AN INTRODUCTION

TO THE

LANDSCAPE

GUIDE FOR FIELD TRIPS OF I.U.C.N/C.C.T.A.
SYMPOSIUM ON CONSERVATION OF NATURE AND
NATURAL RESOURCES IN MODERN AFRICAN STATES

ARUSHA, TANGANYIKA, EAST AFRICA

5TH TO 12TH SEPTEMBER, 1961

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WILD LIFE AND LAND USE ECOLOGY AND CONSERVATION IN MASAILAND AND OTHER AREAS OF THE SOUTHERN, RIFT VALLEY AND CENTRAL PROVINCES IN KENYA AND NORTHERN PROVINCE, TANGANYIKA

GUIDE FOR FIELD TRIPS OF
SYMPOSIUM ON CONSERVATION OF NATURE AND
NATURAL RESOURCES IN MODERN AFRICAN STATES

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5TH TO 12TH SEPTEMBER, 1961

BY

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WITH THE ASSISTANCE OF

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TANGANYIKA INFORMATION SERVICE, EAST AFRICA TOURIST TRAVEL ASSOCIATION

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INTRODUCTION

The purpose of this guide booklet is to provide an introduction to understanding the landscape, the wild life and land use ecology and conservation in the areas through which the Conference field trips pass—Kenya and Tanganyika Masailand, and other areas in Southern, Rift Valley and Central Provinces in Kenya and the Northern Province of Tanganyika. We wish to emphasize that this guide refers to the areas involved in the field trips, not all of East Africa, and it is *not* intended as a complete description, study, review or scientific paper on the areas involved and their ecology and conservation problems. Rather it is an introduction to the landscape and the basic principles involved.

The purpose of the field trips held as an integral part of the Arusha Conservation Conference is to illustrate and emphasize the basic principles discussed in the Conference, i.e. the identity of the natural resources involved, their values, the ways in which they can be developed and used, and the results of both constructive and destructive resource use. Mr. G. Watterson, Secretary-General of I.U.C.N., stated that the tours are intended "to bring home a real understanding of the resource, its value, and the manner in which it can be properly exploited". And that "examples should be seen of both good and bad land management and project development. Mistakes are often more enlightening than success". (Summary of ASP I.)

The field trips have been arranged for the participants to visit a wide variety of habitats ranging from arid semi-desert grassland at 3,000 feet elevation to mountain mist forests at 8,000 feet; from areas where the annual rainfall averages from below 20 inches to about 70; and to examine both constructive and destructive examples of various types of cultivation, grazing, water development, forest and watershed utilization, scenic area development and utilization of the wild life resource. Wherever possible the trips have been routed so that the participants travel from undeveloped to developed resources, from good management to bad, or vice versa; to present clearly, emphasize and compare the results of constructive and destructive resource use.

In many cases scientific knowledge concerning the ecology of the areas involved in these field trips is incomplete. Studies into various aspects of the ecology and conservation of these areas are currently in progress. Among these studies are those undertaken by various members of the East African Agriculture and Forestry Research Organization and the East African Veterinary Research Organization, the D.R.M. Stewarts of the Fauna Research Unit and Capt. Zaphiro of the Kenya Game Department, Dr. P. E. Glover and other personnel of the Tsetse Survey and Control Branch of the Kenya Veterinary Department, Mr. E. Ellis of the Royal National Parks of Kenya, the Kenya and Tanganyika Forest Departments, the (Tanganyika) Northern Regional Research Centre, Dr. P. Greenway and others of the East African Herbarium, and the authors (Lamprey, Biologist, Tanganyika Game Department; and Talbots, Wildlife Research Project sponsored by U.S. National Academy of Sciences—National Research Council, New York Zoological Society, and Government of Kenya).

In addition, recent surveys, reconnaissances, or studies which have been carried out in the area include those by Mr. A. Brooks, Dr. F. F. Darling, M. and Dr. B. Grzimek, Prof. W. H. Pearsall, Dr. H. C. Pereira, Dr. G. Petrides, Prof. H. Heady and Dr. B. Wright.

Those who wish additional detailed information are referred to the above individuals or organizations.

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Arrangement of the Guide

The field trips involved include two Mid-Conference Field Trips provided by courtesy of the Governments of Tanganyika and Kenya, and a series of optional Post-Conference Field Trips.

The guides for each field trip are presented in separate sections (c.f. Contents). To avoid repetition in the detailed tour guide, a series of basic principles common to all trips is presented in the first section. These are then referred to in the appropriate places on each field trip. The Basic Principles section can be read as a background before starting the trips, or it can be used for specific reference when mentioned in the guide.

The guide for each field trip is divided into portions corresponding to the portions of the trip travelled at one time, usually between night stops. For example, Mid-Conference Trip A (Post-Conference Trip 4) is divided into three sections: Arusha to Manyara; Manyara to Ngorongoro; and Ngorongoro Crater. Mid-Conference Trip B (Post-Conference Trip 5) is divided into: Arusha to Marangu; Marangu to Amboseli; Amboseli; Amboseli to Namanga; Namanga to Arusha.

The Field Trip routes may be covered in either direction, therefore mileages are given starting at either end of each day's trip. For example, the Arusha-Manyara division has mileages from Arusha to Manyara given first, with the mileages from Manyara to Arusha following in parentheses.

SECTION 1—BASIC PRINCIPLES

1. Vegetation and Topography

Masai Steppe refers to the predominately level grassland or savannah country of Kenya and Tanganyika which is occupied by the Masai. This land lies both to the east and west of the Great Rift Valley (c.f. map). Scattered mountain masses rise above the steppe.

A highland forest and grassland zone is found higher on the mountains (c.f. Basic Principles 9—Mountain Forests). In the steppe proper the two main vegetation types are *scattered tree grassland or open grassland* and *desert grass—bush land.*

The first type, *scattered tree grassland and open grassland* consists of perennial grassland, either open or with scattered trees or bushes, predominately *Acacia.* This vegetation is found on the Athi-Kapiti Plains south of Nairobi, in the savannah land in Narok District, in parts of the Serengeti Plains region and in parts of the Tanganyika Masai Steppe east of the Great Rift Valley. It is usually found at elevations between about 4,000 feet and 6,500 feet.

Desert grass—bush land is a more arid, poorer vegetation type and is characterized by an assemblage of mostly deciduous bushes, *Acacia* and *Commiphora* being characteristic, with occasional taller trees and sparser grass cover than the previous vegetation type. This vegetation is found in the Amboseli Reserve and farther south in the eastern Tanganyika Masai Steppe. It is usually found at elevations below 4,000 feet.

2. Climate and Desiccation

From the standpoint of understanding the landscape we are concerned with climate as it affects vegetation, soil, and land use. Therefore we are basically concerned with sources of moisture gain and loss. *Actual* rainfall—that which reaches the earth—is rarely *effective* rainfall—that which provides water actually used by vegetation or which goes to subsurface water. High temperatures, low relative humidity, dry winds, and hot sunshine are all factors which bring about loss of moisture through evaporation. These factors are constantly removing water brought by precipitation. Thus the water brought by light showers may be completely evaporated before it has a chance to sink into the soil or plants can use it. A torrential downpour may result in very high runoff of water, with only a small part of the actual rain penetrating and remaining in the soil. A great deal of rain at the wrong time of year may be of less value to plants than much less at the right time. Figures of average annual rainfall then, only tell part of the story. We are more concerned with the distribution and reliability of the rain and the evaporation conditions between rainfalls.

The average annual rainfall appears moderately high throughout most of the Masai steppe country in both Kenya and Tanganyika, but the distribution is very irregular. In such areas it is possible for a fairly rich vegetation to develop over a period of undisturbed years. This vegetation improves and maintains the conditions of moisture needed for its own existence; surface evaporation is reduced by plant growth above which acts as a windbreak and shade, maintaining a higher relative humidity under the plant than in the open, and surface vegetation usually increases the amount of water absorbed into the soil from rains when they do come. Under a good vegetation cover even though the rainfall may be quite irregular, the vegetation can take full advantage of it. However, when such an area is cleared by burning or overgrazing the surface is exposed to wind and sun evaporation which reduces the relative humidity and actually changes the climate at ground level. The drier conditions support a less rich surface vegetation and do not support immediate re-establishment of that vegetation if it is killed or dies. The watershed effectiveness of the area is reduced so that only a fraction of the irregular rainfall becomes effective rainfall (c.f. Basic Principles 3—Watershed).

Consequently, where rainfall is irregular and evaporation high, as described above, the effect of clearing the vegetation is to create a desiccation—drying up—condition similar to that expected from a much lower average annual rainfall. Where climatic conditions such as this exist a given degree of overgrazing may create semi-desert conditions over a large area, which in turn may influence the moisture balance in surrounding areas; while in a more reliable climate the same degree of overgrazing would have little effect on the total vegetation. Due to this climatic characteristic, much of the Masai steppe is particularly

vulnerable to burning- and overgrazing-induced desiccation; and this in part explains why the activities of a relatively small human population have had such a profound effect on the vegetation, soils, and surface climate.

3. Watershed

Effective watershed is land which captures the often irregular rainfall and supplies it to lands below in the form of a fairly uniform flow of clear water throughout the year. A relatively bare hillside may produce more water at the bottom than a well wooded hill, on which the plants use some water; but it acts much like a tin roof, the water rushing down in a spate following the rain, with no further water forthcoming until the next rain. The spate of water only aids grazing for a short period, and it usually carries a quantity of silt with it. Where dams are provided to catch the floods the silt washed down usually fills them in a relatively short time.

Dense grassland can be quite good watershed, so long as it is not so heavily trampled that infiltration of rain water into the ground is impeded. Bare soil is usually the least effective water receiver. The surface often becomes compacted and the rain that falls on it immediately washes off or directly evaporates. The little that sinks in is often evaporated right back out from the desiccating effect of sun and wind on the unprotected soil surface.

4. Vegetation Succession and Stability

In many lands in this region, given the present climate, soils and available vegetation, but excluding other influences such as fire and grazing the vegetation would in time develop toward some form of woody growth—bush, woodland or forest. From bare ground there probably would be a succession of plant types from drought resistant pioneer herbs and grasses through low shrubs and tall grasses toward higher woody growth. Each stage alters the conditions and prepares the way for the next stage. This is known as succession, and each plant type is considered a stage in that succession.

Different treatments of the land can accelerate the succession, halt the succession at any given stage, maintain it there, alter it, or reverse it. A good example is the open red oats grassland that exists in parts of Masailand. A combination of fire and grazing apparently maintain (and probably help to bring about) this grassland stage. Periodic not-too-frequent fires suppress shrubs and woody vegetation, and together with moderate grazing maintain a vigorous growth of perennial grasses. Too heavy grazing weakens or kills the perennial grasses which may be replaced by tougher, sparser pioneer grasses and other plants; while undergrazing or stopping burning may allow shrubs and woody growth to "invade" the grassland.

Different factors work in different areas, so that each landscape is really the result of a series of dynamic interrelationships. The landscape that one looks at is not a static thing, but rather it is constantly changing; not only is land use management required if one wishes to change conditions, it is equally required to maintain them as they are.

5. Grazing and Overgrazing

Grazing animals do not eat grass *in general*, they eat *particular* grasses. Cattle, goats, sheep, and each species of wild ungulate appear to have preferred grasses or other plants which they will eat first if they are available. When the preferred grasses are not available most animals will resort to eating whatever plants are left. However, before resorting to second choice foods they will seek out and eat every available bit of the first choice ones.

Cattle on Masailand usually show a decided preference for several species of perennial grasses. These species are apparently particularly palatable to cattle and are of high nutritional value to them. If cattle grazing pressure is too great on such grassland these preferred grasses will be eaten out and will remain only as occasional relict plants protected from grazing by thorn bushes or rocks. Their places will be taken by a series of other grass which have survived basically because they are not very palatable to cattle, and which in general are poor fodder producers of low nutritional value to cattle. Thus the first sign of overgrazing is often such a change in grassland composition; the area looks the same to a casual observer, but the productivity of the land for cattle has been greatly reduced. Subsequent overgrazing may reduce even these grasses, leaving only the most inedible coarse grasses and herbs, and exposing the ground surface to erosion.

Goats and sheep utilize grass at least as much as cattle in the region, and their grass preferences appear similar. There is little evidence in this region that goats will clear brush or keep it out of grazing. Where goat grazing is heavy enough to much affect the brush it will severely damage or destroy the grasses.

Overgrazing also removes much of the standing dry grass, which, if left, could be burnt periodically during dry seasons. Under many of the conditions prevailing in the Masai steppe grasslands these fires when properly managed encourage high yield perennial grasses and keep the grassland free from invading woody plants such as whistling thorn. Where insufficient fuel for such fires remains, brush invasion may proceed unopposed

Another result of overgrazing is to encourage erosion through destruction of the soil structure and cutting of the grass turf by the animals' hooves.

The degree of grazing that constitutes overgrazing varies by plant species. Generally speaking no more than 60 to 70 per cent of the year's growth can be removed from Masailand perennial grasses without causing damage. Plants with runners and root shoots, such as Star Grass can stand around 70 per cent utilization while the perennial bunch grasses cannot stand over 50 to 60 per cent annual use. Considering these figures it is easier to see how one season's very heavy livestock grazing can result in significant range damage.

Other factors contributing to overgrazing are season of use and intensity of use. Livestock herded by Masai are characteristically moved and grazed in tight bunches, which intensifies the hoof damage and degree of plant use. Wild animals usually graze in loose dispersed formation, continually moving and thus spreading the grazing pressure.

6. Food Preferences of Wild and Domestic Herbivores

As noted above, cattle, goats and sheep in Masailand usually show a decided preference for several species of perennial grasses, and their grass preferences appear similar. A population of mixed species of wild animals makes more efficient use of most marginal grazing land than does domestic livestock, basically because each species appears to have its preferred plant foods to which its feeding habit and digestive tract are adapted. Where a dozen or more species of wild herbivores live in the same area, studies now in progress are showing that the food preferences of the various species are strikingly different and complementary. As an example, wildebeest, zebra and topi are basically grass eaters, yet there is relatively little overlap between each with regard to grass species and stage of growth eaten. Impala, Grant's and Thomson's gazelle are mixed feeders, utilizing grass, herbs and woody plants depending on the season and stage of growth. Their grass preferences are complementary to each other

and to those of wildebeest, zebra and topi. Buffalo are mixed feeders, yet their grass preferences are entirely different from the antelope and zebra. Rhinoceros and giraffe rely mainly on woody shrubs and trees for their feed, thus, where such a mixed population of East African wild ungulates exists, virtually all the vegetation growth of an area provides nutrition for the animal mass living on it. Where cattle, goats and sheep graze a similar area, only a very small part of the total vegetational growth provides preferred and efficient nutrition for the animals involved, much of the potential productivity of the area is wasted, and a small part of it gets disproportionately heavy use.

7. Fire

Fire is probably the most important single landscape modifying tool used by man. It has been used by the inhabitants of this region for many centuries, probably much longer. Many grassland areas and vegetation associations in the Masai steppe are at least partially maintained by fire, and new grassland areas are continually being cleared from forest or bush by fire. Consequently fire must be considered as a factor or a land management tool, not as something intrinsically bad or good. As with any tool, fire can be misused, through too liberal, too scanty, or ill-timed application.

8. Erosion

Erosion, the wearing away of ground by wind or water, is obvious in the form of gullies, benches, blowing sands or dust, and bare sheet washing. However in this region probably the most prevalent erosion is a sheet washing of soil from between the plants of depleted grassland, and even the existence of this form of erosion is not realized by most people.

Grassland in good condition protects the soil by a more or less dense mat of soil-holding plant bases, roots and runners, which physically hold much of the soil surface; while the grass stems and leaves protect even the otherwise exposed surface from wind, water and temperature extremes. In overgrazing-depleted grasslands, plants are farther apart and little standing grass remains, consequently much more surface is exposed; in addition the individual plants often have smaller clumps or individual stems, hence each plant physically holds less soil than plants in vigorous grassland. The result is that during rains, very considerable amounts of soil are inconspicuously washed away into low areas and down the watercourses. Since the poor grade grasses or herbs still remain, the casual observer does not realize what is happening, until he watches the runoff during a rainstorm or has occasion to notice the deposits of soil in low areas or downstream. By this form of erosion the top soil layers from vast acreages are washed into watercourses and eventually carried downstream, and the total amount of soil lost is very significant. An indication of the depth of recent soil loss on a given area can be gotten from examination of the plant or grass bases; often they stand on a small pedestal of soil which has been held against erosion by the roots, the height of the pedestal indicating the depth of soil lost since the growth of the plant. These tiny pedestals in grassland are analagous to the larger ones, considerably over ten feet high, that occur under tree or bush growth in badly eroded areas.

9. Mountain Forests

All the major mountains and larger hills in this region used to have extensive forests. In most cases these forests consisted of associations of cedar (*Juniperus*), podo (*Podocarpus*), and mixed broad-leaved trees. The original forests extended far down the lower slopes of the mountains in comparatively recent times. Fires and cultivation have destroyed most of the lower forests, and

evidence of the former conditions can be seen in the form of small patches of relict forest, remnant gallery forest along watercourses, and forest trees left standing for shade in plantations. On some mountains, such as Meru, Kilimanjaro, Monduli and the Crater Highlands, the Forest Department has created Forest Reserves to preserve remaining original forest in order to maintain its watershed value and to furnish a timber yield from systematic exploitation in carefully controlled small areas. However, on the Mau Forest, Lolkisale, Kitumbeine, Gelai, and other areas uncontrolled grass fires are annually cutting into and reducing the remaining forests.

10. Dry Season Holding Areas

Throughout the Masai steppe in Kenya and Tanganyika, surface water may be abundant during the wet seasons but in the dry seasons it is limited to a relatively few streams and springs, marshes or lakes, whose perennial water originates in the forested mountain areas. During the wet seasons the wild animals would be dispersed throughout the steppe country. As the surface water supplies and grass dried up with the advents of the dry seasons, those animals which required free surface water (such as wildebeest, zebra, Thomson's gazelle, topi, and kongoni) would retreat back to the vicinity of perennial water. They would remain in these dry season holding areas, i.e. the areas within easy access of the only available surface water, until the rains produced more surface water and fresh grazing elsewhere, and they would again disperse. The patterns of Masai livestock grazing were much the same. The carrying capacity for grazing animals of the whole Masai steppe area was determined by the dry season holding areas.

In recent years the forest watersheds have been greatly diminished and the water from most of the remaining watersheds diverted for agriculture or piped to water troughs for the Masai. Of the seven or eight major dry season holding areas that existed less than 20 years ago in the Masai steppe of Northern Tanganyika east of the Great Rift Wall, only two remain, the northern end of Lake Manyara and a portion of the Tarangire River.

11. The Masai

The Masai people are a particularly important factor in wild life conservation in East Africa. Until recently they were tolerant of wild life and they are one of the very few East African tribes who did not hunt extensively. Consequently most of the finest wild life areas left in Kenya and Tanganyika are in Masailand.

Masai are a nilo-hamitic people, formerly notable warriors but now primarily devoted to raising livestock—cattle, goats and sheep. The cattle represent wealth and prestige, so the emphasis of the Masai has been on numbers of animals rather than quality.

In former days the Masai followed their herds using the rangeland in much the same manner as the wild grazing animals, grazing over the whole available country during the wet season and retreating to the permanent water supplies during the dry season. The numbers of their herds were limited by disease, raiding, and available water. With peace, highly effective veterinary services, and the provision of water points, most of the natural limitations on the Masai livestock have been removed. In the absence of effective artificial limits, the livestock numbers have increased enormously in the past 50 years with the result that virtually all of Masailand that is available to grazing is overgrazed, and the areas in the vicinity of the dry season water points are devastated.

In Kenya there are about 60,000 Masai living in about 15,000 square miles of Masailand. Tanganyika's Masai population is about 57,000 living in a land of about 23,250 square miles. The total population density in the combined Masailands is about 3 persons to the square mile.

As long as the numbers of their livestock were within the carrying capacity of the rangeland there was no particular conflict between the Masai and the wildlife. However, as the livestock numbers increased and the pasture lands became extremely degraded, the carrying capacity of the land for wildlife was greatly reduced. In addition, the Masai have become concerned about competition between their herds and the remaining wildlife for what is left of the grazing.

Recently the Masai have begun to appreciate that the wildlife represents an extremely valuable resource. In the past year in Kenya the Masai African District Councils have, with Government assistance, taken over the Amboseli Reserve and established the Masai Mara Game Reserve. These are now being operated by the Masai who receive the entire revenue, and with Government aid they are increasing the tourist potential by improvements on roads and lodging facilities.

SECTION 2—MID CONFERENCE TRIP A

(First Part of Post Conference Trip 1, *and Post Conference Trip* 4)

Arusha to Lake Manyara—77 Miles

(*Mileages* from *Arusha are at left and mileages* to *Arusha are in parenthesis*)

MILE 0 (77)

Arusha, 4,600 feet elevation. Rapidly growing township of some 11,000 population. Provincial capital and centre of a small but flourishing farming area. Its location on the Great North Road makes it the gateway to Tanganyika from the north, and it is very important as a tourist centre and the centre of the Tanganyika safari industry.

Prior to the 1914-18 war Arusha was the German command headquarters for Northern Tanganyika. Their fort which stands behind the new Provincial Administration buildings has been gazetted an Ancient Monument. It is planned to set up the Swynnerton Memorial Museum in the old fort. This will be largely a natural history museum with sections on ethnology, sociology and archaeology. Its function will be largely educational, and it will serve as a place where visitors can have a preview of the natural history of Northern Tanganyika.

MILE 2 (72)

For several miles the road west leaving Arusha passes through the remnants of mountain forest (c.f. Basic Principles, 9—Mountain Forests).

MILE 5 (72)

Arusha airport on south of road. North is Mount Meru (4,565 metres) with the eroding ash hills on its west shoulder. South of the road an area of intensive European farms extends for about 15 miles. The average annual rainfall here is still in the region of 40 inches yet where the land is not carefully managed it appears desert (c.f. Basic Principles 2—Climate and Desiccation).

MILE 8 (69)

Zone of dry land agriculture in land previously overgrazed by Masai livestock. Erosion severe, note gullying from cattle tracks on hill south of road. Vegetation is healing an old erosion gully on north of road (c.f. Basic Principles 8—Erosion).

MILE 13 (64)

Water development dam on north of road, with good example of a non-washing spillway. This is one of several water developments in this immediate area which is the centre of a resettlement area for the Warush people who are being moved from their overcrowded lands on the base of Mount Meru.

Large mountain to north is Monduli. The administrative centre of Masailand is at the mountain base. Monduli is one of a chain of volcanic mountains extending from Kilimanjaro west across the Masai steppe to the Ngorongoro Crater Highlands (c.f. Basic Principles 1—Vegetation and topography). There is still some original forest on Monduli, part of which is now protected as forest reserve.

In the early 1900s this whole area of Masailand through which the road passes had a rich perennial grass cover with scattered small trees. Serious overgrazing has brought the country to its present condition (c.f. Basic Principles 11—Masai, and 5—Overgrazing). Just west of Monduli Mountain is a small plateau with a fine grass cover remaining which survives in its former condition because of East Coast Fever, a tick-borne livestock disease that denies the Masai access to the plateau for grazing. The average annual rainfall through here is over 30 inches, but in the overgrazed areas near the road the effective rainfall is much less (c.f. Basic Principles 2—Climate and Desiccation).

MILE 21 (56)

The road passes over a small plateau with a sparse growth of tall grass which gives the area the appearance of good pasture. Actually the grass has survived because it is unpalatable for livestock which have eaten out all the edible grasses. This grass serves to hold the soil to some extent but is virtually useless for grazing (c.f. Basic Principles 5—Grazing and Overgrazing).

From this point to the east one can see the series of small craterlets scattered to the south of 14,979-foot high Mount Meru. Although there are local areas of plains soils, most of the soils through which the road is passing are of volcanic origin. Looking south, the large mountain is Lolkisale, once heavily forested. Now only one small patch of forest remains and it is reduced each year by the fires set by Masai (c.f. Basic Principles 7—Fire, and 9—Mountain Forests). One small perennial stream still flows off the mountain (c.f. Basic Principles 3—Watershed, and 10—Dry Season Holding Areas).

MILE 23 (54)

There are a series of small earth dams constructed in this area to provide water for the Masai livestock.

MILE 27 (50)

Losimingur Mountain, about 7,500 feet elevation, is directly ahead (west). In recent times this mountain too was forested. Now a little forest has survived the fires and remains on the top and in some of the canyons.

MILE 32 (45)

Eleunata Escarpment. The Eleunata dam (for Masai livestock) is visible to the north-east. Good view of soil and rock structure in the road cut.

MILE 35 (42)

Part of this area along the road (especially the north side) does not belong to the Masai and grazing has been controlled, consequently there is better grass still remaining.

From here westward bush along the road has been selectively cleared as part of a tsetse clearance scheme.

MILE 48 (29)

Makuyuni, another centre of Warush resettlement where provision of water has made cultivation possible. Rainfall here is between 20 and 30 inches. The soils are plains soils, the volcanics having been left near the Eleunata Escarpment.

The road south from here is the main trunk road leading through Tanganyika to the Rhodesias. To the west the road leads to Lake Manyara and the Ngorongoro Crater Highlands.

After the turning toward the west the Highlands are directly ahead (west). The Ngorongoro Crater lies in the low area (about 8,000 feet) in the centre of the mountain mass, with peaks rising on both sides. On the left Oldeani rises to 10,460 feet and on the right Loolmalasin rises to 11,969 feet.

MILE 60 (17)

Mount Lengai, 9,443 feet, East Africa's only active volcano, is the very conical mountain to the right (north) of the Crater Highlands. Lake Manyara is now visible to the south-west, near where the road meets the steep western wall of the Great Rift.

Lake Manyara is a major dry season holding area (c.f. Basic Principles 10—Dry Season Holding Areas). During the wet season the plains animals (wildebeest, zebra, Thomson's gazelle, etc.) range eastwards across the rift and northwards up it. In the dry season they return to the north end of the lake drinking at the points where fresh water flows into the lake.

The National Park is limited to the west side of the lake. The east side is a no hunting area which serves as a buffer zone for the park and the area north of the road is a Game Controlled Area where hunting is allowed under control of the Game Warden.

MILE 70 (7)

Mto Wa Mbu, settlement in the northern end of the Manyara forest. This is one of the few remaining examples in East Africa of lowland forest of much the same type as is found in the Congo. The forest owes its existence to a long line of springs coming from the escarpment which also feed the lake. A portion of the forest has already been destroyed to make small, temporary maize farms, and the process of cutting and burning the trees to make fields can be seen in progress beside the road. It is extremely fortunate that the Tanganyika Government had the foresight to save most of this unique and valuable area from further destruction.

MILE 71 (6)

Entrance to Lake Manyara National Park. The park was established in 1960. It includes the limited area bounded by the rift wall on the west, the road and cultivation on the north, cultivation on the south, and the lake proper on the east. The park contains a variety of habitats ranging from gallery forest to grassland and swamp to soda flats, and a variety of large mammals and birds, especially migratory waterfowl including flamingoes and pelicans.

The proximity of cultivation poses a substantial management problem for the park. Elephant, buffalo, and other animals move from the protection of the park to the surrounding fields where they are shot in defence of the crops. In view of the terrain (including lake bed and steep Rift wall) and the animals involved (including elephant) the problem of restricting this movement is extremely difficult.

The park has a population of game that is resident all year, but like Nairobi National Park and the Ol Tukai region of Amboseli, much of the rest of its wild life grazes over a considerably larger area during the wet season, returning to the park's grazing and water during the dry periods. Overgrazing of domestic livestock has greatly depleted the grazing lands outside the park, especially to the north up the Rift Valley. The wild grazing animals, their wet season grazing lands depleted, will have to rely more and more on the relatively limited grazing around Lake Manyara proper. If the grazing pressure becomes too heavy through too many wild animals being forced to graze in the small area of the park it may become necessary to control the animal's numbers in some way to avoid habitat depletion through overgrazing.

Another vital consideration is the park's water supply. Most of the park's water comes in the form of springs or streams off the escarpment. The watershed feeding these is probably the remaining forestland above and west of the Rift Wall. Survival of the park is dependent on the maintenance of its water supply (c.f. Basic Principles, 3—Watershed).

A first priority of the new National Park's staff is improvement of the access roads to facilitate visitors entering and travelling through the area. Other duties include anti-poaching and the creation of a small biological museum at the park office.

MILE 73 (4)

Western wall of the Great Rift Valley. From observation points here and on the top of the escarpment near Lake Manyara Hotel one can see clearly the lay of the park in relation to agriculture and pastoral lands. Fresh water enters the lake through the forest on the north where there is a considerable swamp and reed bed. Most of the lake to the south is very shallow and during dry periods the water level recedes, leaving wide expanse of soda flats. The lake lies at 3,150 feet elevation on the bottom of the Rift Valley.

MILE 77 (4)

Lake Manyara Hotel. This is a recent development, having been opened by the Government of Tanganyika on 15th August, 1960. The hotel is an example of a privately owned and operated tourist facility just outside a national park, an arrangement which has proved beneficial for all concerned. There are 36 beds at present, and the hotel has been so successful that accommodation for eight more persons are being provided. The hotel will then have a potential of about 16,000 visitor nights a year, since Lake Manyara National Park is open all year.

Manyara to Ngorongoro—35 Miles

(*Mileages* from *Manyara are at left and mileages* to *Manyara are in parenthesis*)

MILE 0 (35)

Lake Manyara Hotel. The road climbs from here out of the Rift Valley through the red earth soils of the Mbulu Highlands area. The Mbulu people are cultivators who also raise some livestock.

MILE 9 (26)

The Ngorongoro Crater Highlands are to the north. Much of the intervening country has been forest (c.f. Basic Principles 9—Mountain Forests). Along the present forest edge one can see where fields have recently been opened, areas where cultivation has been abandoned and the forest is regrowing, and the scars of forest fires.

MILE 16 (19)

To the north near the forest edge are coffee plantations, some of them started by the Germans prior to the 1914-18 war. These plantations and the Mbulu agriculture along the road rely on the forest watershed for irrigation.

MILE 18 (17)

Traditional Mbulu houses near the road. These were partial dug-outs and among other things they provided some defence against raiding tribes, especially the Masai. The more conventional houses with peaked roofs are of recent introduction.

MILE 19 (16)

An area of severe erosion which has been accentuated by increases in cattle numbers in recent years.

MILE 19.5 (15.5)

Road fork. The western road leads to Oldeani, an important coffee growing centre relying on the Crater Highlands for watershed for irrigation. Coffee is Tanganyika second most important export crop. The road north leads up through the forest to Ngorongoro.

The road climbs first through a transition zone below the present highland forest, with wheat fields, coffee plantations and subsistence maize cultivation—some of it on extremely steep slopes.

MILE 23 (12)

The terrace-like Mountain Acacia trees on the slopes to the east were typical of a transition between savannah forest usually at 5,000 to 6,000 feet elevation. Because they are extremely vulnerable to fire they are now rarely found. This grove has been protected from fire because it is in agricultural land.

MILE 24 (11)

Gate to the Ngorongoro Conservation Unit. Until 1959 the Ngorongoro Highlands were part of the Serengeti National Park. In 1959 the status was changed and about 3,000 square miles of the Crater Highlands and part of the Serengeti Plains adjoining the highlands to the north and west made a Conservation Unit. The purpose of the Unit was to achieve a balanced management of the resources, to develop the natural resources of water and grazing in the interests of both human and wild life populations. There is a Conservation Unit Authority with representatives of the Masai Administration, Veterinary Department, Forest Department, Water Development and Irrigation, and Game Department.

The road rises through a magnificent example of dense highland forest. From various points there is a view back south down the forest, to the coffee plantations, wheat fields, and lower down, the Mbulu subsistence farms. Small reservoirs can be seen along the forest edge providing irrigation water for the plantations below. Although the slopes are very steep, the dense vegetation precludes erosion and provides a fine watershed.

Elephant and buffalo can often be seen feeding in openings in the forest vegetation.

MILE 28 (7)

First view of the Ngorongoro Crater looking north. The crater is 12 to 15 miles in diameter and covers an area of about 120 square miles. The crater floor is about 2,000 feet below the level of the rim. The three principle water supplies to the crater are the Lerai Stream which flows into the small Lerai Forest to the left from this view point, the Laitokitok Spring which feeds a long, narrow swamp area in the foreground, and the Munge Stream dropping into the far side of the crater from the north-east.

Driving along the crater rim the road alternates between views north and east into the crater and west into the highland forest area. Open grass glades are heavily grazed by buffalo.

MILE 32 (3)

Small area of Mountain Bamboo. There are also extensive patches of this bamboo on Oldeani Mountain and on Mt. Meru.

MILE 35 (0)

Ngorongoro Crater Lodge. This tourist accommodation was originally run by the Tanganyika National Parks. After the shift from Parks to Conservation Unit administration, the lodge was taken over by a private enterprise. During the past year the lodge has accommodated something over 5,000 visitor nights and the total number of visitor permits issued to visitors to the Crater Highlands from March, 1960, through March, 1961, was 12,678. The value of this area to the tourist industry of Tanganyika is great.

Ngorongoro Crater

Leaving the Crater Lodge, the road south is retraced for about two miles, then the new road to the crater floor branches off to the east. Formerly the only vehicle track into the crater circled around the south side of the rim, then dropped gradually from the east side. The new track, completed within the past two years, allows visitors to reach the crater floor within 30 to 40 minutes.

The cut banks on the track down the crater wall show the dense mat of plant roots holding the soil, illustrating how vegetation halts erosion (c.f. Basic Principles 8—Erosion) even on the steepest slopes.

Lerai Spring issues from the base of the wall near where the track reaches the crater floor. About 1904 the Siedentopf Brothers established ranches in the crater, one at Lerai Springs and the other on the Munge River, across the crater. Remnants of the house and cultivation can still be seen, along with the eucalyptus trees the Germans planted near the Lerai Spring. The other Siedentopf's ranch across the crater is particularly well marked, and the remnants of the thick walled buildings and planted eucalyptus are conspicuous on a hill overlooking the Munge Stream.

The first Europeans to see the crater were a few hunters and explorers in the late 1800's. They were greatly impressed by the crater itself and the resident wild life, but wild life at that time was abundant enough in other areas that the crater populations were not considered exceptional. A few Masai were resident in the crater in the late 1800's. The Siedentopfs established their ranches and attempted to raise cattle and harvest some of the wild life of the crater until the 1914-18 War. Following the war the only resident humans in the crater were a few Masai. Safari parties visited the area regularly, and as the wild life populations on the Masai steppe became progressively more and more depleted, the fame of the still abundant crater population increased.

A perennial water supply and rich soils provide abundant all-year grazing for a high population of wild life and domestic livestock, and there is some movement of both wild and domestic animals into and out of the crater. Wildebeest and zebra are the most abundant wild animals, followed by the gazelles. However, a great variety of wild life can be seen. The Tanganyika Game Department estimates that there are the equivalent of roughly 12,000 wild animal units (wildebeest-sized animals) in the crater. The Conservation Unit has placed the number of cattle regularly grazing in the crater slightly above 3,000, and sheep and goats over 7,500.

In addition, the Conservation Unit places the livestock population in the Crater Highlands surrounding the crater as about 82,661 cattle, 64,288 sheep and goats, and 4,008 donkeys.

During the past several months as a result of extreme drought conditions and over grazing, starving Masai livestock from areas as far away as Longido (over 60 miles airline across the Rift Valley) have been brought to the Crater Highlands to graze. Because of this, additional numbers of livestock have been flooding into the crater.

The carrying capacity of the Ngorongoro Crater and the surrounding highlands is very high, but many parts of the area show signs of severe overgrazing and trampling. One effect of this misuse in the higher areas is to encourage the spread of *Eleusine* grass, a coarse, tough grass which invades overused high altitude grassland here (c.f. Basic Principles 4—Vegetation Succession and Stability). Where grazing has been heavy around the crater rim, whole fields have been taken over by *Eleusine*. The *Eleusine* serves the useful purpose of holding the loose powdery soils against erosion, and the evidence is that where this grass is left alone, i.e. where the area is not overgrazed and heavily trampled by livestock, the more palatable grasses will re-establish themselves.

Uncontrolled grass fires, while helping keep woody vegetation out of the grasslands, are continually eating into the remaining forests in the crater, along the rim, and in the surrounding highlands (c.f. Basic Principles 7—Fire).

The swamps and reed beds in the crater, especially those below the Laitokitok spring and Munge Stream are particularly valuable as habitat for a variety of animals and birds. They have been, for instance, the chosen lying-up area for the lions. The combination of fires, overgrazing by domestic livestock, and the drying-up of the water sources is rapidly destroying these swamp habitats. The Munge Stream has been diverted by a pipeline (leading to cattle water troughs) near its source above the crater, and in June of this year the formerly perennial stream was dry.

A series of new Masai manyattas have been established in the past months around the outlets of the remaining springs in the crater, and the livestock trampling and effect on the vegetation further diminishes the flow reaching the swamps and lower grazing areas.

From the crater floor the effects of recent overgrazing are obvious in a number of areas. Near the Lerai Forest, for example, there is widespread degradation of the perennial grasses and replacement by invading shrubs such as sodum apple (c.f. Basic Principles—5—Overgrazing and 4—Vegetation Succession and Stability). Across the crater above the Siedentopf ranch near the Munge Stream the soil-holding grass turf has been broken in many places, each break resulting in the start of gully erosion. The most striking recent effect of the livestock influx is the almost complete destruction of large areas of reed bed and swamp especially along the Munge Stream.

From the above it is obvious that the principal management problem involved in the crater area is livestock control. If it is decided that the primary purpose of Ngorongoro Crater is for wild life—to harvest the income from tourism and possibly meat—then the region must be firmly managed with that in mind. The water supplies and wild life grazing managed so that the habitat and carrying capacity for wild life does not suffer. In any event, if no grazing controls are to be enforced either in the Highlands or below, and the Highlands continue to be used for emergency grazing during the periodic droughts for the overpopulation of Masai cattle from the surrounding lowlands, the increasing numbers of Masai livestock will cancel out improvements made in water supplies and grazing, and there will be a continual degradation of the watersheds and pastureland.

Another wild life management problem is poaching. Although the occasional spearing of a rhino or lion is a perennial problem, the poaching of rhino in the crater has received considerable publicity in the past two years and, in view of the limited number of rhino and their high tourist value, this appears to be a serious problem.

Here, as in Amboseli, after years of protection, the wild animals apparently have come to regard visitors' vehicles as a part of the habitat, and most of the animals are extraordinarily tame. The numbers and variety of wild animals and birds, and their tameness, combined with the striking topography and vegetation of the crater region make Ngorongoro one of the world's finest wild life areas.

Ngorongoro has proved itself of outstanding value to the tourist industry of East Africa. With improvement of access roads the importance and economic value of Ngorongoro to Tanganyika and to East Africa should continue to increase—if the problems with domestic livestock management can be settled before the habitat for the wild life is too greatly damaged.

SECTION 3—MID CONFERENCE TRIP B

(*First part of Post Conference Trip 6 and Post Conference Trip 5*)

Arusha to Marangu—71 Miles

(*Mileages* from *Arusha are at left and mileages* to *Arusha are in parenthesis*)

MILE 0 (71)

Arusha.—4,600 feet elevation. Driving east for about 15 miles the road passes through the forest zone on the lower slopes of Mt. Meru. 14,979 feet high, Mt. Meru is one of a line of volcanic mountains extending from Kilimanjaro west to the Ngorongoro Crater Highlands. Among these is Lengai, East Africa's one remaining active volcano.

The major mountains all had extensive forests (ci.f. Basic Principles 9—Mountain Forests). Two mountains, Meru and Oldeani, also have areas of Mountain Bamboo. The patch of bamboo forest on Meru, high on the southern lip of the crater, can be seen from the road near Arusha.

North of the road, higher up the mountain is forest reserve. Below the forest reserve the former forest is intensively cultivated by the Warush people, and farther east, by the Wameru. Use of this area is so intense that people are being resettled elsewhere, out on the Masai steppeland where water development schemes are being carried out. Cultivation in the rich forest zone here is mostly in the form of small fields. Coffee, bananas and maize are important crops along and above the road, while subsistence crops and cotton predominate in the now drier, lower areas. From the road all stages of transformation of the forest to cultivation may be seen, with occasional relict patches of the original forest.

MILE 7.5 (63.5)

Tengeru.—4,200 feet elevation with average annual rainfall of about 40 inches. Here are the Northern Regional Research Center and the Natural Resources School. At the school young African men are trained in animal husbandry and farming techniques and, until recently, forestry. Some students are trained for Government work as instructors and technical administrators, while others return to private farms.

The Northern Regional Research Centre carries out both basic and applied research into various aspects of agricultural research, pasture research, disease control, and land planning.

MILE 8 (63)

As the road begins to lose elevation, the forest zone becomes more arid. African and European coffee plantations are beside the road.

North of the road is Ngurdoto Crater National Park, four square miles established in 1960. Ngurdoto is a small crater, 1.5 miles in diameter with a floor 400-500 feet below the rim. This would probably be a crater lake, but water drains out through the side of the rim, and the level floor consists of about one-third swamp, one-third rich, springy star grass turf, and one-third forest which continues up the crater walls and is continuous with the Mt. Meru forest. The crater animal population includes buffalo, elephant, rhinoceros, giraffe, warthog, waterbuck and bushbuck. Some animals, especially buffalo and elephant, probably move back and forth between the large Meru forest and the crater through the forest. This natural wild life sanctuary has been looked after with great care by the Game Department which managed it as a Game Reserve, and at the end of 1960 it was handed over to the National Parks.

MILE 17 (54)

Transition zone from forest to bushland. This area closely resembles the Miombo bushland which covers a large part of Tanganyika south of the Masai steppe. Examples can be seen of arid marginal cultivation, including farming on very steep hills.

MILE 21 (50)

The Miombo-type vegetation gives away to acacia thorn bush vegetation more typical of the Masai steppe country. The Tanganyika Masai steppe is continuous with the Kenya Masai steppe to the north, and from here the Masai steppe country extends about 250 miles south before it gives way to Miombo country (c.f. Basic Principles 1—Vegetation and Topography).

MILE 27 (44)

The road has dropped to the Sanya Plains, lying between and to the south of Meru and Kilimanjaro at an elevation of from about 1,500 to 3,000 feet, with an average annual rainfall ranging from about 30 inches in the north to below 20 inches in the south. This was formerly an outstanding game area noted for its fine grass cover and large herds of plains wild life. The combination of overgrazing by domestic livestock plus loss of the dry season water supplies has vastly reduced the carrying capacity of this area for both cattle and wild animals (c.f. Basic Principles 5—Overgrazing, and 10—Dry season holding areas).

Overgrazing by domestic livestock in the past several decades has destroyed much of the original perennial grass cover of the area. This area has friable volcanic soil and once the protective vegetation cover is destroyed erosion by wind and water is swift. The soil structure and underlying volcanic rocks may be seen where water-cut gullies cross under the road.

A considerable portion of the watershed forest on the lower mountain slopes has been turned to cultivation and a large part of the streams have been diverted for irrigation, both for small subsistence farms and for large plantations. Much less water than in former times reaches the plains area during the dry season. To the south of the road is a line of trees, the Kikuletwa River, largest of the rivers that flowed off Mt. Meru across the Sanya Plains. Due to upstream diversions and intense cultivation along its banks extending into the plains proper, the river ceased to be perennial in 1952. The wild life now relies on small streams from Kilimanjaro, and the carrying capacity of the Sanya Plains for wild life is very greatly reduced (c.f. Basic Principles, 10—Dry season holding areas).

Small herds of wildebeest, zebra and gazelle may be seen, with some ostrich and giraffe in the bush areas.

Adjoining the road is the Sanya Controlled area. Tanganyika has approximately 33,000 square miles of controlled area, i.e. areas where hunting is under control of the game warden, but all other human activities may take place without reference to him. There are three types of such area: areas of outstanding faunal interest which cannot be declared reserves because of established human activities; buffer zones around reserves and national parks; and areas used to achieve standardized yields by controlled hunting on permit.

The revenue from hunting licences alone is significant. In Tanganyika, between 1955 and 1959, the revenue from hunting licences and controlled area permits averaged about £60,000 per year, and it was continually rising, reaching about £72,000 in 1959.

MILE 37 (34)

The road is entering the red earth zone, basement soils instead of volcanic. To the north are West Kilimanjaro and Olmolog, extremely productive and efficient European farms some of which get up to two wheat crops a year.

MILE 40 (31)

Transition from arid Sanya plains to well watered area at base of Mt. Kilimanjaro with average annual rainfall of 40 inches or above. Seasonal grazing land has given way to plantation and subsistence agriculture.

MILE 43.4 (27.6)

Coffee Research and Experiment Station, aimed at improving the already high yield from this important crop.

MILE 47 (24)

Moshi.—Progressive and wealthy township of about 15,000 population. Moshi District is one of the major tourist centres of Tanganyika and the town is well provided with hotels, plus easy access to Amboseli, Tsavo, Ngurdoto and other game areas of the Masai steppe of both countries.

Moshi is one of the richest districts in Tanganyika. The Chagga people grow coffee as their primary cash crop, mixed with bananas which are a staple of their diet. These are grown on the rich, valuable mountain lands on Kilimanjaro. Farther down the slopes maize and other subsistence crops are grown, with cotton mostly under irrigation. There is also considerable production from European estates growing sugar, coffee, sisal, wheat and maize. Although this agriculture is a rich source of income to the district, a by-product of it is to reduce the value of the lower lands for grazing by domestic or wild animals, through diversion of the dry season water. Part of this problem can be overcome

by more efficient use of the water in irrigation—on the southern side of the mountain it has been estimated that between 40 and 70 per cent of the water in African irrigation furrows is wasted, and work is now in progress to correct some of this loss. In addition, several dams have been and are being constructed high on the mountain to provide water by pipelines to the grazing lands below. From the standpoint of wild life conservation it is hoped that some of this water will be made available to wild animals as well as domestic.

MILE 63 (8)

Large estates of sisal, Tanganyika's most important income producing crop.

MILE 65 (6)

Himo, near the Kenya border.—From here one road continues eastward leading to Tsavo National Park, Voi, and Mombasa in Kenya. To the south is the road to Tanga and Dar es Salaam, the Territorial Capital of Tanganyika. This road is being considerably improved at present. Good roads are essential if the potential of the tourist industry is to be realized. To the north is the road leading to Marangu, and thence around the mountain to Kenya. From Himo the road to Marangu climbs rapidly through sisal plantations into the former forest zone, first through maize and other subsistence fields, then to coffee and banana farms.

MILE 71 (0)

Marangu at 4,500 feet elevation, has an average annual rainfall about 70 inches. This hotel, and the one at Kibo, two miles farther up the mountain have 120 beds between them and handled an estimated 12-13,000 visitor nights in the past year. In addition to the pleasant setting—on the shoulder of 19,340-foot high Mt. Kilimanjaro, Africa's highest mountain—the climate, these hotels provide a jumping off point for drives or hikes up a road to Bismark Hut, at about 10,000 feet on the edge of the moorland zone of Mt. Kilimanjaro, for those wishing to climb the mountain, and for fishing in the nearby trout streams.

Marangu to Amboseli—87 Miles

(Mileages from Marangu are at the left and mileages to Marangu are in parenthesis.)

MILE 0 (87)

From Marangu the road climbs between about 4,500 and 6,000 feet elevation around the eastern side of Mt. Kilimanjaro. From Marangu to Loitokitok at the edge of Kenya Masailand, the road passes from the forest zone with rainfall of about 70 inches per year down to the desert grass bushland of the Masai steppe with below 30 inches rainfall per year. (c.f. Basic Principles, 1—Vegetation and Topography).

On Mt. Kilimanjaro, as on Mt. Meru, intensive cultivation has rapidly replaced the forest until the recent establishment of a Forest Reserve, higher up the mountain. The road travels through this zone of intensive agriculture, with fields crowded from the lowest elevation at which crops will grow up the mountain to the forest reserve boundary. In fields beside the road the process of opening the forest can be clearly seen. First the surface vegetation is cleared and burned and the branches lopped off the trees, most of which are left standing. Then the land between the trees is intensively cultivated. There are many examples of excellent cultivation through this area. Often several crops are grown on

the same field: first, tall trees above providing shade and wood; then a layer of bananas below providing fruit for human food, stems and leaves for livestock, and trash for mulch under the coffee; then coffee and occasionally other crops below. This assemblage of different plants with differing requirements for sun, moisture, and root systems is analagous to the natural vegetation which it replaced, and is ecologically very sound land use. Some cattle, goats and sheep are kept here but livestock are generally kept in stalls and fed, rather than allowed to graze in the open.

MILE 9 (78)

View northeast across Kenya Masai steppe toward the Chyulu Mountains. In the foreground are examples of extreme erosion due to destructive cultivation on steep slopes (c.f. Basic Principles, 8—Erosion).

MILE 14 (73)

The road is dropping out of the moist forest zone through a drier transition zone with large acacias. Rainfall is about 40 inches a year.

MILE 32 (55)

The road is now in Masai steppe, acacia thorn savannah country with rainfall near 30 inches a year. Near the road are some good examples of open acacia woodland.

This region has been very seriously overgrazed by Masai for several decades (c.f. Basic Principles, 5—Grazing—Overgrazing). During the past two years a very serious drought and in places, an infestation of Army Worm, has intensified the effects of the previous overgrazing on the landscape, and the carcasses of cattle that have recently died of starvation may be seen all along the road.

MILE 40.8 (46.2)

Outward Bound School.—Outstanding school boys of all races regularly take part in "Outward Bound" courses here, emphasizing character building, leadership through physical training, co-operation, team work, and appreciation of out-door living. The courses normally culminate in a climb up Mt. Kilimanjaro.

MILE 41 (46)

Loitokitok Village.—From here the road to the west leads to the Rongai Forest Station. The important nurseries and plantations of cypress and pine here originally were endangered by raiding elephants from the forest reserve above. About six years ago the Tanganyika Game Department put up an electric fence to exclude these animals. The fence proved successful, and with careful maintenance by the Forest Department it continues to keep the elephants out, providing a working illustration to show that the presence of big game does not necessarily render forestry or agriculture impossible.

The road north from Loitokitok in Kajiado District, Kenya, leads toward Amboseli. This country looks and is terribly devastated by domestic livestock. The descriptions of this region recorded from about 60 years ago record open grassland or acacia woodland, all with a good grass cover and with abundant wild life. Overgrazing by herds of Masai cattle, and more recently, by sheep and goats, have brought about the present semi-desert conditions (c.f. Basic Principles, 2—Climate).

In extreme cases such as this, virtually all of the permanent soil holding vegetation is destroyed and wind and water erosion are not impeded. In many

areas, with the destruction of the perennial grass cover there is an invasion of bushes, acacias and others (c.f. Basic Principles, 4—Vegetation and Succession and Stability). The few vigorous plants and grasses that can be seen along this road are those which are so coarse and unpalatable that the starving livestock has left them alone.

Giraffe, impala, Grant's gazelle and gerenuk may be seen fairly commonly along this road. These animals are browsers or partial browsers, they can exist on leaves and twigs and plants that are unpalatable to cattle and many other wild herbivores (c.f. Basic Principles, 6—Food Preferences of Wild and Domestic Herbivores). In addition, their water requirements are much lower than those of most other species. Grant's gazelle and gerenuk can exist for months without drinking free water. They are apparently able to satisfy the body needs from the moisture in the food they eat.

Wildebeest, zebra, and Thomson's gazelle have requirements for food and water more nearly like cattle, and it is unlikely to see them along this road in the dry season except in the vicinity of water.

MILE 50 (37)

Masai *manyatta*, or temporary village (c.f. Basic Principles, 11—Masai). The *manyatta* or village is a thorn fence *boma* with more or less temporary houses made of brush with a covering of mud and cattle dung. Each night the herds are driven into the *boma* for protection. Several such *manyattas* may be seen along this road.

The construction of a *manyatta* usually entails the delimbing and eventual destruction of most trees in its vicinity. Where several decades of *manyattas* have been constructed in an area, as near watercourses or water points, the tree growth that formerly existed may be completely destroyed.

MILE 51 (36)

To the west of the road is a watercourse, at present lined with maize fields. This is one of a series of springs or stream-fed watercourses along the lower skirts of Mt. Kilimanjaro. These are lined by yellow barked "fever tree" acacias, a sure indicator of water. These courses provide dry season water for both wild life and the domestic livestock (c.f. Basic Principles, 10—Dry Season Holding Areas). Recently the Masai have allowed agricultural peoples from the mountains to cultivate along these watercourses. The combination of diversion of water and additional water loss through evaporation from the fields presents a danger both to the wild life and the livestock.

MILE 54 (33)

Kimana River.—This small river comes from springs not far above the road and it flows into a swamp which can been seen to the east. Elephant, buffalo, rhinoceros, wildebeest, eland, zebra, gazelle and other wild animals water in this area during the dry season. The game warden of Kajiado District realizing the importance of this watering point for wild life declared the area a Sanctuary, in which no hunting is allowed.

The intensity of grazing in this area can be seen from the grazing line under the trees and bushes, where the hungry animals have eaten all edible leaves and shoots within reach, i.e. within about four feet of the ground.

MILE 57 (30)

The Kimana Swamp is visible to the east, showing well the papyrus swamp edged with fever trees.

MILE 67 (20)

Fork in roads: north to Emali on the main Mombasa-Nairobi Road; south to Loitokitok; and west to the gate of the Masai Amboseli Game Reserve.

Rainfall in this area is between 10 and 20 inches annually, but is irregular, the temperatures are very high and there is often a high wind (c.f. Basic Principles, 2—Climate and Dessication).

MILE 87 (0)

Ol Tukai Lodge, Reserve headquarters, about 4,000 feet elevation.

Masai Amboseli Game Reserve

Until this year Amboseli was a National Reserve, a part of the organization of the Royal National Parks of Kenya. The reserve has now been turned over to the Kajiado Masai African District Council. The Council now administers the reserve, receives all money from entrance fees etc., and with the aid of a Government subvention, is to continue the improvements in roads and facilities and management duties previously carried out by the National Parks organization.

The reserve area is just under 1,300 square miles, and is largely flat, volcanic soil. Amboseli proper is an ancient lake bed, lying seven miles from the reserve headquarters, and dry except in very heavy rains. A series of springs emerge from beneath the lava near the headquarters, and the small swamps and streams they produce provide a perennial water supply (c.f. Basic Principles, 10—Dry Season Holding Areas). The permanent and transient populations of wild life centred on this water provide the focal point for visitors to the reserve.

About four years ago, apparently as a result of an earth tremor, the waters started rising in the main Ngoni Nairobi swamp, immediately southwest of Ol Tukai. The increased waters flowed out of the swamp in the Simek River. In order to make the best use of this fortuitous new water supply for wild life, and to provide additional water points for the Masai so they would not have to bring their cattle into the central wild life area, the National Parks with aid from various sources dug and blasted a several mile furrow leading the waters to the ancient Amboseli lake bed. The waters have formed a small lake in the edge of the old lake bed, and this, plus the waters along the eight-mile channel from the swamp, have had a significant effect on the vegetation, bird and animal life of the area.

The basic management problem of the reserve is domestic livestock, the usual problem of overgrazing throughout the reserve and of competition between the domestic livestock and the wild life for the water at Ol Tukai. In recent years, nine water points were put in around the central swamp and forest area to enable the Masai to water their stock without driving them into the ten- by twenty-mile central wild life area. However, during the present drought the Masai have been bringing their cattle into the swamps and forest area and the overgrazing problem is becoming acute.

Poaching is a perennial problem in the Amboseli region. Part of the poaching may stem from Chagga people coming over the border, but part certainly comes from the Masai. All big game, including elephant, are affected, but most serious are the rhino, for which the reserve is famous. Now that the reserve is in the hands of the Masai African District Council, the Masai are, in effect, on trial to see whether or not they can exert effective control in this important matter.

Another reserve management problem posed by Amboseli is the control of vehicles. In the loose soil of the reserve, automobiles can create a considerable erosion problem. Although attempts have been made to restrict vehicles to established tracks, with such level, open land there is nothing to stop cars going anywhere they wish. To protect the habitat it will become necessary to impose strict regulations on driving, and to confine traffic to hard-surfaced roads.

Amboseli provides a magnificent example of the adaptability of wild animals to tourism. Prior to 1948, Amboseli was part of the Southern Game Reserve and a tourist camp was run at Ol Tukai on a private basis. Amboseli was declared a National Reserve in 1948, and the present buildings were begun in 1949. Tourism has increased with the provision of lodging facilities and better roads, and during the past year there have been about 18,000 visitor days spent in the reserve. The wild life, including the normally nervous rhinoceros and elephant, have become acclimatized to visitors and vehicles, and carry on their lives with no obvious concern or disturbance, apparently accepting the flood of visitors as a part of their habitat.

Amboseli is 150 miles from Nairobi. With 18,000 visitor days spent there during the past year, the reserve has proved itself of outstanding importance to Kenya's tourist industry, as well as to the Masai in Kajiado District who will now benefit directly from the revenue. With provision of additional tourist accommodations now under construction, and better roads, the importance and economic value of Amboseli to the district and country should continue to increase—if the problems with the domestic livestock management can be settled before the habitat for the wild life is too severely damaged.

Amboseli to Namanga—47 Miles

(*Mileages from Amboseli are at left and mileages to Amboseli are in parenthesis*)

MILE 0 (47) *Ol Tukai Lodge*

MILE 10 (37)

Road crosses the old bed of Amboseli lake.

MILE 17 (30)

Leaving the lake bed, the road climbs slowly from 4,000 to 4,500 feet elevation through badly overgrazed acacia savannah land. Fifty years ago this region had a top soil and perennial grass cover. The area southwest from Lake Amboseli was open grassland, while that traversed by the road to Namanga was grass with scattered low acacia and commiphora trees. The present semi-desert condition is the result of severe overgrazing (c.f. Basic Principles, 2—Climate and Desiccation, 4—Vegetation Succession and Stability, 5—Overgrazing).

MILE 47 (0)

Namanga.—Western gate to Masai Amboseli Game Reserve, and Namanga Inn. The inn is made possible by water coming from the wooded Ol Doinyo Orok mountains (8,376 feet elevation). As a tourist facility it is extremely well situated, roughly half-way from Nairobi to Arusha and at the entrance to Amboseli. The main road north leads to Nairobi, and that south to Arusha.

Namanga to Arusha—69 Miles

(*Mileages from Namanga are at the left and mileages to Namanga are in parenthesis*)

MILE 0 (69)

Namanga.—Kenya-Tanganyika border, start of tarmac road to Arusha. The land from here to Longido lying at about 5,000 feet elevation was grassland with evenly scattered acacias and commiphera trees about 1910.

MILE 14 (55)

Longido Hill (8,625 feet) is immediately to the east of the road. From Longido south to the base of Mt. Meru is now desert bushland, lying around 4,000 feet elevation. This area was open grassland in 1906. Now the perennial grass cover has been destroyed by overgrazing, the soil eroded away, and bush has invaded (c.f. Basic Principles, 2—Climate and Desiccation, 4—Vegetation Succession and Stability, 5—Overgrazing, 8—Erosion).

The area from here west to Lake Natron (c.f. map) was a game reserve established by the Germans prior to the 1914-18 War, and continued for a time by the British. It was known for fine pastures and large herds of wild life. Starting about 1920, the Masai were allowed to move into this country. For a time they had moderate numbers of livestock and grazed them in the same manner as the wild life (c.f. Basic Principles, 10—Dry Season Holding Areas). Then water points were provided or improved: to the west was the Ngare Nairbor River (west of Longido); a pipeline to a water-tank off 9,653-foot high Gelai Mountain (farther west, c.f. map); and two more pipeline-fed tanks near 9,653-foot Kitumbeine Mountain (c.f. map). Since the piped water is removed to tanks and cattle troughs, only a small seep remains on the mountains for the wild life.

To the east of the road, a dam and spring were provided at Longido; a furrow off Meru, and another off Kilimanjaro. These water points have enabled the Masai to keep their cattle year-long in the areas formerly only used seasonally, with the result that a large area of Masailand has been devastated. The wild life have steadily decreased in numbers since they do not have access to the Masai water improvements and much of their habitat has been degraded.

One interesting effect has been that while the wildebeest, zebra and Thomson's gazelle have decreased, the Grant's gazelle and gerenuk—both of which require little or no surface water and are at least partial browsers—have increased (c.f. Basic Principles, 6—Food Preferences of Wild and Domestic Herbivores).

MILE 20 (49)

Examples of all types of erosion are visible through this area (c.f. Basic Principles, 8—Erosion). There are places in this waste land where the vegetation looks casually like grass. This growth, however, is usually composed of unpalatable herbs or coarse grass inedible to cattle (c.f. Basic Principles, 5—Grazing—Overgrazing).

MILE 40 (29)

This small piece of open grassland is the one piece of land between Meru and Namanga which has not completely changed from grassland to thorn bush waste land. It is the bottom end of a European farm where grazing has been strictly controlled.

From this point, Mt. Meru is directly ahead. The neat coffee estates and other plantations on the lower slopes are separated from the forest reserve by wide firebreaks. Around the edges of the reserve are plantations of eucalyptus, cedar, and cyprus, and in glades in the edges are light coloured patches which are pyrethrum fields.

MILE 46 (23)

View to the west from here across the Great Rift Valley to the Ngorongoro Highlands.

MILE 50 (19)

This shoulder of Mt. Meru is composed largely of volcanic ash soil. The top soil is gone and the subsoil remaining is very soft and of a uniform texture lying in places over 50 feet deep. The depth can be seen in road cuts and gullies in the next few miles. This soil is particularly easily blown or washed away once the protective vegetation is removed. Examples of deeply eroded trails are particularly evident on the rounded hills and slopes on both sides of the road. This is a heavily overgrazed area with a prevailing wind off the mountain, so that except just after a rain there is usually a plume of yellow dust carrying miles west into Masailand.

Apparently in former times much of this slope was forested. It was settled by the Warush, an agricultural people closely associated with the Masai. They furnish the Masai with grain and speak the language.

MILE 52 (17)

Road cut and gully providing good view of soil structure.

MILE 53 (16)

Note eroding cattle tracks coming off the mountain and parallel with the road.

MILE 59 (10)

Overgrazing, and in places abandoned cultivation, has removed the top soil and grass cover and inedible bushes, sodum apple, Mexican Marigold, etc., have invaded large areas (c.f. Basic Principles, 4—Vegetation Succession and Stability).

MILE 61 (8)

Coffe plantation. From here into Arusha was recently forest land, and relict trees remain in the maize fields (c.f. Basic Principles, 9—Mountain Forests).

MILE 69 (0)

Arusha.

SECTION 4—POST CONFERENCE FIELD TRIP 1

The first part of this field trip, from Arusha to Ngorongoro, is identical with Mid Conference Trip A. Therefore those taking this trip should use the guide for Trip A (Section 2 above) to Ngorongoro, and on leaving Ngorongoro use this section.

Ngorongoro to Seronera

(For most of this trip there are choices of routes to be taken and the possibility of side trips to view animals, etc., so very few mileages are given and where given, they must be considered very approximate.)

MILE 0

Ngorongoro Lodge.—For several miles the road skirts the Crater rim passing through areas of forest and highland grassland. Overgrazing-induced *Eleusine* and other coarse grasses have invaded large areas of these grasslands where Masai livestock grazing has been heavy.

MILE 12

Malanja Depression.—To the east Windy Gap affords a fine view of the Crater floor. The gap is a point of entrance and exit from the Crater for both domestic livestock and some wild animals. On the west side of Malanja Depression are striking examples of livestock trail-induced gullies.

MILE 15

To the west is 10,276-foot high Lemagrut Mountain. Scars of recent fires can be seen on its flanks and the remnants of its once extensive forests are in the relatively protected canyons high up the mountain (c.f. Basic Principles, 9—Mountain Forests, and 7—Fire).

The road drops rapidly about 3,000 feet from the crater rim to the Obalbal Depression; from mountain mist forest to overgrazing-induced semi-desert bush land (c.f. Basic Principles, 2—Climate and Desiccation). This area is heavily grazed by Masai because of the proximity of water.

MILE 28

Olduvai Gorge.—Originating near Lake Lagarja, in the central Serengeti Plains, this gorge cuts through the south-eastern plains exposing the underlying rock strata. Several miles upstream from the road crossing is the prehistoric site where Dr. Leakey has unearthed significant relicts of prehistoric man and wild animals.

MILE 28-45

For these 18 miles the road passes through a severely overgrazed area that was formerly well grassed, largely open acacia woodland, with denser woody vegetation along the watercourses. Many abandoned Masai manyattas (temporary villages) may be seen, and near them the stumps of trees and brush cut in the process of their construction. Where decades of manyattas have been constructed in a region, such as this, the effect is to greatly reduce the woody growth, while the very heavy grazing by cattle, goats and sheep effectively precludes most tree regeneration.

Grant's gazelle are usually seen through this area even in the dry season, as these animals unlike wildebeest, zebra, etc., apparently survive for months with no available surface water, and their preferred diet includes small herbs and browse plants which are available in these areas where the perennial grasses have dried up or been destroyed (c.f. Basic Principles, 6—Food Preferences of Wild and Domestic Herbivores).

MILE 45

Open Serengeti Plains.—The eastern plains through which the road passes for the next 15 miles have a loose, largely volcanic ash soil that is highly erodable once the protective vegetation cover is removed. At least six times in the past 40 years Lengai volcano (whose conical peak is occasionally visible to the east) has erupted large quantities of ash which have been deposited on the eastern Serengeti by the prevailing east winds.

MILE 51

Boundary of the Serengeti National Park.

The park formerly included the Crater Highlands. When the park was established it was not realized that the interests of the Masai, with their ever-increasing herds of livestock, and the migratory wild animals would clash. Consequently the park was established with a population of Masai inside it. It soon became evident that competition between the Masai and the wild life for the dry season water supplies and grazing was so serious that the whole concept of a national park was threatened. The boundaries of the park were changed in 1959, after four years of negotiations, including a Government Committee of Inquiry into the situation and numerous presentations by interested persons and conservation organizations from all over the world (including the I.U.C.N.) who stressed the unique international value and importance of the Serengeti and its wild life population. The new park boundaries include a part of the central Serengeti Plains, a "corridor" of bush country with permanent water running westward toward Lake Victoria, and another wider corridor extending north to the Kenya border. The Masai have been excluded from the relatively small portion of the present park that they formerly occupied, and the remainder of the Serengeti Plains and the Crater Highlands, some 3,000 square miles, have been declared the Ngorongoro Conservation Unit in which water developments, etc., are being carried out for the Masai.

MILE 62

Naabi Hill.—From this point much of the central Serengeti region can be seen. To the east-north-east the Ol Donyo Gol mountain range marks the eastern edge of the roughly 2,000-square-mile expanse of the Serengeti Plains proper. Beyond them lie the arid Salei Plains, then the Great Rift Valley. The Crater Highlands rise about 40 miles to the south-east. Immediately to the south of Naabi Hill a line of trees marks Lake Lagarja, the park boundary and the top end of the Olduvai Gorge. About 18 miles to the west are the Itonjo and Nyaroboro hills marking the western edge of the plains proper. North-north-west are the bush-clad hills near Seronera Camp marking the central plains' northern edge.

From Naabi Hill northward the road runs through a plains land with predominately "black cotton" clay soils which are somewhat less vulnerable to overgrazing-induced erosion than the powdery volcanic ash soils to the east.

MILE 80

Simba Kopjes.—Here and at several points throughout the Serengeti Plains there are granitic outcroppings or "kopjes". These have, or had before Masai cut and burned them, woodland or bush vegetation and with their characteristic water, soil, plant and animal communities were most interesting and valuable little ecological islands in the open grass plains.

MILE 95

Seronera Camp, about 5,000-foot elevation on the transition between the bush and open woodland of the north and west, and the open grass plains to the south. This is the park headquarters with accommodations for 32 visitors plus three camping areas. The camp is well located from the standpoint of wild life. It is on a piece of high ground in an open grove of large acacia trees, surrounded by several kopjes, and almost encircled by the Seronera River. The perennial water of the river maintains a year-long wild life population including leopard and lion, in close proximity to the camp. In general the animals have become accustomed to the presence of visitors' vehicles and even the leopard are quite tame.

A network of tracks have been laid out from Seronera offering visitors circular wild life viewing drives which take from a half hour to a day. Seronera has a very good airstrip, and East African Airways run one-day excursion flights to the Serengeti from Nairobi every Sunday during the period when the park is open (June to March, inclusive).

Many of the facilities at Seronera are of quite recent origin. To provide better facilities for visitors and more fully realize the educational and tourist potential of the park, during the past 18 months the accommodations have been more than doubled, stores, garage, and other facilities built, water supplies increased, electricity provided, and a roads improvement programme instituted. A small museum is planned and biological collections are in progress.

Serengeti Park and Region

The Serengeti region is justly world famous for the numbers and variety of its plains wild life, and their spectacular "migrations". From the standpoint of numbers of animals and numbers of species, this region contains what is probably the world's greatest remaining assemblage of plains wild life. From an ecological standpoint, the Serengeti region of Tanganyika must be considered a unit with the adjoining Loita Plains Mara region of Kenya (c.f. map), as there are significant but irregular movements of wild life populations, especially zebra and wildebeest, between the two politically, but not ecologically, separate areas.

During the wet periods when surface water and abundant fresh grazing are available on the open plains of both the Serengeti and the Mara the "plains game", including zebra, wildebeest, Thomson's gazelle, topi, and kongoni congregate on these areas. The animals remain on the open plains during the wet seasons moving from area to area following rain and their particular feeding requirements (c.f. Basic Principles, 6—Food Preferences of Wild and Domestic Herbivores). As surface water and grazing begin to dry up, the animals leave the plains and disperse through the surrounding bush country, following rain and perennial water supplies. This pattern is identical with that described for the eastern Masai steppe (Basic Principles, 10—Dry Season Holding Areas). However, throughout most of the dry season holding area in the Serengeti-Mara region the rainfall is higher (30-40 inches per year) than on the eastern Masai steppe (10-30 inches per year), the perennial water supplies are more numerous and dispersed, and there has been less diversion of them for agriculture (although the watersheds have suffered heavily from fire and in some cases, overgrazing). Consequently during the dry seasons the animals involved are not forced to remain within grazing distance of a few isolated watering points; instead they disperse through a vast area of acacia bush or open woodland. The total area involved in these Serengeti-Mara Region movements is something over 13,000 square miles, and forms one large ecological unit, bounded by barriers to movement of most plains wild life—escarpments, mountains, thick forests, and intensive cultivation or human settlement.

The results of the only complete count (an extensive aerial census and survey carried out in May, 1961, by the Fauna Research Unit of the Kenya Game Department, the Wildlife Research Project, and Wilken Air Services) of the animal populations in this entire vast area included the following census figures: Wildebeest—239,516; zebra—171,873; topi—19,877; buffalo—21,382; and elephant—1,157; and estimates of Thomson's gazelle at between 480,000 and 800,000; and eland between 6,400 and 9,600.

The Western Corridor of the Serengeti National Park is a wedge shaped piece of land extending some 70 miles west from the open grassland of the Serengeti Plains proper. It is an area of red soils with many rocky hills, and the vegetation is principally an open woodland or bush land with *Acacia, Commiphora* and *Balanites* as typical woody components. On level areas, typically on valley bottoms alongside watercourses or on open plains near Lake Victoria, there are dark soil or "Black cotton" clay areas, usually with thick grass covers. Remnant patches of gallery forest are found along watercourses and in pockets in the hills. This whole region is usually burned each year, and the dominant bush and grass vegetation appears to be largely fire maintained (c.f. Basic Principles, 4—Vegetation Succession and Stability).

During the dry seasons many of the plains animals leave the Serengeti Plains proper and gradually move westwards down the Corridor watercourses. Others of the plains animals may move northwards off the plains, or south into the Crater Highlands. Perennial waters along the main rivers of the Corridor provide some dry season water for the animals, but there is a continual movement the animals eddying and flowing back and forth through the hills apparently following rains and their food needs. Some of these animals eventually move northward and eastward, filtering through the settlements, cultivation and grazing lands outside the park. These animals may re-enter the park in the Northern Extension, occasionally joining the herds that have moved directly north from the plains; or they may mill about, some of them returning to the Corridor. When grass fires have removed the standing tall grass, and with rain short new grass is available, large herds of wildebeest, zebra, and other animals move north into the Kenya Mara.

The Northern Extension of the Serengeti National Park is an irregular block of land roughly 30 miles wide extending from the north edge of the open Serengeti Plains about 50 miles north to the Kenya border. The Extension is open woodland, with large areas of *Acacia—Commiphora* bush land, and many small open grass areas. Perennial water is available at several points in the series of wooded watercourses that originate in or across the Extension in a generally east-west direction. The Extension is a very important part of the park, providing extensive dry season water and grazing land, through which the considerable movements of wild life take place to and from the perennial water and rich grasslands of the Kenya Mara.

It is emphasized that the extensive wild life movements described above are not a unified or regular "migration" analogous to that of some birds. Rather, these are an eddying and flowing through a vast area of animals apparently following their requirements for food and water. The direction of movement is correlated with rainfall and grass fires, both of which are themselves irregular in pattern of occurance. Therefore the animals' movements are irregular. No two years' "migrations" will be be precisely the same, and there are often large differences in the patterns of movement from one season to the next.

In addition to the zebra and antelopes (kongoni, topi, eland, wildebeest, Thomson's gazelle, and to a lesser extent, Grant's gazelle) which alternate between open grassland and the bush country, there are a series of species of animal which are yearlong residents in the bush or woodland. Among these are the elephant and buffalo, present in large numbers, and a number of other species including rhinoceros, bush buck, water buck, roan, oribi, klipspringer, steinbok, duiker and impala. Some of these animals, notably elephant, move throughout a wide area during the course of a year, but they rarely enter the open plainsland.

Seronera to Kenya Mara

(*Mileages are approximate*)

MILE 0—*Seronera*

MILE 11

The road forks: the left (west) road leading down the Corridor to Lake Victoria, and the right fork crossing the river to Banagi. When the Serengeti area was a Game Reserve, and during the first years when it was declared a park, Banagi was the headquarters. At present the house is at the disposal of biologists working in the area, and the new Grzimek Memorial biological laboratory has been constructed to provide research facilities. Effective wild life and habitat management requires a working knowledge of the ecology involved. To obtain this knowledge the Director of Tanganyika National Parks has encouraged research in several fields, the biological laboratory has been built, and an extended research programme is being planned.

MILE 18

Kilimafeza Gold Mine.—From here the track passes through the *acacia* woodland or bushland country of the Northern Extension described above. Until the past year the road was a hunting track, most of it visible only when the grass was short.

MILE 27

Campi ya Mawe Area.—These kopjes maintain elements of a denser woodland vegetation, protected from the regular fires which help to shape the rest of the bush country vegetation. They also provide habitat for klipspringer. Varied habitat elements protected in a park, such as these kopjes, add both to the scientific value and the tourist interest of the park.

Many of the down trees along the road have been pushed over by elephants. Where an elephant population is relatively high, the big animals can be a potent factor in modifying the habitat.

MILE 65

Kleins' Camp Guard Post, established for about a year as a park entrance post and an anti-poaching base. The track west follows the south edge of Kuka Mountain. A series of long fingers of open grassland extend south through the bush country from here. The road passes through or near a series of thickets in the grassland, and more can be seen on the hillside to the north. These thickets are being reduced annually by the fires. They are extensively used by wild life. A few patches of remnant denser forest that have survived the fires can be seen higher on the hillsides.

MILE 75

Bologonja River.—A relict patch of gallery forest including *Podocarpus* and giant *Ficus* surrounds the headwaters springs of the Bologonja. The rainfall throughout this area is believed to be between 30 and 40 inches, and the elevation at this point 5,700 feet. This area receives very heavy grazing from "migrating" herds of wildebeest, zebra and eland, and more or less resident buffalo.

The track from Bologonja to the Sand River crossing was graded within the past month. Prior to that there was no established track and the route was only driven occasionally by biologists and hunters. This track has been improved by the Tanganyika National Parks to link up with the new track graded by Narok District in Kenya.

MILE 85

The Sand River.—The Kenya-Tanganyika border passes close to this point. with this road link, a circular tour is now possible from Nairobi taking in Amboseli, Arusha, Lake Manyara, Ngorongoro, Serengeti and the Mara.

MILE 87

Salt Lick and former Spring.—From examination of the remnant palm and fig trees and associated vegetation, it appears that there has been much more woody vegetation here in the recent past.

MILE 92

Egolok Springs, site of the Masai Mara Game Lodge.—In March of this year agreement was reached between the Narok District Masai African District Council and Kenya Government to establish a Masai Mara Game Reserve covering some 700 square miles adjoining the Serengeti National Park and including the Mara Triangle (the former Mara National Reserve). The A.D.C. has appointed a warden and subsidiary staff to run the area, and has passed A.D.C. By-laws for the management of the area, including countrol of burning and grazing.

The by-laws prohibit the burning of vegetation throughout the whole 700 square mile reserve, except under the supervision of the warden under a planned system designed to protect the forest patches, but Masai grazing is allowed. A 200 square mile area of this reserve adjoining the Serengeti National Park and roughly centered on the Egolok Springs has been set aside as the Game Reserve Developed Area in which no grazing nor entry is allowed except by permit of the warden. This is, in effect, a true national park run on a local basis.

Government is paying for the lodge, under construction at Egolok, and providing an annual subsidy. Roads are being improved to facilitate access and game viewing.

MILES 92-108

This drive from Egolok Springs to Talek River is through some of the most productive grazing land left in East Africa. For the past two and a half years the yearlong standing crop of wild herbivores has been over 90,000 pounds per square mile, roughly three times the average expected from well managed, improved (fencing, water, etc.), pastureland in the Kenya Highlands grazed by cattle (c.f. Basic Principles, 6—Food Preferences of Wild and Domestic Herbivores). In addition to the wild life population, there have been increasing numbers of goats and sheep grazed in the area in tightly-packed herds numbering over 2,000 animals. The fine condition of this area, almost unique in Masailand, is due primarily to the tsetse fly which has kept Masai cattle out of the area for at least 50 years, and the fact that goats and sheep have only recently started entering the area in any numbers.

MILE 108

Talek River, is the border of the no-grazing no-entry area. The Talek Plains north of the river were the site of the field base from which the Kenya Veterinary Department's Tsetse Survey and Control branch carried out studies into the ecology and feeding habits of the tsetse fly in this area. These studies constitute some of the most intensive and significant ecological work involving wild life that has been carried out in East Africa. These studies have been carried out over a period of several years, the intensive work at Talek culminating in 1959. The feeding habits part of this work involved correlating the yearlong availability and abundance of wild animals with the actual feeds of tsetse fly, and the

results showed strikingly that the fly's diet in this region was very specific, prefering wart hog, with buffalo and giraffe next, while the plains game (wildebeest, zebra, topi, kongoni, Grant's and Thomson's gazelle) which provided 42 per cent of the available feed animals only provided less than 1 per cent of the total recorded feeds.

MILE 130±

Safari tent camp near the Mara River.

Mara Region

This area is bounded on the west by the Siria Escarpment, north by the Mau Escarpment, east by the Uaso Nyiro River and the Rift Wall, and south by the Loita Plateau and the Tanganyika Border. It is continuous with the Northern Extension of the Serengeti National Park through which the field trip passed. Most of the country is rolling plains land lying at 5,000 to 6,000 feet elevation, having an irregular average annual rainfall from around 20 to slightly over 30 inches. There are two major areas, the Loita Plains in the east, largely volcanic soil, exceedingly overgrazed, and the Mara fly belt in the west with mostly basement soils, parts of it ungrazed by domestic livestock until the past ten years and the southern part (Egolok area) ungrazed by cattle although more recently heavily grazed by goats and sheep.

A drive from Egolok through Talek and up to Aitong clearly illustrates the impact of uncontrolled grazing by domestic livestock. Egolok has had no cattle grazing for at least 50 years, and sheep and goats recently. Talek has had heavy sheep and goat grazing, and cattle this year only. The Bardamit Plains (15 miles north of Talek) have been grazed very heavily by all livestock for about five years, and the plains five miles to the east of the road for possibly two decades. The Aitong region has been grazed by cattle for six years only.

Rainfall, soil and other factors are constant at comparable points along this drive, and the major difference is the length of time livestock have been grazed on it. Increasing effects of livestock overgrazing observed driving from south to north include loss of ground cover, impoverishment of grass species, various types of erosion, brush and weed invasion (c.f. Basic Principles, 2—Climate and Desiccation, 4—Vegetation Succession and Stability, 5—Grazing and Overgrazing, and 8—Erosion). At the same time, the cattle standing crop which is seriously overgrazing the area toward Aitong is, at best, about 16,000 pounds per square mile, while the standing crop of mixed wild herbivores around Egolok is over 90,000 pounds per square mile (c.f. Basic Principles, 6—Food Preference of Wild and Domestic Herbivores).

Fire is a very important factor in the Mara area (c.f. Basic Principles, 7—Fire). Fires are lit by the Masai whenever they will burn at any time of year. Although fire appears to maintain open grassland free of invading woody growth, it is rapidly eating into the remaining forest and thicket areas. This process is greatly accelerated by elephants which, by pushing over and breaking down trees and bush, provide breaks in the woody vegetation which fire can enter and enlarge. In the absence of fire in overgrazed areas there is often a rapid invasion of whistling thorn and weeds.

The Tsetse Survey and Control Branch of the Kenya Veterinary Department administer the house and laboratory facilities at Aitong, and these are used as a field centre for ecological research of the Department, and the facilities have been generously made available to others engaged in research in the area.

Seven miles north of Aitong is the Ol Joro Orogwe Ranch, also administered by Tsetse Survey and Control, who have carried out extensive experimentation on tsetse fly clearance through various forms of habitat management. The Department also maintains a half-mile wide strip cleared of woody vegetation extending from the ranch westwards through a forest zone to the adjoining farming area. The strip protects the Kipsigis and European farming land to the north against the spread of tsetse fly from Masailand.

The Loita Plains adjoining the Mara fly belt to the east (c.f. map) are overgrazing devastated and desiccated. For example, at Ngorengore in the north, the rainfall is about 35 inches per year, yet the vegetation is semi-desert (c.f. Basic Principles, 2—Climate and Desiccation). The drive from Egolok up through the Loita Plains provides an even more striking illustration of the impact of overgrazing than does the Egolok-Aitong trip.

Wildebeest and zebra are the most plentiful animals in the Mara. During the wet season they graze on the open plains, including the Loita, and as the plains dry off they retreat to the perennial water, along the Mara River and farther south. There is an irregular but very significant interchange of population between the Mara and Serengeti areas. Careful wild life censuses in the Mara-Loita area in 1958, 1959, 1960 and 1961 showed the following wildebeest populations: 15,000; 7-8,000; 6-8,000; 17,800. During the same period the zebra population fluctuated from 12,000 to 7,000 to 20,800.

The Mara fly belt has been carefully maintained as a no-hunting area for about ten years, and the wild life especially the lions, have become very tame. The surrounding areas, including the Loita Plains, are regular hunting blocks. The Mara fly belt contains Kenya's finest wild life area and much of the credit for this status goes to the Game Warden, Major Temple-Boreham who took it over as an uncontrolled market-hunting area in 1946 and through strong administration and management created the present condition. However, until the establishment of the Masai Mara Game Reserve this March, it was feared that the area would be lost to wild life through destruction of the habitat (as on the Loita Plains) by very rapidly encroaching cattle and other livestock, and uncontrolled fires. If the A.D.C. By-laws are enforced the core of the Mara wild life habitat should be safe.

A pilot game cropping scheme was held on the Loita Plains this year which proved the practicability and economics of harvest of wildebeest and zebra.

Mara Camp to Narok—c. 114 Miles

MILE 0-c. 103

The track returns to the Talek and Egolok in the centre of the game area, then proceeds northeast to the Loita Plains. The effects of fire and grazing on the landscape are striking, as described above.

About ten miles east of Egolok there are remnant patches of forest to the south of the road, around the small perennial springs, and further on other remnant patches of forest and of thicket can be seen on the southern hills.

MILE c. 103

Uaso Nyiro Game Department Barrier.—The average annual rainfall here is 19.9 inches, from here to Narok the road passes through heavily grazed leleshwa brush. Here and there remnant cedars (*Juniperus*) may be seen beside the road, and this whole area is considered to have previously been dry cedar forest. In the areas where the forest has been removed and leleshwa has taken over, where grazing and fires are not too heavy, a good grass cover develops

beneath the leleshwa and the forest trees regenerate. However, where fires are lit whenever they will burn and grazing is extremely heavy, there is no replacement of the leleshwa by other species, and the result is an almost pure stand of leleshwa with nothing below. The result is heavy erosion and this can be seen at several points on this road, where even the leleshwa stand on pedestals up to ten feet high (c.f. Basic Principles, 5—Grazing and Overgrazing).

MILE 114

Narok.—In addition to the district headquarters there is also a Masai Agricultural School.

Narok to Nakuru

The road passes from Narok at 6,200 feet elevation with average annual rainfall at 27.6 inches up through the Mau Forest to Mau Narok at 9,500 feet with average annual rainfall of over 40 inches. The lower area near Narok was dense cedar forest within the past few decades and has been reduced by cutting, fire and overgrazing. Higher up the mountain the cedar, podo, olive and other hardwoods forest remains.

About 18 miles up is Endabilabil, a centre of Kikuyu farmers who have moved into Masailand. The abandoned and partially grown-over fields were left in 1955. Recultivation was started here in 1958.

At about 27 miles the road forks at Nangipiri, the site of former operations of a Masai owned sawmill. The fork to the left (west) leads to Olokurto, through an area of intense Masai overgrazing where in spite of the high rainfall and even climate, overgrazing has caused invasion of the formerly rich grassland by course grasses and brush (c.f. Basic Principles, 8—Erosion).

The road climbs out of the present forest belt past a Masai A.D.C. owned sheep farm, through the Mau Narok European farms. Much of this area was under forest until comparatively recent times and the stumps, etc., can be seen in areas not intensively cultivated. Leaving the area of cultivation the road drops though forest down to the municipality of Nakuru situated in the Rift Valley 97 miles north of Nairobi at 6,070 feet elevation.

Nakuru is the Provincial Headquarters of the Rift Valley Province, and is the centre of the largest co-operative concern in East Africa, the Kenya Farmers' Association. The population is about 24,500.

Immediately behind Nakuru is Menengai Crater, one of the world's largest extinct craters.

Close beside the municipality is Lake Nakuru. The lake is best known for its flamingoes which may be seen there in thousands much of the year. The open water and marsh around the lake is also the home of many resident bird species and the resting place of numerous migratory birds. Around 400 individual species of birds have been recorded from the lake. On 14th February of this year, Lake Nakuru Bird Sanctuary was opened as part of the Nakuru National Park. This was the culmination of nearly four years efforts to this end on the part of the Kenya Wild Life Society, the people of Nakuru and the Royal National Parks of Kenya, and Nakuru is the first primarily ornithological sanctuary to have attained National Park Status in Africa. Being only two hours' drive from Nairobi on a good tarmac road, Lake Nakuru National Park can become extremely important to Kenya's tourist industry.

Nakuru to Nyeri

From Nakuru at 6,070 feet elevation the road climbs out of the Great Rift Valley to about 7,700 feet at Thomson's Falls. The rainfall at both places is similar, 30 to 40 inches per year, but there is a higher rainfall area between them around the Bahati Forest. Pasture land, large-scale cltivation, and sawmill operations are seen along the route.

Thomson's Falls is named for Joseph Thomson, who in 1883 was the first European to walk from Mombasa to Lake Victoria. There is a pleasant hotel near the falls proper, and they can be seen from the hotel grounds. This is an example of a tourist development utilizing a scenic attraction. This town also serves as a jumping off point for excursions into the wilder northern country.

From Thomson's Falls the road turns south between Mt. Kenya on the east and the Aberdares range on the west. Mt. Kenya rises to 17,058 feet with rich high mountain vegetation including zones of mist forest, mountain bamboo and moorland, with glaciers and striking mountain scenery. The moorland and glacial region of the mountain are included in the Mt. Kenya National Park.

Northwest of Mt. Kenya is an area of large European ranches. One of Kenya's *safari* organizations, has made arrangements with the landowners to conduct hunting *safaris* on about a million acres of these private lands. The *safari* organization pays each landowner a specified amount for each animal killed. This is the first time such an arrangement has been made on a large scale between a *safari* firm and landowners, and it is a significant move for conservation as it gives the wild animals an economic value to the ranches, where otherwise wildlife on private ranchland is often considered to represent an economic loss (through fence and crop damage, and competition with domestic livestock for food).

The Kenya Game Department operates a somewhat parallel arrangement in the case of hunting in Controlled Areas, where a Controlled Area Fee is charged the hunters which includes a stated charge for each animal killed, and this revenue goes to the local African District Council. In this way the wild life can come to represent an economic value to the Africans in whose district the game is hunted.

To the west of the road the Aberdare Range of mountains rises to 13,000 feet. The lower slopes are the boundary of the Kikuyu Reserve, which extends south about 100 miles to Nairobi. The forest belt encircles the Aberdare Range generally at an altitude of 8 to 10,000 feet, with Mountain bamboo on the high slopes. Above that is the moorland zone, with many species of alpine or subalpine plants.

The town of Nyeri is in the heart of the Kikuyu country. There are two first class hotels, one of which operates the famous "Treetops". Treetops is a small hotel built at tree-top height in an opening in the forest above a pool and salt lick a few miles out of Nyeri. Visitors spending the night there can watch a variety of rarely-seen forest animals illuminated with artificial "moons", large flood lamps to which the animals have become accustomed.

Treetops is operated as a concession within the national park. The Aberdare Royal National Park includes most of the higher portions of the Aberdare Mountain Range. To include Treetops there is an extension of the park, over 12 miles long and from about two to seven miles wide. This extension is surrounded by farms and Native Reserve. To keep the forest animals, elephants, etc., from leaving the forest and causing damage on the farms it was necessary to construct some sort of a barrier around the Treetops salient. To accomplish this a seven-mile long ditch was dug around part of the border. This with an accompanying fence have proved successful.

Nyeri to Nairobi

From Nyeri the road climbs past the dense Kikuyu cultivation and over a new parks road across a saddle in the Aberdares. This road was opened by the Queen Mother during the Royal Visit on 15th February, 1959. It climbs through the highland forest to the moorlands where giant *Lobelia*, groundsels, and other alpine or subalpine plants dominate the landscape. The highest point on the road is 10,508 feet above sea level. Mountain scenery, including waterfalls, for which this park is famous is well shown from the road. It is also possible to see herds of elephant and some rhino here in a setting strikingly different from that of the Masai steppes.

Rainfall in the higher parts of the park is above 70 inches per year. The road down the west side of the Aberdares into the Great Rift Valley is through a rainfall gradient dropping to 20 inches per year at Naivasha. It is also an altitudinal gradient from 10,508 feet to Naivasha at about 2,000 feet. Nearby Lake Naivasha is one of the chain of Rift Valley lakes that provide homes for a host of water fowl.

From Naivasha the good tarmac road leads to Nairobi. The spectacular climb up the steep eastern escarpment of the Rift Valley provides an excellent view of the Rift with its extinct volcanoes. Beside the road is Forest Reserve, with native forest on the escarpment and plantations on the top.

Rainfall is 40 inches and above in the densely settled, intensively cultivated Kikuyu Reserve on the highlands leading to Nairobi. At Muguga, three miles to the west of the road, is the headquarters of the East African Agricultural and Forestry Research Organization and the East African Veterinary Research Organization. These two High Commission organizations have excellent research facilities, including libraries, laboratories and experimental areas. Both organizations have been actively carrying out research into various problems affecting wild life.

Nairobi, at 5,500 feet elevation, capital of Kenya, is a modern city of some 242,000 people. Among other things it is a major tourist centre with numerous hotels, an international airport, and a number of *safari* and touring companies. The Coryndon Museum has a comprehensive series of exhibits covering a number of fields of interest in addition to natural history. Nairobi was started in 1899 as a base camp for construction of the Uganda railway. The location provided water (it was then a swamp), and was the transition between the Masai steppe grassland and the then-forested Kikuyu uplands (c.f. Basic Principals, 1—Vegetation and Topography). An outstanding attraction of Nairobi is the Nairobi Royal National Park, located less than five miles from the centre of the city, and adjacent to the international airport (c.f. *section* 6—Nairobi Royal National Park).

SECTION 5—POST CONFERENCE FIELD TRIP 2

(Also Second Part of Post Conference, Trip 6)

Arusha to Himo

This section is identical with the first part of Mid Conference Trip B, presented in section 3 above.

Himo to Tsavo West

From Himo the road east enters Kenya on the main Moshi-Voi road. Leaving the Mt. Kilimanjaro area the rainfall rapidly drops to below 20 inches, and much of the country is arid bushland. A branch road to the north leads to Tsavo National Park. Tsavo Royal National Park covers about 8,000 square miles and

is the largest national park in East Africa, and one of the largest in the world. The park is divided into two parts, Tsavo East, on the north side of the main Nairobi-Mombasa road, and Tsavo West, south of the road. The latter is visited by this field trip.

The perennial waters of Mzima Springs, on this road, support a year-long wild-life population. A glass-sided tank some 20 by 6 feet has been installed in the waters of the spring and from this visitors can view fish, hippopotamous and crocodile through the clear water.

Elephant are one of the most famous animals in the Tsavo, and there is a large population in the park. The animals' movements are not well known, but it is known that the animals move great distances, not necessarily remaining within the park boundaries. Outside of the park to the north along the Galana River an elephant cropping scheme run by the Kenya Game Department has been started which is intended to accomplish two primary aims: to help manage the numbers of elephants in the region; and to provide a legal, more profitable employment for the people of the Walialungulu tribe, who otherwise are devoted to poaching elephant within and without the park. Both the ivory and the meat are used.

Critical management problems in the park include water supplies, poaching, and animals entering farming lands adjacent to the park. Additional water supplies are being provided as finances permit. Anti-poaching (which also includes countering the activities of honey-hunters who enter the park, poach some animals, and start fires) is a continual and continuing duty of the Park's personnel. The problem of animals leaving the park in some places can only be controlled by the construction of barriers, possibly fenced ditches or earth banks. Such measures are extremely costly and have not yet been undertaken as the necessary finances are not available.

The National Parks have constructed a road network of about 700 miles to facilitate visiting and viewing the park, two Park Lodges and a large unfinished new lodge. Additional accommodation is available near by at the town of Voi and other points along the Mombasa-Nairobi road. During 1960, Tsavo East received over 8,000 visitors and Tsavo West about 12,000.

Tsavo West to Nairobi

After entering the main Nairobi-Mombasa road, to the south are the Chyulu Mountains. The mountain base is infested with tsetse fly which has to date excluded grazing of domestic stock. For this reason the area has a fine grass and forest cover, provides watershed for Masailand to the south-west and the Wakamba cultivation and grazing on the north-east, and maintains a good population of wild life. The mountains are of volcanic origin and contain several small, dense forest-filled craters. The area deserves National Park status to preserve the last area of undevastated vegetation in this region, to protect the water shed values, and to conserve the wild life.

The elevation along this part of the road is about 3,000 feet and the rainfall irregular and about 20 inches. The region is particularly vulnerable to over-grazing —induced desiccation and erosion, and this has happened over a large part of it (c.f. Basic Principles, 5—Grazing and Over-grazing, 2—Climate and Desiccation, and 8—Erosion).

Near Kiu the road climbs to about the level of the Athi-Kapiti Plains, about 5,000 feet. To the north is the Machakos District, home of the Wakamba people. The Wakamba are particularly renowned as hunters and soldiers. Sixty per cent

of the men in Kenya's armed forces are Kamba. Recently the Wakamba in Machakos have become progressive farmers. Over-cultivation and over-stocking of the lands were turning the whole region around Machakos to desert. Government enforced drastic measures to effect land reform, to place the cultivation on a sound basis and reduce over-stocking. Although this action was initially resented by the conservative Wakamba, the results were so striking that the methods are now generally accepted, and the area is an example of what effective conservation a firm administration can accomplish.

SECTION 6—NAIROBI ROYAL NATIONAL PARK

Nairobi Royal National Park is situated on the southern outskirts of Nairobi, less than five miles from the city centre. Prior to the establishment of Nairobi, this was a wild area where perennial water from the then thickly forested Ngong Hills and Kikuyu uplands flowed out onto the Athi Plains. The wild life during the wet season grazed throughout the Athi-Kapiti Plains, and even ranging north and eastward toward the Yatta River (c.f. map). In the dry season the plains animals left the drying plains and gathered about the perennial water supplies (c.f. Basic Principles, 10—Dry Season Holding Areas). The waters in what is now Nairobi National Park were one of the most important of these dry season water areas.

Although its wild life importance was realized early during the growth of Nairobi, the area was not declared a National Park until 1945 when it became East Africa's first true National Park. Prior to this, during both wars extensive military camps were established in what is now the park's centre, and their impact on the landscape is still visible in the form of roads, disturbed soil and vegetation.

Since the establishment of the park a series of improvements have been carried out. Water supplies have been improved through small dams. A comprehensive road system allowing visitors to view but not disturb animals in the various habitats in the park has been constructed. There are a series of entrance gates with the attractive buildings and signs for which the Royal National Parks of Kenya are noted. To keep the animals out of the city and vice versa, and more recently, to keep them from crossing the main road to the airport, a 25-mile fence has been built around the portions of the park adjoining the city and airport road. Ordinary fences have proved ineffective against stampeding plains animals so that the parks have adopted a strong, high wire, mesh fence placed on top of a bank of earth.

The park is only about 40 square miles, in area but includes a variety of habitat types, including some forest, bushland, open grassland, rocky gorge and some riverine pools and vegetation. Some of the wild life is resident, but most of the plains game—zebra, wildebeest, eland, kongoni, the gazelles, etc.—are at least partially migrant, spending much of the wet season grazing over the Athi-Kapiti Plains, and returning to the park periodically and during dry periods. This natural grazing pattern is essential to prevent the overgrazing that would occur should the whole Athi-Kapiti Plains population of plains wild life graze yearlong in the park area. Maintenance of access to the plains south of the park is therefore necessary if the park is to retain its present famous wild life population and maintain its habitat. The land in question is Masai grazing land. Should ranching developments, including fencing, or cultivation, be put in that area the park's wild life would suffer greatly. In 1959 a large sum of money was offered to the Masai in return for their maintaining their traditional grazing practices in a part of the then Ngong National Reserve adjoining the National Park. The Masai rejected this offer. This year as part of the arrangement

whereby the Masai A.D.C. took over the Amboseli Reserve, A.D.C. By-laws were passed to assure free access of wild animals to the park by prohibiting cultivation and fencing in the Kitangela area, adjacent to the park.

The yearlong carrying capacity of mixed wild animals in the park is very high, and apparently considerably higher than that of similar land grazed exclusively by domestic livestock (c.f. Basic Principles, 6—Food Preferences of Wild and Domestic Herbivores). To determine what the actual park wild life populations are, the Park Warden in co-operation with local individuals and organizations interested in conservation has been carrying out monthly game censuses for over a year.

Within a very small area, the Nairobi park provides a fine illustration of the differing habitat requirements of the various species of wild animal. Bushbuck, for example, are found in the forest, while impala and dikdik are in the edges, reed buck in the bush and reed beds, while wildebeest, zebra, and the gazelles are in the open grassland.

The grassland animals have been particularly hard hit by the present prolonged drought. A large percentage of both the Masai livestock in the Athi-Kapiti plains south of the park, and the wild life throughout the area have died. The Game Warden of Kajiado District, a pioneer in the use of light aircraft in East African wild life work, for several years has been making regular aearial counts of the wild life of the Athi-Kapiti region. His one recent count (mid-August) indicates that the whole wild life population has been severely depleted. Droughts are a periodic feature of the climate of this region, but two factors have made this one particularly devastating to animal life. First, in the past in times of drought the wild animals were free to travel ("migrate") many miles away from the central plains in search of water and food. Now the growth of Nairobi and various towns, intensive European ranch and farmlands, and a densely settled African area have precluded such movements, and the animals must remain on the central plains. Probably more important, through several decades of serious overgrazing the Masai have severely reduced the carrying capacity of the plainsland itself (c.f. Basic Principles, 5—Grazing and Overgrazing) and through overgrazing—induced surface desiccation, greatly intensified the effects of normal drought (c.f. Basic Principles, 2—Climate and Desiccation).

Another management problem which is increasing in importance is posed by the increasing areas covered by subsistence cultivation in the area adjacent to the park. This recent cultivation has taken over grazing areas formerly used by animals from the park, especially plains game and rhino and the people involved are now complaining of crop damage by these animals. It appears that the only satisfactory solution to this problem is an extension of the game-proof fencing between the park and reserve area and the cultivation. Two crop-raiding rhinoceros from this area have been captured using immobilizing drugs by the Game Warden in charge of capture, and with the aid of the Park Warden they were transported into the park and released.

Over 120,000 visitors a year enter Nairobi Royal National Park. Situated so close to Kenya's major airport and capital city, the Park is a visitor attraction of outstanding value to the country and to East Africa in general.

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