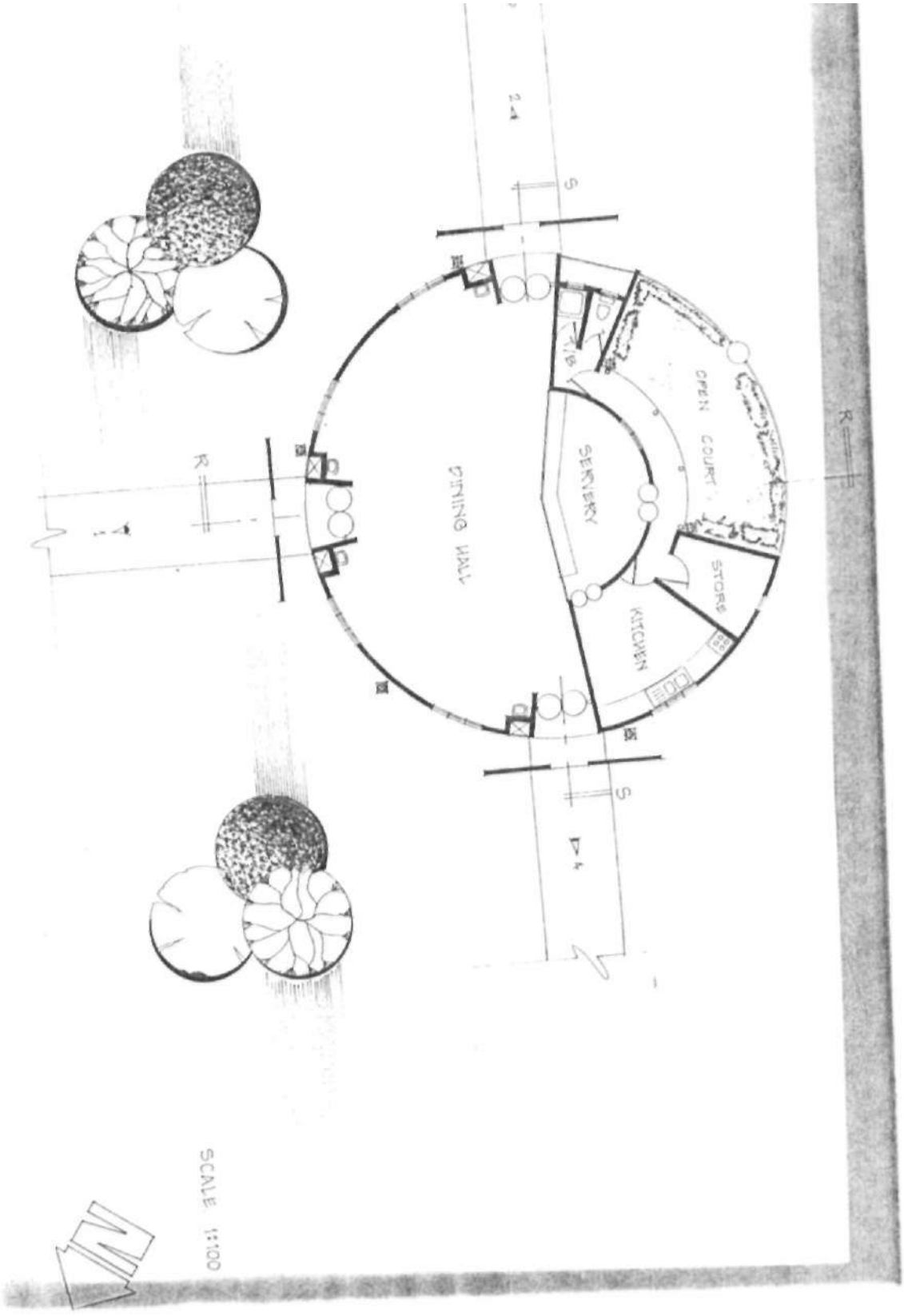


Fig. 53. 12 The Restaurant

and the Personnel Officer. (Fig 5:3:10)

5.3:11 THE EDUCATION BLOCK

The education block contains three sections; the library, the museum and a mini-theatre for audiovisual displays and public lecture. There is also an office attached to each.

5.3:12 THE RESTAURANT

In the restaurant there is a kitchen, a store, servery, Dining hall, toilet/ball and an open courtyard for outdoor cooking (Fig 5.3.12). The dining hall has a capacity of up to thirty people at a time.

CONCLUSION

In this work, the subject of study: Kano zoo was studied in details, the animals collection, the visitors, the existing site plan etc. Also the study area, kano itself was studied from the weather and climate to culture and traditions. etc.

Thereafter the life of the wild Animals that are the zoo inmates was reviewed in details according to category.
Then, the Architectural requirements of the animals according to modern standard, which was also defined, was studied.

Finally a design proposal was made, in which a completely new approach was used. In this design, the natural habitat of the animals was simply imitated. The Animals were allowed to live as close as possible to the way they live in nature.

This is in order to achieve the major role of zoos in modern sense, i.e, to breed and possibly reintroduce the animals back into the wild.

The animals are allowed to develop all natural characteristics that will enable them survive in the wild.

QED

REFERNCES

1.) William Bridges (1979), "Zoological Garden", The Encyclopedia Americana International Edition, Vol.29, Americana corporation.

2.) Zoological Scoiety of London, International zoo year book.

3.) Bill Jordan and Stefan Ormrad (1978). The last great wild beast show, London.

4.) Gerald Durrel, Jersey wild life preservation Trust, London.

5.) Zoological society of Lodon, London zoo guide.

6.) Zoological society of London, Whipsnade zoo Guide.